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Clinical Practice Guidelines for the Management of Overweight and Obesity in Adults, Adolescents and Children in Australia

SYSTEMATIC REVIEW

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List of Abbreviations

AICR	American Institute for Cancer Research
BMI	body mass index
BPD	biliopancreatic diversion
CI	confidence interval
CKD	chronic kidney disease
CVD	cardiovascular disease
DBP	diastolic blood pressure
DSE	diabetes support and education
DXA	dual energy X-ray absorptiometry
ESRD	end-stage renal disease
GFR	glomerular filtration rate
GORD	gastro-oesophageal reflux disease
GP	general practitioner
HbA1c	glycosylated haemoglobin
HR	hazard ratio
HRQoL	health-related quality of life
ICSI	Institute for Clinical Systems Improvement
ILI	intensive lifestyle intervention
IWQoL	impact of weight on quality of life
LAGB	laparoscopic adjustable gastric band
LCD	low calorie diet
NAFLD	non-alcoholic fatty liver disease
NASH	non-alcoholic steatohepatitis
NHMRC	National Health and Medical Research Council
NICE	National Institute for Health and Clinical Excellence

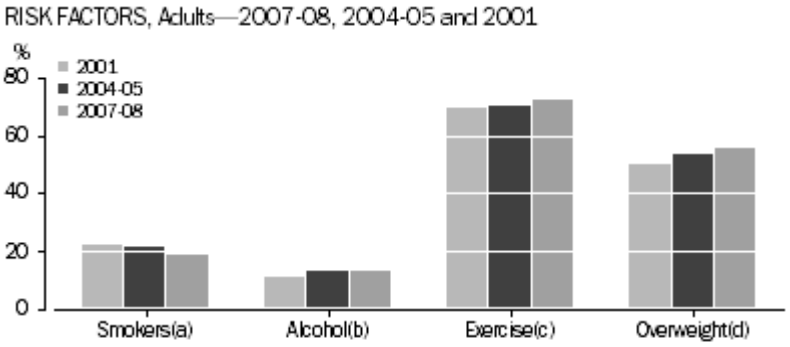
NICS	National Institute for Clinical Studies
NNS	National Nutrition Survey
NP	nurse practitioner
OA	osteoarthritis
OGTT	oral glucose tolerance test
OR	odds ratio
PCD	portion-controlled diet
PCOS	polycystic ovarian syndrome
PICO	Population, Intervention, Comparator, Outcome
RCT	randomised controlled trial
RYGB	Roux-en-Y gastric bypass
SBP	systolic blood pressure
SD	standard deviation
SE	standard error
SG	sleeve gastrectomy
SIGN	Scottish Intercollegiate Guideline Network
VBG	vertical banded gastroplasty
VLCD	very-low-calorie diet
WCRF	World Cancer Research Fund
WHR	waist-to-hip ratio
WMD	weighted mean difference

Background

Overweight and obesity are significant public health problems that are associated with a broad range of chronic clinical conditions and with premature mortality.

The 2007-08 National Health Survey (NHS) collected information on lifestyle behaviours and related characteristics which are recognised as risks to health, including body mass index (BMI). Data from the 2007-08 NHS show that overweight and obesity are the second most common self-reported preventable risk factor for chronic disease after physical inactivity (Figure 1)[1].

Figure 1 – Lifestyle behaviours and related characteristics, National Health Survey, 2001 to 2007/08



(a) Current daily smokers.
(b) Risky/high risk alcohol consumption.
(c) Sedentary/low exercise level.
(d) Self-reported overweight or obese Body Mass Index.

For the first time since the National Nutrition Survey (NNS) in 1995, the 2007-08 NHS also measured the hip circumference, waist circumference, height and weight of participants aged 5 years and over, as well as seeking self-reported data for height and weight from persons aged 15 years and over[2], [3]. BMI results from the survey showed that 25% of persons aged 18 years and over were obese and 37% were overweight. The highest rate of overweight/obesity was in the 65 to 74 year age group (75%). More adult males (68%) were overweight or obese than adult females (55%).

When compared with results from the NNS, the proportion of persons aged 18 years and over who were classified as overweight or obese based on objective measurement had increased over time. The proportion of males classified as overweight or obese increased from 64% in 1995 to 68% in 2007-08; the proportion of females classified as overweight or obese increased from 49% to 55%.

For children aged 5 to 17 years in 2007-08, 25% were classified as overweight or obese based on objective measurement (17% overweight and 8% obese). Proportions of overweight or obesity were similar for both boys and girls (26% and 24% respectively); however the proportion of children who were obese was higher in boys than in girls (10% and 6% respectively).

Self-reported BMI data also indicate an increase over time in the proportion of the population

[1] Australian Bureau of Statistics. 2008. National Health Survey 2007-08. Cat 4364.0.

[2] Australian Bureau of Statistics. 1995. National Nutrition Survey. Cat 4802.0.

[3] Australian Bureau of Statistics. 2008. National Health Survey 2007-08. Cat 4364.0.

classified as overweight / obese - from 50% in 2001 to 54% in 2004-05 and 56% in 2007-08. However, as the data in Figure 2 and Figure 3 demonstrate, adults generally underestimated their weight with 68% of males and 55% of females being classified as overweight or obese based on actual measurements compared to self-reported rates of 63% and 48% respectively[4], [5].

Figure 2 – Measured and self-reported weight category according to BMI in males, National Health Survey, 2007/08

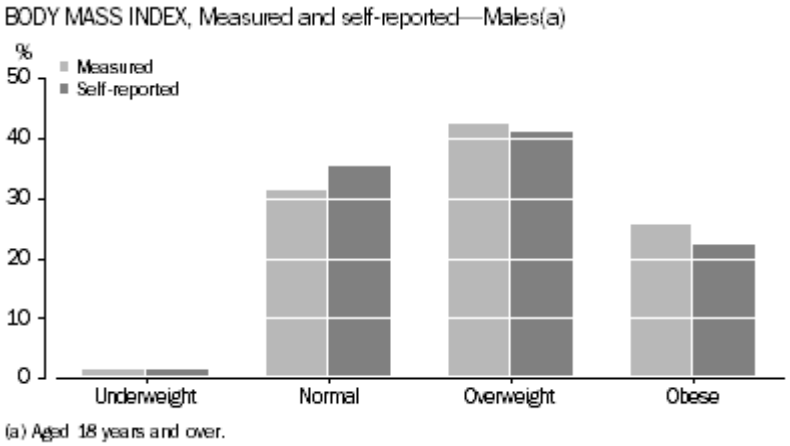
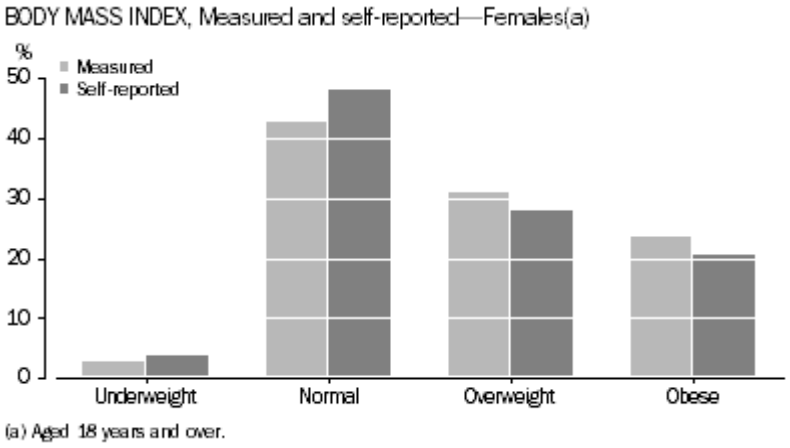


Figure 3 – Measured and self-reported weight category according to BMI in females, National Health Survey, 2007/08



The basis for this systematic review of the literature

The National Health and Medical Research Council (NHMRC) endorsed *The Clinical Practice Guidelines for the Management of Overweight and Obesity in Children and Adolescents (2003)* and *The Clinical Practice Guidelines for the Management of Overweight and Obesity in Adults (2003)* (the 'guidelines') in September 2003. The Department of Health and Ageing commissioned NHMRC to review these guidelines in 2010.

[4] Australian Bureau of Statistics. 1995. National Nutrition Survey. Cat 4802.0.

[5] Australian Bureau of Statistics. 2008. National Health Survey 2007-08. Cat 4364.0.

NHMRC convened a multidisciplinary Steering Committee (the Committee) including researchers, GPs, practice nurses, consumers, and specialists with expertise in overweight and obesity management to oversee the revision of the guidelines. This Committee selected the questions for key clinical areas that required review. NHMRC contracted this systematic review through a competitive tender process. The review methodologist prepared a review protocol that outlined the key questions to be addressed in the systematic review and the methods to be used. Committee feedback and approval of the protocol was sought prior to review commencement.

Given there are recent international evidence based guidelines on the management of obesity, the Committee considered some of the existing recommendations were sufficient to be referred to without the requirement for updating. The following publications met the committee's criteria for high quality source guidelines:

- Scottish Intercollegiate Guideline Network (SIGN). Management of Obesity (2010)
- National Institute for Health and Clinical Excellence (NICE). Obesity: the prevention, identification, assessment and management of overweight and obesity in adults and children (2006)
- Ministry of Health, New Zealand. Clinical Guidelines for Weight Management in New Zealand Children and Young People (2009) and Clinical Guidelines for Weight management in New Zealand Adults (2009)
- Institute for Clinical Systems Improvement (ICSI). Prevention and Management of Obesity (2011)
- American College of Sports Medicine
- Absolute Cardiovascular Risk guidelines
- The NHMRC-endorsed diabetes guidelines suite

The systematic review is focused in scope as directed by the Committee. Given the amount of literature published on obesity and the dates of these guidelines, it was decided that evidence from 2007 onwards was sufficient to be reviewed for inclusion. The Committee considered that evidence for the association between weight change and the occurrence of chronic diseases and associated risk factors required comprehensive review. Further, the evidence demonstrating the effectiveness of individual component and multi-component interventions needed to be examined separately.

These questions formed the basis for this systematic review of the literature.

Review questions

The PICO (population, intervention, comparator, outcomes) criteria were used to develop clinical questions for the review[6]. The following are the four elements of the PICO criteria:

- the target population for the question
- the intervention being considered
- the appropriate comparator for the question (where relevant)

[6] Richardson W, Scott M, Wilson M et al. The well built clinical question: a key to evidence based decisions. ACP Journal Club 1995; 123:A-12.

- the clinical outcomes that are most relevant to the question.

The questions that were proposed are as follows:

1. **What are the health outcomes associated with weight loss in individuals with overweight or obesity?**

Population	**Interventions**	**Comparators**	**Outcomes**
1. Persons of any age with overweight or obesity 2. Persons with any degree of overweight or obesity	The following methods of weight loss: - Non-medication management (nutrition, physical activity, psychological) - Medication management - Surgical management	Degree of weight loss: - % relative change in body weight - Change in BMI or BMI z-score / BMI for age centiles - Change in waist circumference No weight loss No treatment	Cardiovascular disease Diabetes Musculoskeletal conditions Mental health Cancer Fertility All-cause mortality

2. **What are the impacts of weight reduction interventions on degree and duration of weight loss?**

Population	**Interventions**	**Comparators**	**Outcomes**
1. Persons of any age with overweight or obesity 2. Persons with any degree of overweight or obesity	1. The following methods of weight loss: - Non-medication management (nutrition, physical activity, psychological) - Medication management - Surgical management (alone or in combination) 2. EPOC categories of intervention: - Professional interventions - Financial interventions (provider and patient) - Organisational interventions (provider-oriented, patient-oriented, structural) - Regulatory interventions	No treatment Placebo intervention	1. Degree of weight loss 2. Duration of weight loss - 12 months to 3 years - >3 to 5 years - >5 years 3. No weight loss

*EPOC = Cochrane Effectiveness of Practice and Organisation of Care

Criteria for considering studies for this review

Types of studies

The types of studies sought were as follows:

- Publications where overweight and obesity was a topic for study were considered for inclusion;
- Quantitative study types were considered;
- Studies reported in a language other than English were excluded.

Studies were considered hierarchically – in the first instance randomised, placebo controlled clinical trials and systematic reviews and/or meta-analyses of randomised controlled trials were included. Where these were unavailable, other levels of evidence were sought.

Types of participants

- Studies involving participants of any age with any degree of overweight or obesity were considered for inclusion.
- Studies involving participants with overweight or obesity due to a specific clinical condition e.g. Prader Willi Syndrome, were excluded.

Types of outcome measures

Primary outcomes

Overweight and obesity were assessed with one or more of the following measures:

- dual energy X-ray absorptiometry (DXA)
- underwater weighing
- BMI or BMI z-score / BMI-for-age centiles
- waist circumference
- weight for height growth chart
- body weight (kgs or lbs)

Secondary outcomes

In addition, study measures assessed for Question 1 included:

- change in biomarkers for CVD or diabetes, including blood pressure, serum lipids, serum glucose, glycosylated haemoglobin, renal function
- changes in risk scores, including AUSDRISK and CVD risk calculator
- use of validated functional or pain assessment measure for musculoskeletal conditions
- mental health by any validated measure, including measures of psychological distress and quality of life measures
- morbidity by any empirical measures
- mortality.

Timing of outcome assessment

Studies with a duration including follow-up period of 12 months or greater were included in this review.

Search methods for identification of studies

Electronic databases searched

Searches were conducted in the following electronic databases:

- MEDLINE (2007 – current)
- PsychINFO (2007 – current)
- CINAHL (2007 – current)
- Cochrane Library (all years)

Limited handsearches of reference lists were conducted where additional studies were required to further explore specific topics of enquiry.

Terms used to search the databases

Relevant Medical Index Subject Heading (MeSH) terms and subject headings were combined with key words of relevance to enable databases to be searched. The following search terms were used:

Overweight and obesity search terms

1 obesity/ (MeSH term, all sub trees and subheadings included)

2 hyperphagia/ (MeSH term, all subheadings included)

3 (obes* or adipos* or overweight* or over weight*) (in abstract or title)

4 (overeat* or overfeed*) (in abstract or title)

5 weight-gain/ (MeSH term, all subheadings included)

6 weight-loss/ (MeSH term, all subheadings included)

7 body-mass-index/ (MeSH term)

8 weight gain (in abstract or title)

Study type search terms

1 (meta anal* or metaanal*) (in abstract or title)

2 meta-analysis.pt

3 review, systematic/

4 randomized controlled trial.pt.

5 random allocation/

6 double blind method/

7 single blind method/

8 controlled clinical trial.pt.

9 placebos/

10 comparative study.pt

Treatment type search terms

1 diet therapy (MeSH)

2 drug therapy (MeSH)

3 surgery (MeSH)

4 exercise (MeSH)

5 psychological techniques (MeSH)

6 behavior therapy (MeSH)

7 cognitive therapy, behavior/

Additional key words of relevance were sought during the electronic searches. None were identified.

It was proposed that separate searches would be conducted for each research question. However, once coding of abstracts commenced it became apparent that many studies that included disease outcome measures were not identified through specific searches. Therefore all studies where overweight and / or obesity were the subject of the study were coded for inclusion in both questions 1 and 2 simultaneously.

Methods of the review

Study selection

Two reviewers assessed abstracts and full articles for their relevance to the review. Full articles were retrieved for further assessment if the information provided in the abstract suggested that the study was relevant to the PICO questions posed above. When a title or abstract could not be rejected with certainty, the full text of the article was obtained for further evaluation.

Inter-rater agreement for study selection was measured using the kappa statistic. Where duplicate publications and companion papers were located, information was maximised by using all versions of the study that contained new data.

All published materials identified during the search strategy were coded for their relevance to the review. The following inclusion criteria were applied to abstract selection:

1 the study design was a randomised, placebo controlled clinical trial, systematic review or meta-analysis

2 the study appraised one or more of the following weight loss interventions:

- physical activity
- nutrition
- psychology
- medication
- surgery

3 the details of the weight loss intervention were described

4 participants had overweight or obesity measured using one or more valid measures

5 weight change was measured using a valid measure

6 medical causes of obesity were absent

7 the study was not a duplicate publication containing only data that had been published in full elsewhere

8 outcomes were measured after a period of at least 12 months

9 the study included a control group suitable for determining the overall effect of the intervention

The following specific exclusion criteria were applied:

- the article was a methodological paper
- the article was published in a language other than English

Abstracts that did not meet inclusion criteria were coded according to reason for rejection.

Data extraction

Data extracted included the following:

1 general information: authors, country, year of publication

2 study design

3 intervention: key features of weight reduction intervention(s) (e.g. method, timing), setting

4 participants: number of participants, degree of overweight or obesity, inclusion and exclusion criteria, total number and number in comparison groups, withdrawals / losses to follow-up (reasons / description), number of included studies (for systematic reviews / meta-analyses)

5 outcomes: degree of weight change, degree of change in other relevant outcome measure, duration of follow-up, compliance, adverse events

A template data extraction form was developed and sent to NHMRC for review prior to data extraction

Quality assessment of studies

The quality assessment of included studies was based on the National Health and Medical Research Council's "Levels of Evidence and Grades for Recommendations for Developers of Guidelines[7].

Quality assessment included appraisal of:

1 the level of evidence

2 a study quality rating

3 a magnitude of effect rating

4 a relevance rating

One reviewer assigned quality scores for each of the above quality items. A second reviewer randomly reviewed the quality scores of a subset of 10% of studies to assess accuracy.

[7] NHMRC. Levels of Evidence and Grades for Recommendations for Developers of Guidelines. December 2009. Available at: http://www.nhmrc.gov.au/_files_nhmrc/file/guidelines/evidence_statement_form.pdf

Level of evidence

The level of evidence of the individual study was first assigned using the NHMRC (2009) hierarchy (Table 1)[8]. The following evidence hierarchy was used:

Table 1: NHMRC Level of Evidence Hierarchy

Level	Intervention	Diagnostic accuracy	Prognosis
I	A systematic review of level II studies	A systematic review of level II studies	A systematic review of level II studies
II	A randomised controlled trial	A study of test accuracy with: an independent, blinded comparison with a valid reference standard, among consecutive persons with a defined clinical presentation	A prospective cohort study
III-1	A pseudo-randomised controlled trial	A study of test accuracy with: an independent, blinded comparison with a valid reference standard, among non-consecutive persons with a defined clinical presentation	All or none
III-2	A comparative study with concurrent controls	A comparison with reference standard that does not meet the criteria required for Level II and III-1 evidence	Analysis of prognostic factors amongst persons in a single arm of a randomised controlled trial
III-3	A comparative study without concurrent controls	Diagnostic case-control study	A retrospective cohort study
IV	Case series with either post-test or pre-test / post-test outcomes	Study of diagnostic yield (no reference standard)	Case series or cohort study of persons at different stages of disease

[8] Ibid

Study quality rating

A quality score was then assigned to each study according to study type. The study assessment criteria applied were adapted from the following sources:

- NHMRC (2000). How to Review the Evidence: Systematic identification and review of the scientific literature
- NHMRC (2000). How to use the evidence: assessment and application of scientific evidence
- SIGN (2006). Methodology Checklist 1: Systematic reviews and meta-analyses
- Liddle J et al. (1996). Method for evaluating research guideline evidence

Systematic reviews

1 Were the questions and methods clearly stated?

2 Was the search procedure sufficiently rigorous to identify all relevant studies?

3 Did the review include all the potential benefits and harms of the intervention?

4 Did the review only include randomised controlled trials?

5 Was the methodological quality of primary studies assessed?

6 Were the data summarised to give a point estimate of effect and confidence intervals?

7 Were differences in individual study results adequately explained?

8 Was there an examination of which study population characteristics (disease subtypes, age/sex groups) determine the magnitude of effect of the intervention?

9 Were the reviewers' conclusions supported by data cited?

10 Were sources of heterogeneity explored?

Randomised controlled trials

1 Method of treatment assignment

a. Correct, blinded randomisation method described

OR randomised, double-blind method stated

AND group similarity documented

b. Blinding and randomisation stated but method not described

OR suspect technique (e.g. allocation by drawing from an envelope)

c. Randomisation claimed but not described and investigator not blinded

d. Randomisation not mentioned

2 Control of selection bias after treatment assignment

a. Intention to treat analysis AND full follow-up

b. Intention to treat analysis AND <15% loss to follow-up

c. Analysis by treatment received only OR no mention of withdrawals

d. Analysis by treatment received

AND no mention of withdrawals

OR more than 15% withdrawals/loss-to-follow-up/post-randomisation exclusions

3 Blinding

a. Blinding of outcome assessor

AND patient and care giver

b. Blinding of outcome assessor

OR patient and care giver

c. Blinding not done

4 Outcome assessment (if blinding was not possible)

a. All patients had standardised assessment

b. No standardised assessment OR not mentioned

Rating scale

The following were used to rate the quality of systematic reviews and meta-analyses against the criteria listed above:

A High: all or all but one of the criteria were met

B Medium: 2 or 3 of the criteria were not met

C Low: 4 or more of the criteria were not met

For randomised controlled trials, the following rating was used:

A All criteria scored ‘a’

B One or more criteria score ‘b’

C One or more criteria score ‘c’ or ‘d’

Magnitude of effect rating

Studies were then classified according to their magnitude of effect using the following ranking (Table 2):

Table 2: NHMRC Magnitude of Effect Rating

Ranking	**Statistical significance**	**Clinical importance of benefit**
High	Difference is statistically significant AND	There is a clinically important benefit for the full range of estimates defined by the confidence interval
Medium	Difference is statistically significant AND	The point estimate of effect is clinically important but the confidence interval includes some clinically unimportant effects
Low	Difference is statistically significant AND OR Difference is not statistically significant AND	The confidence interval does not include any clinically important effects The range of estimates defined by the confidence interval includes clinically important effects

Relevance of evidence rating

The relevance of the evidence will be classified using the following ranking:

- High = evidence of an effect on patient-relevant clinical outcomes OR evidence of an effect on a surrogate outcome predictive of patient-relevant outcomes
- Medium = evidence of an effect on proven surrogate outcomes but for a different intervention OR evidence of an effect on proven surrogate outcomes but for a different intervention and population
- Low = evidence confined to unproven surrogate outcomes

Data synthesis

A narrative summary of the information derived from publications was first developed by chronicling and ordering the evidence to produce an account of the evidence.

For Question 1 studies were grouped according to the specific clinical conditions that characterise the study subjects or outcomes being investigated (e.g. diabetes).

For Question 2 studies were grouped according to their component interventions, drawing upon the taxonomy used to classify quality improvement strategies, developed by the Cochrane Effective Practice and Organisation of Care (EPOC) group.

The relative effectiveness of the type of follow-up, frequency, intensity and duration was appraised, including differences between follow-up strategies that target the clinician and / or the patient.

Where required, meta-analyses were conducted of all available data from primary studies identified in included systematic reviews / meta-analyses or included RCTs. Change data for available blood pressure, lipids and blood glucose control measures were extracted from included studies. Where data were not reported in full in the systematic review / meta-analysis, the primary study was retrieved and data extracted. Outcome measures were converted to the same units of measurement to enable calculation of weighted mean differences.

RevMan version 5 was used to conduct meta-analyses according to a fixed effects model for the main effect outcomes. Heterogeneity was assessed using the X^2 test. Where there was heterogeneity in subgroup analyses a random effects model was used. Subgroup analyses were performed for type of weight loss intervention, presence of comorbid chronic diseases, and age (paediatric versus adult cohorts).

Data summary

An evidence statement of the literature for each key question was completed using the NHMRC Evidence Statement Form. The body of evidence was rated according to the following components:

- evidence base
- consistency
- clinical impact
- generalisability
- applicability

These components were rated according to the NHMRC Body of Evidence Matrix (2009) (Table 3).

Table 3: NHMRC Body of Evidence Matrix

	A	**B**	**C**	**D**
	Excellent	**Good**	**Satisfactory**	**Poor**
Evidence base	one or more level I studies with a low risk of bias or several level II studies with a low risk of bias	one or two level II studies with a low risk of bias or a SR/several level III studies with a low risk of bias	one or two level III studies with a low risk of bias, or level I or II studies with a moderate risk of bias	level IV studies, or level I to III studies/SRs with a high risk of bias
Consistency	all studies consistent	most studies consistent and inconsistency may be explained	some inconsistency reflecting genuine uncertainty around clinical question	evidence is inconsistent
Clinical impact	very large	substantial	moderate	slight or restricted
Generalisability	population/s studied in body of evidence are the same as the target population for the guideline	population/s studied in the body of evidence are similar to the target population for the guideline	population/s studied in body of evidence differ to target population for guideline but it is clinically sensible to apply this evidence to target population	population/s studied in body of evidence differ to target population and hard to judge whether it is sensible to generalise to target population
Applicability	directly applicable to Australian healthcare context	applicable to Australian healthcare context with few caveats	probably applicable to Australian healthcare context with some caveats	not applicable to Australian healthcare context

SR = systematic review; several = more than two studies

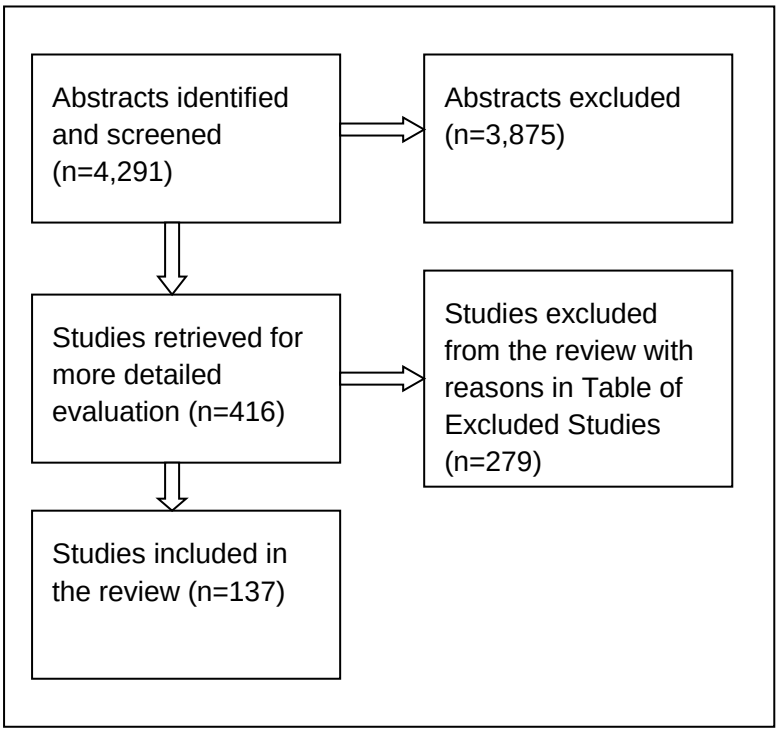
NHMRC. Levels of Evidence and Grades for Recommendations for Developers of Guidelines. December 2009. Available at: http://www.nhmrc.gov.au/_files_nhmrc/file/guidelines/evidence_statement_form.pdf

Description of studies

Studies identified

The search strategy, last performed in July 2011, identified 4,291 abstracts for perusal. On review of the abstracts, 416 articles were retrieved for perusal. Of these 137 relevant studies were identified (Figure 4).

Figure 4: Results of systematic literature search



Excluded abstracts

Evaluation of included abstracts led to 3,875 abstracts being excluded. These abstracts and their primary reason for exclusion can be summarised as follows:

- study topic not overweight / obesity (53%)
- insufficient duration of follow-up (31%)
- study type not randomised controlled trial or meta-analysis / systematic review of randomised controlled trials (4%)
- methodology study (4%)
- duplicate (3%)
- not in year range specified (2%)
- medical cause of overweight / obesity (2%)
- study in pregnancy (1%)
- not English language (0.1%)

Excluded studies

Following an evaluation of the methods and results section of the publications, 279 were excluded from the review. These studies and their reasons for exclusion are presented in the table: Table of Excluded Studies.

In summary, the reasons for exclusion of publications can be grouped as follows:

- The nature of the control group did not enable the intervention effect to be reliably estimated e.g. comparison was an active treatment group (n=100);
- Issues associated with the presentation of the data from the studies e.g. weight change data not provided (n=65);
- Participants not overweight / obese OR data for overweight / obese participants not provided separately to other participants (n=47);
- Intervention type not a subject of the review (n=28);
- Medical cause of obesity the subject of the study (n=14);
- Data published in full in an included primary study (n=11);
- Duration of intervention, including follow-up, was less than 12 months (n=9);
- Methodology paper (n=3); and
- Trial discontinuation (n=2).

Included studies

A total of 137 studies met the inclusion criteria and were included in this review. The kappa statistic for trial selection was 0.69; (95% CI 0.60 to 0.78).

Summary tables outlining the changes in outcome measures within each of the comparison groups are provided for each included study in the table “Evidence Tables”.

Study design

There were 70 systematic reviews / meta-analyses and 67 randomised controlled clinical trials that were included in the review.

Methodological quality of included studies

The methodological quality of included studies is described in the table “Evidence Tables”.

The majority of studies had one or more methodological limitations that reduced the quality rating. Numerous RCTs were rated “C” for quality because loss to follow-up of participants exceeded 15% of the total sample.

The magnitude of effect observed in included studies was primarily low to medium for lifestyle and pharmacological interventions and primarily high for surgical interventions.

The relevance of evidence rating was high for most studies.

Weight loss interventions in included studies

Numerous approaches exist to assist people to lose weight. The primary interventions that are the focus of this review are lifestyle interventions (including dietary interventions, physical activity / exercise interventions and psychological interventions), pharmacological interventions and surgical interventions.

Specific details of the weight loss interventions used in included studies are described in full in the “Evidence Tables” section of the review. The following is provided as a summary of the key features of weight loss interventions in primary studies.

Dietary approaches

Dietary approaches are not standardised into a formal taxonomy. Analysis of dietary trials can be complicated by this lack of taxonomy; for instance, the Atkins diet has been described as both a high fat and a high protein diet, making its allocation into a single dietary category difficult.

The New Zealand Clinical Guidelines for Weight Management in New Zealand Adults categorise dietary interventions as follows:

- Nutrition advice;
- Low energy diets – 1000 to 1,600 kcal or 4,200 to 6,720 kJ per day;
- Very low energy diets - < 1,000 kcal or < 4,200 kJ per day;
- Low glycaemic index diets – defined as 55 or under (low), 56 to 69 (medium) and 70 or higher (high);
- Modified macronutrient diets – diets that differ substantially from the acceptable distribution range of 50 to 55% total energy from carbohydrates, 20 to 35% from total fat and 15 to 25% from protein. These can be further categorised as:
    - Low carbohydrate (≤ 40% total energy from carbohydrates);
    - Low fat (≤ 10% total energy from fat);
    - High protein (≥ 35% total energy from protein); and
    - High carbohydrate (≥ 65% total energy from carbohydrate).

Each of these categories of dietary interventions was used in various primary studies in this review. The majority of clinical studies assessed the effects of low fat or low energy diets on primary and secondary outcomes. A principal determinant of weight loss associated with dietary change is the degree of adherence to the diet, irrespective of the particular macronutrient composition. Adherence, when reported, varied widely in studies included in this review.

Physical activity and exercise

Physical activity and / or exercise may be included as components of lifestyle interventions for weight loss. Physical activity can be defined as any body movement that involves the use of one or more large muscle groups and raises the heart rate. Exercise, a type of physical activity, is variously defined and has cross-over with physical activity in its definition; it can be considered a planned, structured and usually repetitive activity that enhances or maintains physical fitness and / or overall health and wellness. The frequency, intensity and duration of the activity are parts of an exercise prescription. Exercise may consist of aerobic activity, flexibility-based activity and / or anaerobic activity such as weight training (Ainsworth et al., 2011).

Lifestyle interventions specified in studies included in this review used a variety of different types of physical activity in treating overweight and obesity. Most studies that included a physical activity component specified a type of aerobic activity for participants. The majority of studies combined physical activity with diet for lifestyle-based weight loss; few specified physical activity alone as a weight loss intervention.

Psychological interventions

Psychological interventions are a class of treatments for weight loss in overweight and obesity that are used alone or in combination with other intervention types. The goal of psychological therapies is to assist the individual to make long-term changes in their lifestyle by monitoring and modifying their food intake and physical activity levels. There are a variety of different types of psychological interventions that can be used to facilitate weight loss.

The majority of studies in this review that included a psychological intervention incorporated behavioural or cognitive-behavioural strategies for lifestyle change.

Family based interventions and group interventions were utilised in a small number of included studies; more commonly in studies including paediatric rather than adult participants.

Pharmacotherapies

Weight loss drugs were commonly used in included studies in conjunction with lifestyle interventions in order to facilitate greater weight losses than lifestyle interventions alone. The majority of included studies assessed orlistat or sibutramine. Sibutramine was voluntarily withdrawn from the market in Australia at the time this review was conducted. However, studies regarding sibutramine have been included and described in the review where inclusion criteria were met.

A subset of studies reported data for rimonobant, a pharmacological agent withdrawn from sale after it was demonstrated to be associated with elevated psychiatric risk to patients taking the drug. Although a number of studies included data regarding rimonobant, this information has not been incorporated into the specific analysis for each review question.

Studies regarding newer pharmacological agents, including taranabant, met inclusion criteria and have been included in this review.

Bariatric surgery

A range of surgical procedures can be performed with the purpose of inducing weight change in patients with overweight or obesity. Bariatric surgeries can be classified as:

- Restrictive procedures: including vertical banded gastroplasty (VBG), laparoscopic adjustable gastric banding (LAGB) and sleeve gastrectomy (SG);
- Malabsorptive procedures including bilio-pancreatic diversion (BPD) and duodenal switch procedure, causing malabsorption by bypassing the majority of the small bowel absorptive area; and
- Combination procedures: such as the Roux-en-Y gastric bypass (RYGB), which also alters neuro-hormonal pathways that regulate energy balance. Malabsorption after RYGB is primarily limited to micronutrients; lifelong vitamin and mineral supplementation is required to prevent nutritional deficiencies.

All of these procedures have been used in included studies in this review. Systematic reviews and meta-analyses of the impacts of bariatric surgical procedures on primary and secondary outcomes associated with overweight and obesity have been published in age cohorts as young as 9 years of age, and for a wide range of secondary outcome measures. The majority of included studies that used bariatric surgery as a weight loss intervention tested LAGB impacts on outcomes.

Other therapies

A range of other therapies may be used to facilitate weight loss in people with overweight and obesity. These include herbal medicines, physical therapies and acupuncture. Nutritional supplements or foods are an additional class of interventions that may be used as a weight loss strategy. Where these studies were identified by the search strategy, they were appraised and included if inclusion criteria were met.

Impact of excess body weight on health

The rationale for weight loss in people with overweight and obesity is that obesity is associated with multiple health risks. Substantial literature has emerged which has found that overweight and obesity are associated with major morbidity and mortality. This literature was recently summarised in a comprehensive systematic review and meta-analysis by Guh et al. (2009), who appraised 87 high quality prospective cohort studies among adults with overweight and obesity. The following relative risk increases in diseases associated with overweight and obesity were identified (Table 4):

Table 4: Relative risk of disease according to gender and overweight / obesity

Disease	**Measure***	**Overweight***		**Obesity***	
		Male	**Female**	**Male**	**Female**
Type 2 Diabetes Mellitus	BMI	2.4 (2.1-2.7)	3.9 (3.1-4.8)	6.7 (5.6-8.2)	12.4 (9.0-17.1)
	WC	2.3 (1.7-3.1)	3.4 (2.4-4.8)	3.1 (3.8-6.9)	11.1 (8.2-15.0)
Cardiovascular Disease					
Hypertension	BMI	1.3 (1.1-1.5)	1.7 (1.2-2.2)	1.8 (1.5-2.2)	2.4 (1.6-3.7)
	WC	NR	1.4 (1.3-1.5)	NR	1.9 (1.8-2.0)
Coronary artery disease	BMI	1.3 (1.2-1.4)	1.8 (1.6-2.0)	1.7 (1.5-2.0)	3.1 (2.8-3.4)
	WC	1.4 (1.2-1.7)	1.8 (1.4-2.4)	1.8 (1.5-2.3)	2.7 (2.1-3.5)
Cerebrovascular accident (stroke)	BMI	1.2 (1.1-1.3)	1.2 (1-1.3)	1.5 (1.3-1.7)	1.5 (1.3-1.7)
Cancer					
Breast (postmenopausal)	BMI	NR	1.08 (1.03-1.14)	NR	1.13 (1.05-1.2)
Colorectal	BMI	1.5 (1.4-1.7)	1.5 (1.3-1.6)	2.0 (1.6-2.4)	1.7 (1.5-1.8)
Endometrial	BMI	NA	1.5 (1.45-1.6)	NA	3.2 (2.9-3.6)
Ovarian	BMI	NA	1.2 (1.1-1.23)	NA	1.3 (1.2-1.4)
Prostate	BMI	1.1 (1.0-1.3)	NA	1.1 (0.9-1.3)	NA
Renal	BMI	1.4 (1.3-1.5)	1.8 (1.7-2.0)	1.8 (1.6-2.1)	2.6 (2.4-2.9)
Pancreas	BMI	1.3 (0.9-1.8)	1.2 (1.0-1.6)	2.3 (1.7-3.2)	1.6 (1.2-2.2)
Other					
Asthma	BMI	1.2 (1.1-1.3)	1.3 (1.1-1.5)	1.4 (1.1-1.8)	1.8 (1.4-2.3)
Osteoarthritis	BMI	2.8 (2.1-3.7)	1.8 (1.75-1.85)	4.2 (2.8-6.4)	2.0 (1.9-2.04)
Gallbladder disease	BMI	1.1 (0.9-1.4)	1.4 (1.1-2.0)	1.4 (1.0-2.0)	(1.2-4.6)

*BMI=body mass index; WC=waist circumference; NA=not applicable; NR=not reported

These results demonstrate that both overweight and obesity are associated with the incidence of multiple comorbidities, including but not limited to type 2 diabetes mellitus, cardiovascular diseases, cancers, asthma, osteoarthritis and gallbladder disease.

The association between BMI and cardiovascular risk factors (blood pressure, lipids, diabetes) contributes to the increased risk of cardiovascular disease (CVD) experienced by people with overweight or obesity. It is unclear how much of an effect excess body weight has on CVD risk independent of the effect it exerts through these established cardiovascular risk factors.

Mental health

There is an association between body weight and mental health disorders. The odds for any mood disorder in people with obesity is approximately 1.2 (95%CI 1.03 to 1.48) and for any anxiety disorder is approximately 1.5 (95%CI 1.23 to 1.72) when compared with those with a BMI of 18.5–29.9 kg/m^2. Mood disorders include major depression, dysthymia, bipolar disorder, and anxiety disorders (panic disorder, agoraphobia without panic, specific phobia, social phobia, general anxiety disorder, post-traumatic stress disorder, and obsessive–compulsive disorder). The prevalence of any mood and any anxiety disorder increases with increasing BMI. People with mental health disorders also experience weight gain in association with medications as weight gain is a frequent side-effect of a number of mood stabilising medications and atypical antipsychotic medications (Scott et al 2008).

Studies that assessed the impact of weight loss interventions that involved switching of medications used to treat mental health problems in people with diagnosed mental health disorders were excluded from this review. However, the impacts of weight loss interventions on mental health outcomes among people with overweight and obesity were included and have been reported in analyses below.

Obesity in childhood and adolescence

Obesity in childhood and adolescence is also associated with a number of adverse consequences for physical and mental health, both in the short term (for the child or adolescent with obesity) and the long term (for the adult who had obesity as a child).

Short-term complications of childhood obesity include type 2 diabetes, hypertension, hyperlipidaemia, accelerated growth and bone maturation, ovarian hyperandrogenism and gynaecomastia, cholecystitis, pancreatitis and fatty liver; rarely, patients develop cirrhosis and renal disease (focal glomerulosclerosis) (Reilly et al., 2003). Sleep apnoea and sleep-disordered breathing also occur in children and adolescents with obesity (Carter et al., 2011).

Orthopaedic disorders, including genu valgum, slipped capital femoral epiphysis, and tibia vara, occur more commonly in children with obesity. Excess weight in young children can cause bowing of the tibia and femurs; the resulting overgrowth of the proximal tibial metaphysis (Blount disease). Pulmonary consequences observed in children and adolescents include an increased frequency of reactive airways, poor exercise tolerance, increased work of breathing, and increased oxygen consumption. Those develop obesity-hypoventilation syndrome experience right-sided heart failure with right ventricular hypertrophy (Ogden et al., 2007; Reilly et al., 2003).

Reilly and Kelly (2010) conducted a systematic review of 28 observational studies to characterise the association between childhood and adolescent obesity and risk of both premature mortality and physical morbidity in adulthood:

- Evidence of associations between child or adolescent overweight and obesity, and premature mortality in adult life was found in seven of the eight included studies that

contained relevant data to answer this research question. The study that did not find an association used recalled perceived overweight at age 12 to 13 years as the exposure measure, rather than objectively measured overweight or obesity.

- Eleven studies assessed associations between child and adolescent overweight and obesity, and adult cardiometabolic mortality. All reported that child or adolescent overweight and obesity were associated significantly with increased risk of later diabetes, stroke, coronary heart disease and hypertension.
- Nine studies assessed the association between overweight and obesity, and physical morbidity (risk of cancer in five studies, disability pension in two, asthma and atopy in one, polycystic ovarian syndrome in one study). Late adolescent obesity was associated with significantly increased risk of disability pension in adult life. Obesity at age 14 years was associated with significantly increased risk of asthma and polycystic ovarian syndrome in adult life. Associations between overweight and obesity and cancer risk, predominantly for breast cancer, were conflicting.

There is therefore a significant body of evidence across adult and paediatric populations demonstrating multiple health risks associated with overweight and obesity.

Question 1: What are the health outcomes associated with weight loss in individuals with overweight or obesity?

Although weight gain has been demonstrated to increase health risks in paediatric and adult populations, it does not necessarily follow that weight loss can reverse these impacts. Therefore, a review of studies assessing the impacts of weight loss on health outcomes has been included in this systematic review.

The importance of study design in determining the benefits of weight loss

The effects of weight loss on morbidity and mortality for people with overweight or obesity are difficult to determine from prospective observational studies such as cohort studies. Observational studies show inconsistent and often conflicting results which have been attributed to inability to control for known confounding factors (such as underlying disease states and intention to lose weight) with these study designs. Further, many existing studies were not specifically designed to test the hypothesis that weight loss increases or decreases relative risk of morbidity and mortality. Methodological problems have also been identified, including the inability to accurately quantify the method by which the weight loss was achieved.

As a result, intervention studies, in particular randomised placebo-controlled trials of weight loss interventions, provide the highest quality of evidence available regarding the association between weight loss and subsequent morbidity and mortality. This study design provides the benefit of being able to control for the various sources of confounding that influence study results.

Weight loss studies conducted with children aged < 5 years

Very few studies included in this review report data from participants aged < 5 years.

A recent comprehensive systematic review of the literature was conducted by Bond et al. (2011) in order to determine the effectiveness of weight management interventions for children aged less than five years. As uncontrolled study designs and self-reported outcomes potentially bias the results in favour of the intervention, this review was limited to controlled trials with objective measures. Despite an exhaustive search, no controlled trials of treatment in children aged less than five years were identified by the authors.

Cardiovascular disease

There is strong evidence from epidemiological studies that obesity is associated with increased risk and worse prognosis of CVD. Supporting evidence from controlled clinical trials is lacking.

A number of large, prospective, long-term studies have demonstrated that obesity is an independent risk factor for all-cause mortality and death from CVD in both males and females (Garrison and Castelli, 1985; Manson et al, 1995; Calle et al., 1999). As described in Table 4, Guh et al (2009) has demonstrated increased risk of hypertension, coronary heart disease and stroke associated with overweight and obesity in both males and females.

Abdominal obesity is recognised as an independent risk factor for CVD. Compared with BMI, anthropometric measures of abdominal obesity appear to be more strongly associated with metabolic risk factors, incident CVD events and death. Overall risk estimates calculated from meta-analysis of prospective studies suggest that a 1cm increase in waist circumference is associated with a 2% increase in risk of a CVD event and that a 0.01 unit increase in Waist – Hip Ratio is associated with a 5% increase in risk of a CVD event (Koning et al., 2007).

Although excess body weight increases CVD risk, the impacts of weight loss on reducing cardiovascular risk are less well defined. Prospective observational studies examining the impact of weight loss on mortality suggest that weight loss increases rather than decreases the risk of premature death among obese individuals (the 'obesity paradox') and that increased BMI in patients with a past history of CVD may be associated with a lower rather than higher risk of mortality.

- Simonsen et al. (2008) conducted a review of prospective cohort studies on intentional weight loss and mortality among healthy individuals, while carefully considering the designs and problems in these studies. Of the studies evaluated, two found decreased mortality with intentional weight loss, three found increased mortality, and four found no significant associations between intentional weight loss and total mortality;
- Poobalan et al. (2007) systematically reviewed cohort studies and trials conducted with participants with overweight and obesity and with weight change and mortality estimates with 2 or more years of follow-up. The impact of weight loss on mortality in men was not clear with some studies indicating weight loss to be detrimental, whilst other studies showed benefits if it were a personal decision. Other studies with no gender separation had similarly mixed results. One study indicated that overweight / obese women with obesity-related illness, who lost weight intentionally within 1 year, had significantly reduced mortality rates of 19–25%. Studies of overweight / obese diabetics irrespective of gender showed significant benefit of intentional weight loss on mortality in a meta-analysis, hazard ratios = 0.75 (0.67–0.83);
- Uretsky et al. (2007) investigated the effects of obesity on CVD outcomes in 22,576 treated hypertensive patients with known CVD. During 2 year follow up, all-cause mortality was 30% lower in overweight and obese patients, despite less effective blood pressure control in these patients compared with the normal weight group.

The adverse consequences of weight loss on CVD mortality are thought to be associated with unintentional rather than intentional weight loss (Lopez-Jiminez et al., 2008). Analysis of prospective observational data from over 28,000 overweight women aged between 40 and 64 years with no pre-existing illness suggest that intentional weight loss of over 9 kg was associated with a decrease in all-cause, cardiovascular and cancer mortality of approximately 25%. Among women with comorbid heart disease or diabetes, any weight loss was associated with 10% reduction in CVD and a 20% reduction in mortality (Williamson et al., 1995).

The method by which weight is lost is likely to influence cardiovascular morbidity and mortality. Starvation, very-low-calorie diets, liquid protein diets, and obesity surgeries have been associated with increased risk of cardiac arrhythmias, and various pharmacologic agents have been associated with adverse cardiovascular events (Lavie et al., 2009). In contrast, intentional weight loss from low fat and / or low calorie diets appears to be associated with a lower incidence of cardiovascular events (Eilat-Adar et al., 2005).

Included studies

Most intervention studies included in this review that consider the relationship between weight loss and CVD report the impact of weight loss interventions on risk factors for CVD (elevated blood pressure, serum glucose and adverse lipid profile) rather than CVD endpoints such as vascular events or disease mortality.

There were 39 studies in this review that assessed the relationship between weight change and one or more CVD risk factors or outcomes; there were 21 systematic reviews / meta-analyses (Table 5) and 18 RCTs (Table 6). There were two systematic reviews / meta-analyses and two RCTs that assessed vascular disease endpoints and three systematic reviews / meta-analyses and two RCTs that assessed CVD mortality. Each of the following are duplicate publications that include the same data: Horvath et al. (2008) and Siebenhofer et al. (2009); Padwal et al. (2003) and Rucker et al. (2007); and Picot et al. (2009) and Colquitt et al. (2009).

1. Vascular events

Siebenhofer et al. (2009) conducted a systematic review and meta-analysis of 8 RCTs including 3,751 adult participants that assessed the impact of orlistat or sibutramine on vascular endpoints. All participants had essential hypertension (baseline SBP > 140 ± DBP > 90 mmHg) and a BMI of between 28 and 43 kg/m^2. Orlistat and sibutramine both resulted in a mean weight loss of 3.7 kg over up to 4 years study duration. Two orlistat studies presented data on cardiovascular morbidity. In the first study, five cardiovascular events occurred in patients receiving orlistat (myocardial infarction, 'chest pain' and atrial fibrillation), compared with four in patients receiving placebo (myocardial infarction, worsening of coronary artery disease, 'chest pain'). In the second study, patients with resting left ventricular ejection fraction < 50% at baseline did not improve with placebo but increased by 4.3% in the orlistat group. No sibutramine studies reported cardiovascular events.

James et al. (2010) conducted a randomised controlled trial including 10,744 older adult participants (aged 55 years or above) that assessed sibutramine and lifestyle management or lifestyle management alone. All participants had a history of CVD, type 2 diabetes with at least one other cardiovascular risk factor, or both. Mean weight loss during the lead-in period was 2.6 kg; after randomisation, the participants in the sibutramine group achieved and maintained further weight reduction (mean 1.7 kg at 12 months). The risk of a primary outcome event (non-fatal myocardial infarction, non-fatal stroke, resuscitation after cardiac arrest or cardiovascular death) was 11.4% in the sibutramine group as compared with 10.0% in the placebo group (hazard ratio (HR) 1.16; 95% CI, 1.03 to 1.31). The rates of non-fatal myocardial infarction and non-fatal stroke were 4.1% and 2.6% in the sibutramine group and 3.2% and 1.9% in the placebo group, respectively (HR for non-fatal myocardial infarction 1.28; 95% CI, 1.04 to 1.57; HR for non-fatal stroke 1.36; 95% CI, 1.04 to 1.77; P = 0.03).

Uusitupa et al. (2009) conducted a randomised controlled trial including 522 participants with impaired glucose tolerance that assessed intensive diet and exercise counselling with a control intervention of general health behaviour information. In addition, the authors presented follow-up data for a population-based cohort who had received no form of lifestyle advice or intervention (termed "natural controls" by the authors). People lost an average of 4.5 kg (SD 5) in the

intervention group and 1 kg (SD 3.7) in the control group after 12 months. After a median follow-up time of 10.2 years there were 57 (out of 257) new CVD events (hospital admission for acute coronary events, coronary heart disease, stroke or hypertensive disease) in the intervention group and 54 (out of 248) in the control (health behaviour information) group. There were no statistically significant differences in CVD morbidity between intervention and control groups (22.9 versus 22.0 per 1,000 person years (HR = 1.04, 95% CI, 0.72 to 1.51)). When compared with the population-based cohort (the "natural controls"), adjusted hazard ratios for CVD morbidity were not statistically different (0.89 (95% CI, 0.62 to 1.27) and 0.87 (0.89 (95% CI, 0.60 to 1.27) in intervention and control groups respectively).

Curioni et al. (2006b) conducted a systematic review to assess the impact of weight loss on stroke incidence. No RCTs were identified that could be included in the review.

Summary

Orlistat and sibutramine both lead to modest reductions in body weight in people with essential hypertension; and sibutramine to reduced body weight in people with a history of CVD and / or diabetes. Sibutramine in conjunction with lifestyle management has been associated with increased risk of subsequent non-fatal myocardial infarction and non-fatal stroke in people with a past history of CVD and / or diabetes. There were insufficient data included in this review to determine the association between orlistat and vascular events. Lifestyle interventions in people with impaired glucose tolerance did not significantly reduce vascular events over a 10 year period in the RCT included in this review.

2. CVD Mortality

Siebenhofer et al. (2009) also reported data regarding mortality in participants of orlistat and sibutramine studies. There were three of four orlistat studies that reported mortality. No deaths occurred in two of the studies. In the third study (XENDOS 2001 to 2006), there were three deaths in orlistat treated participants and none in placebo treated participants. One sibutramine study reported mortality. There were no deaths in either the treatment or placebo groups.

Pontiroli et al. (2011) conducted a systematic review and meta-analysis of 8 non-randomised controlled clinical trials including 44,022 adult participants that assessed the impact of bariatric surgery on CVD mortality. All participants had morbid obesity (mean BMI 47.0±1.1 kg/m^2). BMI reduction was between 7 and 17 kg/m^2 in the intervention group compared with no change in controls. Deaths occurred in 3,317 participants (400/14,052 in participants receiving surgery and 2,917/29,970 in controls) over up to 12 years of follow-up. Surgery was associated with a reduced risk of CVD mortality (OR = 0.58; 95% CI, 0.46 to 0.73), all-cause mortality (OR = 0.70; 95% CI, 0.59 to 0.84) and global mortality (OR = 0.55; 95% CI, 0.49 to 0.63). The effect of gastric banding and gastric bypass were similar for global and all-cause mortality (OR = 0.57 vs. 0.55, and 0.66 vs. 0.70, respectively) but different for CVD mortality (OR = 0.71 vs. 0.48).

Treadwell et al. (2008) conducted a systematic review and meta-analysis of 18 predominantly uncontrolled case series studies of bariatric surgery performed in 641 paediatric patients (age 9 to 21 years). Weight loss associated with LAGB was between 10.6 and 13.7 kg/m^2; weight loss with RYGB was 17.8 to 22.3 kg/m^2 over an average of 3 years follow-up. No deaths were reported in LAGB studies; four deaths were reported in the RYGB studies – one associated with the surgery and three from causes unlikely to be directly related to the surgery; three deaths were reported after BPD – from protein malnutrition, pulmonary oedema and acute necrotising pancreatitis respectively. None were believed to be associated with CVD per se.

The RCT conducted by James et al. (2010) with 10,744 older adult participants (aged 55 years or above) assessed all-cause and CVD mortality for sibutramine and lifestyle management or

lifestyle management alone. All participants had a history of CVD, type 2 diabetes with at least one other cardiovascular risk factor, or both. Mean weight loss during the lead-in period was 2.6 kg; after randomisation, the participants in the sibutramine group achieved and maintained further weight reduction (mean 1.7 kg at 12 months). The risk of cardiovascular death or death from any cause was not increased over up to 7 years of follow-up.

The RCT conducted by Uusitupa et al. (2009) involving 522 participants with impaired glucose tolerance assessed intensive diet and exercise counselling with a control intervention of general health behaviour information. In addition, the authors presented follow-up data for a population-based cohort who had received no form of lifestyle advice or intervention (termed "natural controls" by the authors). People lost an average of 4.5 kg (SD 5) in the intervention group and 1kg (SD 3.7) in the control group (health behaviour information) after 12 months. After a median follow-up time of 10.2 years the total number of deaths were 214 (11%) in the "natural controls" and 16 (3%) in the intervention group. Compared with the population-based cohort with impaired glucose tolerance, adjusted HRs were 0.21 (95% CI, 0.09 to 0.52) and 0.39 (95% CI, 0.20 to 0.79) for total mortality with more intensive and less intensive lifestyle intervention.

Shea et al. (2010) conducted a RCT with 318 participants that investigated the impact of lifestyle interventions on mortality in overweight and obese people aged 60 years and older. The mean age of participants was 69 years and mean BMI was 34 kg/m^2. Diet / exercise and diet only results were pooled; and exercise only and control results were pooled. The diet / exercise and diet group lost an average of 4.8 kg (SD 7.5) at 18 months compared with the exercise and control groups, which lost 1.4 kg (SD 5.1) at 18 months. There were 15 deaths in the diet / exercise and diet groups compared with 30 deaths in the exercise and control groups. The hazard ratio associated with intentional weight loss was 0.5 (95% CI, 0.3 to 1.0). Among older participants (aged > 67.1 years) those randomised to diet / exercise or diet had a lower mortality rate compared with those randomised to exercise or control (HR 0.4; 95% CI, 0.2 to 1.0). The total mortality rate of those who lost > 5% of their body weight was not different to those who lost < 5% of their body weight (HR 1.5; 95% CI, 0.4 to 5.5).

Summary

Data from studies assessing lifestyle show reduced mortality in older people and in adult patients with impaired glucose tolerance over up to 8 years of follow-up.

Surgically-induced weight loss in adults (gastric banding and gastric bypass) is associated with a reduced risk of CVD, all-cause and global mortality in patients with morbid obesity. Gastric bypass appears to be associated with greater reductions in CVD mortality than gastric banding. Changes in CVD and all-cause mortality in surgery performed in children are difficult to determine. However, available evidence demonstrates deaths from complications associated with RYGB and BPD in paediatric patients. Data from studies assessing the association between sibutramine and mortality suggest that mortality is not increased at up to 7 years of follow-up.

There are insufficient data regarding long-term orlistat use to determine the association with CVD and all-cause mortality.

Table 5: Systematic reviews and meta-analyses reporting CVD risk factors and endpoints

Study	BP	Lipids	Blood glucose	Vascular events	Mortality	Maximum length of follow-up
Curioni 2006				X		Stroke incidence – no studies identified
Lifestyle						
Aucott 2009	X					6 years
Galani 2007 (inc. prediabetes)	X	X	X			6 years
Horvath 2008 (hypertension)	X					3 years
Janssen 2010 (paediatric)	X	X	X			2 years
Kelly 2008 (paediatric)	X	X	X			2 years
Li 2008 (paediatric)	X	X	X			Not reported
Norris 2005a (prediabetes)	X	X	X			10 years
Whitlock 2010 (paediatric)	X	X	X			1 year
Shaw 2006	X	X	X			1 year
Witham 2010	X	X				3 years
Medications						
Czernichow 2010 (paediatric)	X	X	X			15 months
Horvath 2008	X					4 years

Padwal 2003	X	X	X			4 years
Rucker 2007	X	X	X			4 years
Siebenhofer 2009	X			X	X	4 years
Viner 2010 (paediatric)	X	X	X			1 year
Whitlock 2010 (paediatric)	X	X	X			1 year
Surgery						
Colquitt 2009 / Picot 2009	X	X	X			10 years
Pontiroli 2011					X	12 years
Treadwell 2008 (paediatric)	X	X	X		X	11 years

Table 6: Randomised controlled trials reporting CVD risk factors and endpoints

Study	BP	Lipids	Blood glucose	Vascular events	Mortality	Duration including follow-up
Lifestyle						
Azadbakht 2007	X	X				14 months
Dale 2008 (prediabetes)	X	X	X			2 years
Ford 2010 (paediatric)		X				18 months
Groenveld 2010	X	X	X			1 year
Johnston 2010 (paediatric)	X	X				2 years
Savoye 2007 (paediatric)	X	X	X			1 year
Shea 2010					X	8 years
Ter Bogt 2009	X	X				1 year
Uusitupa 2009 (prediabetes)	X	X	X	X	X	10.6 years
Medications						
Daniels 2007 (paediatric)	X					1 year
Greenway 2010	X	X				1 year
James 2010	X			X	X	6 years

Madsen 2008		X	X			3 years
Proietto 2010	X	X	X			13 months
Ryan 2010	X	X				2 years
Smith 2010	X	X				2 years
Wilson 2010 (paediatric)		X				100 weeks
Surgery						
O'Brien 2010 (paediatric)	X	X	X			2 years

3. Blood pressure

Weight loss may play an important role in prevention of hypertension. In the Framingham study, participants with overweight were followed over 8 years. Weight loss of 7kg or more was associated with a 22% to 26% reduction in the relative risk of developing hypertension (Moore et al., 2005).

There were 19 systematic reviews / meta-analyses (Table 5) and 14 RCTs (Table 6) included in this review that assessed the relationship between weight change and blood pressure.

Lifestyle - adults

Aucott et al. (2009) conducted a systematic review and meta-analysis of 16 studies in 57,708 adult participants followed for up to 6 years that assessed the impact of lifestyle interventions (diet, exercise, behaviour or environmental) on blood pressure. Weight change across studies was between -11 and +4 kg; BMI change across studies was between -0.1 and -10.4 kg/m^2. Blood pressure change across controlled trials was: systolic blood pressure (SBP) -15mmHg to +4mmHg change; DBP (DBP) -5 mmHg to +2.2 mmHg. Blood pressure across all studies (including cohort studies) was: SBP -13mmHg to +6.1mmHg DBP -7mm Hg to +2.2 mmHg. A 5 kg weight loss was equivalent to a 5.6 mmHg drop in SBP of participants in studies with follow-up < 36 months. There were insufficient studies with follow-up of > 36 months for longer term effects of weight change on blood pressure to be assessed.

Galani & Schneider. (2007) conducted a systematic review and meta-analysis of 30 studies involving 11,579 adult participants (3,566 participants with overweight and 8,013 with obesity) followed for up to 6 years that assessed the impact of lifestyle intervention (diet and exercise +/- behaviour therapy) on blood pressure. Participants with overweight and obesity lost an average of 2.2 and 3.5 kg and reduced BMI an average of 1.1 and 1.3 kg/m^2 respectively. Participants with impaired glucose tolerance lost an average of 2.9 kg and reduced BMI an average of 1.3 kg/m^2. SBP and DBP dropped an average of 2.1 / 1.6 and 2.8 / 1.4 mmHg in participants with overweight and obesity respectively. In participants with impaired glucose tolerance, SBP and DBP decreased an average of 3.5 / 1.8 mmHg.

Horvath et al. (2008) conducted a systematic review and meta-analysis of seven RCTs involving 1,632 adult participants with hypertension that assessed the impact of dietary interventions on weight loss and BP change over up to 36 months of follow-up. Diet was associated with a weight loss of 4.1 kg (95% CI, -5.0 to -3.3), SBP reduction of 6.3 mmHg (95% CI, -9.9 to -2.7) and DBP reduction of 3.4 mmHg (95% CI, -5.6 to -1.3).

Norris et al. (2005a) conducted a systematic review and meta-analysis of RCTs involving 5,168 participants with prediabetes followed for up to 10 years that assessed the impact of lifestyle interventions on weight loss and metabolic indicators. Overall, pooled weight reduction at 12 months was 2.8 kg (95 % CI -1.0 to -4.7) (3.3% of baseline body weight) and decrease in BMI was 1.3 kg/m^2 (95% CI, -0.8 to -1.9). Weight loss at two years was 2.6 kg (95% CI, -1.9 to -3.3). At follow-up intervals of up to 10 years, weight reduction was maintained. Weight loss of 2.8 kg was associated with reduction in SBP of 4 mmHg (95% CI, -1.9 to -6.2) and DBP of 1.6 mmHg (95% CI, -0.5 to -2.7).

Shaw et al. (2006) conducted a systematic review and meta-analysis of 41 studies involving 3,476 adult participants followed for up to 12 months that assessed the impact of exercise with our without dietary interventions on blood pressure. Participants in both groups lost weight across trials. Exercise with diet resulted in a mean weight loss of between 3.4 and 17.7 kg, diet alone resulted in a mean weight loss of between 2.3 and 16.7 kg, exercise alone resulted in a mean weight loss of between 0.5 and 7.6 kg and control group participants experienced weight

changes of between 0.1 kg loss and 0.7 kg gain. Exercise with diet resulted in a mean SBP / DBP change of between 3.1 / 2.0 and 12.5 / 7.9 mmHg, diet alone resulted in a mean SBP / DBP change of between 0.8 / 1.1 and 13.0 / 7.5 mmHg, exercise alone resulted in a mean SBP / DBP change of between 0.8 / 1.2 and 9.9 /5.9 mmHg and control group participants experienced blood pressure changes of -1 mmHg SBP and between -1 and +0.6 mmHg DBP. Increased intensity of exercise did not have a significant impact on SBP or DBP compared with lower intensity exercise.

Witham et al. (2010) conducted a systematic review and meta-analysis of studies involving 1,954 adult participants followed for up to 3.2 years that assessed the impact of diet and / or physical activity compared with control on blood pressure. Diet and physical activity was associated with greater weight change (-3.8kg; 95% CI, -6.2, -1.4) than physical activity (-1.4kg; 95% CI, -2.4, -0.4) or diet (0.1kg; 95% CI, -1.6, 1.7). Mean weight change across control groups varied between -1.1 kg and +1.2 kg. Blood pressure was assessed in two studies. Blood pressure improved in one study but not the other. In the first study, at 90 days SBP / DBP dropped by 4.0 / 1.1 mmHg in the intervention group and 0.8 / 0.8 mmHg in the control group. Antihypertensives could be successfully stopped in 93% of the weight loss group and 87% of the control group by 12 months. In the other study there were not significant differences in SBP or DBP between intervention and control groups at 12 or 24 months.

Azadbakht et al. (2007) conducted a RCT involving 89 participants (mean age 45.5 years) of Middle-Eastern descent that assessed the impact of low-fat with control (moderate-fat) diet over 14 months. After 14 months, the moderate-fat diet appeared to be more successful in reducing weight (-5.0 kg (SD 2.5) in the moderate-fat group vs. -1.2 kg (SD 1.1) in the low-fat group; $P<0.0001$) and waist circumference (-5.5 cm (SD 2.4) in the moderate-fat group vs. -2.3 cm (SD 1.3) in the low-fat group; $P<0.0001$). SBP decreased in both groups (-7.4 mmHg (SD 2.3) in the moderate-fat group versus -3.3 mmHg (SD 1.2) in the low-fat group). DBP also decreased in both groups (-2.9 mmHg (SD 1.2) in the moderate-fat group vs. -1.3 mmHg (SD 1.1) in the low-fat group).

Dale et al. (2008) conducted a RCT involving 79 adult participants (mean age 45 to 48 years) with prediabetes that assessed the impact of diet and exercise on anthropometry and blood pressure. By 2 years, weight change in the intervention and control groups was -1 kg versus -0.8 kg; waist circumference was -1 cm versus -2 cm and BMI was -0.7 kg/m^2 versus -0.8 kg/m^2. Changes in SBP in intervention and control groups were -5 mmHg versus -1 mmHg; and DBP were 1 mmHg versus 2 mmHg.

Groeneveld et al. (2010) conducted a RCT involving 816 adult construction industry workers in The Netherlands that assessed the impact of a motivational interviewing-based lifestyle intervention on weight change over 12 months. Mean BMI at baseline was 28.8 kg/m^2 in the intervention group and 28.2 kg/m^2 in controls. The intervention group lost weight and BMI by 12 months (0.9 kg and 0.4 kg/m^2 respectively) and the control group gained weight and BMI (0.9 kg and 0.3 kg/m^2 respectively). SBP and DBP changes were -4.9 / -3.7 mmHg in the intervention group and -3.8 / -3.2 mmHg in controls respectively.

Ter Bogt et al. (2009) conducted a RCT including 457 participants that compared a nurse practitioner (NP)-led with a general practitioner (GP)-led lifestyle intervention in patients aged between 40 and 70 years with a BMI between 25 and 40 kg/m^2. All participants had hypertension, dyslipidaemia or both. There were more weight losers and stabilisers in the NP group than in the GP-Usual Care (UC) group (77% versus 65%; $P < 0.05$). Mean weight change was -1.9% (SD 4.9) in the NP group and -0.9% (SD 4.9) in the GP-UC group ($P < 0.05$). Significant reductions occurred also in waist circumference (-2.4 cm (SD 7.1) in the NP group

and by 1.2 cm (SD 5.9) in the GP-UC group. No significant differences occurred for changes in blood pressure. Results were pooled across groups and compared for successful versus unsuccessful weight losers. A successful weight loss of 8.9% and / or waist circumference decrease of 7.9 cm corresponded to a reduction in SBP of 11.1 mmHg and reduction in DBP of 3.6 mmHg.

Uusitupa et al. (2009) conducted a RCT including 522 participants with impaired glucose tolerance that assessed intensive diet and exercise counselling with a control intervention of general health behaviour information. In addition, the authors presented follow-up data for a population-based cohort who had received no form of lifestyle advice or intervention (termed "natural controls" by the authors). People lost an average of 4.5 kg (SD 5) in the intervention group and 1 kg (SD 3.7) in the control group after 12 months. Mean SBP and DBP reduced -5.2 / -4.7 mmHg versus -1.5 / -2.8 mmHg in intervention and control groups respectively.

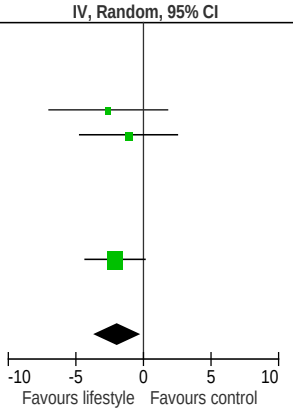
Meta-analysis of primary studies from included reviews and of included RCTs was conducted in order to determine pooled estimates of the impact of lifestyle interventions on blood pressure in adults with no diabetes / pre-diabetes using all available data.

Lifestyle interventions ≤ 1 year in duration: an approximate reduction in body weight of 4 kg (weight loss results were heterogeneous when pooled) was associated with corresponding changes in SBP and DBP of -2.0 mmHg (95% CI, -3.7 to -0.2) and -3.2 mmHg (95% CI, -4.5 to -2.0) respectively.

SBP

	Lifestyle			Control				Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Azadbakht 2007	-7.4	2.3	45	-3.3	1.2	44	0.0%	-4.10 [-4.86, -3.34]	
Croft 1986	-11	15.3	66	-4	15.3	64	0.0%	-7.00 [-12.26, -1.74]	
Fletchner-Mors 2000	-13	19.9	37	-1	20.5	38	0.0%	-12.00 [-21.14, -2.86]	
Gordon 1997	-12.5	6.3	19	-9.9	6.4	14	15.7%	-2.60 [-6.99, 1.79]	
Groeneveld 2010	-4.9	21	261	-3.8	21	256	23.1%	-1.10 [-4.72, 2.52]	
Heshka 2003	-2.2	13.4	148	-2.4	12.6	159	0.0%	0.20 [-2.71, 3.11]	
HPT 1990	-5	9.7	117	-3.6	9.7	114	0.0%	-1.40 [-3.90, 1.10]	
Kukkonen 2005	1	23.6	20	4	19.9	26	0.0%	-3.00 [-15.86, 9.86]	
Kuller 2001	-4.1	14.3	245	-0.1	14.3	245	0.0%	-4.00 [-6.53, -1.47]	
Stefanick 1998	-3.1	7.6	91	-1	7.7	91	61.2%	-2.10 [-4.32, 0.12]	
Wing 1998	-12.3	9.5	31	-2.4	18.9	33	0.0%	-9.90 [-17.16, -2.64]	
Total (95% CI)			**371**			**361**	**100.0%**	**-1.95 [-3.69, -0.21]**	

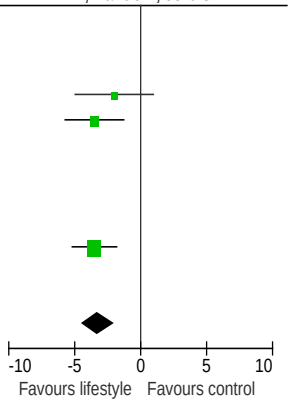
Heterogeneity: Tau² = 0.00; Chi² = 0.31, df = 2 (P = 0.85); I² = 0%
Test for overall effect: Z = 2.19 (P = 0.03)



DBP

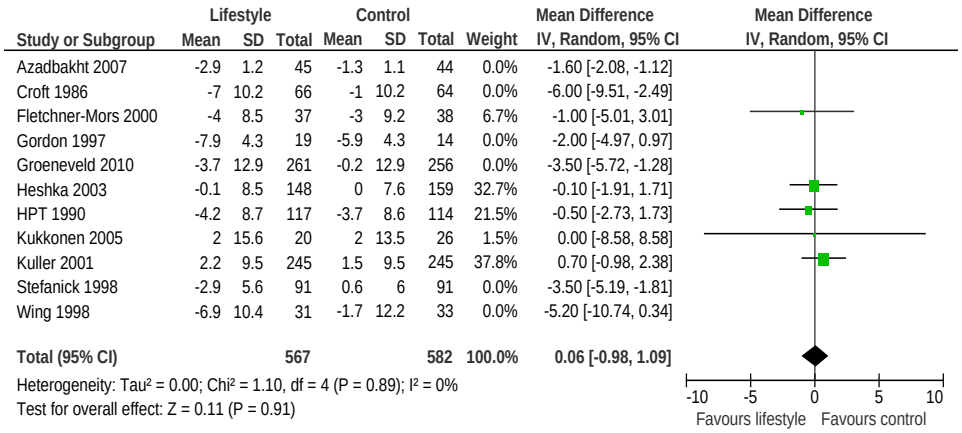
	Lifestyle			Control				Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Azadbakht 2007	-2.9	1.2	45	-1.3	1.1	44	0.0%	-1.60 [-2.08, -1.12]	
Croft 1986	-7	10.2	66	-1	10.2	64	0.0%	-6.00 [-9.51, -2.49]	
Fletchner-Mors 2000	-4	8.5	37	-3	9.2	38	0.0%	-1.00 [-5.01, 3.01]	
Gordon 1997	-7.9	4.3	19	-5.9	4.3	14	17.0%	-2.00 [-4.97, 0.97]	
Groeneveld 2010	-3.7	12.9	261	-0.2	12.9	256	30.3%	-3.50 [-5.72, -1.28]	
Heshka 2003	-0.1	8.5	148	0	7.6	159	0.0%	-0.10 [-1.91, 1.71]	
HPT 1990	-4.2	8.7	117	-3.7	8.6	114	0.0%	-0.50 [-2.73, 1.73]	
Kukkonen 2005	2	15.6	20	2	13.5	26	0.0%	0.00 [-8.58, 8.58]	
Kuller 2001	2.2	9.5	245	1.5	9.5	245	0.0%	0.70 [-0.98, 2.38]	
Stefanick 1998	-2.9	5.6	91	0.6	6	91	52.7%	-3.50 [-5.19, -1.81]	
Wing 1998	-6.9	10.4	31	-1.7	12.2	33	0.0%	-5.20 [-10.74, 0.34]	
Total (95% CI)			**371**			**361**	**100.0%**	**-3.24 [-4.47, -2.02]**	

Heterogeneity: Tau² = 0.00; Chi² = 0.81, df = 2 (P = 0.67); I² = 0%
Test for overall effect: Z = 5.20 (P < 0.00001)

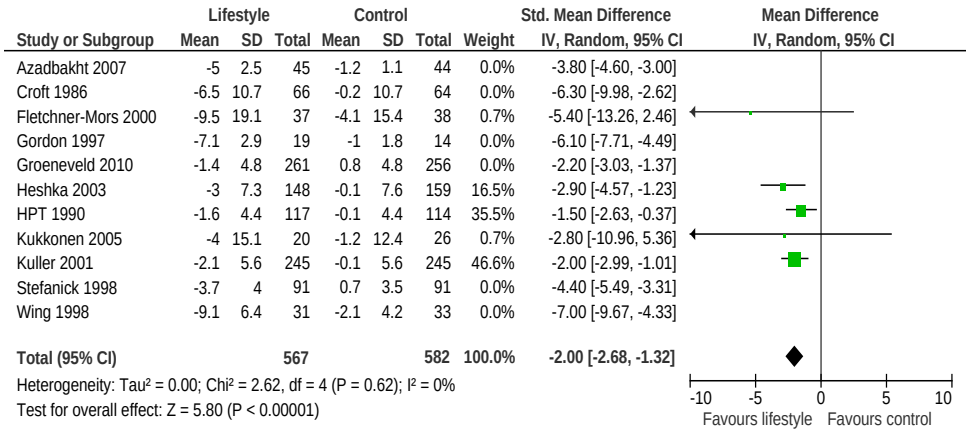


Lifestyle interventions > 2 years in duration: the impact of lifestyle change (diet with or without physical activity) was a pooled reduction in body weight of 2.0 kg (95% CI, 2.7 to -1.3), reflecting weight regain occurring between year 1 and year 2 after intervention commencement. Corresponding changes in SBP but not DBP were maintained over 2 years – pooled changes in SBP and DBP were -2.6 mmHg (95% CI, -6.3 to 0.1) and 0.06 mmHg (95% CI, -1.0 to 1.1) respectively. Heterogeneity prevented pooling of SBP changes.

DBP



Weight



Lifestyle - paediatric

Janssen et al. (2010) conducted a systematic review of 86 intervention studies involving 1,633 participants aged between 5 and 17 years and followed for up to 2 years. There were eight intervention studies (four RCTs) and three observational studies that assessed the impact of exercise or physical activity interventions (between 60 and 180 minutes a week of prescribed exercise or self-reported physical activity) on blood pressure. Despite the small sample sizes, the results from these intervention studies were positive with reports of significant reductions in systolic blood pressure in response to aerobic exercise training, with effect sizes that all tended to be large (> 0.80). Two of the aerobic based interventions also reported significant reductions (~6% to 11%) in DBP. The summary effect size measures for the aerobic exercise interventions were -1.39 (95% CI, -2.53 to -0.24) for SBP and - 0.39 (95% CI, -1.72 to 0.93) for DBP. Unlike the aerobic-based exercise programs, only two of the four studies that employed other training modalities, such as resistance exercise, reported a significant effect on blood pressure, with small to modest effect sizes being observed. The summary effect size measures for the non-

aerobic exercise interventions were -0.61 (95% CI, -2.27 to 1.05) for SBP and -0.51 (95% CI, -2.18 to 1.06) for DBP.

Kelly et al. (2008) conducted a systematic review of 16 RCTs involving 1,025 participants aged between 12 and 20 years and followed for up to 24 months to assess the impact of lifestyle interventions on weight change. All participants were at least 10% above average weight for height. In seven of the 16 studies participants reduced BMI or percent overweight. In these studies, mean BMI of participants at baseline was between 26.6 and 43.3 kg/m^2. The effect size of reported weight loss was between 0.35 and 0.61. There were two studies that also reported BP change. In one study, DBP but not SBP was reported to improve with lifestyle self-education plus high intensity physical activity compared with lifestyle self-education alone (effect size not reported) in participants aged between 13 and 16 years with a baseline mean % body fat > 40%. In the other study, diet, exercise and behaviour therapy in combination were associated with an effect size of 0.61 BMI reduction, 0.95 SBP reduction and 0.69 DBP reduction in female participants aged between 13 and 15 years (baseline BMI not reported).

Li et al. (2008) conducted a systematic review of 22 school-based intervention studies (16 RCTs and 6 controlled clinical trials) involving over 6,997 participants. There were 17 studies that were conducted among overweight and / or obese Chinese children aged between 3 and 19 years. There were 11 studies that reported the effect on overweight / obesity; nine studies reported that overweight / obesity improved and two studies reported that it did not improve. Pooled estimates of weight change were not calculated. Seven studies reported blood pressure outcomes: BP improved in five studies and was not improved in two studies. Pooled estimated of the degree of improvement were not reported.

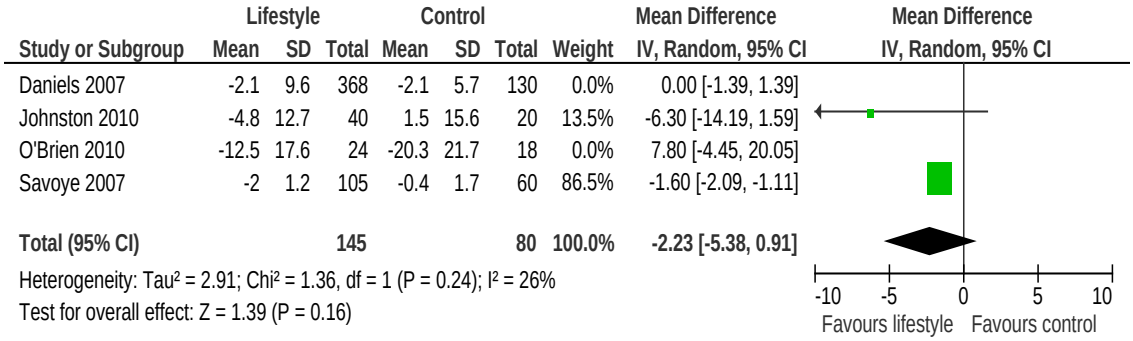
Whitlock et al. (2010) conducted a systematic review and meta-analysis of 13 clinical trials involving 1,258 participants aged between 4 and 18 years that assessed lifestyle with or without pharmacological interventions over up to 12 months. Comprehensive behavioural interventions were associated with a reduction in BMI of between 1.9 and 3.3 kg/m^2. Two trials reported on blood pressure. Neither found group differences on DBP; one reported reductions in SBP

Johnston et al. (2010) conducted a RCT involving 60 participants aged 10 to 14 years with a BMI > 85th centile for age and gender that assessed over 12 months the impact of a school-based lifestyle intervention on Mexican-American children. BMI changes with diet, activity and diet / activity combined were -0.5, 0.4 and -0.2 kg/m^2 respectively. Waist circumference changes with diet, activity and diet / activity combined were -1.1, 2.3 and 1.0 cm respectively. SBP and DBP did not decrease significantly over the course of the intervention.

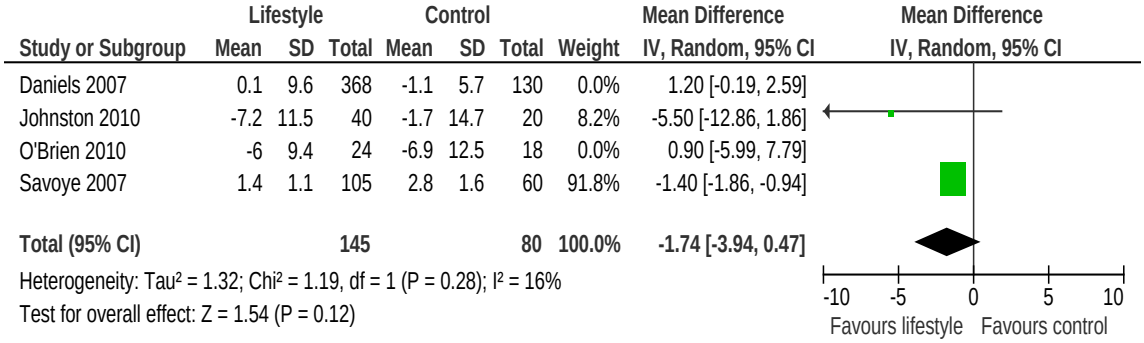
Savoye et al. (2007) conducted a RCT involving 209 participants aged 8 to 16 years with a mean BMI of 35.8 kg/m^2 that assessed the impact of diet, physical activity and behaviour modification on BMI and metabolic indicators over 12 months. Participants who received the lifestyle intervention reduced BMI by 1.7 kg/m^2 (95% CI, -2.3 to -1.1) whereas those who received the control intervention (counselling every 6 months) increased BMI by 1.6 kg/m2 (95% CI, 0.8 to 2.3). The intervention was associated with non-significant reductions in SBP (-2 versus -0.4 mmHg) and non-significant increases in DBP (1.4 versus 2.8 mmHg).

Pooled estimates were calculated from available data to estimate the relationship between weight reduction and BP in paediatric participants. An approximate decrease in body weight of 7 kg (results were heterogeneous when pooled) was associated with corresponding changes in SBP and DBP of -2.2 mmHg (95% CI, -5.4 to 0.9) and -1.7 mmHg (95% CI, -3.9 to 0.5) respectively.

SBP



DBP



Medications - adult

Horvath et al. (2008) (same data as Siebenhofer et al. 2009) conducted a systematic review and meta-analysis of eight RCTs involving 3,742 adult participants with hypertension that assessed the impact of pharmacological interventions on weight loss and BP change over 4 years of follow-up. Orlistat (n = 3,132 participants) was associated with a weight loss of 3.7 kg (95% CI, -2.8 to -4.7), SBP reduction of 2.5 mmHg (95% CI, -0.9 to -4.0) and DBP reduction of 1.9 mmHg (95% CI, -0.9 to -3.0). Sibutramine (n = 610 participants) was also associated with a weight loss of 3.7 kg (95% CI, -2.6 to -4.9) and DBP increase of 3.2 mmHg (95% CI, 1.4 to 4.9). SBP was not reported.

Padwal et al. (2003) (same data as Rucker et al. 2007) conducted a systematic review and meta-analysis of 30 RCTs involving 19,889 adult participants with an average BMI of 35 to 36 kg/m^2 that assessed the impact of orlistat (16 studies, 10,631 participants), sibutramine (10 studies, 2,623 participants) and rimonabant (not reported here) on weight and BP change over 4 years of follow-up. Orlistat was associated with a weight loss of 2.9 kg (95% CI, -2.5 to -3.2), placebo-subtracted SBP reduction of 1.5 mmHg (95% CI, -0.9 to -2.2) and DBP reduction of 1.4 mmHg (95% CI, -0.7 to -2.0). Sibutramine was associated with a weight loss of 4.2 kg (95% CI, -3.6 to -4.7 kg), an increase in SBP of 1.7 mmHg (95% CI, 0.1 to 3.3) and DBP increase of 2.4 mmHg (95% CI, 3.5 to 5.6).

Greenway et al. (2010) conducted a RCT including 1,742 participants aged 18 to 65 years (BMI 27 to 45 kg/m^2) that compared naltrexone / bupropion with placebo. Waist circumference decreased 6.2 cm (95% CI, -7.1 to -5.4) versus 2.5 cm (-3.3 to -1.6) in the naltrexone 32 mg / bupropion group compared with the placebo group. Corresponding changes in SBP were -1.0 mmHg (95% CI, -0.9 to 0.7) versus -1.9 mmHg (95% CI, -1.2 to -2.7) and DBP were 0 mmHg (95% CI, -0.5 to 0.6) versus -0.9 (95% CI, -1.4 to -0.3).

James et al. (2010) conducted a RCT including 10,744 older adult participants (aged 55 years or above) that assessed the impact of sibutramine and lifestyle management or lifestyle management alone on BP. All participants had a history of CVD, type 2 diabetes with at least one other cardiovascular risk factor, or both. Mean weight loss during the lead-in period was 2.6 kg; after randomisation, the participants in the sibutramine group achieved and maintained further weight reduction (mean 1.7 kg at 12 months). Mean BP decreased during the lead-in period in both groups (reduction of 4.7 SBP and 1.7 DBP). Mean BP remained below initial values in both groups throughout the treatment period but was consistently higher in the sibutramine group than in the placebo group. The mean BP decreased in both groups overall, with greater reductions in the placebo group than in the sibutramine group (mean difference 1.2/1.4 mm Hg).

Proietto et al. (2010) conducted a RCT including 1,041 adult participants randomised to placebo medication and lifestyle intervention or taranabant (0.5, 1 or 2 mg) and lifestyle intervention for 12 months. At baseline BMI was between 34.4 and 34.9 kg/m^2; waist circumference was between 109.5 and 110.3 cm; SBP was between 120.3 and 121.2 mmHg; DBP was between 77.2 and 78.2 mmHg. At follow-up weight and waist circumference reductions with placebo were -1.4 kg and -3 cm respectively. Taranabant 0.5 mg, 1 mg and 2 mg were associated with weight/waist circumference reductions of 5.0 / 5.6, 5.2 / 5.7 and 6.4 / 6.9 respectively. There were no statistically significant changes in SBP or DBP between baseline and follow-up in placebo or taranabant groups. Mean SBP / DBP changes for placebo and taranabant 0.5 mg, 1 mg and 2 mg were 0.7 / -0.04, 0.1 / -0.6, -0.5 / -0.5 and 0.7 / -0.4 mmHg respectively.

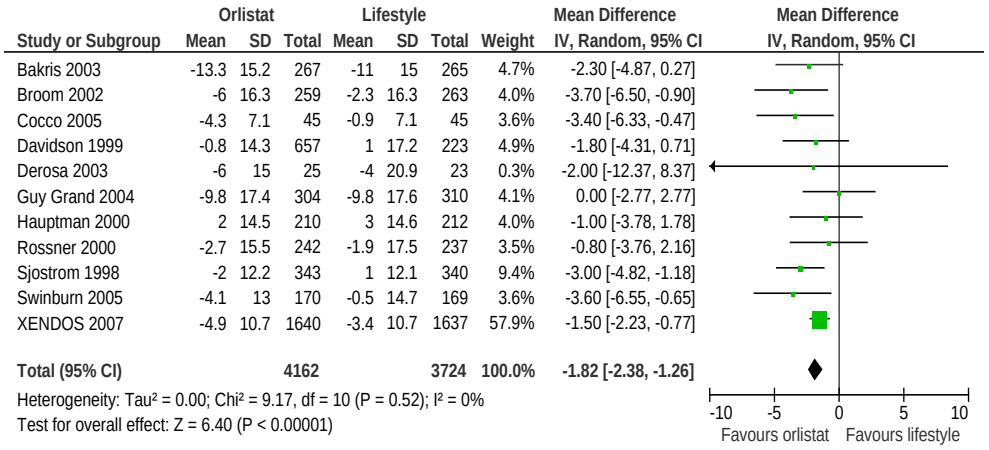
Ryan et al. (2010) conducted a RCT involving 390 participants aged 20 to 60 years (BMI 40 to 60 kg/m^2) that assessed intensive primary care lifestyle intervention and a choice of pharmacotherapy (sibutramine hydrochloride, orlistat, or diethylpropion hydrochloride) over 2 years. Percentage weight loss was 9.7% (SD 1.3) in the intervention and 0.4% (SD 0.7) in the control groups. SBP decreased by 14.7 mmHg (SD 2.4) in the intervention and by 8.6 mmHg (SD 2.6) in the control group. DBP decreased by 4.4 mmHg (SD 1.8) in the intervention and by 3.2 mmHg (SD 1.5) in the control group. There was a substantial drop-out of participants in the intervention group. Of 101 who were enrolled into the intervention group, ten completed the 2 years of the study (compared with 86 of 89 enrolled in the usual care group).

Smith et al. (2010) conducted a RCT involving 3,182 participants aged 18 to 65 years with a BMI between 27 and 45 kg/m^2 that compared lorcaserin with placebo over 2 years of follow-up. Weight change was -5.8 kg (SE 0.2) versus -2.2 kg (SE 0.1) and waist circumference change was -6.8 cm (SE 0.2) versus -3.9 cm (SE 0.2) between intervention and control groups. There were no significant differences in blood pressure changes between intervention and control groups. SBP decreased by 1.4 mmHg (SE 0.3) versus 0.8 mmHg (SE 0.3) mmHg and DBP decreased by 1.1 mmHg (SE 0.2) versus 0.6 mmHg (SE 0.2).

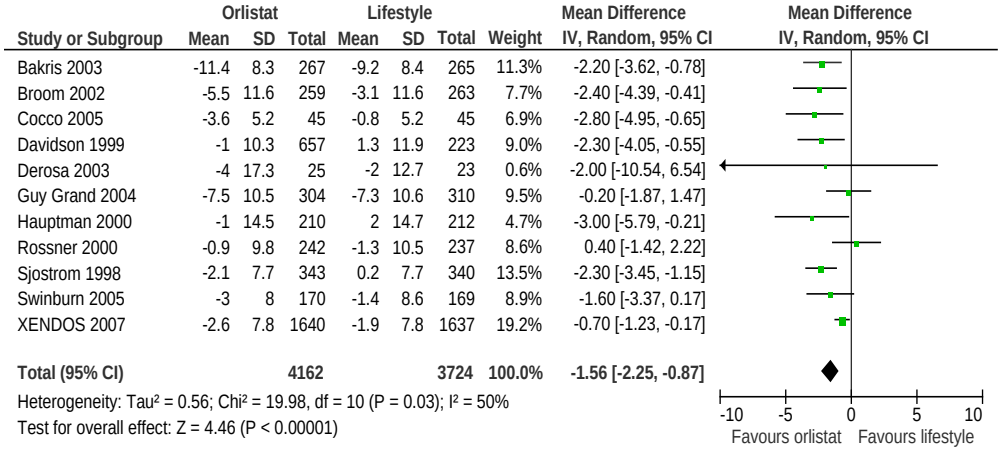
Meta-analysis of primary studies from included reviews was conducted in order to determine pooled estimates of the impact of pharmacological compared with lifestyle interventions on blood pressure in adults with no diabetes / pre-diabetes using all available data.

Orlistat therapy: a pooled mean difference in body weight of -3.4 kg (95% CI, -3.8 to -3) was associated with corresponding changes in SBP and DBP of -1.8 mmHg (95% CI, -2.4 to -1.3) and -1.6 mmHg (95% CI, -2.3 to -0.9) respectively compared with lifestyle therapy.

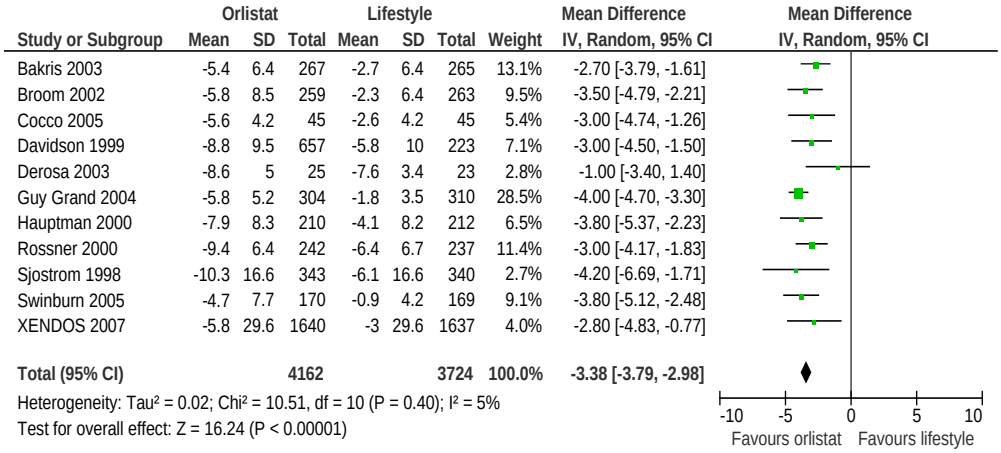
SBP



DBP

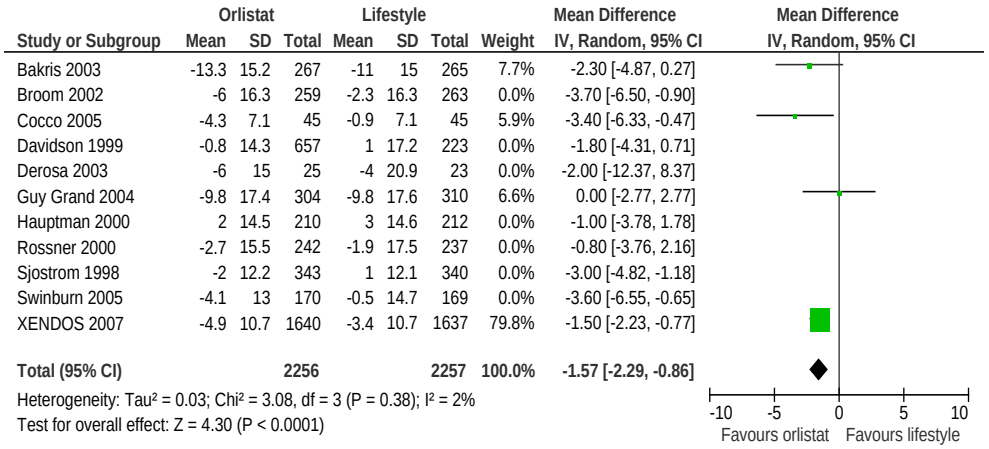


Weight

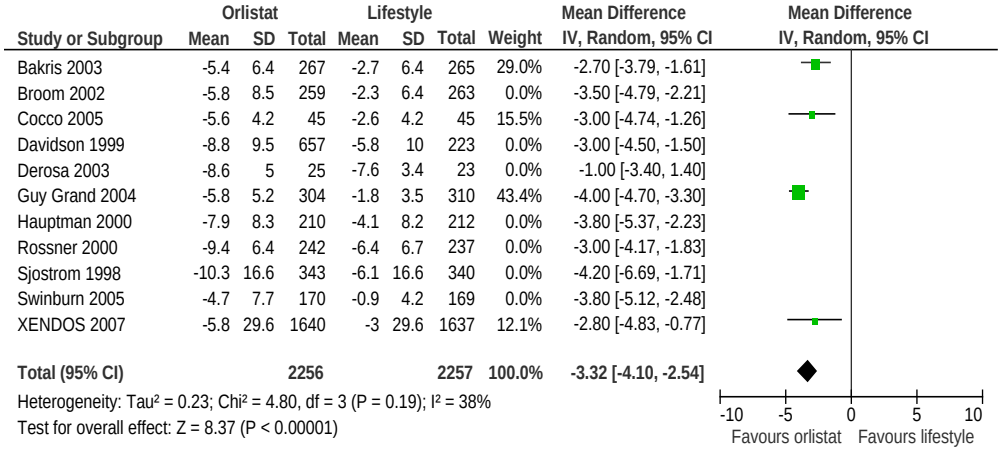


Orlistat therapy in adults with hypertension a pooled mean difference in body weight of -3.3 kg (95% CI, -4.1 to -2.5) was associated with a corresponding change in SBP of -1.6 mmHg (95% CI, -2.3 to -0.9). DBP decreased approximately 1.3 mmHg across studies compared with lifestyle therapy. However, results were heterogeneous when pooled.

SBP

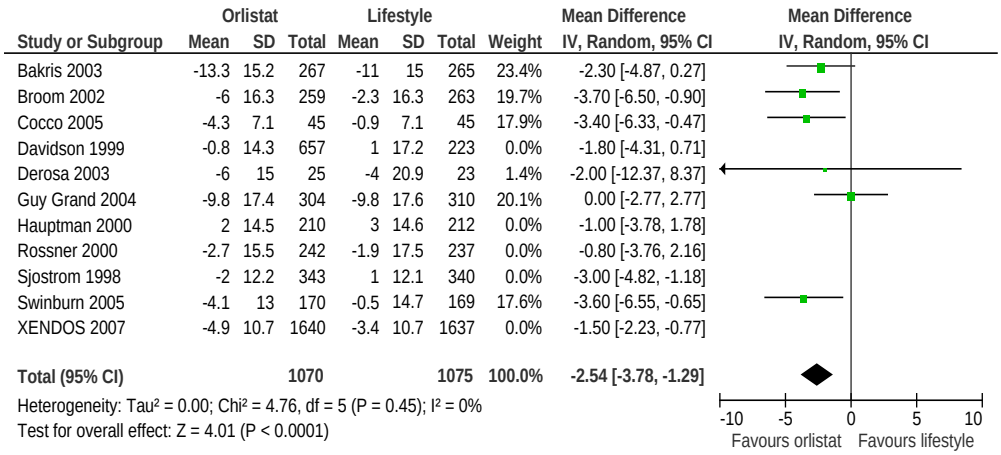


Weight



Changes in body weight and DBP remained stable at 1 year and 2 years in participants without hypertension who were treated with orlistat. Reductions in SBP were greater at 1 year than at 2 years, suggesting increase in SBP over time even when weight reduction is maintained. Heterogeneity prevented pooled estimates of DBP change at 2 years to be calculated.

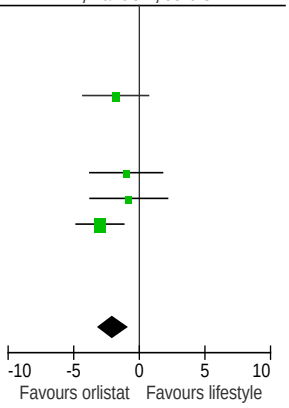
SBP – 1 year



SBP – 2 years

	Orlistat			Lifestyle				Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Bakris 2003	-13.3	15.2	267	-11	15	265	0.0%	-2.30 [-4.87, 0.27]	
Broom 2002	-6	16.3	259	-2.3	16.3	263	0.0%	-3.70 [-6.50, -0.90]	
Cocco 2005	-4.3	7.1	45	-0.9	7.1	45	0.0%	-3.40 [-6.33, -0.47]	
Davidson 1999	-0.8	14.3	657	1	17.2	223	22.6%	-1.80 [-4.31, 0.71]	
Derosa 2003	-6	15	25	-4	20.9	23	0.0%	-2.00 [-12.37, 8.37]	
Guy Grand 2004	-9.8	17.4	304	-9.8	17.6	310	0.0%	0.00 [-2.77, 2.77]	
Hauptman 2000	2	14.5	210	3	14.6	212	18.4%	-1.00 [-3.78, 1.78]	
Rossner 2000	-2.7	15.5	242	-1.9	17.5	237	16.2%	-0.80 [-3.76, 2.16]	
Sjostrom 1998	-2	12.2	343	1	12.1	340	42.8%	-3.00 [-4.82, -1.18]	
Swinburn 2005	-4.1	13	170	-0.5	14.7	169	0.0%	-3.60 [-6.55, -0.65]	
XENDOS 2007	-4.9	10.7	1640	-3.4	10.7	1637	0.0%	-1.50 [-2.23, -0.77]	
Total (95% CI)			**1452**			**1012**	**100.0%**	**-2.00 [-3.20, -0.81]**	

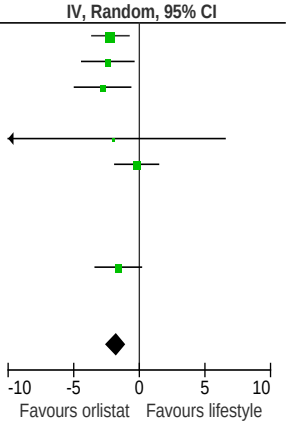
Heterogeneity: Tau² = 0.00; Chi² = 2.31, df = 3 (P = 0.51); I² = 0%
Test for overall effect: Z = 3.29 (P = 0.0010)



DBP – 1 year

	Orlistat			Lifestyle				Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Bakris 2003	-11.4	8.3	267	-9.2	8.4	265	29.8%	-2.20 [-3.62, -0.78]	
Broom 2002	-5.5	11.6	259	-3.1	11.6	263	15.3%	-2.40 [-4.39, -0.41]	
Cocco 2005	-3.6	5.2	45	-0.8	5.2	45	13.1%	-2.80 [-4.95, -0.65]	
Davidson 1999	-1	10.3	657	1.3	11.9	223	0.0%	-2.30 [-4.05, -0.55]	
Derosa 2003	-4	17.3	25	-2	12.7	23	0.8%	-2.00 [-10.54, 6.54]	
Guy Grand 2004	-7.5	10.5	304	-7.3	10.6	310	21.6%	-0.20 [-1.87, 1.47]	
Hauptman 2000	-1	14.5	210	2	14.7	212	0.0%	-3.00 [-5.79, -0.21]	
Rossner 2000	-0.9	9.8	242	-1.3	10.5	237	0.0%	0.40 [-1.42, 2.22]	
Sjostrom 1998	-2.1	7.7	343	0.2	7.7	340	0.0%	-2.30 [-3.45, -1.15]	
Swinburn 2005	-3	8	170	-1.4	8.6	169	19.3%	-1.60 [-3.37, 0.17]	
XENDOS 2007	-2.6	7.8	1640	-1.9	7.8	1637	0.0%	-0.70 [-1.23, -0.17]	
Total (95% CI)			**1070**			**1075**	**100.0%**	**-1.76 [-2.54, -0.98]**	

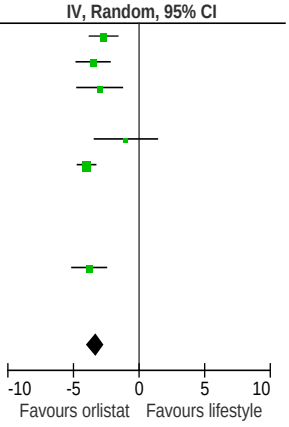
Heterogeneity: Tau² = 0.01; Chi² = 5.06, df = 5 (P = 0.41); I² = 1%
Test for overall effect: Z = 4.41 (P < 0.0001)



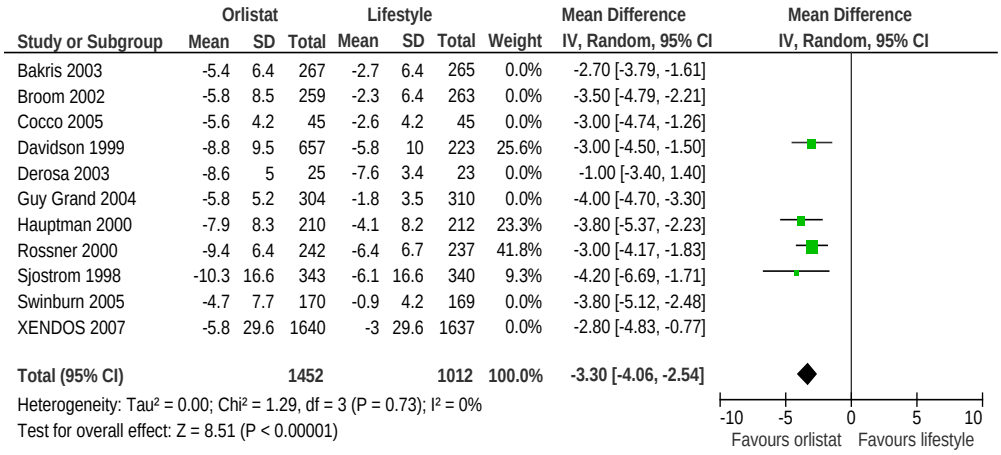
Weight – 1 year

	Orlistat			Lifestyle				Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Bakris 2003	-5.4	6.4	267	-2.7	6.4	265	20.2%	-2.70 [-3.79, -1.61]	
Broom 2002	-5.8	8.5	259	-2.3	6.4	263	16.7%	-3.50 [-4.79, -2.21]	
Cocco 2005	-5.6	4.2	45	-2.6	4.2	45	11.3%	-3.00 [-4.74, -1.26]	
Davidson 1999	-8.8	9.5	657	-5.8	10	223	0.0%	-3.00 [-4.50, -1.50]	
Derosa 2003	-8.6	5	25	-7.6	3.4	23	6.7%	-1.00 [-3.40, 1.40]	
Guy Grand 2004	-5.8	5.2	304	-1.8	3.5	310	28.9%	-4.00 [-4.70, -3.30]	
Hauptman 2000	-7.9	8.3	210	-4.1	8.2	212	0.0%	-3.80 [-5.37, -2.23]	
Rossner 2000	-9.4	6.4	242	-6.4	6.7	237	0.0%	-3.00 [-4.17, -1.83]	
Sjostrom 1998	-10.3	16.6	343	-6.1	16.6	340	0.0%	-4.20 [-6.69, -1.71]	
Swinburn 2005	-4.7	7.7	170	-0.9	4.2	169	16.3%	-3.80 [-5.12, -2.48]	
XENDOS 2007	-5.8	29.6	1640	-3	29.6	1637	0.0%	-2.80 [-4.83, -0.77]	
Total (95% CI)			**1070**			**1075**	**100.0%**	**-3.31 [-3.99, -2.62]**	

Heterogeneity: Tau² = 0.29; Chi² = 8.69, df = 5 (P = 0.12); I² = 42%
Test for overall effect: Z = 9.51 (P < 0.00001)

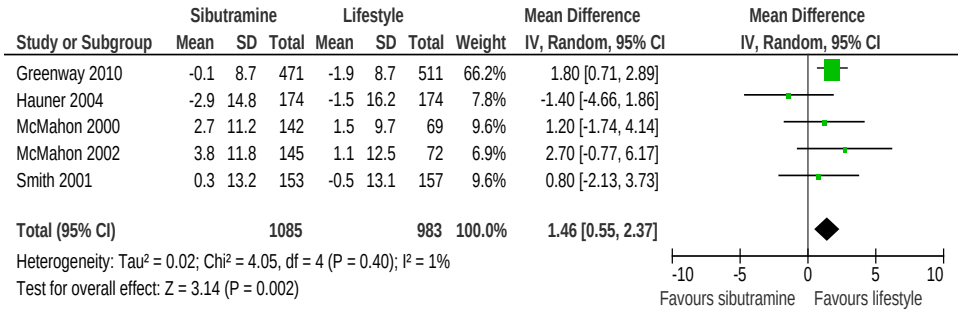


Weight – 2 years

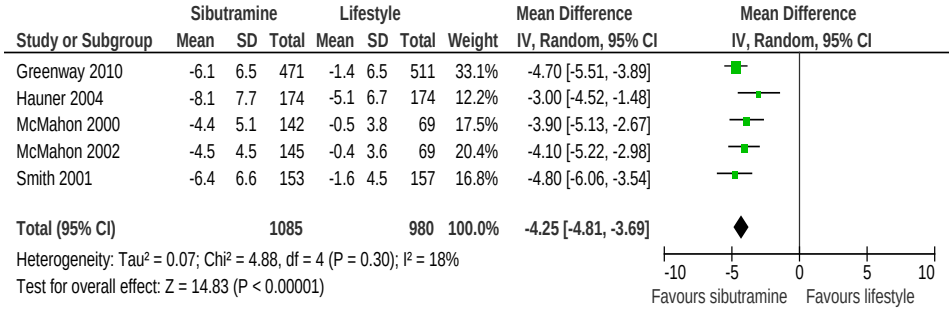


Sibutramine therapy: a pooled reduction in body weight of 4.3 kg (95% CI, -4.8 to -3.7) was associated with corresponding changes in SBP of 1.5 mmHg (95% CI, 0.6 to 2.4) compared with lifestyle therapy. Significant heterogeneity prevented DBP pooled estimates of DBP to be calculated.

SBP

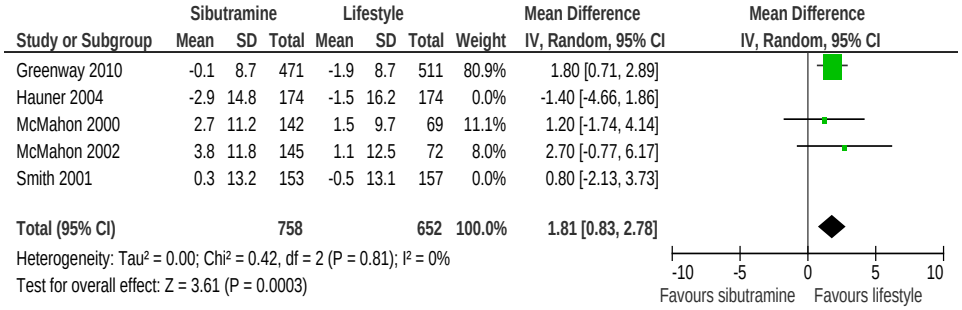


Weight

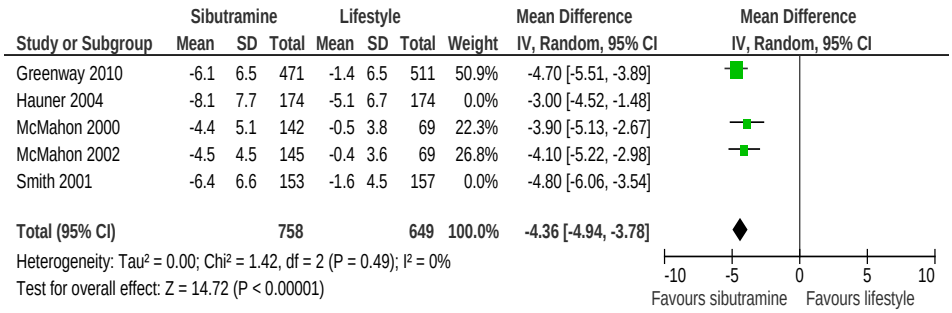


Sibutramine therapy in adults with hypertension: a pooled reduction in body weight of 4.4 kg (95% CI, -4.9 to -3.8) was associated with a corresponding change in SBP of 1.8 mmHg (95% CI, 0.8 to 2.8). The approximate reduction in DBP was 2.3 mmHg compared with lifestyle. However, results of DBP studies were too heterogeneous to be pooled.

SBP



Weight



Medications – paediatric

Czerinow et al. (2010) conducted a systematic review and meta-analysis of eight RCTs involving 1,391 participants aged between 10 and 18 years that assessed the impact of orlistat (three studies, 621 participants, age 10 to 18 years) and sibutramine (five studies, 770 participants, age 12 to 18 years) on weight change and blood pressure over follow-up of up to 15 months. Orlistat was associated with a weight loss of 6.2 kg (95% CI, -1.7 to -14). SBP and DBP reductions were not reported due to statistical heterogeneity. Sibutramine was also associated with a weight loss of 5.3 kg (95% CI, -3.5 to -7.2), BMI reduction of 2.3 kg/m^2 (95% CI, -1.8 to -2.8) and waist circumference change of -5.7 cm (95% CI, -4.6 to -6.9); SBP and DBP increased by 1.0 mmHg (95% CI, 0.1 to 1.9) and 1.7 mmHg (95% CI, 1.0 to 2.4) respectively.

Viner et al. (2010) conducted a systematic review and meta-analysis of six RCTs involving 1,259 participants aged between 12 and 18 years that assessed the impact of orlistat (573 participants) and sibutramine (686 participants) on weight change and blood pressure over follow-up of up to 1 year. Orlistat was also associated with a BMI reduction of 0.8 kg/m^2 (95% CI, -0.47 to -1.19); SBP and DBP change were not reported. Sibutramine was associated with a BMI reduction of 2.2 kg/m^2 (95% CI, -1.6 to -2.8); SBP and DBP increased by 1.4 mmHg (95% CI, 0.1 to 2.6) and 1.7 mmHg (95% CI, 1.0 to 2.5) respectively.

Whitlock et al. (2010) conducted a systematic review and meta-analysis of seven clinical trials involving 1,294 participants aged between 12 and 18 years that assessed lifestyle with or without pharmacological interventions follow up of over up to 12 months. Orlistat and behaviour therapy were associated with a reduction in waist circumference of 2.7 cm (compared with 0.9 cm in placebo group). A small reduction in DBP in the orlistat group (-0.51 mmHg), compared with an

increase in the placebo patients (+1.30 mm Hg; p=0.04) was observed. Change in SBP was similar in both groups and was not statistically different.

Daniels et al. (2007) conducted a RCT involving 498 participants aged 12 to 16 years (BMI between 28.1 and 46.3 kg/m^2) that compared sibutramine plus behaviour therapy with behaviour therapy alone. Over the 12 months duration of the study, participants in the sibutramine group reduced BMI by 2.9 kg/m^2 compared with a reduction of 0.3 kg/m^2 in the control group. Small mean decreases in SBP and DBP were seen in both sibutramine and placebo groups at the study end point (SBP: -2.1 mmHg versus -2.1 mmHg; DBP: -0.1 mmHg versus -1.1 mmHg respectively).

Data were insufficient for meta-analysis of included studies.

Surgery - adult

Picot et al. (2009) (data also reported in Colquitt et al. 2009) systematically reviewed 26 studies (23 RCTs and 3 cohort studies) conducted in 5,766 adults with mean BMI across primary studies of between 30 and 60 kg/m^2. Across included studies: LAGB was associated with a % excess weight loss of between 39.0% and 87.2% and BMI reduction of between 7.4 and 18 kg/m^2; BPD was associated with a BMI reduction of between 13 and 18 kg/m2; RYGB was associated with a % weight loss of between 60.5% and 84.4% and BMI reduction of between 10.7 and 15 kg/m^2; VBG was associated with a per cent excess weight loss of between 37% and 68.8%; sleeve gastrectomy was associated with a % excess weight loss of between 66% and 69.7% and a BMI reduction of 27.5 kg/m^2. Three studies provided detailed information regarding hypertension. In the first study, LAGB was associated with a reduction in antihypertensive use at 2 years of 49.3% (from 70% to 20.7%) compared with no change among control group participants. Corresponding weight loss was 21.1 kg (62.5% of excess body weight lost). In the second study, VBG and LAGB were associated with a reduction in the prevalence of hypertension of 12% (from 14% to 2%) and 8% (from 10% to 2%) respectively over 2 years. The corresponding decreases in weight were 70% and 54.9% respectively of excess body weight. In the third study, open RYGB and laparoscopic RYGB were associated with a reduction in the prevalence of hypertension at 3 years of 49% (from 49% to 0%) and 5% (from 31% to 26%) respectively. The corresponding decreases in weight were 67% and 77% respectively of excess body weight.

Surgery - paediatric

Treadwell et al. (2008) conducted a systematic review and meta-analysis of 18 predominantly uncontrolled case series studies of bariatric surgery performed in 641 paediatric patients (age 9 to 21 years). Weight loss associated with LAGB was between 10.6 and 13.7 kg/m^2; weight loss with RYGB was between 17.8 and 22.3 kg/m^2 over an average of 3 years follow-up. With LAGB there was 71% resolution of hypertension (15 out of 21 participants) and with RYGB there was 75% resolution of hypertension (15 out of 20 participants).

O'Brien et al. (2010) conducted a RCT with 50 adolescents between 14 and 18 years of age with a BMI > 35 kg/m^2, assigned either to a supervised lifestyle intervention or to undergo LAGB, and followed up for 2 years. Overall, the mean changes in the LAGB group were a weight loss of 34.6 kg (95% CI, -30.2 to -39.0), representing an excess weight loss of 78.8% (95% CI, -66.6% to -91.0%), 12.7 BMI units (95% CI, 11.3 to 14.2), and a BMI z-score change from 2.39 (95% CI, 2.05 to 2.73) to 1.32 (95% CI, 0.98 to 1.66). The mean losses in the lifestyle group were 3.0 kg (95% CI, -2.1 to -8.1), representing excess weight loss of 13.2% (95% CI, -2.6% to -21.0%), 1.3 BMI units (95% CI, 0.4 to 2.9), and a BMI z-score change from 2.41 (95% CI, 2.21 to 2.66) to 2.26 (95% CI, 1.91 to 2.43). SBP decreased by 12.5 mmHg in the LAGB group and decreased

by 20.3 mmHg in the lifestyle group; DBP decreased by 6 mmHg in the LAGB group and decreased by 6.9 mmHg in the lifestyle group.

Summary

Lifestyle interventions in adults with overweight and with obesity are associated with significant reductions in both SBP and DBP. Where a 5 kg loss of body weight was achieved, this was associated with up to 5mmHg reductions in SBP and DBP. However, when results were pooled, estimates of effect suggest that adult participants generally do not achieve 5 kg weight reductions with lifestyle interventions, particularly over durations greater than 1 year. Smaller reductions in body weight are associated with equivalent reductions in SBP (2 kg = 2 mmHg reduction) but the impact on DBP is less certain.

The lifestyle intervention influences the association between weight loss and blood pressure reduction. Diet and exercise / physical activity were associated with greater weight reductions than either diet or exercise / physical activity alone. Exercise / physical activity were associated with greater reductions in SBP (1.3mmHg per kg weight lost) than dietary interventions (0.8 mmHg per kg weight lost). Higher intensity exercise did not influence SBP or DBP changes.

The impacts of lifestyle interventions in paediatric patients with overweight and obesity are more difficult to determine from included studies. Results were too heterogeneous to enable pooled estimates of effect on body composition to be determined. However, paediatric patients achieved reductions in SBP and DBP of similar order of magnitude to reductions observed in adults. As the majority of paediatric patients with excess body weight are likely to be normotensive at baseline, the significance of this finding on long-term CVD outcomes in paediatric patients in unknown.

The impact of pharmacological weight loss agents on blood pressure varies between agents. Placebo-subtracted additional BP reduction with orlistat was approximately an extra 0.5 mmHg SBP and DBP for each kilogram of weight loss in meta-analysis of data obtainable from included studies. Sibutramine was associated with increases in mean SBP and DBP in meta-analyses included in this review.

In paediatric patients, sibutramine was associated with greater reductions in body weight and with smaller increases in SBP and DBP (< 2 mmHg), although one RCT observed a small decrease in SBP and DBP with sibutramine use over 12 months in adolescents.

Surgery was associated with very large reductions in body weight and with significant resolution of hypertension in affected individuals. In adults, reduction in prevalence of hypertension with LAGB was between 49% and 80%; reduction in prevalence of hypertension with VBG was 86%; and reduction in prevalence of hypertension with RYGB was between 16% and 100%. In paediatric patients, LAGB was associated with reductions in BMI of between 10.6 and 13.7 kg/m2 and RYGB with reductions in BMI of between 17.8 and 22.3 kg/m^2. Resolution of hypertension was reported in 71% of patients with LAGB and 75% of patients with RYGB.

The effect of weight reduction on blood pressure may decrease over time. A systematic review of 14 studies evaluating lifestyle, pharmacological and surgical weight loss interventions demonstrated that weight reduction was associated with reduction in SBP and DBP. However, blood pressure was found to increase over time, regardless of whether weight loss was maintained (Aucott et al, 2005).

4. Lipids

Obesity is associated with several adverse changes in lipid metabolism, including high serum concentrations of total cholesterol, low-density lipoprotein (LDL) cholesterol, very-low-density

lipoprotein (VLDL) cholesterol, and triglycerides, and a reduction in serum high density lipoprotein (HDL) cholesterol. The relative contribution of lifestyle factors versus excess bodyweight per se to abnormal lipids has not been established. The impacts of weight loss on lipids are therefore important to appraise.

There were 15 systematic reviews / meta-analyses (Table 5) and 15 RCTs (Table 6) that assessed the relationship between weight change and lipids.

Lifestyle - adults

Galani et al. (2007) conducted a systematic review and meta-analysis of 30 studies involving 11,579 adult participants (3,566 with overweight and 8,013 with obesity) followed up to 6 years that assessed the impact of lifestyle interventions (diet, exercise and / or behaviour therapy) on lipids. Participants with overweight and obesity lost an average of 2.2 and 3.5 kg and reduced BMI an average of 1.1 and 1.3 kg/m^2 respectively. Participants with impaired glucose tolerance lost an average of 2.9 kg and reduced BMI an average of 1.3 kg/m^2. Total cholesterol, HDL, LDL and triglycerides changed as follows:

(mmol/L)	Overweight (95% CI)	Obesity (95% CI)	Prediabetes (95% CI)
Total cholesterol	-0.3 (-0.4, -0.1)	-0.1 (-0.2, -0.03)	-0.1 (-0.3, -0.02)
HDL	0.01 (-0.22, 0.04)	0.04 (0.01, 0.08)	0.02 (0.00, 0.04)
LDL	-0.2 (-0.3, -0.03)	Not reported	-0.05 (-0.2, 0.1)
Triglycerides	-0.2 (-0.4, -0.1)	-0.2 (-0.3, -0.04)	-0.2 (-0.3, -0.1)

Norris et al. (2005a) conducted a systematic review and meta-analysis of nine RCTs involving 5,168 participants with prediabetes followed for up to 10 years that assessed the impact of lifestyle interventions on weight loss and metabolic indicators. Overall, pooled weight reduction at 12 months was 2.8 kg (95 % CI, -1.0 to -4.7) (3.3% of baseline body weight) and decrease in BMI was 1.3 kg/m2 (95% CI, -0.8 to -1.9). Weight loss at two years was 2.6 kg (95% CI, -1.9 to -3.3). At follow-up intervals of up to 10 years, weight reduction was maintained. Weight loss of 2.8 kg was associated with reduction in total cholesterol of 0.1 mmol/L (95% CI, -0.02 to -0.2), reduction in LDL of 0.04 mmol/L (95% CI, 0.2 to 0.2), increase in HDL of 0.02 mmol/L (95% CI, -0.03 to 0.07) and reduction in triglycerides of 0.2 mmol/L (95% CI, -0.1 to -0.3).

Shaw et al. (2006) conducted a systematic review and meta-analysis of 41 studies involving 3,476 adult participants followed for up to 12 months that assessed the impact of exercise with without dietary interventions on lipids. Participants in both groups lost weight across trials. Exercise with diet resulted in a mean weight loss of between 3.4 and 17.7 kg, diet alone resulted in a mean weight loss of between 2.3 and 16.7 kg, exercise alone resulted in a mean weight loss of between 0.5 and 7.6 kg and control group participants experienced weight changes of between 0.1kg loss and 0.7 kg gain. Exercise with diet resulted in a mean change in total cholesterol of between -1.23 and -0.15 mmol/L / HDL of -0.1 to 0.18 mmol/L / triglycerides of -0.69 to -0.10 mmol/L; diet alone resulted in a mean change in total cholesterol of between -1.4 and -0.19 mmol/L / HDL of -0.05 to 0.12 mmol/L / triglycerides of -0.6 to 0.03 mmol/L; exercise alone resulted in a mean change in total cholesterol of between -0.25 and 0.18 mmol/L / HDL of 0.01 to 0.11 mmol/L / triglycerides of -0.16 to 0.12 mmol/L; and control group participants experienced changes in total cholesterol of -0.23 to -0.13 mmol/L / HDL of -0.02 to 0.01 mmol/L /

triglycerides of 0.00 to 0.06 mmol/L. Increased intensity of exercise was not associated with a consistent effect on total cholesterol, triglycerides or HDL across included studies.

Witham et al. (2010) conducted a systematic review and meta-analysis of nine studies involving 1,954 adult participants followed for up to 3.2 years that assessed the impact of diet and / or physical activity compared with control on lipids. Diet and physical activity was associated with greater weight change (-3.8 kg; 95% CI -6.2 to -1.4) than physical activity (-1.4 kg; 95% CI -2.4 to -0.4) or diet (0.1 kg; 95% CI, -1.6 to 1.7). The meta-analysis of four studies with lipids data found no significant changes: total cholesterol -0.36 mmol/l (95% CI, -0.75 to 0.04), HDL (0.04; 95% CI, -0.04 to 0.12), LDL (-0.04; 95% CI, -0.25 to 0.18) or triglycerides (0.4; 95% CI, -0.5 to 1.4) with lifestyle interventions.

Azadbakht et al. (2007) conducted a RCT involving 89 participants (mean age 45.5 years) of Middle-Eastern descent that assessed the impact of low-fat with control (moderate-fat) diet over 14 months. After 14 months, the moderate-fat diet appeared to be more successful in reducing body weight (-5.0 kg (SD 2.5) in the moderate-fat group versus -1.2 kg (SD 1.1) in the low-fat group; $P < 0.0001$) and waist circumference (-5.5 cm (SD 2.4) in the moderate-fat group versus -2.3 cm (SD 1.3) in the low-fat group; $P<0.0001$). Total cholesterol decreased in both groups (-10.3 mg/dL (SD 4.1) in the moderate-fat group versus -5.9 mg/dL (SD 3.3) in the low-fat group). Decreases were also observed in moderate versus low-fat groups in triglycerides (-10.1 mg/dL versus -2.3 mg/dL) and LDL (-6.9 mg/dL versus -3.9 mg/dL) and increases in HDL (6.6 mg/dL versus 3.8 mg/dL).

Dale et al. (2008) conducted a RCT involving 79 adult participants (mean age 45 to 48 years) with prediabetes that assessed the impact of diet and exercise on anthropometry and lipids. By 2 years, weight change in the intervention and control groups was -1 kg versus -0.8 kg; waist circumference was -1 cm versus -2 cm and BMI was -0.7 kg/m^2 versus -0.8 kg/m^2. Changes in lipids in intervention and control groups were: total cholesterol -0.4 mmol/L versus 0.2 mmol/L, triglycerides -0.1 mmol/L versus 0.3 mmol/L and HDL 0.0 mmol/L versus 0.1 mmol/L.

Groeneveld et al. (2010) conducted a RCT involving 816 adult construction industry workers in The Netherlands that assessed the impact of a motivational interviewing-based lifestyle intervention on weight change over 12 months. Mean BMI at baseline was 28.8 kg/m^2 in the intervention group and 28.2 kg/m^2 in controls. The intervention group lost weight and BMI by 12 months (0.9 kg and 0.4 kg/m2 respectively) and the control group gained weight and BMI (0.9 kg and 0.3 kg/m^2 respectively). HDL changes were 0.07 mmol/L and 0.05 mmol/L increase in the intervention and control groups respectively.

Ter Bogt et al. (2009) conducted a RCT including 457 participants that compared a nurse practitioner (NP)-led with a general practitioner (GP)-led lifestyle intervention in patients aged between 40 and 70 years with a BMI between 25 and 40 kg/m^2. All participants had hypertension, dyslipidaemia or both. There were more weight losers in the NP group than in the GP-UC group (77% versus 65%; $P < 0.05$). Mean weight change was -1.9% (SD 4.9) in the NP group and -0.9% (SD 4.9) in the GP-UC group ($p < 0.05$). Significant reductions occurred also in waist circumference (-2.4 cm (SD 7.1) in the NP group and 1.2 cm (SD 5.9) in the GP-UC group). No significant differences occurred for changes in blood pressure. Results were pooled across groups and compared for successful versus unsuccessful weight losers. A successful weight loss of 8.9% and or waist circumference decrease of 7.9 cm corresponded to a reduction in total cholesterol of 0.4 mmol/L, reduction in LDL of 0.26 mmol/L and reduction in HDL of 0.05 mmol/L.

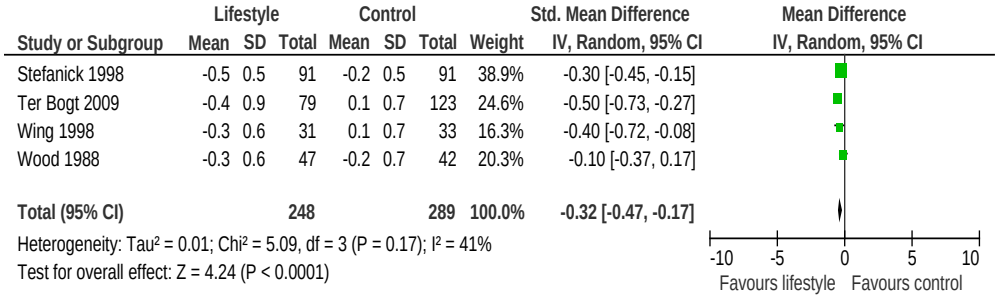
Uusitupa et al. (2009) conducted a RCT including 522 participants with impaired glucose tolerance that assessed intensive diet and exercise counselling with a control intervention of

general health behaviour information. People lost an average of 4.5 kg (SD 5) in the intervention group and 1kg (SD 3.7) in the control group after 12 months. Changes in lipids were as follows:

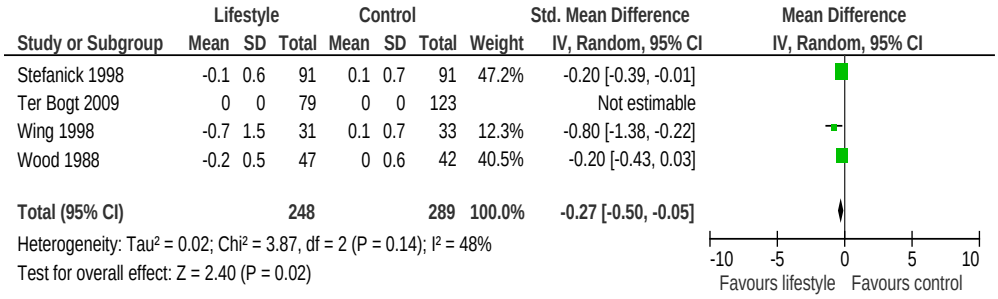
	Intervention Mean (SD)	Control Mean (SD)
Total cholesterol (mmol/L)	-0.12 (0.73)	-0.10 (0.72)
Triglycerides (mmol/L)	-0.19 (0.56)	-0.02 (0.67)
HDL (mmol/L)	-0.05 (0.19)	0.02 (0.17)

Pooled estimates were calculated to estimate the relationship between weight reduction and lipids in people with no diabetes or pre-diabetes from available data. A 1.2 kg (95% CI, -1.0 to -1.4) reduction in body weight corresponded to a reduction in total cholesterol of 0.3 mmol/L (95% CI, -0.5 to -0.2) and in triglycerides of 0.3 mmol/L (95% CI, -0.5 to -0.1).

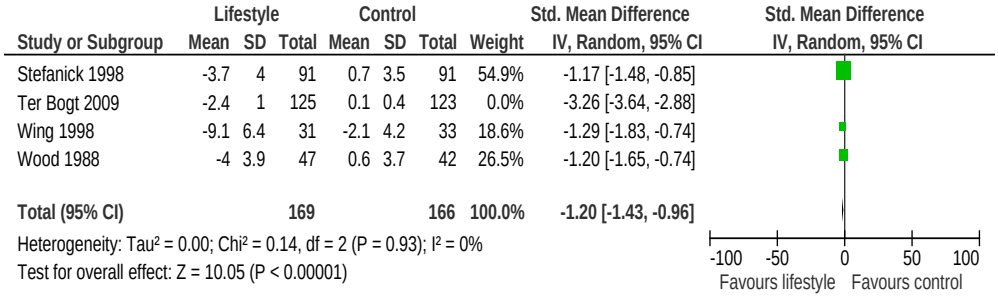
Total cholesterol



Triglycerides



Weight



Lifestyle - paediatric

Janssen et al. (2010) conducted a systematic review of 86 intervention studies involving 1,633 participants aged between five and 17 years and followed for up to two years. There were eight intervention studies (four RCTs) and three observational studies that assessed the impact of exercise or physical activity interventions (between 60 and 180 minutes a week of prescribed exercise or self-reported physical activity) on blood pressure. For the interventions that were based on aerobic exercise, effect sizes were: total cholesterol -0.46 to -0.6, triglycerides -3.3 to 0.3, HDL -0.04 to 0.7 and LDL -0.2 to -1.4. No effect sizes were calculated for resistance exercise.

Kelly et al. (2008) conducted a systematic review of 16 RCTs involving 1,025 participants aged between 12 and 20 years and followed up for up to 24 months that assessed the impact of lifestyle interventions on weight change. All participants were at least 10% above average weight for height. In 7 of the 16 studies participants reduced BMI or % overweight. In these studies, mean BMI of participants at baseline was between 26.6 and 43.3 kg/m^2. The effect size of reported weight loss was between 0.35 and 0.61. There were three studies that also reported changes in lipids. In one study, total cholesterol / HDL ratio, LDL particle size and triglycerides were reported to improve with lifestyle self-education plus high intensity physical activity compared with lifestyle self-education alone (effect size not reported) in participants aged between 13 and 16 years with a baseline mean % body fat > 40%. In the second study, home-based diet, physical activity and behaviour change advice in participants aged 13.2 years on average with a baseline mean BMI of 26.6 resulted in effect sizes for total cholesterol of 0.72 and triglycerides of 0.56 over 24 months. In the third study, diet, exercise and behaviour therapy in combination were associated with an effect size of 0.61 BMI reduction and 0.48 LDL reduction but no other significant changes to lipids in female participants aged between 13 and 15 years (baseline BMI not reported).

Li et al. (2008) conducted a systematic review of 22 school-based intervention studies (16 RCTs and 6 controlled clinical trials) involving over 6,997 participants. There were 17 studies that were conducted among overweight and / or obese Chinese children aged between 3 and 19 years. There were 11 studies that reported the effect on overweight / obesity; nine studies reported that overweight / obesity improved and two studies reported that it did not improve. Pooled estimates of weight change not calculated. Seven studies reported lipids outcomes: lipids improved in six studies and were not improved in one study. Pooled estimates of the degree of improvement were not reported. In one study of students aged 12 to 16 years who participated in health education and physical intervention, total cholesterol decreased from 4.7 to 1.5 mmol/L over 32 months; a second study of students in grades 7 and 8 who participated in dietary modification, physical activity, health education and ear acupuncture decreased total cholesterol from 4.5 to 4.1 mmol/L over 2 years; a third study of students aged 9 to 19 years who participated in a reduced energy diet, increased physical activity and a psychological consultation decreased total cholesterol from 5.3 to 3.3 mmol/L and triglycerides from 2.3 to 1.0 mmol/L over 2 years of follow-up; a fourth study of students aged 7 to 12 years who participated in health education and physical activity decreased total cholesterol from 4.2 to 3.9 mmol/L over 3 months of follow-up; a fifth study of students aged 15 to 23 years who participated in aerobic exercise, portion-controlled diet and psychological counselling decreased total cholesterol 0.6 mmol/L over 10 months of follow-up; and a sixth study in students aged 8 to 12 years randomised to low-calorie diet, physical activity or both reported significant improvements in blood lipids in the physical activity group but not diet or diet and physical activity groups – point estimates were not provided.

Whitlock et al. (2010) conducted a systematic review and meta-analysis of 13 clinical trials involving 1,258 participants aged between 4 and 18 years that assessed lifestyle with or without pharmacological interventions over up to 12 months. Comprehensive behavioural interventions were associated with a reduction in BMI of between 1.9 and 3.3 kg/m^2. None of the four trials reporting lipid levels found group differences in HDL or triglyceride levels, and only one found reductions in LDL levels.

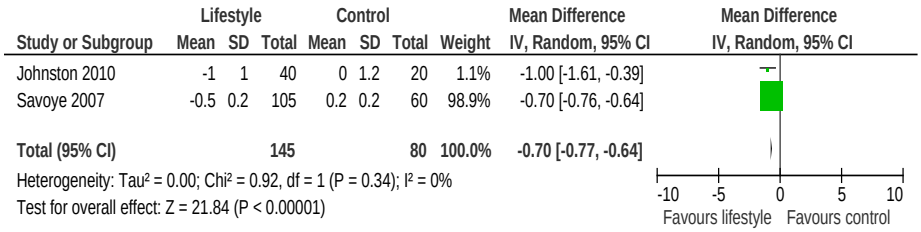
Ford et al. (2010) conducted a RCT involving 106 participants aged 9 to 17 years with a BMI > 95th centile for age and gender that assessed over 18 months the impact of feedback from a real-time computerised device (Mandometer) designed to slow down speed of eating and reduce total intake. Compared with lifestyle therapy control, those in the Mandometer group had significantly lower mean BMI SDS at 18 months compared with standard care (baseline adjusted mean difference 0.27; 95% CI, 0.11 to 0.43). HDL cholesterol concentration improved significantly (mean adjusted difference -0.07; 95% CI, -0.14 to -0.00; P = 0.043) compared with the standard care group. There were no significant changes in other lipids (data not provided).

Johnston et al. (2010) conducted a RCT involving 60 participants aged 10 to 14 years with a BMI > 85th centile for age and gender that assessed over 12 months the impact of a school-based lifestyle intervention on Mexican-American children. BMI changes with diet, activity and diet / activity combined were -0.5, 0.4 and -0.2 kg/m^2 respectively. Waist circumference changes with diet, activity and diet / activity combined were -1.1, 2.3 and 1.0 cm respectively. SBP and DBP did not decrease significantly; nor did lipids change significantly over the course of the intervention.

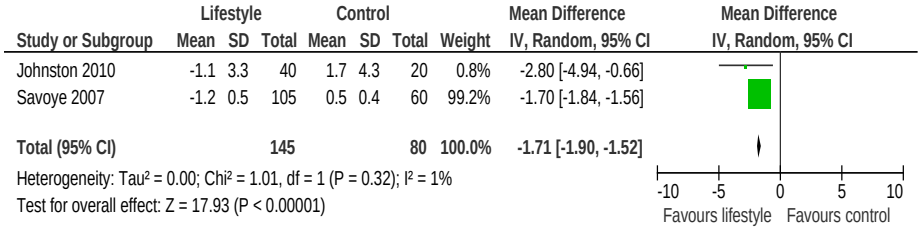
Savoye et al. (2007) conducted a RCT involving 209 participants aged 8 to 16 years with a mean BMI of 35.8 kg/m^2 that assessed the impact of diet, physical activity and behaviour modification on BMI and metabolic indicators over 12 months. Participants who received the lifestyle intervention reduced BMI by 1.7 kg/m^2 (95% CI, -2.3 to -1.1) whereas those who received the control intervention (counselling every 6 months) increased BMI by 1.6 kg/m^2 (95% CI, 0.8 to 2.3). The intervention was associated with significant reductions in total cholesterol (-9.2 mg/dL versus +3.7 mg/dl) and triglycerides (-21.3 mg/dL versus -8.1 mg/dl); non-significant reductions in LDL (-2.4 mg/dL versus +1.5 mg/dL); and significant increases in HDL (3.2 mg/dL versus 1.4 mg/dl).

Pooled estimates were calculated to estimate the relationship between weight reduction and lipids in paediatric participants with no diabetes or pre-diabetes from available data. Significant heterogeneity between studies in observed changes in body weight was observed. Lifestyle interventions were associated with a reduction in total cholesterol of 0.7 mmol/L (95% CI, -0.8 to -0.6) and in triglycerides of 1.7 mmol/L (95% CI, -1.9 to -1.5).

Total cholesterol



Trigylcerides



Medications - adult

Padwal et al. (2003) (same data as Rucker et al. 2007) conducted a systematic review and meta-analysis of 30 RCTs involving 19,889 adult participants with an average BMI of 35 to 36 kg/m^2 that assessed the impact of orlistat (16 studies, 10,631 participants), sibutramine (10 studies, 2,623 participants) and rimonabant on weight and lipid changes over 4 years of follow-up. Orlistat was associated with a weight loss of 2.9 kg (95% CI, -2.5 to -3.2), placebo-subtracted reduction in total cholesterol of 0.32 mmol/L (95% CI, -0.28 to -0.37), LDL reduction of 0.26 mmol/L (95% CI, -0.22 to -0.30) and HDL reduction of 0.03 mmol/L (95% CI, -0.02 to -0.04). Triglycerides did not change significantly (-0.03 mmol/L; 95% CI, -0.12 to +0.07). Sibutramine was associated with a weight loss of 4.2 kg (95% CI, -3.6 to -4.7), increased HDL (0.04 mmol/L; 95% CI, 0.01 to 0.08) and reduced triglycerides (0.18 mmol/L; 95% CI, -0.07 to -0.30). Insufficient data were available to estimated pooled changes in total cholesterol and LDL-cholesterol with sibutramine.

Greenway et al. (2010) conducted a RCT including 1,742 participants aged 18 to 65 years (BMI 27 to 45 kg/m2) that compared naltrexone / bupropion with placebo. Waist circumference decreased by 6.2 cm (95% CI, -5.4 to -7.1) versus 2.5 cm (95% CI, -1.6 to 3.3) with naltrexone 32 mg / bupropion compared with placebo. Corresponding changes in triglycerides were -12.7% (95% CI, -15.8 to 9.5) versus -3.1% (95% CI, -6.6 to 0.6), HDL were 8% (95% CI, 6.3 to 9.7) versus 0.8% (95% CI, -1 to 2.5) and LDL were -2% (95% CI, -4 to 0.1) versus -0.5% (95% CI, -2.6 to 1.6).

Madsen et al. (2008) conducted a RCT including 93 adult participants randomised to orlistat or placebo for 3 years. Both groups also participated in diet and exercise counselling. Mean BMI at baseline was 37 kg/m^2 and cholesterol was 6 mmol/L. Weight change from baseline to 3 years was -8.9 ± 8.3 kg in the treatment group and 6.3 ± 9.1 in the control group. There were no statistically significant differences in lipids between intervention and control groups; results were therefore pooled and resulted in the following: total cholesterol= -7.5% (95% CI, -2.9 to -11.8%), HDL cholesterol = 1.6% (95% CI, -2.7 to 6.1 %) and triglycerides = -12% (95% CI, -1.3 to -21.5%).

Proietto et al. (2010) conducted a RCT including 1,041 adult participants randomised to placebo medication and lifestyle intervention or taranabant (0.5, 1 or 2 mg) and lifestyle intervention for 12 months. At baseline BMI was between 34.4 kg/m^2 and 34.9 kg/m^2; waist circumference was between 109.5 cm and 110.3 cm; total cholesterol was between 191.5 mg/dL and 198.5 mg/dL, HDL was between 50 mg/dL and 51.3 mg/dL and triglycerides were between 128 mg/dL and 135 mg/dL. At follow-up weight and waist circumference reductions with placebo were -1.4 kg and -3 cm respectively. Taranabant 0.5 mg, 1 mg and 2 mg were associated with weight / waist circumference reductions of 5.0 / 5.6, 5.2 / 5.7 and 6.4 / 6.9 respectively. Mean total cholesterol, HDL and triglycerides changes were 7% / 9.2% / 0% (placebo), 4% / 10.6% / -3.9% (taranabant 0.5 mg), 4.4% / 11.2% / -3.3% (taranabant 1 mg) and 4.2% / 11.7% / -5.4% (taranabant 2 mg) respectively. Increases in total cholesterol were statistically significantly less

with all doses of taranabant than the increase observed with placebo. Reductions in triglycerides were statistically greater than placebo for taranabant 2 mg only. There were no statistically significant differences between taranabant doses and placebo for increases in HDL.

Ryan et al. (2010) conducted a RCT involving 390 participants aged 20 to 60 years (BMI 40 to 60 kg/m^2) that assessed intensive primary care lifestyle intervention and a choice of pharmacotherapy (sibutramine hydrochloride, orlistat, or diethylpropion hydrochloride) over 2 years. Percentage weight loss was 9.7% (SD 1.3) in the intervention and 0.4% (SD 0.7) in the control groups. Triglycerides decreased 9.2% (SD 3.5) in the intervention and 4.8% (SD 4.3) in the control group. HDL increased 7.9% (SD 1.8) in the intervention and 1.5% (SD 1.8) in the control group. There were no significant changes in LDL cholesterol in intervention versus control groups (1.8% versus 0.7%). There was a substantial drop-out of participants in the intervention group. Of 101 who were enrolled into the intervention group, 10 completed the two years of the study (compared with 86 of 89 enrolled in the usual care group).

Smith et al. (2010) conducted a RCT involving 3,182 participants aged 18 to 65 years with a BMI between 27 and 45 kg/m^2 that compared lorcaserin with placebo over 2 years. Weight change was -5.8 kg (SD 0.2) versus -2.2 kg (SD 0.1) and waist circumference change was -6.8 cm (SD 0.2) versus -3.9 cm (SD 0.2) between intervention and control groups. Total cholesterol changes between intervention and control groups were -0.9% (SD 0.3) versus 0.6% (SD 0.3), LDL was 2.9% (SD 0.6) versus 4.0% (SD 0.6), HDL was 0.1% (SD 0.3) versus -0.2% (SD 0.3) and triglycerides were -6.2% (SD 1.0) versus -0.1% (SD 1).

Orlistat may not significantly influence saturated fat intake compared with placebo. Svendsen et al. (2009) conducted a RCT on orlistat vesus placebo in 44 participants with metabolic syndrome and a mean BMI of 37.5 kg/m^2. At 1 year, overall weight reduction was 7.2 kg (SD 8.1) in the orlistat group and 3.9 (SD 7.4) in the placebo group. Dietary intake did not differ between the orlistat and placebo group.

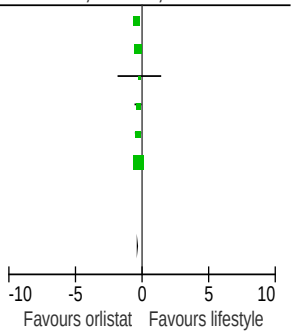
Orlistat studies

Pooled estimates were calculated to estimate the relationship between weight reduction with orlistat and lipids in people with no diabetes or pre-diabetes from available data. A 3.2 kg (95% CI, -3.8 to -2.6) reduction in body weight corresponded to a reduction in total cholesterol of 0.3 mmol/L (95% CI, -0.4 to -0.3) compared with lifestyle. Significant heterogeneity existed in pooled estimates of triglycerides and HDL.

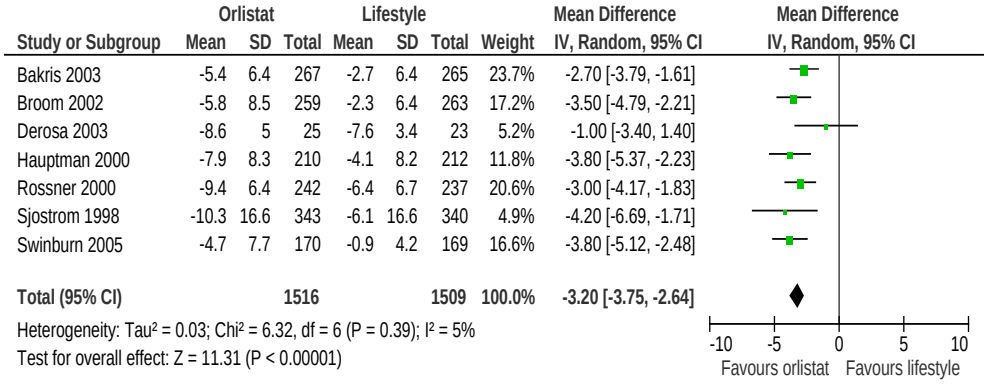
Total cholesterol

	Orlistat			Lifestyle				Std. Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Bakris 2003	-0.4	0.9	267	0	0.8	265	19.7%	-0.40 [-0.54, -0.26]	
Broom 2002	-0.1	0.8	259	0.2	0.8	263	21.9%	-0.30 [-0.44, -0.16]	
Derosa 2003	-1	2.8	25	-0.8	2.8	23	0.2%	-0.20 [-1.79, 1.39]	
Hauptman 2000	0	1.2	210	0.3	1	212	9.3%	-0.30 [-0.51, -0.09]	
Rossner 2000	-0.4	1	242	-0.1	1.1	237	11.6%	-0.30 [-0.49, -0.11]	
Sjostrom 1998	-0.1	0.7	343	0.2	0.7	340	37.4%	-0.30 [-0.40, -0.20]	
Swinburn 2005	-0.1	0.7	2	0.7	0	169		Not estimable	
Total (95% CI)			**1348**			**1509**	**100.0%**	**-0.32 [-0.38, -0.26]**	

Heterogeneity: Tau² = 0.00; Chi² = 1.50, df = 5 (P = 0.91); I² = 0%
Test for overall effect: Z = 9.76 (P < 0.00001)



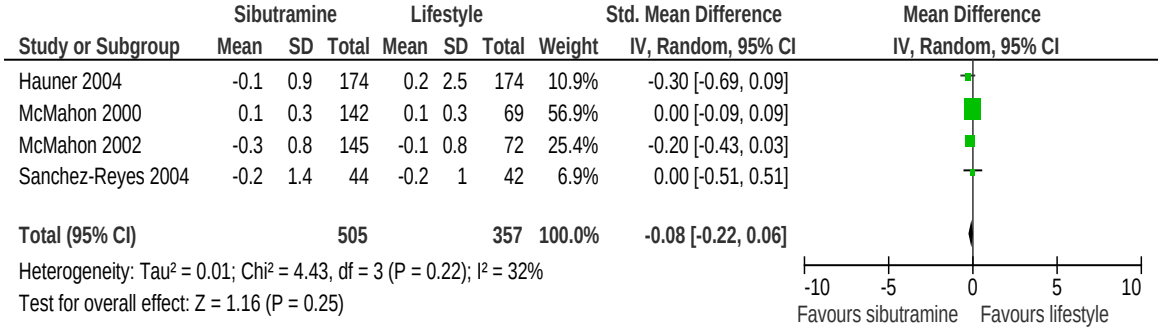
Weight



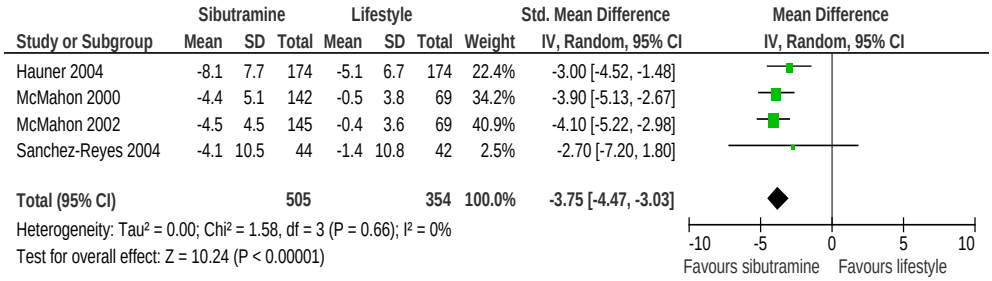
Sibutramine studies

Pooled estimates were also calculated to estimate the relationship between weight reduction with sibutramine and lipids in people with no diabetes or pre-diabetes from available data. A 3.8 kg (95% CI, -4.5 to -3.0) reduction in body weight corresponded to a reduction in triglycerides of 0.1 mmol/L (95% CI, -0.2 to 0.1). Significant heterogeneity existed in pooled estimates of total cholesterol and HDL.

Triglycerides



Weight



Medications – paediatric

Czernichow et al. (2010) conducted a systematic review and meta-analysis of eight RCTs involving 1,391 participants aged between 10 and 18 years that assessed the impact of orlistat (three studies, 621 participants, age 10 to 18 years) and sibutramine (five studies, 770 participants, age 12 to 18 years) on weight change and blood pressure over follow-up of up to 15 months. Orlistat was associated with a weight loss of 6.2 kg (95% CI, -1.7 to -14). Total cholesterol, HDL, LDL and triglycerides pooled estimates were not reported due to statistical heterogeneity. Sibutramine was also associated with a weight loss of 5.3 kg (95% CI, -3.5 to

-7.2), BMI reduction of 2.3 kg/m^2 (95% CI, -1.8 to -2.8) and waist circumference decrease of 5.7 cm (95% CI, -4.6 to -6.9); there were no statistically significant changes in total cholesterol, triglycerides, HDL or LDL cholesterol.

Viner et al. (2010) conducted a systematic review and meta-analysis of six RCTs involving 1,259 participants aged between 12 and 18 years that assessed the impact of orlistat (573 participants) and sibutramine (686 participants) on weight change and blood pressure over follow-up of up to 1 year. Orlistat was also associated with a BMI reduction of 0.8 kg/m^2 (95% CI, -0.47 to -1.19). There were no statistically significant changes in total cholesterol, HDL, LDL or triglycerides. Sibutramine was associated with a BMI reduction of 2.2 kg/m^2 (95% CI, -1.6 to -2.8); a statistically significant increase in HDL cholesterol (0.09 mmol/L; 95% CI, 0.05 to 0.13) and decrease in triglycerides (0.31 mmol/L; 95% CI, -0.23 to 0.39) were observed. No significant changes in total cholesterol or LDL cholesterol were observed.

Whitlock et al. (2010) conducted a systematic review and meta-analysis of seven clinical trials involving 1,294 participants aged between 12 and 18 years that assessed lifestyle with or without pharmacological interventions over follow up of up to 12 months. Sibutramine and behaviour therapy were associated with a reduction in waist circumference by 7 to 8 cm (compared with 2 to 3 cm in placebo group). Four trials reported the effects on lipid profiles. Of these, statistically significant differences were only reported in one trial. This study demonstrated greater improvements in HDL cholesterol and reductions in triglycerides compared to the placebo group. Differences in LDL cholesterol were not statistically different between groups. Orlistat and behaviour therapy were associated with a reduction in waist circumference of 2.7 cm (compared with 0.9 cm in placebo group). Levels of LDL, HDL and triglycerides were measured in two orlistat trials, and no significant differences were found between groups in either trial.

Wilson et al. (2010) conducted a RCT involving 77 participants aged 13 to 18 years (BMI 95th centile for age and sex, and body weight less than 136 kg) that compared metformin slow-release and lifestyle intervention with placebo and lifestyle intervention. The lifestyle intervention had dietary and exercise components. Over the 12 months that metformin was received, BMI decreased by 0.9 kg/m^2 (SE 0.5) in the intervention group and increased by 0.2 kg/m^2 (SE 0.5) in the control group. Intervention versus control changes in lipids were HDL +1 mg/dL versus 0.00 mg/dL and triglycerides -2 mg/dL versus +1 mg/dL respectively. Within 24 weeks of ceasing metformin, body composition and metabolic differences between intervention and control had disappeared.

Surgery - adult

Picot et al. (2009) (data also reported in Colquitt et al. 2009) systematically reviewed 26 studies (23 RCTs and 3 cohort studies) conducted in 5,766 adults with mean BMI across primary studies of between 30 and 60 kg/m^2. Across included studies: LAGB was associated with a % excess weight loss of between 39.0% and 87.2% and a BMI reduction of between 7.4 and 18 kg/m^2; BPD was associated with a BMI reduction of between 13 and 18 kg/m^2; RYGB was associated with a % weight loss of between 60.5% and 84.4% and BMI reduction of between 10.7 and 15 kg/m2; VBG was associated with a % excess weight loss of between 37% and 68.8%; sleeve gastrectomy was associated with a % excess weight loss of between 66% and 69.7% and a BMI reduction of 27.5 kg/m^2. Four studies provided detailed information regarding hyperlipidaemia. In the first study, LAGB was associated with a reduction in use of lipid lowering agents at 2 years (from 41% to 14%) compared with a 4% reduction among control group participants (from 31% to 27%). Corresponding weight loss with surgery was 21.1 kg (62.5% of excess body weight lost). In the SOS study, odds of recovery from hypertriglyceridaemia and low HDL cholesterol at 10 years were higher (OR 2.6; 95% CI, 1.9 to 3.6 and OR 2.4; 95% CI, 1.4 to 3.8 respectively) with

bariatric surgery (all types combined) than no surgery. Odds of recovery from hypercholesterolaemia between surgical and non-surgical groups at 10 years were not significantly different. Corresponding weight change at 10 years was -16% in the surgical group and 1.5% in the control group. In the third study, non-banded and banded gastric bypass were associated with a reduction in the prevalence of hyperlipidaemia of 50% and 62% respectively over 2 years. The corresponding decreases in weight were 64% and 57% respectively of excess body weight. In the fourth study, open RYGB and laparoscopic RYGB were associated with a reduction in the prevalence of hyperlipidaemia at 3 years of 100% (from 25% to 0%) and 88% (from 14% to 2%) respectively. The corresponding decreases in weight were 67% and 77% respectively of excess body weight.

Surgery - paediatric

Treadwell et al. (2008) conducted a systematic review and meta-analysis of 18 predominantly uncontrolled case series studies of bariatric surgery performed in 641 paediatric patients (age 9 to 21 years). BMI change associated with LAGB was between 10.6 and 13.7 kg/m^2; BMI change with RYGB was 17.8 to 22.3 kg/m2 over an average of 3 years follow-up. With LAGB there was 86% resolution of dyslipidaemia (6 out of 7 participants). Resolution of dyslipidaemia with RYGB was not reported.

O'Brien et al. (2010) conducted a RCT with 50 adolescents between 14 and 18 years of age with a BMI greater than 35, assigned either to a supervised lifestyle intervention or to undergo LAGB, and followed up for 2 years. Overall, the mean changes in the LAGB group were a weight loss of 34.6 kg (95% CI, -30.2 to-39.0), representing an excess weight loss of 78.8% (95% CI, -66.6% to -91.0%), 12.7 BMI units (95% CI, 11.3 to 14.2), and a BMI z-score change from 2.39 (95% CI, 2.05 to 2.73) to 1.32 (95% CI, 0.98 to 1.66). The mean losses in the lifestyle group were 3.0 kg (95% CI, -2.1 to -8.1), representing excess weight loss of 13.2% (95% CI, -2.6% to -21.0%), 1.3 BMI units (95% CI, 0.4 to 2.9), and a BMI z-score change from 2.41 (95% CI, 2.21 to 2.66) to 2.26 (95% CI, 1.91 to 2.43). Plasma triglycerides decreased by 52 mg/dL in the LAGB group and by 32 mg/dL in the lifestyle group. HDL increased by 9.3 mg/dL in the LAGB group and by 3.9 mg/dL in the lifestyle group.

Summary

Lifestyle interventions in adults with overweight and with obesity were associated with varied effects on lipids, depending on the type of lifestyle intervention. Lifestyle changes improved lipid profile regardless of whether weight was lost. In paediatric patients who lose weight, improvements in total cholesterol and triglycerides were also observed. As the majority of paediatric patients with excess body weight are likely to have normal lipid status at baseline the significance of this finding on long-term CVD outcomes is uncertain.

Pharmacological weight loss agents have different impacts on lipids. Orlistat is associated with the greatest impacts on lipids of the pharmacological weight loss agents. In contrast, the impacts of sibutramine and taranabant on lipids were small and inconsistent across included studies in this review. Pooled estimates suggest a modest impact of sibutramine on triglycerides and HDL. Pharmacologically-associated weight loss is not consistently associated with improvements in lipids in paediatric patients.

Surgery was associated with very large reductions in body weight and with significant resolution of hyperlipidaemia in affected adult and paediatric patients. The absence of pooled estimates of changes in lipids associated with varying degrees of weight reduction does not enable a relationship between kilograms of weight lost and changes in serum lipid levels to be characterised.

5. Heart failure

There were no included studies in this review that assessed the relationship between heart failure and weight loss interventions.

Observational studies demonstrate a significant association between obesity and heart failure. Approximately 6,000 participants in the Framingham Heart Study without a history of heart failure (mean age 55 years) were followed for a mean of 14 years; heart failure developed in 496 (8.4 %) of this group. The risk of heart failure was increased approximately two-fold in participants with obesity (BMI ≥ 30 kg/m^2) compared with non-obese participants. After adjusting for established risk factors (e.g. hypertension, coronary disease, diabetes, left ventricular hypertrophy), the risk of heart failure increased 5 % in men and 7 % in women for each increment of 1 kg/m^2 in BMI. The risk was also increased in overweight (BMI 25 to 29.9 kg/m^2) women but not men (Kenchaiah et al. 2002).

However, among patients with overweight or obesity and a history of heart failure, increasing BMI appears to be associated with lower rates of re-hospitalization and death (Davos et al., 2003).

6. Metabolic syndrome

Lifestyle interventions that are effective in reducing body weight are associated with reduced prevalence of the metabolic syndrome. Ilanne-Parikka et al. (2008) conducted a RCT in 522 participants with prediabetes aged 40 to 64 years and followed for 3.9 years. Intensive lifestyle intervention significantly reduced the prevalence of metabolic syndrome (from 74% to 63%) and abdominal obesity (from 80% to 68%) compared with the control group (metabolic syndrome: 74% to 71%; abdominal obesity: 72% to 72%). Lifestyle intervention reduced odds of metabolic syndrome (OR 0.62; 95% CI, 0.40 to 0.95) and abdominal obesity (OR 0.48; 95% CI, 0.28 to 0.81) but not reduced fasting plasma glucose.

Orlistat has been demonstrated to be an effective pharmacological intervention in people with the metabolic syndrome. Svendsen et al. (2009) conducted a RCT on orlistat vesus placebo in 44 participants with metabolic syndrome and a mean BMI of 37.5 kg/m^2. At 1 year, overall weight reduction was 7.2 kg (SD 8.1) in the orlistat group and 3.9 (SD 7.4) in the placebo group. Dietary intake did not differ between the orlistat and placebo group.

Summary

Weight loss is associated with a substantial reduction in the prevalence of the metabolic syndrome. The amount of weight loss required by an individual with metabolic syndrome to reverse the syndrome was not clear from the included studies and is likely to be dependent on the patient's risk factors for metabolic syndrome, particularly the baseline weight of the affected individual.

7. Prediabetes

Impaired glucose tolerance (IGT) and impaired fasting glucose (IFG), now referred to collectively as prediabetes, increase the risk for progression to clinical diabetes, incident CVD, and cardiovascular mortality (Franz et al., 2007).

Adults

Galani et al. (2007) conducted a systematic review and meta-analysis of 30 studies involving 11,579 adult participants (3,566 with overweight and 8,013 with obesity) followed up to 6 years that assessed the impact of lifestyle intervention (diet and exercise +/- behaviour therapy) on fasting serum glucose. Participants with impaired glucose tolerance lost an average of 2.9 kg

and reduced BMI an average of 1.3 kg/m^2. Fasting serum glucose decreased an average of 0.2 mmol/L (95% CI, -0.1 to -0.3). HbA1c changed by -0.04% (95% CI, -0.2 to +0.1).

Norris et al. (2005a) conducted a systematic review and meta-analysis of nine RCTs involving 5,168 participants with prediabetes followed for up to 10 years that assessed the impact of lifestyle interventions on weight loss and metabolic indicators. Overall, pooled weight reduction at 12 months was 2.8 kg (95 % CI; 1.0 to 4.7) (3.3% of baseline body weight) and decrease in BMI was 1.3 kg/m^2 (95% CI, -0.8 to -1.9). Weight loss at two years was 2.6 kg (95% CI, -1.9 to -3.3). At follow-up intervals of up to 10 years, weight reduction was maintained. Weight loss of 5.5 kg was associated with reduction in HbA1c of 0.2%.

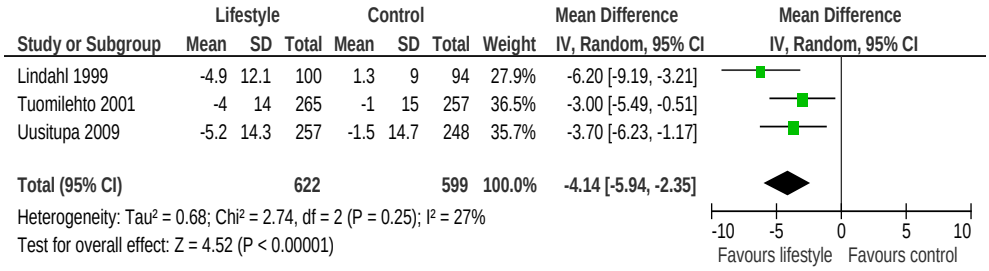
Dale et al. (2008) conducted a RCT involving 79 adult participants (mean age 45 to 48 years) with prediabetes that assessed the impact of diet and exercise on anthropometry and fasting glucose. By 2 years, weight change in the intervention and control groups was -1 versus -0.8 kg; waist circumference was -1 cm versus -2 cm and BMI was -0.7 kg/m^2 versus -0.8 kg/m^2. Changes in fasting glucose in intervention and control groups were -0.1 mmol/L versus 0.0 mmol/L.

Knowler et al. (2009) conducted a RCT including 2,766 participants (age > 25 years; BMI > 24 or > 22 kg/m^2 in Asians) that assessed the impact of metformin and lifestyle advice versus intensive diet and exercise or lifestyle advice alone on weight and fasting glucose in people with prediabetes. Over up to 10 years of follow-up mean weight loss associated with lifestyle was approximately 2 kg overall. A modest weight loss of 2.5 kg with metformin was maintained. Placebo was associated with a < 1 kg mean weight loss overall. Diabetes incidence in the 10 years since randomisation was reduced by 34% (95% CI, -24 to -42) in the intensive lifestyle group and 18% (95% CI, -7 to -28) in the metformin and lifestyle advice group compared with placebo.

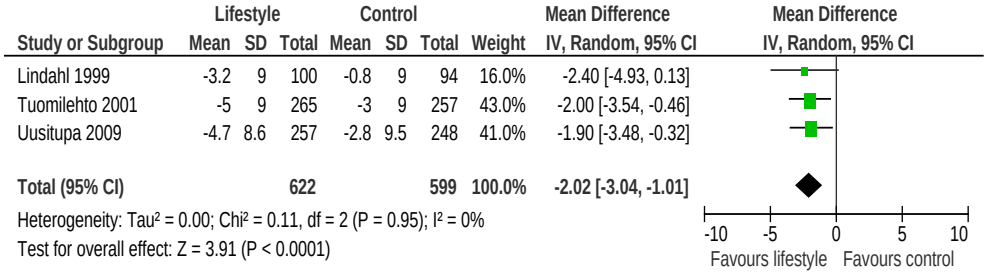
Uusitupa et al. (2009) conducted a RCT including 522 adult participants (mean age 53.7 to 55.9 years) with impaired glucose tolerance and excess body weight (mean BMI 26.8 to 31.7 kg/m^2) that assessed intensive diet and exercise counselling with a control intervention of general health behaviour information. In addition, the authors presented follow-up data for a population-based cohort who had received no form of lifestyle advice or intervention (termed “natural controls” by the authors). People lost an average of 4.5 kg (SD 5) in the intervention group and 1 kg (SD 3.7) in the control group after 12 months. Mean 2-hour postprandial glucose decreased 0.8 mmol/L (SD 1.9) and 0.3 mmol/L (SD 2.2) in the intervention and control groups respectively.

Lifestyle interventions in adults with prediabetes: an approximate weight loss of 4 kg (results heterogeneous therefore unable to be pooled) was associated with corresponding changes in SBP and DBP of -4.1 mmHg (95% CI, -5.9 to -2.4) and -2.0 mmHg (95% CI, -3.0 to -1.0) respectively.

SBP

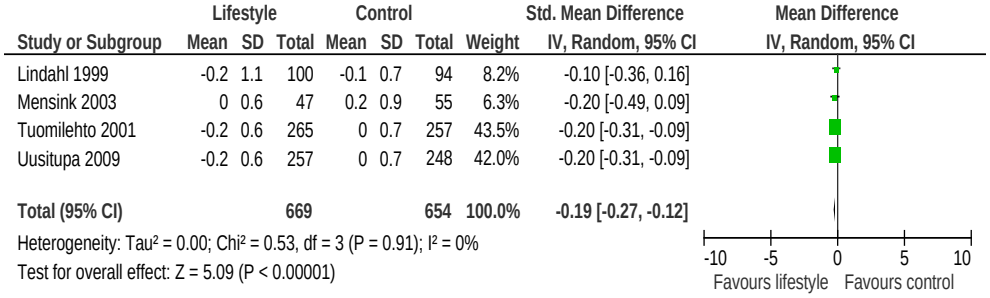


DBP



A weight loss of 3.7 kg was associated with a corresponding change in triglycerides of 0.2 mmol/L (95% CI, -0.3 to -0.1). Results of changes in total cholesterol and HDL were heterogeneous when pooled.

Triglycerides



Paediatric patients

Although not affected with prediabetes, the impact of weight reduction on fasting glucose in adolescents with obesity is favourable. Savoye et al. (2007) conducted a RCT involving 209 participants aged 8 to 16 years with a mean BMI of 35.8 kg/m^2 that assessed the impact of diet, physical activity and behaviour modification on BMI and metabolic indicators over 12 months. Participants who received the lifestyle intervention reduced BMI by 1.7 kg/m^2 (95% CI, -1.1 to -2.3) whereas those who received the control intervention (counselling every 6 months) increased BMI by 1.6 kg/m^2 (95% CI, 0.8 to 2.3). The intervention was associated with significant reductions in fasting glucose (-3.4 versus -1.8 mg/dl).

O'Brien et al. (2010) conducted a RCT with 50 adolescents between 14 and 18 years of age with a BMI > 35, assigned either to a supervised lifestyle intervention or to undergo LAGB, and followed up for 2 years. Overall, the mean changes in the LAGB group were a weight loss of 34.6 kg (95% CI, -30.2 to -39.0), representing an excess weight loss of 78.8% (95% CI, -66.6% to -91.0%), 12.7 BMI units (95% CI, 11.3 to 14.2), and a BMI z-score change from 2.39 (95% CI, 2.05 to 2.73) to 1.32 (95% CI, 0.98 to 1.66). The mean losses in the lifestyle group were 3.0 kg (95% CI, +2.1 to -8.1), representing excess weight loss of 13.2% (95% CI, -2.6% to -21.0%), 1.3 BMI units (95% CI, 0.4 to 2.9), and a BMI z-score change from 2.41 (95% CI, 2.21 to 2.66) to 2.26 (95% CI, 1.91 to 2.43). Plasma glucose decreased by 6.8 mg/dL in the LAGB group and increased by 2.8 mg/dL in the lifestyle group (p = 0.13).

Summary

Weight loss in patients with prediabetes is associated with reduced likelihood of development of type 2 diabetes mellitus. A lifestyle-induced 1 kg weight loss that is maintained reduces the likelihood of development of type 2 diabetes mellitus by 16% in people with prediabetes. Larger weight losses are associated with greater reductions in risk.

Lifestyle intervention appears to have an impact on the likelihood of development of type 2 diabetes mellitus that is independent of its effects on weight loss.

Weight loss also decreases fasting serum glucose, HbA1c and post-prandial glucose. A 5% loss of body weight reduces fasting and post-prandial glucose by between 5% and 10%. In adolescent patients, lifestyle-induced BMI reduction is associated with reduced fasting serum glucose, even in the absence of prediabetes.

Lifestyle interventions in patients with prediabetes decrease SBP, DBP and triglycerides. A 4 kg reduction in weight is associated with a 4 mmHg decrease in SBP, a 2 mmHg decrease in DBP and a 0.2 mmol/L reduction in triglycerides.

Diabetes

Epidemiological studies demonstrate that obesity is associated with increased risk and worse prognosis in patients with type 2 diabetes mellitus (Franz, 2007).

The impact of weight loss on mortality in patients with type 2 diabetes appears favourable. Williamson et al. (2000), in an analysis of participants with type 2 diabetes in the Cancer Prevention Study 1 with intentional weight loss experienced a 25% reduction in total mortality over an average follow-up of 13 years. In an analysis of the National Health Interview Study, which followed 1,400 overweight adults with diabetes over time, people who tried to lose weight had a 23% lower mortality than those not trying to lose weight, even if weight loss was not achieved (Gregg et al., 2004). It is therefore uncertain whether the impacts of weight loss interventions on mortality are due to the weight loss per se or due to the intervention's effects independent of weight loss.

Lifestyle interventions may prevent development of diabetes in patients with obesity. Lifestyle interventions, including exercise training and at least mild weight reduction with caloric restriction, have been associated with up to 60% reduction in the risk of developing type 2 diabetes mellitus, greater than that noted in patients treated with metformin (Knowler et al., 2002).

Lifestyle

a. Glycaemic control

Norris et al. (2005b) conducted a meta-analysis of 22 RCTs involving 4,659 participants over up to 5 years that assessed the impact of non-pharmacological weight loss interventions on type 2 diabetes. Estimates were pooled for any intervention versus usual care, very low calorie diet (VLCD) versus low calorie diet (LCD) and physical activity versus no or less intensive physical activity. Weight losses of up to 12 kg were achieved with lifestyle interventions. Weight losses of approximately 3 kg (95% CI, -0.5 to 6.4) were achieved with diet versus usual care. The corresponding decrease in HbA1c was approximately 0.7% across these studies. More intense physical activity was associated with greater weight reduction but not with greater reductions in HbA1c.

Nield et al. (2007) assessed 36 articles reporting 18 RCTs of dietary interventions in 1,467 participants with type 2 diabetes. Low fat, low carbohydrate, low calorie and very low calorie diets were assessed over follow-up of up to 18 months. Diet and exercise were associated with a 1% reduction in HbA1c at 12 months in studies where participants were newly diagnosed with type 2 diabetes mellitus. In these primary studies, a decrease in weight of 2.5 kg to 5 kg was associated with an approximate 0.5% to 1% reduction in HbA1c.

Thomas et al. (2006) conducted a meta-analysis of 14 RCTs that compared exercise with no exercise in 377 people with type 2 diabetes followed for up to 12 months. Exercise significantly

improved HbA1c (-0.6%; 95% CI, -0.9 to -0.3) but not body weight (WMD 0.0 kg; 95% CI, -3.8 to 3.8 kg). There were no significant changes in lipids or blood pressure with the exception of a small reduction in serum triglycerides (WMD -0.25 mg/dL; 95% CI, -0.48 to -0.02).

Huisman et al. (2009) conducted a systematic review and meta-analysis of 34 RCTs involving 5,469 participants with type 2 diabetes mellitus who participated in lifestyle interventions for weight loss. The overall effect sizes for weight loss in the short term (< 6 months) were low (0.18) and even lower in the longer term (> 6 months; (0.06)). The overall effect sizes for HbA1c outcomes were higher (0.35) and remained stable in the longer term (0.34).

The Look AHEAD study (Belalcazar et al., 2010; Pi Sunyer et al., 2007; Wing et al., 2010b) investigated changes in CVD risk factors with intensive lifestyle interventions in people with excess body weight and type 2 diabetes.

- Belalcazar et al. (2010) investigated a subset of 1,759 participants with type 2 diabetes who had recorded C reactive protein (CRP) and fitness results. The mean age was 57.5 years, 12% had CVD and participants were sedentary. Over the 12 months, intensive lifestyle intervention (ILI) was associated with a 9kg weight loss, 3.2 kg/m2 BMI reduction and 7.4 cm reduction in waist circumference. Corresponding HbA1c decreased by 0.7%.
- Pi Sunyer et al. (2007) assessed the impacts of ILI versus diabetes self-education (DSE) at 12 months on 5,145 participants aged between 45 and 74 years with a BMI > 25 kg/m2 (or > 27 kg/m2 if taking insulin). Intensive lifestyle intervention (ILI) was associated with an 8.6% reduction in weight (versus 0.7% reduction in DSE). Use of glucose lowering medications with ILI decreased from 86.5% to 78.6% of participants; DSE was associated with increased medication use (from 86.5% to 88.7%). Mean HbA1c decreased with ILI from 7.3% to 6.6% and did not change significantly with DSE (from 7.3% to 7.2%).
- Wing et al. (2010b) assessed impacts at 4 years of follow-up across the 5,145 participants. Over 93% of participants were assessed. Participants in ILI had greater percent weight losses than those in DSE (-6.15% versus -0.88%) and greater reductions in HbA1c (-0.36% versus 0.09%) (P < 0.0001).

Cheskin et al. (2008) conducted a RCT with 119 adult participants with type 2 diabetes mellitus that assessed portion controlled (PCD) versus standard diet for weight loss. Mean BMI was 35 kg/m^2. At 86 weeks, PCD was associated with weight loss of 5.6 kg (versus 4.7 kg with standard diet). HbA1c did not change with PCD but decreased by 1.2% with standard diet.

Christian et al. (2008) conducted a RCT with 310 participants with type 2 diabetes mellitus (mean BMI 35.4 kg/m^2) that compared nutrition and physical activity counselling with health education pamphlets over 12 months. Weight decreased 0.2 kg in the intervention group and increased 1.4 kg in the control group. HbA1c decreased 0.14% in the intervention group and decreased 0.46% in the control group. As 98% of participants were taking antihyperglycaemic medications, the impact of medication use on HbA1c was unable to be controlled for.

Results were too heterogeneous to enable pooled estimates of effect to be calculated across primary studies.

b. Blood pressure

The Look AHEAD study (Belalcazar et al., 2010; Pi Sunyer et al. 2007; Wing et al., 2010b) investigated changes in CVD risk factors with intensive lifestyle interventions in people with excess body weight and type 2 diabetes.

- Pi Sunyer et al. (2007) assessed the impacts of Intensive lifestyle intervention (ILI) versus diabetes self-education (DSE) at 12 months on 5,145 participants aged between 45 and 74 years with a BMI > 25 kg/m2 (or >27 kg/m2 if taking insulin). ILI was associated with an 8.6% reduction in weight (versus 0.7% reduction in diabetes self-education - DSE). SBP and DBP changes with ILI and DSE were -6.8 versus -2.8 mmHg SBP and -3.0 versus -1.8 mmHg DBP respectively.
- Wing et al. (2010b) assessed impacts at 4 years of follow-up across the 5,145 participants. Over 93% of participants were assessed. Participants in ILI had greater percent weight losses than those in DSE (-6.15% versus -0.88%) and greater reductions in SBP (-5.33 versus -2.97 mmHg) and DBP (-2.92 versus -2.48 mmHg).

Cheskin et al. (2008) conducted a RCT with 119 adult participants with type 2 diabetes mellitus that assessed portion controlled (PCD) versus standard diet for weight loss. Mean BMI was 35 kg/m^2. At 86 weeks, PCD was associated with weight loss of 5.6 kg (versus 4.7 kg with standard diet). SBP decreased 7.6 mmHg with PCD and 14 mmHg with standard diet; DBP decreased 2.7 mmHg with PCD and 9.7 mmHg with standard diet.

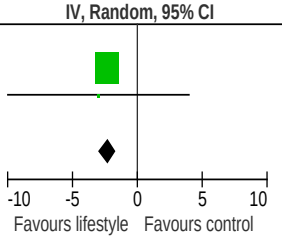
Christian et al. (2008) conducted a RCT with 310 participants with type 2 diabetes mellitus (mean BMI 35.4 kg/m^2) that compared nutrition and physical activity counselling with health education pamphlets over 12 months. Weight decreased 0.2 kg in the intervention group and increased 1.4 kg in the control group. SBP decreased 2.6 mmHg in the intervention and 4.7 mmHg in the control group. DBP decreased 2.6 mmHg in the intervention and 2.5 mmHg in the control group.

Lifestyle interventions in adults with type 2 diabetes: a pooled weight loss of 5.3 kg (95% CI, -5.0 to -5.6) corresponding to changes in SBP and DBP of -2.3 mmHg (95% CI, -3.0 to -1.6) and -0.4 mmHg (95% CI, -0.9 to 0.1) respectively.

SBP

	Lifestyle			Control				Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Pi Sunyer 2007	-6.8	20	2496	-2.8	15	2463	0.0%	-4.00 [-4.98, -3.02]	
Wing 2010b	-5.3	12.5	2496	-3	12.4	2463	99.0%	-2.30 [-2.99, -1.61]	
Zapotoczky 2001	-1	9.5	18	2	11.1	16	1.0%	-3.00 [-9.99, 3.99]	
Total (95% CI)			**2514**			**2479**	**100.0%**	**-2.31 [-3.00, -1.62]**	

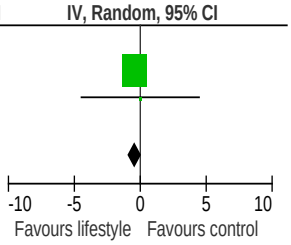
Heterogeneity: Tau² = 0.00; Chi² = 0.04, df = 1 (P = 0.85); I² = 0%
Test for overall effect: Z = 6.56 (P < 0.00001)



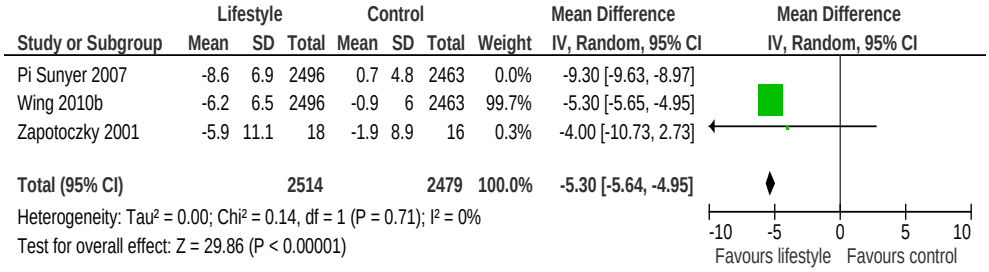
DBP

	Lifestyle			Control				Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Pi Sunyer 2007	-3	10	2496	-1.8	10	2463	0.0%	-1.20 [-1.76, -0.64]	
Wing 2010b	-2.9	7.5	2496	-2.5	10	2463	98.8%	-0.40 [-0.89, 0.09]	
Zapotoczky 2001	-4	5.8	18	-4	7.3	16	1.2%	0.00 [-4.47, 4.47]	
Total (95% CI)			**2514**			**2479**	**100.0%**	**-0.40 [-0.88, 0.09]**	

Heterogeneity: Tau² = 0.00; Chi² = 0.03, df = 1 (P = 0.86); I² = 0%
Test for overall effect: Z = 1.58 (P = 0.11)



Weight



c. Lipids

The Look AHEAD study (Belalcazar et al., 2010; Pi Sunyer et al. 2007; Wing et al., 2010b) investigated changes in CVD risk factors with intensive lifestyle interventions in people with excess body weight and type 2 diabetes.

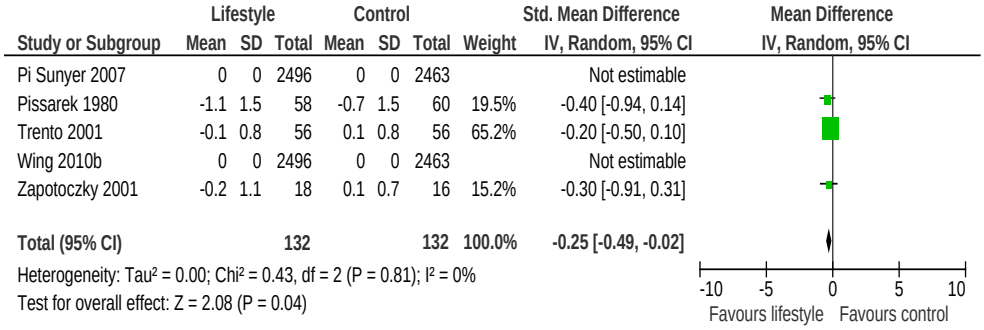
- Belalcazar et al. (2010) investigated a subset of 1,759 participants with type 2 diabetes who had recorded CRP and fitness results. The mean age was 57.5 years, 12% had CVD and participants were sedentary. Over the 12 months, intensive lifestyle intervention (ILI) was associated with a 9kg weight loss, 3.2 kg/m2 BMI reduction and 7.4 cm reduction in waist circumference compared with DSE which was associated with 0.8 kg weight loss, 0.3 kg/m2 BMI reduction and 0.9 cm reduction in waist circumference. Corresponding changes in lipids between ILI and DSE were: LDL (-4.3 versus -4.8 mg/dL), HDL (3.2 versus 1.4 mg/dL) and triglycerides (-32.4 versus -12.6 mg/dL).
- Pi Sunyer et al. (2007) assessed the impacts of ILI versus diabetes self-education (DSE) at 12 months on 5,145 participants aged between 45 and 74 years with a BMI > 25 kg/m2 (or >27 kg/m2 if taking insulin). Intensive lifestyle intervention (ILI) was associated with an 8.6% reduction in weight (versus 0.7% reduction in diabetes self-education - DSE). Corresponding changes in lipids between ILI and DSE were: LDL (-5.2 versus -5.7 mg/dL), HDL (3.4 versus 1.4 mg/dL) and triglycerides (-30.3 versus -14.6 mg/dL).
- Wing et al. (2010b) assessed impacts at 4 years of follow-up across the 5,145 participants. Over 93% of participants were assessed. Participants in ILI had greater percent weight losses than those in DSE (-6.15% versus -0.88%) and greater reductions in HDL-C (3.67 versus 1.97 mg/dl) and triglycerides (-25.56 versus -19.75 mg/dl) but not LDL (-11.27 versus -12.84 mg/dl).

Cheskin et al. (2008) conducted a RCT with 119 adult participants with type 2 diabetes mellitus that assessed portion controlled (PCD) versus standard diet for weight loss. Mean BMI was 35 kg/m^2. At 86 weeks, PCD was associated with weight loss of 5.6 kg (versus 4.7 kg with standard diet). Total cholesterol decreased 0.2 mmol/L in the PCD group and increased 0.1 mmol/L in the standard diet group. Other changes in lipids with PCD and standard diet were HDL: 0.2 versus 0.4 mmol/L; and triglycerides: 0.02 versus -0.15 mmol/L respectively.

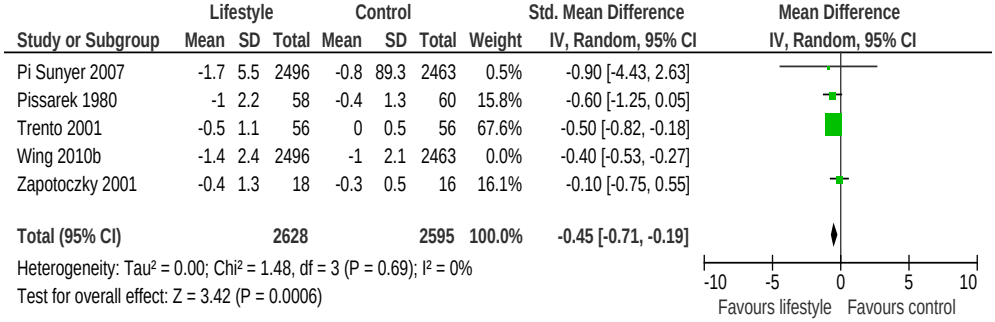
Christian et al. (2008) conducted a RCT with 310 participants with type 2 diabetes mellitus (mean BMI 35.4 kg/m^2) that compared nutrition and physical activity counselling with health education pamphlets over 12 months. Weight decreased 0.2 kg in the intervention group and increased 1.4 kg in the control group. Changes in lipids in the intervention and control groups were as follows: Total cholesterol (-15.8 versus -3.9 mg/dL), HDL (-0.4 versus 1.6 mg/dL) and triglycerides (-13.6 versus -9.5 mg/dL).

Lifestyle interventions in adults with type 2 diabetes: an approximate weight loss of 5 kg (results heterogeneous when pooled) corresponded with changes in total cholesterol and triglycerides of -0.25 mmol/L (95% CI, -0.5 to -0.02) and -0.45 mmol/L (95% CI, -0.7 to -0.2) respectively.

Total cholesterol



Triglycerides



Medications

a. Glycaemic control

Norris et al. (2005c) conducted a meta-analysis of 22 RCTs involving 3,379 participants (296 participants who received fluoxetine, 2,036 participants who received orlistat and 1,047 participants who received sibutramine) that assessed the efficacy of pharmacotherapy for weight loss in adults with type 2 diabetes over approximately 12 months. Orlistat was associated with reductions in weight of 2 kg (95% CI, -1.3 to -2.8) at 12 months of follow-up and a reduction in HbA1c of 0.5% (95% CI, -0.3 to -0.6). Sibutramine was associated with a weight reduction of 5.1 kg (95% CI, -3.2 to -7) at 12 months and a non-significant reduction in HbA1c of 0.5% (95% CI, +0.2 to -1.3). Fluoxetine was associated with reductions in weight of 5.1 kg (95% CI, -3.3 to -6.9) and reductions in HbA1c of 1% (95% CI, -0.6 to -1.4).

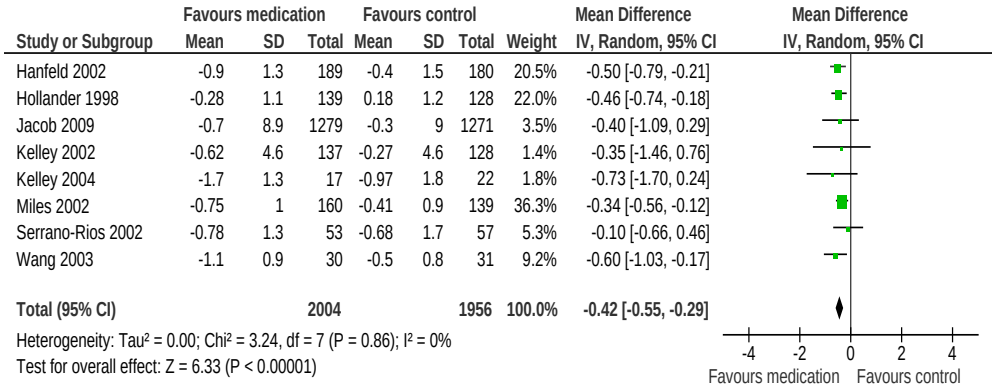
Eliasson et al. (2007) conducted a RCT of topiramate versus placebo over 12 months in 38 participants with type 2 diabetes mellitus and a mean BMI of 33 kg/m^2. In topiramate-treated patients, there were significant reductions in body weight (-7.2 ± 4.3 kg) and HbA1c (-1.1 ± 0.9%). In comparison, participants in the placebo group experienced no significant reduction in body weight (0.01 ± 2.5 kg) or HbA1c (-0.3 ± 0.8%).

Jacob et al. (2009) conducted a RCT with 2,250 participants that assessed the impact of orlistat on glycaemic control in people with type 2 diabetes mellitus (mean BMI 35 kg/m^2) over 12 months. Orlistat 120 mg–treated patients had significantly greater decreases in bodyweight (-3.77 kg) than placebo-treated patients (-1.42 kg). Compared with the placebo group, more than twice as many orlistat 120 mg–treated patients lost > 5% of baseline body weight

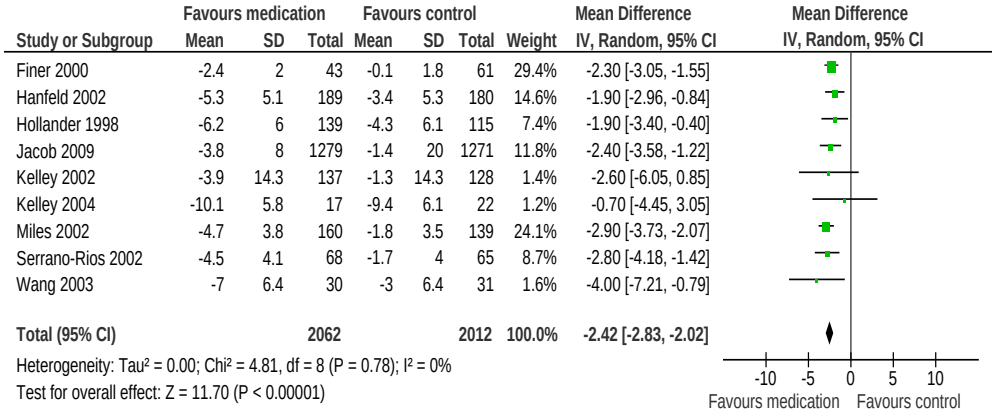
(34.8 vs.14.1%), or lost > 10% of baseline body weight (9.7 versus 3.7%). Orlistat 120 mg provided significantly larger mean decreases in HbA1c compared with placebo (-0.74% versus -0.31%; P < 0.0001).

Pooled estimates of effect of orlistat on HbA1c were calculated. Orlistat resulted in a pooled weight loss of 2.4 kg (95% CI, -2.0 to -2.8) compared with lifestyle control. Corresponding change in HbA1c was a reduction of 0.4% (95% CI, -0.3 to -0.6).

HbA1c



Weight



b. Blood pressure

Norris et al. (2005c) conducted a meta-analysis of 22 RCTs involving 3,379 participants (296 participants who received fluoxetine, 2,036 participants who received orlistat and 1,047 participants who received sibutramine) that assessed the efficacy of pharmacotherapy for weight loss in adults with type 2 diabetes over approximately 12 months. Sibutramine was associated with a weight reduction of 5.1 kg (95% CI, -3.2 to -7) at 12 months and changes in BP as follows: SBP (WMD -0.8; 95% CI, -1.7 to -0.02) and DBP (WMD 1.4; 95% CI, 0.1 to 2.8).

c. Lipids

Norris et al. (2005c) conducted a meta-analysis of 22 RCTs involving 3,379 participants (296 participants who received fluoxetine, 2,036 participants who received orlistat and 1,047 participants who received sibutramine) that assessed the efficacy of pharmacotherapy for weight loss in adults with type 2 diabetes over approximately 12 months. Orlistat was associated with reductions in weight of 2 kg (95% CI, -1.3 to -2.8) at 12 months of follow-up and changes in lipids

as follows: total cholesterol (WMD -0.4; 95% CI, -0.5 to -0.3), LDL (WMD -0.3; 95% CI, -0.4 to -0.2), HDL (WMD -0.02; 95% CI, -0.04 to -0.01), triglycerides (WMD -0.2; 95% CI, -0.4 to -0.1). Sibutramine was associated with a weight reduction of 5.1 kg (95% CI, -3.2 to -7) at 12 months and changes in lipids as follows: total cholesterol (WMD -0.1; 95% CI, -0.4 to 0.2), LDL (WMD -0.1; 95% CI, -0.3 to 0.2), HDL (WMD 0.07; 95% CI, 0.03 to 0.11), triglycerides (WMD -0.3; 95% CI, -0.5 to -0.1). Fluoxetine was associated with reductions in weight of 5.1 kg (95% CI, -3.3 to -6.9) and changes in lipids as follows: total cholesterol (WMD 0.5; 95% CI, -0.3 to 1.3), HDL (WMD 0.03; 95% CI, -0.05 to 0.11), triglycerides (WMD -0.5; 95% CI, -1.2 to 0.2).

Eliasson et al. (2007) conducted a RCT of topiramate versus placebo over 12 months in 38 participants with type 2 diabetes mellitus and a mean BMI of 33 kg/m^2. In topiramate-treated patients, there were significant reductions in body weight (-7.2 ± 4.3 kg). Triglycerides decreased by 0.11 (SD 1.0) mmol/L and LDL by 0.1 (SD 0.4) mmol/L. HDL increased by 0.1 (SD 0.2) mmol/L and total cholesterol increased by 0.01 (SD 0.4) mmol/L. In comparison, participants in the placebo group experienced no significant reduction in body weight (0.01 ± 2.5 kg) or significant changes in lipids.

Surgery

Buchwald et al. (2009) conducted a meta-analysis of 621 studies which were predominantly case series of bariatric surgery, including in patients with type 2 diabetes. There were 135,246 participants with a mean age of 40.2 years and a mean BMI at baseline of 47.9 kg/m^2. Approximately 80% were female, 22% had type 2 diabetes, and 10.5% had undergone previous bariatric surgical procedures. Weight loss with bariatric surgery was 38.5 kg (95% CI, -36.6 to -40.1). Weight loss varied according to surgical procedure, from 32 kg with gastric banding to 44.7 kg with gastric bypass. Mean BMI reduction was 14 kg/m^2 (95% CI, -13.4 to -14.5). BMI reduction varied from 10.6 kg/m^2 with gastric banding to 18.8 kg/m^2 with biliopancreatic diversion / duodenal switch procedures. Corresponding change in HbA1c in patients with type 2 diabetes was -2.1% overall (95% CI, -1.6 to -2.6).

Fried et al. (2010) conducted a meta-analysis of 16 observational studies of bariatric surgery in 343 participants with type 2 diabetes where the mean study BMI was < 35 kg/m^2. At baseline the mean BMI of participants was 29.4 kg/m^2 and HbA1c was 8.7%. Follow-up was up to 216 months. Across studies mean BMI decreased by 5.1 kg/m2 (95% CI, -4.9 to -5.3). HbA1c decreased by 2.7% (95% CI, -2.6 to -2.8).

Dixon et al. (2008) conducted a RCT with 60 participants (mean age 47 years; mean BMI 37 kg.m^2) that compared the impacts of lifestyle modification with LAGB surgery in patients with type 2 diabetes. The intervention group reduced body weight by 21.1 kg and waist circumference by 17.9 cm. HbA1c decreased 1.8%. The control group reduced body weight by 1.5 kg and waist circumference by 4 cm. Hba1c decreased 0.9%. At 2 years, remission of type 2 diabetes was achieved by 22 (73%) in the surgical group and four (13%) in the conventional-therapy group. Relative risk of remission for the surgical group was 5.5 (95% CI, 2.2 to 14.0). Surgical and conventional-therapy groups lost a mean (SD) of 20.7% (8.6%) and 1.7% (5.2%) of weight, respectively, at two years (P < 0.001). Remission of type 2 diabetes was related to weight loss (R^2 = 0.46, P < 0.001) and lower baseline HbA1c levels (combined R^2 = 0.52, P < 0.001). BP decreased in both the intervention and control groups. In the intervention group mean SBP decreased by 6 mmHg and mean DBP decreased by 0.7 mmHg. In controls, SBP decreased by 1.7 mmHg and DBP by 0.9 mmHg. Changes in lipids were as follows in the intervention versus control groups: total cholesterol (3.6 mg/dL versus -0.4 mg/dL), triglycerides (-71.7 mg/dL versus -2.1 mg/dL) and HDL (12.6 mg/dL versus 2.6 mg/dL).

Summary

Weight loss in patients with diabetes is associated with improved glycaemic control. Weight loss of 2.5 to 5 kg is associated with reductions in HbA1c of 0.5% to 1% regardless of the method of weight loss. Reduction in body weight of 8% reduces medication use by approximately 8%.

Physical activity decreases HbA1c independent of weight loss. A reduction in HbA1c of approximately 0.6% can be achieved through physical activity alone.

In adults with type 2 diabetes mellitus a 5% reduction in body weight decreases SBP by approximately 2.5 mmHg and DBP by < 1 mmHg. Sibutramine-associated weight loss of 5 kg is not associated with significant reductions in BP.

Triglycerides decrease with lifestyle-associated weight loss in adults with type 2 diabetes mellitus. A 5 kg weight loss reduces triglycerides by approximately 0.5 mmol/L and total cholesterol by 0.25 mmol/L.

The time in the illness trajectory when weight is lost appears to influence glucose control. Early in the course of the disease, when insulin resistance is still prominent, both energy restriction and weight loss appear to improve blood glucose levels. However, as the disease progresses and insulin deficiency becomes more prominent, weight loss appears to have less impact on glucose control (Norris et al., 2005b).

The beneficial effects on blood glucose control begin to occur before much weight loss occurs. This includes in patients receiving dietary interventions that create a total deficit in energy intake and in patients receiving bariatric surgery, where improvement in blood glucose occurs before weight loss begins (Buchwald et al., 2009).

Mental health

There is a substantial body of research exploring the impact of overweight and obesity on mental health. The majority of published studies are cross-sectional in nature, limiting inferences that can be drawn regarding the causal relationship between excess body weight and mental health problems.

Population surveys suggest that most overweight and obese persons in the community do not have mood disorders. However, studies of comorbidity, family history and biology of mood disorders and obesity suggest that, although comorbid mood disorders and obesity may be coincidental, the two conditions may be related (McElroy et al., 2004).

Many observational studies in adults demonstrate a positive association between obesity and depression, and increased odds of future depression in people with obesity. Other studies fail to demonstrate any association, particularly in males. Similarly, an association between anxiety and obesity in adults has been identified in some but not all observational cohorts. The causal direction of the relationship is uncertain and high quality controlled trials are needed to explore the association (Gariepy et al., 2010).

Atlantis and Baker (2008) conducted a systematic review of epidemiological studies that assessed the association between obesity and depression. Review of 24 epidemiological studies (4 cohort and 20 cross-sectional studies) demonstrated weak evidence supporting the hypothesis that obesity increases the incidence of depression.

Excess body weight has also been found to be associated with mental health problems in children and adolescents. Cross-sectional and longitudinal data suggest that obesity in childhood may be associated with poor self-esteem, poorer cognitive development and lower

educational attainment in some people, with increased risk of mental health problems in later life (Sanderson et al., 2011; Walker et al., 2009; Wang et al., 2008b).

The association between quality of life and excess body weight has been explored in numerous observational studies. Overweight and obesity have been associated with poorer health-related quality of life than persons with no overweight or obesity in some research. In a population cohort of Australian adults who were participants in the Australian Diabetes, Obesity and Lifestyle (AusDiab) study, followed over 5 years, health-related quality of life was found to be a predictor of weight gain over 5 years, suggesting a bi-directional association between obesity and health-related quality of life. Higher BMI at baseline was associated with deterioration in health-related quality of life over 5 years for seven of the eight health-related quality of life domains in women and six out of eight in men. Conversely, quality-of-life domains related to mental health were inversely associated with BMI change (Cameron et al., 2011). Cross-sectional data suggest that the degree to which health-related quality of life is affected by excess body weight is influenced by age, gender and the degree of overweight or obesity (Larsson et al., 2002; Sullivan et al., 1993).

Assessment of quality of life in studies of weight loss is complicated by the variety of different measures of quality of life that are used across trials. Kolotkin et al. (2009) compared one-year changes in health-related quality of life (HRQOL) as a function of weight change using three different measures: a weight-related measure (Impact of Weight on Quality of Life-Lite (IWQOL-Lite)) and two generic measures (SF-36; EQ-5D). This study found differences between weight-related and generic measures of health-related quality of life in a one-year weight loss trial, reflecting the potential value of using more than one measure in a trial. Although weight loss was generally associated with improved IWQOL-Lite, physical SF-36 subscale and EQ-5D scores, a small amount of weight gain was associated with a slight improvement on weight-specific HRQOL and almost no change on the EQ-5D.

Antipsychotic-induced weight gain is a major concern in the treatment of psychosis, with up to 80% of individuals being treated with antipsychotics suffering from medication-induced weight gain. Alvarez-Jiminez et al (2008), in a meta-analysis of ten RCTs, found that adjunctive non-pharmacological interventions, either individual or group interventions, or cognitive-behavioural therapy as well as nutritional counselling were effective in reducing or attenuating antipsychotic-induced weight gain compared with treatment as usual (WMD 2.6 kg; 95% CI, 1.9 to 3.2 kg).

Cabassa et al. (2010) conducted a review of 23 studies that assessed lifestyle interventions for adults with serious mental illness. Lifestyle interventions in included studies were mainly based on dietary interventions, supplemented with physical activity advice and behavioural techniques. Twelve of the 23 studies demonstrated some improvement in either weight loss or risk factors for metabolic syndrome; however, the majority of studies were of short duration (median of 16 weeks). Pooled estimates of weight loss across studies were not calculated.

Faulconbridge et al. (2009) conducted a RCT examining changes in symptoms of depression in 194 obese participants (age 44 years; BMI 37.6 kg/m^2) who participated in a one year randomised trial of lifestyle modification with or without sibutramine. At one year, participants in combined therapy lost 12.1% (SD 8.8) of their body weight and participants in the sibutramine group lost 5.5% (SD 6.5) of their body weight. Mean Beck Depression Inventory scores across all participants declined from 8.1 (SD 6.9) to 6.2 (7.7) with no significant differences between groups. However, 13.9% of participants reported increases in symptoms of depression over the 12 months.

Included studies - adults

There were six systematic reviews and meta-analyses (Blaine 2007; Oude Luttikhuis 2009; Picot, 2009 / Colquitt 2009; Treadwell 2008; Witham 2010; Whitlock 2010) and seven RCTs (Cooper et al., 2010; Ford et al., 2010; Hughes 2008; McCallum 2007; Morey et al., 2009; O'Brien et al., 2010; Villareal et al. 2011) included in this review that assessed the relationship between weight change and mental health. Blaine et al. examined depression and self-esteem outcomes; Oude-Luttikhuis et al. examined depression and psychological wellbeing in paediatric patients; Treadwell et al. examined mood disorders in paediatric patients; all other studies examined quality of life.

Blaine et al. (2007) conducted a systematic review and meta-analysis of 117 studies, one of which was a randomised controlled trial, in order to examine the short- and long-term effects of weight loss treatment on depression and self-esteem. Adults (4,574 participants) were aged between 21 and 60 years and had a mean BMI across studies of between 25 and 57 kg/m^2. Drugs or surgery (DS) were compared with psychotherapy for main outcomes. DS treatments produced a significant pooled weight reduction (-50.3 lb) and were associated with a moderate reduction in depression (equivalent to 3.7 points on the Beck Depression Inventory) but only a modest improvement in self-esteem. In contrast, psychotherapy was associated with a smaller pooled weight loss (-13 lb) and no reduction in depression but an improvement in self-esteem that was twice the size of the DS treatment effect. Psychotherapy that was associated with larger weight losses was also associated with greater improvements in self-esteem.

Picot et al. (2009) (data also reported in Colquitt et al. 2009) systematically reviewed 26 studies (23 RCTs and 3 cohort studies) conducted in 5,766 adults with mean BMI across primary studies of between 30 and 60 kg/m^2. Across included studies: LAGB was associated with a % excess weight loss of 39.0% to 87.2% and BMI reduction of 7.4 to 18 kg/m^2; BPD was associated with a BMI reduction of 13 to 18 kg/m2; RYGB was associated with a % weight loss of 60.5% to 84.4% and BMI reduction of 10.7 to 15 kg/m^2; vertical banded gastroplasty was associated with a % excess weight loss of 37% to 68.8%; sleeve gastrectomy was associated with a % excess weight loss of 66% to 69.7% and a BMI reduction of 27.5 kg/m^2. Quality of life was reported in one RCT and two cohort studies. The RCT findings demonstrated an improvement in quality of life at two years in patients who had undergone surgery (LAGB); one cohort study showed that after 3.2 years there were no significant differences between those who had received surgery (various procedures pooled) and those who had not. The other cohort study reported that all health-related quality of life measures were improved at 10 years compared with baseline for the surgery group (various procedures pooled), but not for all participants in the non-surgical group.

Witham et al. (2010) conducted a systematic review and meta-analysis of nine RCTs in 1,954 adults that examined weight loss diet and physical activity. Pooled weight loss across studies was 3 kg (95% CI, -0.9 to -5.1). Health-related quality of life was assessed in two studies. Improvement occurred in one study but not the other.

Cooper et al. (2010) conducted a RCT with 150 participants (age 20 to 60 years; mean BMI 34.7 kg/m^2) that compared cognitive behaviour therapy (CBT) and behaviour therapy (BT) with a control condition (guided self-help - GSH) over 3 years of follow-up. At 24 weeks the mean percentage weight losses were 6.7%, 11.3% and 10.0% respectively in the GSH, BT, and CBT conditions. At 1-year follow-up, those who had lost weight at the end of treatment had regained, overall, almost half the weight that they had lost (median regain of weight lost, 43.5% in BT and 58.0% in CBT) and at 3-year follow-up they had regained almost all the weight lost (89.8% regain in BT; 88.6% regain in CBT). Treatment had a beneficial effect on patients' psychiatric symptoms and their quality of life. There was a statistically significant improvement from baseline

to the end of treatment in brief symptom inventory (BSI) scores across all treatment groups (mean (SD) improvement = 0.30). Adjusting for pre-treatment BSI scores and weight change, those receiving CBT achieved slightly lower scores on the BSI than those receiving BT but the difference was not statistically significant. Across all three groups there were statistically significant improvements in the eight SF-36 domains and the two summary scores (physical component score (PCS) and mental component score (MCS)) from baseline to the end of treatment (mean (SD) improvement PCS 3.96 (9.23); MCS 5.43 (9.21) although generally there were statistically significant deteriorations in scores during follow-up (mean (SD) deterioration PCS 3.20 (10.2); MCS 2.40 (7.53)).

Morey et al. (2009) conducted a RCT with 641 overweight (BMI 25 – 40kg/m^2), long-term (> 5 years) survivors (aged 65 to 91 years) of colorectal, breast, and prostate cancer, randomly assigned to a 12-month, home-based tailored program of telephone counselling and mailed materials promoting exercise, improved diet quality, and modest weight loss (n = 319) or delayed intervention (control) group (n = 322). At 12 months the mean changes in SF36 between intervention and control groups were as follows: physical function -2.2 versus -4.8; general health 0.8 versus -1.9; pain -0.8 versus -3.2; vitality -0.5 versus -2.4; social functioning -1.3 versus -5.1; mental health 0.5 versus -2.0; physical role -2.4 versus -4.7 and emotional role -0.7 versus -0.6. Weight loss was greater in the intervention than the control group (2.1 kg (95% CI, -1.7 to -2.4 kg) versus 0.9 kg (95% CI, -0.5 to -1.3 kg)).

No included systematic review / meta-analysis specifically assessed mental health outcomes in older people. Villareal et al. (2011) conducted a randomised trial in 107 participants aged over 65 years comparing diet and exercise, diet, exercise and a control group. Varying degrees of weight change were observed (-9% with diet-exercise; -10% with diet; nil with exercise or control). Quality of life (the physical-component summary score of the SF-36) improved 15% in the diet-exercise group, 14% in the diet group and 10% in the exercise group but did not change significantly in controls.

Included studies - paediatric

Treadwell et al. (2008) conducted a systematic review and meta-analysis of 18 predominantly uncontrolled case series' of bariatric surgery performed in 641 paediatric patients. One included study reported mental health outcomes; for RYGB performed in a case series of 11 paediatric patients aged between 15 and 18 years. There was 36% of the cohort who had a diagnosed mood disorder (depression / anxiety). Improvement or resolution was not observed in up to 2.7 years of follow-up.

Oude Luttikhuis et al. (2009) conducted a systematic review and meta-analysis of 64 RCTs involving 5,230 participants that assessed weight change associated with lifestyle and pharmacological interventions in paediatric patients. Meta-analysis indicated a reduction in overweight at 12 months follow-up in lifestyle interventions in children, and in lifestyle interventions in adolescents with our without orlistat or sibutramine. With behaviour therapy BMI SDs decreased by 0.04 (95% CI, -0.12 to 0.04) and by 0.14 (95% CI, -0.18 to -0.10) in children less than 12 years and in children 12 years of age or older respectively. Measures of psychological well-being, like global self-worth, self esteem, quality of life and absence of depressive symptoms or internalising behaviour problems were provided in 11 studies. Intervention duration for the aforementioned studies ranged from 3 to 24 months.

- One study recorded positive changes in global, athletic and physical well-being;
- One study recorded improvement in child problem solving, internalising behaviours and total competence in both study arms at the end of treatment and persisting at follow up.

- One study found that adolescents randomised to both treatment conditions demonstrated significant improvements on dimensions of global self-concept, physical appearance, and physical self-worth over time.
- Depression scores were recorded in five studies. A reduction in depression scores was evident in all studies. However, the decrease over time reported by one study was not significant. Another study recorded a decrease in both groups, with a significant decrease identified in the children from the behavioural therapy for mother only study arm. This decrease was also noted to be particularly prominent in the early intervention stages. Depressive symptoms were shown to be slightly higher in the control group than that of the soccer group at six months in a third study. However this change was not reported as being significant. Three studies found significant improvements in quality of life by child- and / or parent-report over time, without differences across groups. None of the studies reported adverse changes in the children's psychological well-being.

Ford et al. (2010) conducted a RCT involving 106 participants aged 9 to 17 years with a BMI > 95th centile for age and gender that assessed over 18 months the impact of feedback from a real-time computerised device (Mandometer) designed to slow down speed of eating and reduce total intake. Compared with lifestyle therapy control, those in the Mandometer group had significantly lower mean BMI SDs at 18 months compared with standard care (baseline adjusted mean difference 0.27; 95% CI, 0.11 to 0.43). Quality of life, measured with the Paediatric Quality of Life Inventory 4.0, improved in both arms during the study, with no significant difference at 12 months (data not provided).

Hughes et al. (2008) conducted a RCT of behaviour therapy versus standard care in 134 children aged 5 to 11 years with a BMI > 97th centile. At 12 months there were no significant reductions in BMI z-score in either group. However there was a significant reduction in waist z-score in the intervention versus control group (-0.20 (95% CI, -0.5 to -0.03) versus -0.20 (95% CI, -0.4 to 0.05)). There were no significant between group differences in parent proxy quality of life scores for physical or psychosocial health in either group, although there was a trend towards improvement in both groups. Similarly, there was a trend towards improvement in quality of life psychosocial health scores on child self-report in both groups and a significant improvement in child self-report physical health in the control but not the intervention group.

McCallum et al. (2007) conducted a RCT of a primary care intervention for childhood overweight and obesity in 163 children aged 5 to 9 years with overweight or mild obesity. At 15 months there was no significant change in BMI z-score in the intervention or control groups. There was little evidence of harm or benefit with respect to child-reported body satisfaction and appearance / self-worth. Parent proxy quality of life was not significantly improved by 15 months, nor were there significant differences between intervention and control groups in child-reported quality of life.

O'Brien et al. (2010) conducted a RCT with 50 adolescents between 14 and 18 years of age with a BMI > 35kg/m^2, assigned either to a supervised lifestyle intervention or to undergo LAGB, and followed up for 2 years. Overall, the mean changes in the LAGB group were a weight loss of 34.6 kg (95% CI, -30.2 to -39.0), representing an excess weight loss of 78.8% (95% CI, -66.6% to -91.0%), 12.7 BMI units (95% CI, 11.3 to 14.2), and a BMI z-score change from 2.39 (95% CI, 2.05 to 2.73) to 1.32 (95% CI, 0.98 to 1.66). The mean losses in the lifestyle group were 3.0 kg (95% CI, -2.1 to -8.1), representing excess weight loss of 13.2% (95% CI, -2.6% to -21.0%), 1.3 BMI units (95% CI, 0.4 to 2.9), and a BMI z-score change from 2.41 (95% CI, 2.21 to 2.66) to 2.26 (95% CI, 1.91 to 2.43). Plasma glucose decreased by 6.8 mg/dL in the LAGB group and increased by 2.8 mg/dL in the lifestyle group (p = 0.13). The Child Health Questionnaire (CF-50)

was used to assess quality of life. At 2 years, members of the lifestyle group scored lower than the community norm for general behavior, general health, physical functioning, and self-esteem, whereas the gastric banding group remained below the community mean for general behavior and family cohesion but significantly higher for change in health and family activities. No changes occurred for either group in general behavior, mental health, or family cohesion during the study.

Summary

Weight loss is associated with varying impacts on mood disorders, self-esteem and quality of life. Improvements are not uniform across studies, and there are few data to suggest that the extent of the weight loss or the method by which weight is lost influences the degree of improvement in mental health outcomes. Rather studies, particularly in children and older people, suggest that lifestyle changes may improve quality of life even if no weight is lost. In children and adolescents, available data suggests that weight loss is not uniformly associated with improvement in quality of life indices. Further, in the absence of weight loss, children and adolescents participating in lifestyle interventions may experience improvement in quality of life or indicators of mental health, suggesting a positive impact of the intervention itself. In people with previous breast, prostate or colorectal cancer, health-related quality of life declines less rapidly with lifestyle-induced weight loss.

Cancer

Excess body weight, whether in people with overweight or obesity, is an important risk factor for some cancers. In 2002, the International Agency for Research on Cancer (IARC) reviewed the evidence for an association between body weight and cancer. The IARC concluded that sufficient evidence existed for avoiding weight gain to protect against cancer. This evidence applied to colon, breast (postmenopausal), endometrial, kidney (renal cell) and oesophageal cancers. No effect was found for premenopausal breast cancer, and insufficient evidence was available for all other cancers (IARC, 2002).

Subsequent meta-analyses have been conducted of case-control and cohort studies that demonstrate increased risk of cancers of the pancreas, rectum, thyroid, haematological system and gallbladder in people with obesity (Renehan et al., 2008; WCRF/AICR, 2007). This led to the World Cancer Research Fund and American Institute for Cancer Research (WCRF/AICR) issuing summary findings on the association of obesity with cancer in 2007 (WCRF/AICR, 2007). According to their evidence statements, convincing evidence was found for body fatness and colorectal, pancreatic, oesophageal, postmenopausal breast, kidney and endometrial cancers as well as for the association of abdominal fatness and colorectal cancer. Probable evidence existed for body fatness and gall bladder and premenopausal breast cancers and for abdominal fatness and endometrial, pancreatic and postmenopausal breast cancers. Suggestive evidence was found for body fatness and lung and liver cancers.

Cancer survivors are at greater risk for second malignancies, other comorbidities, and accelerated functional decline. Retrospective observational data suggest that obesity is an independent prognostic factor for the development of distant metastases and death after the diagnosis of breast cancer, and for recurrence of other malignancies, including prostate cancer (Ewertz et al., 2011; Rodriguez et al, 2007).

Although the association between excess body weight and cancer is recognised, the impact of weight loss on reduction in cancer risk is less well established. Because sustained intentional weight loss is not common, epidemiologic data have been sparse on the benefits of weight loss in relation to reduced risk of cancer. The IARC further found insufficient evidence for a protective benefit of intentional weight loss for any cancer site (IARC, 2002). The WCRF/AICR similarly

found insufficient evidence to draw firm conclusions regarding the association between intentional weight loss and cancer risk (WCRF/AICR, 2007).

Wolin and Colditz (2008) conducted a review and update of evidence on weight loss in relation to leading cancers since the IARC report of 2002. Findings are summarised as follows:

Breast cancer: The IARC report concluded that obesity and weight gain are directly and positively related to postmenopausal breast cancer (IARC 2002). The WCRF/AICR concurred, finding convincing evidence for body fatness and probable evidence for abdominal fat and weight gain (WCRF/AICR, 2007). A meta-analysis conducted as part of the WCRF/AICR report found a 5% increase in risk of postmenopausal breast cancer with each 5 kg of weight gain. It was estimated that adult weight gain accounts for 24% of postmenopausal breast cancer and that weight gain after menopause accounts for 7% of breast cancer among women who do not use postmenopausal hormone therapy. However, these findings may not translate to all groups, as no association was found among African-American women. Available evidence suggests that weight loss reduces the risk of developing breast cancer. The Nurses' Health Study, a prospective cohort study of 87,143 women followed for up to 26 years, found that women with excess body weight who lost 10 kg or more after menopause and kept the weight off were at lower risk of developing breast cancer than those who maintained their weight (RR 0.43; 95% CI, 0.21 to 0.86) (Eliassen et al., 2006).

Colon cancer: The risk of developing colon cancer is thought to be reduced through a number of lifestyle factors, with maintaining a healthy weight and physical activity being among the most important. The IARC report found consistent positive associations between body fatness, as indicated by BMI, and risk of colorectal cancer. Risk of colon cancer was increased by 50–100% when comparing the highest and lowest categories of BMI with a linear trend across levels of BMI. Overweight and obesity appear to be more strongly related to colon cancer incidence in men than in women. In addition to BMI, evidence exists that central body fat distribution and abdominal fatness are associated with increased risk of colon cancer and adenoma. Limited evidence is available on the association between weight change and the risk of colon cancer. There are limited data regarding weight loss and colon cancer. One study was identified, conducted in Austrian adults and which showed an inverse association between weight loss and colon cancer in men.

Prostate cancer: IARC (2002) found insufficient evidence to draw a conclusion about the relationship between obesity and the risk of prostate cancer. Subsequent studies suggest that obesity increases the risk for advanced prostate cancer and prostate cancer mortality, but not the risk of less aggressive disease. Only a handful of studies have specifically examined the effects of weight gain or loss on the risk of prostate cancer. For example, in the Cancer Prevention Study II Nutrition Cohort, the authors observed a significantly decreased risk of high-grade prostate cancer in men who lost > 11lbs as compared to those who were weight-stable (change of 5 lbs). Similarly, in another observational study a significant trend of reduced risk with weight loss from the age of 50 years and increased risk with weight gain from the age of 50 years relative to no change was observed. The association for BMI change from the age of 50 years was stronger among men with BMI >24.4 kg/m^2 at the age of 50 years. Men who gained > 10% weight and had a BMI >24.4 kg/m2 were twice as likely to develop prostate cancer as men with BMI 24.4 kg/m^2 who, at baseline, were within 5% of their BMI at age 50. A third observational study found that weight gain from the age of 18 years significantly increased the risk of fatal, but not incident, prostate cancer (Wright et al, 2007). However, other observational studies of similar size have not found an association. Therefore the impact of weight loss on prostate cancer risk has not definitively been established.

Oesophageal cancer: The IARC found sufficient evidence and WCRF/AICR found convincing evidence that body fatness increases the risk of oesophageal cancer. Specifically, obesity appears to increase the risk of oesophageal adenocarcinoma (but not squamous cell carcinoma). There is some evidence that weight loss reduces oesophageal adenocarcinoma. In one observational study, a gain of 1 kg/m^2 after the age of 20 years increased the risk of oesophageal adenocarcinoma by 14%; those with a gain ≥ 8 kg/m^2 had 3.4 times the risk as those with an increase between 0 and 3.9 kg/m^2. Two subsequent observational studies have demonstrated similar results.

Pancreatic cancer: Although IARC found insufficient evidence in 2002, by 2007 the WCRF/AICR had found convincing evidence that body fatness increased risk of pancreatic cancer and abdominal fatness probably increased risk. In a meta-analysis of cohort data, the WCRF/AICR reported a 14% increased risk of pancreatic cancer for every 5 kg/m^2 increase in BMI. Subsequent reports have been conflicting. No evidence regarding weight loss and risk reduction was identified.

Endometrial cancer: In 2002, IARC found sufficient evidence that obesity increased the risk of endometrial cancer. The WCRF/AICR meta-analysis found a 52% increase in risk for every 5 kg/m^2 increase in BMI and a 31% increase in risk for every 5 kg/m^2 as a young adult. The WCRF/AICR also found probable evidence that abdominal fatness increases the risk of endometrial cancer. No evidence regarding weight loss and reduction in risk was identified.

Renal cancer: The WCRF/AICR report found an increased risk of kidney cancer with increased BMI. A meta-analysis found a 31% increase in risk for each 5 kg/m^2 increase in BMI based on cohort data and a 205% increase in risk based on case–control data. No evidence regarding weight loss and reduction in risk was identified.

There was one RCT that was included in this review that included older, long-term survivors of colorectal, breast, and prostate cancer who participated in a diet and exercise intervention or control (Morey et al., 2009). Functional decline and quality of life were assessed in participants (results described above); rates of recurrence of cancer were not reported.

Summary

There is evidence demonstrating reduced post-menopausal breast cancer risk in women with obesity who lose 10 kg or more after menopause and keep the weight off. There is insufficient evidence to determine the impact of weight loss on risk of other cancers.

Chronic kidney disease

Obesity is an independent risk factor for chronic kidney disease (CKD). Observational studies have established obesity as a risk factor for the development of end-stage renal disease (ESRD), with risk increasing as BMI increases (Wang et al., 2008a). Documented detrimental renal effects of obesity include elevated glomerular hyperfiltration (GFR), elevated renal blood flow and renal hypertrophy that may lead to development of obesity-related glomerulopathy (Navaneethan et al., 2009). Obesity has also been associated with nephrolithiasis in both sexes (Obligado and Goldfarb, 2008). Further, obesity is associated with high blood pressure, diabetes and hypercholesterolaemia, each of which is independently associated with abnormalities in renal function (Guh et al., 2009).

Included studies

There were two systematic reviews and meta-analyses included in this review that assessed the relationship between weight change and chronic kidney disease (Afshinnia et al., 2010; Navaneethan et al., 2009).

Afshinnia et al. (2010) pooled findings from 522 adult participants across four RCTs, one non-randomised clinical trial and eight prospective cohort studies. The mean BMI of participants in primary studies ranged between 31 and 48 kg/m^2. Studies were up to 2 years in duration. Lifestyle, pharmacological and surgical interventions were included. The mean reduction in BMI across studies was 2.2 to 7.3 kg/m^2. The corresponding change in proteinuria was -1.7 g / 24hrs (95% CI, -2.6 to -0.7) and change in microalbuminuria was -19 mg (95%CI, -17.1 to -10.6). Surgical weight loss methods were associated with a greater reduction in creatinine clearance (mL / min) than non-surgical methods (-23.7 (95% CI, -36.1 to -11.4) versus 0.5 (95% CI, -11.5 to 12.4) respectively).

Navaneethan et al. (2009) pooled the results of 528 adult participants across two RCTs and 11 observational studies up to 2 years in duration. The mean BMI of participants in primary studies ranged between 30 and 54 kg/m^2. Surgical interventions resulted in significantly greater weight reduction than non-surgical interventions (-16.5 versus -3.7 kg/m^2 BMI). The corresponding changes in GFR were -25.6 versus +4.3 ml / min for surgical versus non-surgical interventions respectively. Further, participants who received non-surgical interventions experienced reductions in proteinuria of approximately 1.3 g / 24 hours. (Insufficient data were available to estimate changes in proteinuria for participants who received surgical interventions).

Summary

These reviews and meta-analyses demonstrate an association between weight loss in adults with obesity who have mild to moderate CKD and a significant decrease in proteinuria and albuminuria, regardless of the method of weight loss used. Direct correlation between proteinuria and body weight suggest that higher categories of BMI are associated with the greatest reduction in indicators of abnormal renal function.

Surgical interventions are associated with greater weight losses than non-surgical weight losses, and with corresponding greater improvements in indicators of abnormal renal function. In contrast, although weight loss attained through non-surgical interventions was associated with improvements in proteinuria, no significant association with a change in GFR was observed.

Although these results demonstrate a modest improvement in some indicators of CKD, including a 110 mg decrease in proteinuria and 1.1 mg decrease in microalbuminuria per kilogram of weight loss, no study has been able to capture any change in the rate of progression of CKD within a study period. Participants of these reviews had mild to moderate renal impairment. Therefore, the effects of weight loss in patients with ESRD, who are receiving dialysis, cannot be inferred from these findings. Furthermore, given the smaller sample size, studies did not adjust for potential confounders such as the use of reno-protective medications and improvement in other important comorbid conditions, such as insulin resistance, which might independently influence the outcome measures studied.

Other genitourinary conditions

Obesity has significant consequences for the reproductive system, depending upon the amount and distribution of body fat. Epidemiological evidence shows that being overweight or obese is associated with menstrual disorders, infertility, miscarriage and poor pregnancy outcome (Pasquali et al. 2007). Population-based studies suggest an elevated risk for sexual dysfunction and for subfertility among couples in which the male partner is obese (Hammoud et al., 2008). Obesity has also been associated with urinary stress incontinence in female patients (Hunskaar, 2008).

Included studies

There were three studies in this review that assessed the relationship between weight change and genitourinary conditions; there was one systematic review / meta-analysis and two RCTs. The systematic review / meta-analysis assessed the impact of weight change on fertility in women with polycystic ovarian syndrome (PCOS); one RCT assessed the impact of weight change on urinary stress incontinence; the other assessed the impact of weight change on erectile dysfunction. A fourth study assessed the efficacy of insulin sensitising drugs for weight loss in women who predominantly are diagnosed with PCOS.

Moran et al. (2011) conducted a systematic review and meta-analysis of six RCTs including 304 adult, female participants with PCOS that assessed the impact of lifestyle interventions on female fertility endpoints. Intervention resulted in mean decreases in body weight (-3.5 kg), waist circumference (-2 cm), WHR (-0.04) and % weight change (-7%) compared with control groups. Reductions were observed in mean total testosterone (-0.27nmol/L), hirsuitism (-1.19 on Ferriman-Gallwey score), fasting insulin (-2.0 µU/mL) and OGTT insulin (-1.3 µU/mL).

Nieuwenhuis-Ruifrok et al. (2009) conducted a meta-analysis of 14 RCTs investigating the effect of insulin sensitising drugs on weight loss across 649 women of reproductive age, the majority of whom had PCOS. Treatment with metformin showed a statistically significant decrease in BMI compared with placebo (WMD -0.68; 95% CI, -1.13 to -0.24). The effect on BMI increased with larger doses of metformin and with longer duration of therapy (> 8 weeks). Reproductive outcomes were not extracted for the meta-analysis, only weight changes.

Wing et al. (2010) conducted a RCT with 338 females (BMI between 25 and 50 kg/m^2) randomised to lifestyle intervention or control group and followed for 18 months to assess impacts of weight change on urinary incontinence episodes. Participants assigned to the weight loss program received a 6-month, group based behavioural weight loss intervention, after which they underwent a second randomisation with their group to a motivationally focused maintenance program (N = 110) or a standard skills based maintenance approach (N = 111). Participants in the control group received structured education about weight loss, physical activity and healthy eating. The percent weight loss in the intervention group averaged 8.0%, 7.5% and 5.5% at six, 12 and 18 months, respectively, vs. approximately 1.5% in the control group. Compared with controls at 12 months the intervention group reported a greater percent reduction in weekly stress urinary incontinence episodes (65% vs. 47%, P < 0.001), and a greater proportion achieved at least a 70% decrease in weekly total and stress urinary incontinence episodes. At 18 months a greater proportion of women in the weight loss intervention group had more than 70% improvement in urge incontinence episodes but there were no significant differences between the groups for stress or total urinary incontinence.

Reis et al. (2010) conducted a RCT with 20 adult males with morbid obesity (mean BMI 54 to 56 kg/m^2) randomised to lifestyle intervention and Roux-en-Y gastric bypass or to information-only control and followed for 24 months. Mean reduction in BMI in intervention versus control groups was 55.7 to 31.0 versus 54.0 to 52.3 kg/m^2. International Index of Erectile Function questionnaire results (IIEF5), total testosterone and free testosterone increased significantly in the intervention group (19.7 to 23.0; 3.4 to 7.0; and 10.0 to 12.7 respectively) but not in the control group (17.2 to 17.3; 3.4 to 2.9; and 14.4 to 8.4 respectively).

Summary

Lifestyle interventions in females that reduce excess body weight and / or improve abdominal obesity can decrease stress related urinary incontinence, and can improve sex hormones and

hirsuitism associated with polycystic ovarian syndrome. In men gastric bypass-induced weight loss can improve sex hormone profile and erectile function.

Gastrointestinal disease

Obesity has been implicated as an important risk factor for the development of a range of benign and malignant gastrointestinal diseases, including functional abnormalities, inflammatory conditions, hepatic, biliary and pancreatic disease and gastrointestinal tumours (John 2006).

Included studies

There were three systematic reviews included in this review that assessed the relationship between weight change and GORD (de Groot et al., 2009 (adult); de Jong et al., 2010 (adult); Treadwell et al., 2008 (paediatric)) and one systematic review that assessed the relationship between weight change and non-alcoholic steatohepatitis (NASH) (Chavez-Tapia et al., 2010 (adult)).

GORD

De Groot et al. (2009) conducted a systematic review in adults of four RCTs and 30 observational studies up to 4 years in duration. The mean BMI of participants in primary studies ranged from 23.5 to 56 kg/m2. Surgical interventions were associated with mean excess weight loss of 72% across studies of RYGB and mean BMI decreases from 39.8 to 31.5 kg/m2 across studies of restrictive surgical procedures (LAGB and VBG). In contrast, lifestyle interventions that included a dietary component were not consistently associated with weight loss. Weight reduction was associated with improved symptoms of GORD in the majority of studies. Surgical weight loss with RYGB had the most favourable effect on GORD, LAGB conflicting effects, and VBG no effect.

De Jong et al. (2010) conducted a systematic review in adults of 20 prospective observational surgical studies of LAGB that were up to 5 years in duration. The mean BMI of participants in primary studies was greater than 42 kg/m^2 in all studies. The preoperative incidence of reflux symptoms was between 16% and 57% across primary studies. BMI decreased by between 9 and 19 kg/m^2 across primary studies. Improvements were observed in the prevalence of reflux symptoms and medication use in participants with established GORD but newly developed reflux occurred in 15% of participants. Similarly, the prevalence of established oesophagitis decreased but newly developed oesophagitis was observed in 23% of participants. A lower percentage of patients with pathological reflux was observed postoperatively.

Treadwell et al. (2008) conducted a systematic review in paediatric patients (aged 9 to 21 years) of 17 uncontrolled case series studies and one comparative observational study that reviewed the impacts of bariatric surgery on disease outcomes. For GORD outcomes, the only data that were available were for the assessment of the association between RYGB and GORD in five participants in the systematic review. Over the 1 to 6.3 years of follow-up patients who received RYGB reduced BMI by 17.8 to 22.3 kg/m^2 (4.1 BMI units is equivalent to 7% reduction in body weight in this group); 60% of participants with GORD experienced resolution of their symptoms (3 out of 5 participants).

Summary

The association between weight loss and symptoms of GORD in adults was mainly positive. Diet and lifestyle interventions leading to weight reduction were positively associated with improved symptoms of GORD in some but not all patients. RYGB was found to have a favourable effect on GORD based on assessment of participant's symptoms of GORD. VBG was not associated with improved symptoms of GORD. Associations between LAGB and GORD symptoms and

objective measures of disease were conflicting across studies. Although the majority of patients with established GORD experienced improvement after LAGB, a significant proportion of patients developed new GORD after the surgery. On balance, RYGB appears the most efficacious surgery for adult patients with morbid obesity suffering from concomitant GORD. There were insufficient data for assessing the association between weight loss and GORD in paediatric patients.

Non-alcoholic steatohepatitis (NASH)

Non-alcoholic fatty liver disease (NAFLD) is increasingly recognised as a condition that may progress to end-stage liver disease. The risk of NAFLD is approximately 4 to 5-fold higher in people with obesity than in people with normal body weight (Musso 2003). Other risk factors for NAFLD include elevated waist circumference, hyperinsulinaemia, hypertriglyceridaemia and impaired glucose tolerance or type 2 diabetes (Goldstein 2004).

NAFLD has a broad spectrum of clinical and histological manifestiations, ranging from simple statosis to its inflammatory presentation, known as non-alcoholic steatohepatitis (NASH). The degree of inflammation and fibrosis associated with NASH determine the long-term prognosis for affected individuals.

Chavez-Tapia et al. (2010) conducted a systematic review of 21 observational studies to assess the effect of weight loss through bariatric surgery on NASH. The mean BMI of participants in primary studies ranged from 31 to 58 kg/m^2. Improvement in liver function was observed in the majority of studies on at least one marker of liver function. However, hepatic deterioration was observed in other studies.

Summary

The association between weight loss through bariatric surgery and NASH is therefore unclear. The lack of randomised clinical trials to demonstrate the beneficial or harmful effects of bariatric surgery procedures as a therapeutic approach for patients with NASH means that no firm conclusions can be drawn regarding the role of bariatric surgery in management of NASH. Despite positive results observed in cohort studies, due to their high risk of bias and the potential risk for worsening in fibrosis scores, bariatric surgery needs to be assessed in randomised clinical trials.

Musculoskeletal conditions

Observational studies demonstrate that obesity is associated with a range of musculoskeletal conditions, including osteoarthritis, lower back pain, spinal disc disorders and disorders of soft-tissue structures such as tendons, fascia and cartilage (Wearing et al., 2006). In children and adolescents, the musculoskeletal effects of obesity include slipped capital femoral epiphysis, Blount disease, musculoskeletal pain and increased fracture risk (Chan and Chen, 2009).

Obesity is the main modifiable risk factor for the onset of knee osteoarthritis (OA). The strong association between BMI and OA of the knee is thought to be mainly due to an increase in mechanical loads to the tibiofemoral cartilage (Pottie et al., 2006). The observation that obesity is also a risk factor for OA of non-weight bearing joints such as the hand has suggested that the link between overweight and OA might also occur through systemic inflammation (Yusuf et al., 2010).

Obesity is also associated with mobility disability, particularly in older adults. Cross-sectional and longitudinal data suggest that increased severity of obesity is associated with poor lower extremity mobility, and that mobility declines as the duration over which obesity is experienced increases (Vincent et al, 2010).

Rejeski et al. (2010) conducted a structured narrative review of six RCTs and 30 prospective observational studies that assessed the impact of weight loss on physical disability in older adults (age > 65 years). Based on prospective epidemiological studies, BMI was found to exhibit a curvilinear relationship with physical disability; there appears to be some protective effect associated with older adults being overweight. The greatest risk for physical disability occurred in older adults with ≥ class II obesity. Obesity at age 30 years was found to constitute a greater risk for disability later in life than when obesity develops at age 50 years or later; however, physical activity was shown to reduce the adverse effects obesity has on late life physical disability in some studies. Data from the limited number of RCTs demonstrated that physical activity improved functional disability in weight loss programs for older adults.

Included studies

There was one meta-analysis and five RCTs included in this review that assessed the relationship between weight change and musculoskeletal conditions (Christensen et al., 2007; Jenkinson et al., 2009; Manini et al., 2010; Morey et al., 2009; Villareal et al., 2011; Villareal et al., 2008). Morey et al. (2009) conducted a RCT with older, long-term survivors of colorectal, breast or prostate cancer.

Christensen et al. (2007b) reviewed four RCTs including 454 patients to assess the impact of weight loss on knee pain and function in patients with excess body weight. A weight loss of 6.1 kg (-4.7 to -7.6) was associated with reduced knee pain and physical disability (Effect size (ES) 0.20 (95% CI, 0.00 to 0.39) and 0.23 (95% CI, 0.04 to 0.42) respectively). Meta-regression analysis showed that disability could be significantly improved when weight was reduced by > 5% of body weight, or at the rate of >0.24% reduction per week.

Jenkinson et al. (2009) conducted a randomised trial in 389 participants aged 45 years and over with self-reported knee pain, comparing diet and quadriceps strengthening with diet alone, quadriceps strengthening alone and control. At 2 years there was a significant reduction in knee pain in the knee exercise groups compared with those in the non-exercise groups (% risk difference 11.6; 95% CI, 1.8% to 21.4%). The number needed to treat to benefit from a ≥ 30% improvement in knee pain at 24 months was 9 (95% CI, 5 to 55). Improvement in function was also evident at 24 months with quadriceps strengthening. The mean difference in weight loss at 24 months in the dietary intervention group compared with no dietary intervention was 3.0 kg (95% CI, 1.4 to 4.5); for exercise versus no exercise the difference was 0.4 kg (95% CI, -0.8 to 1.7). This difference in weight loss was not associated with improvement in knee pain or function.

Manini et al. (2010) conducted a randomised trial in 424 participants aged 70 to 89 years comparing moderate intensity physical activity (walking, strength and balance exercises) with a patient education control. At one year participants in the active intervention did not lose significant amounts of weight; they did improve short-duration mobility tasks of daily life but not long-distance mobility tasks such as walking 400 metres.

Villareal et al. (2011) conducted a randomised trial in 107 participants aged over 65 years comparing diet and exercise, diet, exercise and a control group. At one year participants in the diet-exercise group had lost 9% of their body weight and had improved their strength, gait speed, physical performance, functional status but decreased bone mineral density at the hip (-1.1%). Participants in the diet group also lost weight (10% of their body weight) and improved their physical performance and functional status (10%) but did not improve their strength, gait speed or bone mineral density at the hip (-2.6%). Participants who exercised did not lose weight but did improve their strength, gait speed, physical performance and bone mineral density at the hip (1.5%).

Villareal et al. (2008), in a smaller randomised trial of 27 participants aged 70 ± 5 years compared a lifestyle intervention (diet, exercise and behaviour therapy) with control, and found that participants who received the active intervention lost 10% of their body weight (controls gained 1% of their body weight). Compared with controls, the treatment group reduced bone mineral density at the hip and trochanter, and increased serum bone markers.

Morey et al. (2009) conducted a RCT with 641 overweight (BMI 25 to 40lg/m^2), long-term (> 5 years) survivors (aged 65 to 91 years) of colorectal, breast, and prostate cancer, randomly assigned to a 12-month, home-based tailored program of telephone counselling and mailed materials promoting exercise, improved diet quality, and modest weight loss (n = 319) or delayed intervention (control) group (n = 322). At 12 months the mean changes in basic lower extremity function were 0.34 (95% CI, -0.84 to 1.52) in the intervention group compared with -1.89 (95% CI, -0.70 to -3.09) in the control group (P = 0.005). Weight loss was greater in the intervention than the control group (2.1 kg (95% CI, 1.7 to 2.4 kg) versus 0.9 kg (95% CI, 0.5 to 1.3 kg)).

Summary

A moderate weight loss of about 5% in patient with obesity reduces functional disability and, to a lesser extent, pain associated with knee osteoarthritis. Studies were not identified that explored the effects of moderate diet weight loss on systemic inflammation or structural progression of osteoarthritis. The included RCT published by Jenkinson et al. (2009) after the meta-analysis by Christensen et al. (2007) suggest that the type of weight loss intervention influences changes in pain and disability. Specific exercises positively influence pain and function even if no weight is lost, and small weight losses achieved through dietary change do not appear to influence knee pain and function. However, participants in this study did not have osteoarthritis demonstrated by an objective investigation prior to study commencement. It is unclear from these studies whether the greater the weight loss, the greater the benefit for pain and function.

Manini et al. (2010) and Villareal et al. (2011) showed that physical activity was associated with improved strength, short-duration mobility and physical performance in the absence of significant weight loss. Weight loss in the absence of physical activity did not result in improved strength or gait speed. Villeareal et al. (2008) and Villareal et al. (2011) assessed changes in bone mineral density with lifestyle weight loss interventions. Results suggest that weight loss ≥ 9% was associated with reduced bone mineral density but that physical activity offset the degree to which bone mineral density was reduced.

Among older, long-term survivors of colorectal, breast, and prostate cancer, a diet and exercise intervention reduced the rate of self-reported functional decline compared with no intervention.

Sleep apnoea

Sleep apnoea is characterised by repetitive pauses in breathing during sleep due to obstruction of the upper airway. In adults, most but not all individuals with obstructive sleep apnoea also have obesity. The adverse consequences of obstructive sleep apnoea include cardiovascular, mental health and traumatic outcomes. There are a variety of treatments for obstructive sleep apnoea, depending on the specific cause of the obstruction. Physical interventions, pharmacological preparations and a variety of surgical interventions may be indicated (SIGN 2003). In people with obesity, the impact of weight loss on sleep apnoea symptoms and adverse outcomes is not well characterised.

Included studies

There were two systematic reviews (Greenburg 2009; Treadwell 2008) and two RCTs (Tuomilehto 2009; Foster 2009) included in this review that assessed the relationship between weight change and obstructive sleep apnoea.

Greenburg et al. (2009) conducted a meta-analysis of 12 uncontrolled studies that assessed the impact of bariatric surgery on objectively measured obstructive sleep apnoea (using the apnoea-hypopnia index). There were 342 adolescent and adult participants with a BMI between 32 kg/m^2 and 73 kg/m^2. The pooled mean BMI was reduced by 17.9 kg/m^2 (95% CI, -16.5 to -19.3) from 55.3 kg/m^2 (95% CI, 53.5 to 57.1) to 37.7 kg/m^2 (95% CI, 36.6 to 38.9). The random-effects pooled baseline apnoea hypopnea index of 54.7 events / hour (95% CI, 49.0 to 60.3) was reduced by 38.2 events / hour (95% CI, 31.9 to 44.4) to a final value of 15.8 events / hour (95% CI, 12.6 to19.0).

Tuomilehto et al. (2009) conducted a randomised trial of control versus very low calorie diet and supervised lifestyle counselling as treatment for 72 adults with mild obstructive sleep apnoea and BMI between 28 and 40 kg/m^2. After 1 year the lifestyle intervention had reduced BMI by an average of 3.5 ± 2.1 kg/m^2; the odds of having obstructive sleep apnoea were substantially lowered to 0.24 (95% CI, 0.08 to 0.72).

Foster et al. (2009) conducted a randomised trial of behavioural weight loss versus education control in 264 participants with type 2 diabetes and a BMI of 36.7kg/m^2 (SD 5.7). After 1 year, participants receiving the active intervention lost an average of 10.8 kg.

Treadwell et al. (2008) conducted a systematic review and meta-analysis of 18 predominantly uncontrolled case series' of bariatric surgery performed in 641 paediatric patients (age 9 to 21 years). Four included studies reported obstructive sleep apnoea outcomes; two studies of LAGB in 9 to 19 year old patients and two studies of RYGB in 12 to 21 year old patients. Resolution of sleep apnoea was observed in 100% of participants with the condition (36 participants) across the four studies. Weight loss associated with LAGB was between 10.6 and 13.7 kg/m^2; weight loss with RYGB was 17.8 to 22.3 kg/m^2 over an average of three years follow-up.

Summary

Weight loss by surgical or non-surgical interventions can resolve obstructive sleep apnoea. The amount of weight loss required to resolve obstructive sleep apnoea is uncertain. However, weight loss of between 7% and 13% reversed mild obstructive sleep apnoea in a significant proportion of adults and more substantial weight loss in paediatric patients was associated with sleep apnoea reversal in all cases.

Immune function

Obesity is associated with impaired immune function, including decreased cytokine production, decreased response to antigen / mitogen stimulation, reduced macrophage and dendritic cell function and natural killer cell impairment. Impaired immune response is thought to increase risk of infection and to mediate the increased risk of developing certain cancers (Table 4) (Karlsson and Beck, 2010).

Observational data suggest that impaired immune response with obesity leads to increased susceptibility to a number of infectious agents, including tuberculosis, *Helicobacter pylori,* influenza and a range of other viruses (Karlsson and Beck, 2010).

The biological mechanisms that link obesity to cancer development appear to include (but are not limited to) altered natural killer cell immune function. Studies assessing natural killer cell function in people with obesity are limited. Available data from uncontrolled case series studies suggests that obesity is associated with suppressed natural killer cell function and that significant weight loss (induced by bariatric surgery) increases function (Moulin et al., 2009).

Included studies

There was one RCT included in this review that assessed the relationship between weight change and immune function.

Campbell et al. (2008) investigated the effect of 12-month aerobic exercise, relative to stretching control, on in vitro immune function in a randomised controlled trial of 115 postmenopausal, overweight, or obese sedentary women, aged 50 to 75 years. The exercise goal was 45 minutes a day, 5 days a week. Control women participated in one day a week of stretching classes. Immune markers (natural killer cell cytotoxicity, T-lymphocyte proliferation, immune cell counts and phenotypes, and serum immunoglobulins) were assessed.

From baseline to 12 months, the exercise group participated in 87% of the prescribed physical activity minutes per week. The exercise intervention resulted in decreased body weight versus control (exercise: -1.8 kg; control: +0.3 kg; P value: 0.002), and decreased percent body fat (exercise: -1.5%; control: +0.02%, P value: <0.0001). The main outcomes, natural killer cell cytotoxicity and T-lymphocyte proliferation did not differ between groups at 12 months. Secondary outcome and subgroup (i.e. stratification by baseline categories of BMI, immune status, CRP and age) analyses did not show any clear patterns of association.

Summary

This randomised controlled trial showed no effect of minimal weight loss achieved through aerobic exercise on in vitro immune function.

Other outcomes

Asthma

Obesity has been implicated as a risk factor for asthma. Numerous cross-sectional epidemiologic investigations have shown a modest association between obesity and prevalent asthma (Ford, 2005). Beuther et al. (2007) conducted a meta-analysis of seven prospective epidemiologic studies including 333,102 participants followed for up to 21 years. Compared with normal body weight, overweight and obesity (defined according to BMI) were associated with an increase in incident asthma (OR 1.51; 95% CI, 1.27 to 1.80). A dose-response association was observed. The OR for incident asthma for normal weight versus overweight was 1.38 (95% CI, 1.17 to 1.62) and for obesity was 1.92 (95% CI, 1.43 to 2.59). The increase was similar in males and females. No studies regarding weight loss and reduction in odds of asthma were identified.

Eneli et al. (2008) conducted a systematic review of 15 studies that assessed weight loss and asthma. In five studies, asthma was the primary outcome assessed. More often, asthma related outcomes were included in a list of outcomes from different clinical conditions (e.g. percentage weight loss, type 2 diabetes, sleep apnoea, hypertension, dyslipidaemia). The method of asthma diagnosis was usually not described. The median sample size for the asthma subpopulation in the included papers was 28 subjects (range 6 to 40), with median length of follow-up of 1 year (range 8 weeks to 14 years). All of the studies were conducted in adults (mostly women) and in white populations, which limits the generalisability of the findings to men and other racial / ethnic groups. There was a single paediatric study, with a single subject with asthma. There were 11 studies that assessed surgical interventions and four studies that assessed lifestyle interventions.

Regardless of the type of intervention (surgical versus lifestyle), all 15 studies noted an improvement in at least one asthma outcome after weight loss.

One of the earlier studies to focus on asthma outcomes was conducted by Dixon et al (1999) in Australia. Asthma was assessed preoperatively and at least 12 months after surgery using a scaled asthma score based on severity, daily impact, medications needed, hospitalisation, sleep and exercise. Patients were categorised into mild, moderate or severe asthma based on the National Asthma Campaign criteria. Although 10 had a history of severe asthma at baseline, none had severe asthma at the 12 month follow-up. The impact of asthma on daily living activities improved by 50%. There was a 57% decline in the number of patients that needed daily medications (from 14 to 6) after weight loss. The mean preoperative scaled asthma score of 44.5 (16) decreased to 14.3 (11) at follow-up ($p < 0.001$). The investigators reported a correlation coefficient of 0.21 between per cent weight loss and improvement in asthma scores.

MacGregor and Greenberg (1999) in Australia also described strong evidence of reversibility in their weight loss study. In a subset of five patients with asthma who had bariatic surgery, asthma symptoms improved following weight loss. The symptoms worsened after subjects regained some of their weight. Subsequently, the five patients underwent revisional surgery, lost weight again and the frequency of asthma symptoms decreased again. In the single patient in the study who did not lose weight despite surgery, the frequency of his asthma symptoms remained unchanged.

The majority of studies show improvement in asthma with weight loss in a significant proportion of people with excess body weight and asthma. However, not all people with asthma who have obesity will experience improvement in their asthma symptoms with weight loss.

Question 2: What are the impacts of weight reduction interventions on degree and duration of weight loss?

A large number of interventions have been developed, implemented and evaluated nationally and internationally in order to achieve weight reduction in children, adolescents and adults with overweight or obesity. Most are considered 'complex' or 'multi-component' interventions due to the multiple components of the intervention[9]. Common labels and concepts can be used to define complex / multi-component interventions.

Terminology for complex / multi-component interventions in the obesity literature differs to other literature. In the obesity literature, components of complex / multi-component interventions may include lifestyle interventions, pharmacotherapy, surgery and other intervention types, including but not limited to nutritional supplements, complementary and alternative medicines and acupuncture. Combinations of these interventions are usually referred to as multi-component interventions. In contrast, in other disease literature multi-component interventions refer to interventions that include one or more elements of a disease management approach. For example, a combination of patient interventions such as patient education or self-management, clinician education, financial incentives to health care provider or patient, or multidisciplinary approaches to care may constitute a multi-component intervention. For the purposes of this review, weight loss interventions that include one or more type of lifestyle intervention, pharmacotherapy and surgery will be referred to as multi-component interventions. Interventions that incorporate a combination of disease management approaches to improve quality of care will be referred to as disease management approaches.

[9] MRC Medical Research Council. A framework for the development and evaluation of RCTs for complex interventions to improve health. London: MRC Medical Research Council; 2000.

Multi-component interventions

There is a high degree of variability in the number and combination of strategies incorporated into multi-component interventions. The majority include lifestyle interventions with our without medication management.

Dietary interventions are included in most multi-component interventions. There are many types of dietary intervention that have been trialled, varying from brief advice to intensive and structured dietary management by a dietitian. Physical activity interventions may be used to augment the success of the intervention. These also vary in nature, from brief advice provided by a usual health care provider to structured physical activity that is supervised and delivered by an exercise physiologist or fitness industry professional.

Differences in the health care and non-health care settings in which multi-component interventions are conducted, cultural and socio-economic characteristics and preferences of the different target populations and providers, and variation in views regarding what constitutes an effective approach to weight reduction and management all contribute to the variability observed across weight loss trials. Evidence regarding what kind and how many interventions should be included in a weight reduction multi-component intervention is difficult to generate. Rather, each component of multi-component interventions may have evidence supporting its effectiveness and may be appropriate for incorporation into a multi-component intervention, depending on the setting in which it is based, the target patient group and available resources for intervention implementation. Each of these strategies, and published evidence supporting the efficacy of each strategy, are discussed in the following sections.

Study design and multi-component interventions

Numerous study designs have been used to evaluate the effectiveness of multi-component interventions for weight loss in paediatric and adult populations with excess body weight. The majority are non-controlled studies. These are vulnerable to inherent biases which may result in an overestimate of intervention effectiveness[10]. Controlled clinical trials, particularly randomised controlled trials, are less prone to bias.

Many studies are affected by large drop-out of participants and / or loss to follow-up of participants. This results in an increased risk of selection bias that limits the generalisability of findings of studies to target populations in general.

Goals of multi-component interventions

The goal most commonly cited for multi-component interventions in studies included in this review is to achieve improvements in anthropometry. The clinical outcomes usually targeted in adult studies are reductions in body weight (either in kilograms or pounds); however, other objectively measured markers of body composition such as BMI and, less commonly, waist circumference may be targeted. In paediatric patients, the clinical outcome usually targeted is reduced BMI. In adults with chronic disease states, indicators of chronic disease may be incorporated into program goals. Blood pressure, serum lipids, glycaemic status and measures of pain and / or function are most commonly included (Table 7).

[10] Lemmens K. A model to evaluate quality and effectiveness of disease management. Quality and Safety in Health Care 2008; 17:447-53.

Table 7: Outcome indicators relevant to multi-component interventions

Short-term	Long-term	Health system
Body weight	Type 2 diabetes	Primary care utilisation
BMI	Prediabetes	Cost-effectiveness / cost-benefit
Waist circumference	Coronary heart disease	
Diet	Cerebrovascular disease	
Physical activity	Mortality	
Blood pressure	Quality of life	
Lipid levels	Depression / anxiety	
Fasting serum glucose	Workforce productivity	
HbA1c	Self-assessed health status	
Depression / anxiety	Pain / mobility	
Workforce productivity	Other chronic health conditions	
Self-assessed health status		
Pain / mobility		

Some studies assess size acceptance interventions that focus on eating behaviours rather than weight loss. Provencher et al. (2009) conducted a RCT of a size acceptance intervention in 144 premenopausal women with a BMI > 25kg/m^2. Women in groups received 14 weekly sessions of between 3 and 6 hours duration led by a registered dietitan and a clinical psychologist. Participants completed a workbook as they were guided through self-reflection and observations, group discussions, practical exercises and lectures. Topics included enjoyment of physical activity, healthy nutrition, recognition of cues to hunger and satiety, and acceptance of body image. This was compared with a wait list control and with a group that received social support but no guidance regarding lifestyle. A reduction in BMI of 2% was observed at 16 months in the intervention group, 1% in the social support group and 0% in the control group.

Process of care indicators are less commonly the target of many disease management approaches; although compliance of patients with lifestyle changes may be incorporated, these are not usually objectively assessed. Similarly, attendance at appointments with clinicians and / or allied health providers, psychosocial indicators (such as self-efficacy, attitude, self-assessed health status), and screening for presence of comorbid or antecedent conditions that contribute to obesity are used infrequently as measures of processes of care.

Effectiveness of multi-component interventions

Interventions that address all three key lifestyle areas related to obesity – nutrition, physical activity and behaviour – are more effective than those that address only one or two of them. Kirk et al. (2011) conducted a review of systematic reviews that assessed approaches to management of obesity in adults. The reviewers concluded that multi-component interventions were an evidence-based approach to obesity management in adults. In contrast, single component interventions are effective in improving behaviour, but not in achieving weight loss. The authors did not provide quantitative data regarding the degree of weight loss achieved with various multi-component interventions.

Included studies

Studies conducted in adults demonstrate that multi-component lifestyle interventions lead to greater reductions in weight than single component lifestyle interventions.

- Seo and Sa (2008) analysed 24 controlled clinical trials that were categorised according to the number of components included in the lifestyle intervention. Three-component interventions were more successful than two-component or single component interventions (effect sizes 0.52 versus 0.22 and 0.08 respectively). Mean weight losses achieved were approximately 3.5 kg.
- Shaw et al. (2005) conducted a meta-analysis of 36 RCTs and found that three-component interventions (behaviour or cognitive behaviour therapy in conjunction with diet and exercise) compared to two component interventions (diet and exercise alone) increased weight loss achieved by up to an additional 4.9 kgs in adults.

Anti-obesity medications increase the degree of weight loss in adults.

- Curioni et al. (2006b) conducted a meta-analysis of four RCTs in adults and demonstrated that rimonobant pharmacotherapy in addition to a hypocaloric diet increased the efficacy of weight loss by approximately 5 kg over 12 months compared with hypocaloric diet alone. Similarly, Nissen et al. (2008) conducted a RCT in 839 adult participants (mean BMI 35 kg/m2) that demonstrated rimonobant pharmacotherapy in addition to a hypocaloric diet. Diet plus rimonobant resulted in weight losses of 4.3 kg (95% CI, -5.1 to -3.5) at 18 months compared with 0.5 kg (95% CI, -1.3 to 0.3) in the diet alone group. Van Gaal et al. (2008) also conducted a RCT in 1,507 adult participants (mean BMI 36 kg/m2) that showed rimonobant in addition to a hypocaloric diet produced greater weight loss (5.5 kg) than diet alone (1.2 kg) at two years follow-up.
- Franz et al. (2007) conducted a meta-analysis of 80 studies in adults and showed that at two years of follow-up pharmacotherapy and lifestyle therapy in combination resulted in 2 to 5 kg more weight loss than lifestyle therapy alone.
- Horvath et al. (2008) (data also reported in Siebenhofer et al. 2009) conducted a meta-analysis of eight RCTs in adults that compared pharmacotherapy and lifestyle with lifestyle intervention alone. At up to 36 months of follow-up, orlistat resulted in an additional 3.7 kg (95% CI, -4.7 to -2.8) of weight loss and sibutramine in an additional 3.7 kg (95% CI, -4.9 to -2.6) weight loss compared with hypocaloric diet alone.
- Smith et al. (2010) conducted a RCT involving 3,182 participants aged 18 to 65 years with a BMI between 27 and 45 kg/m2 that compared lorcaserin and behaviour therapy with behaviour therapy alone (with placebo). Weight change was -5.8 kg (SE 0.2) versus -2.2 kg (SE 0.1) and waist circumference change was -6.8 cm (SE 0.2) versus -3.9 cm (SE 0.2) between locaserin and placebo groups. After one year 48% of patients receiving locaserin had lost 5% of their body weight compared with 20% of patients in the placebo group. People in the locaserin group lost 5.8% (SE 0.2%) of their body weight and the placebo group lost 2.2% (SE 0.1%) of their body weight.

Direct comparisons of single and combination pharmacotherapy suggest an increased weight reduction with multiple medications. Neovius et al. (2008) conducted a meta-analysis of eight RCTs that directly compared weight loss drugs. Overall, sibutramine was more efficacious than orlistat for weight loss (11.7 versus 8 kg over 12 months). Four studies showed sibutramine monotherapy was more effective than orlistat monotherapy; three showed the drugs were

equivalent for monotherapy as weight loss agents up to 12 months of follow-up. Three studies assessed sibutramine and orlistat as combination therapy. The combination of both drugs resulted in more weight loss than orlistat monotherapy (-10.8 versus -5.5 kg) but was not superior to sibutramine monotherapy (-13.7 versus -9.4 kg) ($p > 0.05$).

In paediatric patients, multi-component interventions are associated with greater reductions in BMI than single component interventions.

- McGovern et al. (2008) conducted a meta-analysis of RCTs that assessed the efficacy of treatments for paediatric obesity. Effect sizes were calculated. Effect sizes for physical activity and diet were -0.02 (95% CI, -0.21 to 0.18) and -0.22 (95% CI, -0.56 to 0.11) respectively. Addition of orlistat resulted in an effect size of -0.29 (95% CI, -0.46 to -0.12) and sibutramine in an effect size of -1.01 (95% CI, -1.28 to -0.73).

Anti-obesity medications also appear to increase the degree of weight loss in adolescent patients.

- Whitlock et al. (2010) analysed 20 studies conducted in patients aged between 4 and 18 years. Results demonstrate that comprehensive lifestyle interventions that include nutrition, physical activity and behavioural components, can produce short-term improvements in weight. Losses of 1.9 to 3.3 kg/m2 over 6 to 12 months can be achieved compared with control group participants. The addition of sibutramine to comprehensive lifestyle intervention produced an estimated additional 2.2 kg/m2 reduction in BMI. The addition of orlistat was not shown to improve weight loss.
- Oude Luttikhuis et al. (2009) conducted a meta-analysis of 64 studies that appraised lifestyle and pharmacological interventions for weight loss in paediatric patients. Combined behavioural lifestyle interventions compared to standard care or self-help produced a significant and clinically meaningful reduction in overweight in children and adolescents. In obese adolescents, orlistat and sibutramine, as an adjunct to lifestyle interventions increased weight loss but also increased adverse effects. In children less than 12 years of age, parent-focussed lifestyle interventions were more effective than standard care in reducing BMI z-score at 6 months (effect size -0.06; 95% CI, -0.12 to -0.01) but non-significant by 12 months (effect size -0.04; 95% CI, -0.12 to 0.04). In children 12 years and older, lifestyle interventions were more effective than standard care in reducing BMI z-score at 6 and 12 months (effect size -0.14; 95% CI, -0.17 to -0.12 at 6 months and effect size -0.14; 95% CI, -0.18 to -0.10 at 12 months). In children 12 years and older, orlistat increased the BMI reduction by an additional 0.8 kg/m2 (95% CI, 0.4 to 1.1) compared with lifestyle intervention alone; and sibutramine increased BMI reduction by an additional 1.7 kg/m2 (95% CI, 1.4 to 1.9) compared with lifestyle alone.

Surgery is more effective than lifestyle or pharmacotherapy in reducing body weight in people with obesity. The degree of weight loss achieved is influenced by the type of surgery that is performed.

Surgery is more effective than lifestyle treatment for obesity in adolescents. O'Brien et al. (2010) conducted a prospective, randomized controlled trial of 50 adolescents between 14 and 18 years of age with a BMI > 35, assigned either to a supervised lifestyle intervention or to undergo gastric banding, and followed up for 2 years. Overall, the mean changes in the gastric banding group were a weight loss of 34.6 kg (95% CI, -30.2 to -39.0), representing an excess weight loss of 78.8% (95% CI, 66.6% to 91.0%), 12.7 BMI units (95% CI, 11.3 to 14.2), and a BMI z-score change from 2.39 (95% CI, 2.05 to 2.73) to 1.32 (95% CI, 0.98 to 1.66). The mean losses in the

lifestyle group were 3.0 kg (95% CI, +2.1 to -8.1), representing excess weight loss of 13.2% (95% CI, 2.6% to 21.0%), 1.3 BMI units (95% CI, 0.4 to 2.9), and a BMI z-score change from 2.41 (95% CI, 2.21 to 2.66) to 2.26 (95% CI, 1.91 to 2.43).

The least invasive form of surgical intervention is the intragastric balloon. In some publications, intragastric balloon is not considered a form of anti-obesity surgery. The effect of intragastric balloon on weight loss has been investigated in two meta-analyses included in this review.

- Fernandes et al. (2007) conducted a meta-analysis of nine RCTs in adults and found that diet and intra-gastric balloon was more effective than intra-gastric balloon in inducing weight loss (5.1 kg versus 3.2 kg).
- Imaz et al. (2008) conducted a meta-analysis of 16 studies in adults and demonstrated that intragastric balloon with lifestyle intervention resulted in greater weight loss than lifestyle intervention alone (loss attributed to the balloon was 6.7 kg; 17.6% of excess weight lost).

The degree of weight loss achieved with different types of bariatric surgery has been investigated in a number of meta-analyses included in this review.

- Padwal et al. (2011) conducted a meta-analysis of 31 RCTs involving 2,619 patients (mean age 30 to 48 years; mean BMI 42 to 58 kg/m2) that compared bariatric surgery with lifestyle management. Compared with lifestyle management alone, differences in BMI from baseline at year 1 (15 trials; 1,103 participants) were as follows: jejunoileal bypass (WMD: -11.4 kg/m2), mini-gastric bypass (WMD: -11.3 kg/m2), BPD (WMD: -11.2 kg/m2), sleeve gastrectomy (WMD: -10.1 kg/m2), RYGB (WMD: -9.0 kg/m2), horizontal gastroplasty (WMD: -5.0 kg/m2), VBG (-6.4 kg/m2), and LAGB (WMD: -2.4 kg/m2). Weight losses were greatest with diversionary procedures, intermediate with diversionary / restrictive procedures, and lowest with purely restrictive procedures.
- Similarly, Picot et al. (2009) (data also reported in Colquitt et al. 2009) systematically reviewed 26 studies (23 RCTs and 3 cohort studies) conducted in 5,766 adults with mean BMI across primary studies of between 30 and 60 kg/m2. Surgery was more effective than non-surgical options for weight loss. Across included studies: LAGB was associated with a per cent excess weight loss of 39.0% to 87.2% and BMI reduction of 7.4 to 18 kg/m2; BPD was associated with a BMI reduction of 13 to 18 kg/m2; RYGB was associated with a per cent excess weight loss of 60.5% to 84.4% and BMI reduction of 10.7 to 15 kg/m2; VBG was associated with a per cent excess weight loss of 37% to 68.8%; sleeve gastrectomy was associated with a per cent excess weight loss of 66% to 69.7% and a BMI reduction of 27.5 kg/m2. Weight loss was still apparent at up to 10 years after surgery.
- Buchwald et al. (2009) conducted a meta-analysis of 621 studies which were predominantly case series of bariatric surgery, including in patients with type 2 diabetes. There were 135,246 participants with a mean age of 40.2 years and a mean BMI at baseline of 47.9 kg/m2. Approximately 80% were female, 22% had type 2 diabetes and 10.5% had undergone previous bariatric surgical procedures. Weight loss with bariatric surgery was 38.5 kg (95% CI, -36.6 to -40.1). Weight loss varied according to surgical procedure: 32 kg with gastric banding, 36 kg with gastroplasty, 43.5 kg with BPD, and 44.7 kg with gastric bypass. Mean BMI reduction was 14 kg/m2 (95% CI, -13.4 to -14.5). BMI reduction was 10.6 kg/m2 with gastric banding, 13.8 kg/m2 with gastroplasty, 16.3 kg/m2 with gastric bypass and 18.8 kg/m2 with BPD / duodenal switch procedures.

Influence of intensity of intervention in multi-component interventions

The intensity of interventions, including the duration over which the intervention is provided, the frequency of contact between provider and participants, and whether the intervention is directed at parent, child or both, appears to influence the success of weight loss interventions in paediatric cohorts.

- Whitlock et al. (2010), in a meta-analysis of 20 studies in paediatric patients, found that programs that incorporate medium intensity (26 to 75 contact hours) or high intensity (over 75 contact hours) achieve greater BMI reductions than programs with lower intensity.
- Collins et al. (2007) conducted a meta-analysis of studies that assessed lifestyle interventions in the management of overweight and obese adolescents. Daily versus weekly frequency of contact between the provider and caregiver was compared. Daily contact was associated with significantly greater weight reduction than weekly contact at 6 months follow-up (average of 9% versus 5% weight reduction respectively).
- Okely et al. (2010) compared parent-centred with child-centred lifestyle therapy in 165 participants aged 8 years old (BMI 24.4 to 25.2kg/m2). The parent intervention focussed on diet and the child intervention on physical activity. All groups received 10 weekly face-to-face sessions followed by three monthly relapse-prevention phone calls up to 12 months post-intervention. The mean reduction in BMI z-score at 12 months in the parent group was 0.4 (95% CI, -0.3 to -0.5), in the child group was 0.2 (95% CI, -0.1 to -0.3) and in the combined intervention group (parent + child) was 0.3 (95% CI, -0.2 to -0.4).
- Sargent et al. (2011) conducted a systematic review of 17 studies in 3,086 children and adolescents that assessed the components of primary care interventions to treat paediatric overweight and obesity. In eight of the 17 studies, positive changes in anthropometry were observed. The following anthropometric changes were observed: reduction of body weight between 4.0 kg and 7.4 kg; reduction in BMI between 0.8 kg/m2 and 3.3 kg/m2; and reduction in BMI z-score between 0.10 and 0.11. The monthly rate of contacts in effective interventions ranged from 0.2 (one contact in 6 months) to 11.3 (34 contacts in 3 months). The six interventions with a contact rate of monthly or less (rate < 2) reported one to three significant outcomes in either anthropometry or behaviour change. In contrast, each of the six effective interventions with higher intensity (at least one contact every 2 weeks) reported two or more significant outcomes.

In adults, the intensity of multi-component interventions across settings and in different patient groups also appears to influence the success of weight loss interventions.

- Tsai et al. (2009), demonstrated that in primary care-delivered weight reduction interventions, high intensity interventions (contact at least each fortnight) produced greater weight losses (between 4.3 kg and 7.7 kg) compared with moderate intensity (contact at least once a month) and low intensity (less than once a month) interventions (weight losses between 0.1 kg and 2.3 kg).
- Shaw et al. (2005) found that increasing the intensity of behavioural interventions (more behavioural strategies, more frequent clinical contact, or longer duration of intervention) resulted in increased weight reduction of approximately an additional 2.3 kg in adults.
- Hemmingsson et al. (2009) conducted a RCT with 120 women with abdominal obesity (waist circumference 88 to 120 cm) that compared physically active commuting with

control over 18 months. Principles of behaviour change for both groups were founded on the Transtheoretical Model. All participants were encouraged to gradually increase their daily amount of walking up to 5,000 steps per day above their baseline level, particularly by building routines for physical activity in everyday life. The intervention group also received a physician-prescribed detailed physical activity prescription that included but was not limited to active commuting by walking or cycling. Walking increased an average of 1,500 steps per day between baseline and 18 months in the intervention group and by 750 steps per day in the control group. The physician prescription was associated with a significant increase in cycling for commuting (39% versus 9%). Both groups achieved similar reductions in waist circumference (2.1 cm in intervention and 2.6 cm in control groups). Analysis according to the stage of change of participants was not performed.

- Keranen et al. (2009) conducted a RCT of intensive versus short-term weight loss counselling with 18 month follow-up in 82 adults with a BMI > 27 kg/m2. Counselling was based on self-management principles. Intensive counselling consisted of visits every two weeks for 20 weeks. Short-term counselling consisted of two visits two weeks apart. At six months weight loss in the intervention versus control group was 5 kg (SD 5.7) versus 2.4 kg (SD 2.5). By 18 months the weight losses in the intervention and control group were 2.6 kg (SD 6) and 0.7 kg (SD 3.5) respectively.
- Littman et al. (2007) conducted a RCT with 173 sedentary post-menopausal women (BMI > 25 or % body fat > 33%) randomised to a facility-based and home-based moderate intensity physical activity intervention (45 minutes a day, 5 days a week for 12 months) or to a stretching control group. At 12 months the intervention group lost 1.3 kg (95% CI, -2.1 to -0.6) versus a gain of 0.1 kg (95% CI, -0.6 to 0.8) in the control group.

Processes of care by which each of these intervention components are delivered – disease management approaches – also influence weight loss success. These are discussed below.

Disease management approaches

Recent reviews of disease management approaches have drawn on the taxonomy used to classify quality improvement strategies, developed by the Cochrane Effective Practice and Organisation of Care (EPOC) group. For the purposes of this review, the following EPOC taxonomy was used to classify studies:

1. Patient interventions
    - Patient education;
    - Self-management techniques;
    - Patient reminders;
2. Professional interventions
    - Clinician education;
    - Audit and feedback;
    - Clinician reminders;
    - Facilitated relay of clinical information;
3. Financial interventions
    - Financial interventions directed at the provider;

- Financial interventions directed at the spouse or caregiver;

4. Organisation of care
    - Provider-oriented
        - Team changes;
        - Multidisciplinary teams;
        - Case management;
    - Patient-oriented
        - Group versus individual interventions;
        - Indirect delivery of intervention to patient (e.g. intervention directed at spouse or family);
    - Structural
        - The setting of service delivery;
        - The method of service delivery.

Patient interventions

Patient education

Patient education interventions are frequently incorporated into multi-component interventions. Patient education interventions are designed to promote increased understanding of specific elements of obesity management, or to teach specific prevention and / or treatment strategies to patients and / or their caregivers. Evidence from the general health care literature suggests that patients with better knowledge of their condition and its management have better outcomes. Although the target of patient education is usually the patient themselves, family members or support persons may be the target of patient education, particularly in the case of obesity in paediatric patients.

Some studies recommend tailoring patient education to the specific needs of the individual in order to ensure the education is relevant and applicable to the individual's circumstances. A meta-analysis of the long-term effectiveness of tailoring of nutrition education in adults in general (not limited to adults with overweight or obesity) found that tailoring increases fruit and vegetable intake and reduces fat intake significantly more than generic patient education (Eyles and Mhurchu, 2009). There were insufficient data to enable the impact of tailoring on adults with excess body weight to be assessed.

Included studies

The majority of studies conducted with paediatric patients included in this review incorporate a health education component. Topics for which assessment of paediatric education has been performed include nutrition, increasing physical activity, reducing sedentary behaviour and behavioural components. All age groups, from pre-school to late adolescence, have been included in intervention studies that incorporate a patient education component. Most studies have been conducted in clinic-based or school settings. In clinic-based settings, health education has generally been delivered face-to-face to the parent or adolescent, with or without including the child, with written materials used to reinforce key messages. In school settings, the child or adolescent is usually the recipient of group-based face-to-face patient education. This

may be supplemented with written material, including pamphlets or a workbook. Patient education in included studies was provided by a broad range of health care providers including dietitians, medical practitioners, school or practice nurses, psychologists and school teachers (particularly physical education teachers).

- Collins et al. (2007) in a meta-analysis of studies that included a diet education component delivered to children, adolescents or their carers demonstrated a pooled WMD weight loss of 1.8 kg (95% CI, -2.4 to -1.2). However, given the diversity of interventions and lack of standardisation across treatment arms, it is not possible to determine to what extent the dietary education contributed to the weight loss achieved with the overall dietary intervention.
- DeMattia et al. (2007) conducted a meta-analysis that included a number of primary studies that assessed health education. The first study reported the results of a RCT testing a two year curriculum to promote healthy eating and limited TV watching in pre-school aged children. BMI decreased in the intervention group and increased in the control group. Point estimates were not provided. The difference did not reach statistical significance. TV viewing decreased 24% and increased 12% in intervention and control groups respectively. A second study reported the results of an 18-lesson 6-month classroom curriculum for 8 to 10 year olds to reduce screen time. At follow-up the treatment group's BMI increased 0.3 points versus 0.7 in the control group. A third study provided health education over two years in students between grades 6 and 7. Excess body weight decreased from 24% to 20% in the intervention and increased from 22% to 24% in the control groups.
- Li et al. (2008) conducted a systematic review of 22 school-based intervention studies (16 RCTs and 6 controlled clinical trials) involving over 6,997 participants. There were 17 studies that were conducted among overweight and / or obese Chinese children aged between 3 and 19 years. The majority of studies focussed on improving the level of knowledge, physical activity levels and / or diet of overweight children and adolescents. Four studies used an intervention that focussed on health education, two on health education and physical activity, seven on health education, physical activity and diet, three on physical activity alone and the remaining six on physical activity and diet. In studies where health education alone was used, BMI in overweight / obese students did not improve over up to two years of follow-up. When combined with diet and / or physical activity interventions, BMI decreased. Pooled estimates of weight change not calculated. Comparisons of diet and exercise with or without health education were not made.
- McCallum et al. (2007) conducted a RCT with 163 participants aged 5 to 9 years (BMI z-score < 3) who were randomised to education materials and four standard GP consultations over 12 weeks that targeted nutrition, physical activity and sedentary behaviour or to a control group. GPs received an education package regarding the delivery of the intervention comprising three evening group sessions in brief solution-focused therapy techniques. GPs used the approach to set and record appropriate, healthy lifestyle goals with the family assisted by a written, personalised 20-page behaviour change resource designed at a 12-year old reading level. The intervention did not result in weight loss in either the intervention or control groups. BMI z-score from baseline to 15 months decreased by 0.03 (95% CI, -0.17 to 0.10).
- Plachta-Danielzik et al. (2007) conducted a RCT with 1,764 children aged six years and followed for four years. An intervention program was delivered to children and parents that incorporated messages about increased fruit and vegetable intake, reduced fat

intake, being physically active at least one hour a day and decreasing television viewing to less than one hour a day. Lessons were provided to children over two to three weeks within the second term of the first school year. Methods of delivery included nutrition fairy tales, interactive games and healthy breakfast preparation. After each unit, running games were offered for 20 minutes on the schoolyard. Parents received education at a parental school meeting. The odds ratio of remission of overweight in the intervention compared with control group was 2.5 (95% CI, 0.9 to 7.2); the odds ratio of remission of obesity in intervention versus control group was 1.7 (95% CI, 0.4 to 6.9).

A patient education component is also commonly incorporated into adult studies. Patient education usually focuses on healthy nutrition that creates a required energy deficit, increasing physical activity and strategies for behaviour change. Education regarding weight loss and lifestyle change may be incorporated into broader disease management patient education, particularly in patients with obesity who also have diabetes. Most studies have been conducted in clinic-based settings, either specialty weight loss clinics or in primary care. Patient education is mainly delivered face-to-face either individually or within groups. Other materials, including written, web-based or audiovisual materials may be used to reinforce patient education messages. Patient education in included studies was provided by a broad range of health care providers including dietitians, medical practitioners, psychologists and lay leaders. There were no included meta-analyses that assessed patient education as a stand-alone intervention in adult patients with overweight or obesity. The following RCTs demonstrate modest reductions in body weight with patient education that are improved by combining patient education with other interventions.

- Silva et al. (2010) conducted a RCT in 239 women (mean age 38 years; mean BMI 31.5 kg/m2) that compared health education with a behavioural intervention which focussed on promoting autonomous forms of exercise regulation and intrinsic motivation. At 12 months the health education group lost 1.5 kg (SD 4.3) and the behavioural intervention group lost 5.6 kg (SD 4.1).
- Schmitz et al. (2007) conducted a RCT with 164 female participants (mean age 36 years, mean BMI 29.4 kg/m2) to assess the impact of strength training on weight loss. The control group received patient education only. Participants in the intervention group received gym-based strength training supervised by fitness trainers for the first 16 weeks then unsupervised. Control group participants received written information about national physical activity guidelines that provided written advice regarding physical activity goals. At two years participants in the intervention group reduced body fat by 3.7% (SD 1.0%) and control group by 0.1% (SD 1.0%).
- Teixeira et al. (2010) conducted a RCT with 225 female participants (mean age 37.6 years, mean BMI 31.3 kg/m2) that compared group behavioural therapy sessions or general health education (control) over 12 months. In the intervention group weight change was -7.3 % (SD 5) at 12 months and -5.5% (SD 5) at 24 months. In the control group weight change was -1.7% (SD 5) at 12 months and -2.2% (SD 7.5) at 24 months.
- Neve et al. (2010) conducted a meta-analysis of 18 RCTs that assessed weight loss or maintenance interventions delivered via the internet. Web-based education resulted in weight losses of between 1.3 and 2.6 kg at up to 12 months follow-up.

The following studies were conducted in adults with obesity and type 2 diabetes mellitus or prediabetes. In this patient group, patient education alone has a non-significant effect on body weight.

- The Look AHEAD study (Belacazzar et al., 2010; Pi Sunyer et al. 2007; Wing et al., 2010b) investigated changes in body weight and CVD risk factors with intensive lifestyle interventions (ILI) versus patient education in people with excess body weight and type 2 diabetes. Across 5,145 participants aged between 45 and 74 years with a BMI > 25 kg/m2 (or >27 kg/m2 if taking insulin), ILI was associated with an 8.6% reduction in weight at 12 months compared with 0.7% reduction with patient education. At 4 years of follow-up participants in ILI had greater percent weight losses than those in the patient education group (-6.2% versus -0.1%).
- Christian et al. (2008) conducted a RCT with 310 participants with obesity and type 2 diabetes mellitus (mean BMI 35.4 kg/m2) that compared health education pamphlets with nutrition and physical activity counselling over 12 months. Weight decreased 0.2 kg with counselling and increased 1.4 kg with pamphlets.

Summary

Studies in this review demonstrate the following:

- patient education is a component of the majority of multi-component intervention;
- the degree to which the patient education component is responsible for observed improvements in processes of care and patient outcomes is uncertain
- as a stand-alone intervention, patient education is not usually associated with significant weight reduction
- patient education is provided by a broad range of health care providers – effectiveness of health education according to provider type has not been systematically appraised
- patient education can be provided individually or in group sessions – effectiveness of patient education according to individual versus group provision has not been systematically appraised

There is insufficient evidence currently available to recommend a specific type of education or provide guidance on the most effective setting for education, format for education or frequency of sessions.

Chronic disease self-management

Adoption of self-management skills by the person with obesity is necessary in order to manage their obesity and is an important goal of behavioural therapies for obesity. In health care, self management refers to interventions, training and skills by which patients with a chronic condition, disability, or disease can effectively care for their condition. This is termed ‘chronic disease self management’. There are a variety of common models of chronic disease self management, including programs such as the Stanford chronic disease self management program and the Flinders model of chronic condition self-management, Wagner’s Chronic Care model, and health coaching. Features in common across self management approaches include lifestyle skills teaching, health professional training, individualised approaches to assessment and care planning, emphasis on defining the person’s goals and suitability for people at different stages of change (Daniels et al., 2009).

The evaluation of the Australian Sharing Health Care Initiative addressed the translation of different models of chronic disease self-management into health and community service contexts in Australia. Although not obesity specific, participants showed improvements in self-

management practices, but those receiving flexible and tailored support, and telephone coaching reported the greatest benefits[11].

A Cochrane meta-analysis of 17 trials involving 7,442 participants of lay-led self management programs demonstrated small, short-term improvements in participants' self-efficacy, self-rated health, cognitive symptom management, and frequency of aerobic exercise. The authors concluded that there is currently no evidence to suggest that such programs improve psychological health, symptoms or health-related quality of life, or that they significantly alter healthcare use. No included studies assessed self management for obesity (Foster et al., 2009).

Chronic disease self management approaches for obesity remain largely untested. Obesity has been the focus of limited chronic disease self management initiatives internationally. The Global Alliance for Self Management Support has developed a protocol for self management support for obesity, with peer leaders facilitating weekly sessions, the goal of which is to increase personal skills for behaviour change and to advocate for more supportive social and environmental conditions for obesity management. For example, numerous diabetes self management studies have incorporated lifestyle change and / or weight loss goals (King et al., 2010).

A recent systematic review of primary health care provider education and training using the Chronic Care Model for childhood obesity appraised 15 studies that included components of the model (Jacobsen & Gance-Cleveland, 2011). The authors found that studies in this area are based primarily on descriptive pre-experimental study designs. However, health care providers in included studies voiced that assessment paperwork (i.e. tools) were a barrier to engaging in counselling with children and families. Further, the authors concluded that there is currently no evidence that permanent changes to the delivery of obesity care are sustained with self-management approaches.

Pettman et al. (2008) conducted a RCT in rural South Australia that assessed a group-based lifestyle program adapted from the Stanford chronic disease self management program in 153 overweight or obese adults with metabolic syndrome. Program self-management features included short-term goal setting / action planning and an adapted 'symptom cycle' as described by the Stanford model. Improvements were noted in waist circumference (-3 cm) and body fat mass (-4%) after the 4 months of sessions.

Included studies

Various elements of chronic disease self management have been evaluated independently in included studies; however no cohesive group of interventions structured as a chronic disease self management program were assessed:

- Parikh et al. (2010) conducted a RCT of a peer-led intervention to promote weight loss in 99 adults (mean age 48 years with a BMI > 25 kg/m2). Lay leaders provided simple, actionable messages that focussed on enhancing self-efficacy to make lifestyle changes. The intervention was provided over 10 weeks in eight 1.5 hour group workshops. Compared with wait list controls, participants in the intervention group lost more weight at 12 months (3.3 kg versus 1.1 kg; $p < 0.01$).
- Haapala et al. (2009) conducted a RCT with 125 participants aged 25 to 44 years (BMI 25 to 36 kg/m2) that investigated the effectiveness of a mobile phone-operated weight loss program based on self-management principles. The intervention group kept an internet lifestyle diary which facilitated goal setting and reminders to the participant via

[11] Francis C. Implementing chronic disease self-management in community settings. Australian Health Review 2007; 31:499-509.

text message based on a self management approach. By 12 months the experimental group lost more weight than the control group (4.5 (SD 5)) versus 1.1 kg (SD 5.8).

- Keranen et al. (2009) conducted a RCT of intensive versus short-term weight loss counselling with 18 month follow-up in 82 adults with a BMI > 27 kg/m2. Counselling was based on self management principles. At six months weight loss in the intervention versus control group was 5 kg (SD 5.7) versus 2.4 kg (SD 2.5). By 18 months the weight losses in both groups were 2.6 kg (SD 6) and 0.7 kg (SD 3.5) respectively.
- McConnon et al. (2007) conducted a RCT with 221 adult participants with a BMI of ≥30 who received an internet-based lifestyle intervention or usual care for weight reduction. The website provided advice, tools and information to support behaviour change and supported self-management. After 12 months the internet group lost 1.3 kg and the usual care group lost 1.9 kg.
- Bosch-Capblanch et al. (2007) conducted a systematic review of three RCTs in paediatric and adult participants that assessed the impact of contracts between health care practitioners and patients or their carers on patient adherence. Contracts included any verbal or written statement specifying at least one treatment activity to be observed and a commitment of adherence to it. Contracts were a part of a self-management approach in all studies. Contracts increased weight loss achieved compared with no contract in one study (WMD 5 kg – paediatric patients) but not the other two studies (both conducted in adult patients).

Summary

Studies in this review demonstrate the following:

- elements of self management approaches have been assessed, usually in the context of behavioural interventions targeting lifestyle change and / or weight loss
- where applied, self management techniques are a component of a multi-component intervention rather than a stand-alone intervention
- interventions that include self-management support increase weight loss in the short term
- chronic disease self management may address multiple chronic conditions where obesity co-occurs with other conditions for which lifestyle modification is beneficial (e.g. diabetes)
- self-efficacy, motivation and readiness to change need to be targeted in order to improve the efficacy of self-management

A challenge with implementation of self management for adult or childhood obesity is the requirement for coordination of care, with the correct patient groups receiving primary, secondary and tertiary level care, and the need for health professional training. These factors have not been assessed in clinical trials in this review.

Patient reminder systems

Patient reminder systems include any effort (e.g. telephone calls, letters, electronic systems) to remind patients about important aspects of their care. Reminders can be automated or manually derived. Automated reminders can be generic, tailored to the characteristics of the patient's personal characteristics or responsive to changes in key indicators of patient status.

Included studies

The following study included patient reminders as part of a multi-component weight loss approach:

- McConnon et al. (2007) conducted a RCT with 221 adult participants with a BMI of ≥30 who received an internet-based lifestyle intervention or usual care for weight reduction. The website provided advice, tools and information to support behaviour change and supported self-management. Patient reminders were provided through automatic generic emails that were generated if participants did not visit the website regularly. After 12 months the internet group lost 1.3 kg and the usual care group lost 1.9 kg.

Other included studies tested behavioural reinforcement techniques that utilised various technology solutions. However, these are not generally classified as patient reminder systems:

- Richardson et al. (2008) conducted a meta-analysis of nine studies that assessed the impact of pedometer-based walking programs on weight loss in adults. Increase in activity from pre-intervention to post-intervention ranged from 1,800 to 4,500 steps per day. Mean weight change at up to 12 months of follow-up was 1.3 kg (95% CI, -0.7 to -1.9).
- DeMattia et al. (2007) performed a meta-analysis of 12 intervention studies in children or adolescents that aimed to limit sedentary behaviours. Physical activity monitors were used to provide feedback to 8 to 12 year olds to increase moderate to vigorous physical activity. Neither BMI z-score or time spent in sedentary behaviour decreased significantly.
- Ford et al. (2010) trialled a behavioural type of patient reminder – real-time computerised feedback regarding speed of eating – in a RCT with 106 participants aged 9 to 17 years. Participants had a BMI > 95th centile for age and gender. The trial assessed over 18 months the impact of feedback from a real-time computerised device (Mandometer) designed to slow down speed of eating and reduce total intake. Compared with lifestyle therapy control, those in the Mandometer group had significantly lower mean BMI SDS at 18 months compared with standard care (baseline adjusted mean difference 0.27; 95% CI, 0.11 to 0.43).

Summary

There were limited data available from included studies regarding the impact of patient reminders on weight loss. There is therefore insufficient evidence to determine whether patient reminders increase weight loss.

Professional interventions

Clinician education

Interventions designed to promote increased understanding of the principles guiding clinical care, or awareness of specific recommendations for a target condition or patient population are referred to as clinician education. Clinician education may take many forms, including, but not limited to, conferences or workshops, distribution of education materials in written, audio and electronic forms, educational outreach visits, learning modules, and self-directed learning.

Cross-sectional survey data from Australian general practitioners suggest that providers are uncertain about definition criteria of childhood obesity and how to calculate BMI, and lack access

to BMI percentile charts. Approximately 22% of respondents indicated awareness of national guidelines for the management of children with obesity (McMeniman et al., 2011). Thus, clinician education may be an important strategy to improve weight management.

Included studies

The following studies in adult patients described clinician education components:

- Flodgren et al. (2010) conducted a meta-analysis of six studies that examined interventions to change the behaviour of health professionals to promote weight reduction in adults with excess body weight. Results demonstrate that GP education is associated with a non-statistically significant reduction in the body weight of patients at one year compared with usual care (WMD -1.2 kg; 95% CI, -0.4 to 2.8).
- Sargent et al. (2011) conducted a systematic review of 17 studies in 3,086 children and adolescents that assessed the components of primary care interventions to treat paediatric overweight and obesity. In eight of the 17 studies, positive changes in anthropometry were observed. Eight of the nine interventions incorporated specific training for delivery personnel before the intervention commencement. Five involved training for medical professionals and four involved training for allied health professionals. The following anthropometric changes were observed: reduction of body weight between 4.0 kg and 7.4 kg; reduction in BMI between 0.8 kg/m2 and 3.3 kg/m2; and reduction in BMI z-score between 0.10 and 0.11. Nurses were involved in participant assessment and delivery of control conditions in two studies. No successful interventions were delivered by a nurse. Interventions involving medical professionals (general practitioner or community paediatrician) or allied health professionals alone or together were positively associated with reduction in anthropometric measures and lifestyle behaviours.
- Tsai et al. (2009), in a meta-analysis of ten clinical trials with 24 intervention arms, found that patients of primary care physicians who received nutrition counselling training lost 0.9 kg while patients of primary care physicians in control groups gained 1.3 kg ($p > 0.05$).
- Martin et al. (2008) conducted a RCT with 137 low income female participants with a BMI ≥ 25 kg/m2 that received a behavioural intervention delivered by primary care physicians which focussed on weight loss and subsequent weight maintenance or received standard care. Primary care physicians in the intervention group received seven hours of training (two hours on general obesity treatment as described in national obesity guidelines and five hours on stages of change, motivational interviewing and behaviour change techniques) whereas primary care physicians in the control group received only the two hours of general training. The primary care physicians then delivered five physician-counselled office visits on a monthly basis and a single, 15-minute session at month six. Maximal weight loss was observed at month nine (-1.5 kg versus 0.6 kg). By month 18 the weight change of intervention participants was -0.5 ± 3.3 kg compared with 0.07 ± 3.8 kg in the control group.
- Ryan et al. (2010) conducted a RCT with 390 participants of non-surgical approaches delivered in primary care for adult patients with a BMI between 40 and 60 kg/m2. The intervention group received a 900 kcal liquid diet, group behavioural counselling, lifestyle instructions and pharmacotherapy (sibutramine, orlistat or diethylpriopion). The usual care group had instruction in an internet weight management program. Primary care physicians received instruction in guidelines-based approaches to obesity management,

including pharmacotherapy, low calorie diets, meal replacements, physical activity, calorie balance, self-monitoring, structured diets and behavioural interventions. This was delivered over two 6-hour training sessions. Training also included peer-tutored review of earlier behavioural lectures, small group exercises to practice therapeutic skills, and observation of the senior interventionist conducting several group sessions. Certification and monthly monitoring ensured that physicians had clear understanding of the training. After two years, 31% of intervention participants achieved a 5% weight loss and 7% achieved a 20% weight loss or more. In the usual care group, 9% achieved 5% weight loss and 1% achieved a 20% weight loss. Last observation carried forward analysis at year 2 for the intervention group -8.3% ± 0.8% and −0.0% ± 0.4% for the usual care group.

- Christian et al. (2008) conducted a RCT with 310 participants with type 2 diabetes mellitus (mean BMI 35.4 kg/m2) that compared nutrition and physical activity counselling with health education pamphlets over 12 months. Primary care physicians received three hours of training in motivational interviewing. Weight decreased 0.2 kg in the intervention group and increased 1.4 kg in the control group.

The following studies in paediatric patients included a clinician education component:

- McCallum et al. (2007) conducted a RCT with 163 participants aged 5 to 9 years (BMI z-score < 3) who were randomised to education materials and four standard GP consultations over 12 weeks that targeted nutrition, physical activity and sedentary behaviour or to a control group. GPs received an education package regarding the delivery of the intervention comprising three evening group sessions in brief solution-focused therapy techniques. GPs used the approach to set and record appropriate, healthy lifestyle goals with the family assisted by a personalised 20-page behaviour change resource designed at a 12-year old reading level. The intervention did not result in weight loss in either the intervention or control groups. BMI z-score from baseline to 15 months decreased by 0.03 (95% CI, -0.17 to 0.10).
- Wake et al. (2009) conducted a RCT with 258 paediatric participants (age 5 to 9 years, BMI z-score < 3) that assessed a GP based family oriented lifestyle intervention for weight loss. GPs attended two 2.5 hour group training sessions for instruction in stages of change and for training in brief, solution-focussed family therapy. GPs also received a 30 minute DVD which role modelled scenarios of GPs using solution focussed therapy in consultations. Each GP then conducted two simulated patient sessions that were appraised by an actor playing the ‘parent’. GPs who did not receive a passing grade were offered additional training. The intervention involved four standard consultations over 12 weeks targeting change in lifestyle. This was supported by purpose-designed written materials. Control group participants did not receive any intervention. Subjects in both groups did not reduce BMI or improve anthropometric indices. After 12 months adjusted mean difference in BMI between intervention and control groups was -0.11 (95% CI, -0.45 to 0.22).

Summary

Studies in this review demonstrate the following:

- interventions that incorporate a health professional education component can result in greater weight losses than standard care;

- health professional education is usually combined with a range of other strategies in order to improve obesity management, including patient education and weight loss therapies that target lifestyle change;
- clinician education commonly involves instruction in nutritional and / or physical activity guidelines, behavioural therapeutic techniques and the use of anti-obesity medications;
- most included studies assessing the impact of clinician education on patient care have targeted primary care providers, particularly general practitioners;
- in some cases, clinician education is targeted to a specific risk group of patients, particularly management of paediatric patients or patients with comorbid diabetes.

As the majority of studies of clinician education also incorporate other obesity intervention components the degree to which clinician education contributes to positive outcomes in multi-component obesity interventions is uncertain. As a stand-alone intervention, clinician education does not appear to significantly improve patient outcomes.

Audit and feedback

Audit and feedback interventions involve providing information to one or more members of the health care team caring for the patient. The health care provider targeted for most interventions of this type are general practitioners.

A recent systematic review of primary health care provider education and training using the Chronic Care Model for childhood obesity appraised 15 studies that included components of the model (Jacobsen & Gance-Cleveland, 2011). The authors found that studies in this area are based primarily on descriptive pre-experimental study designs. However, analysis of multi-component interventions in included studies demonstrated the use of clinical information systems (systems to provide data to evaluate the progress of the practice in meeting its goals and tracking patient progress) in 23% of studies. The relative impact on weight loss was not able to be assessed due to significant heterogeneity between studies.

No studies included in this review assessed audit and feedback for health professionals as an intervention to improve weight loss.

Summary

There is no evidence from studies included in this review to determine the association between audit and feedback interventions and weight loss.

Clinician reminders

Clinician reminder interventions refer to paper-based or electronic systems intended to prompt a health professional to recall patient-specific information or to perform a specific task. When accompanied by an evidence-based recommendation in response to the reminder, this is sub-classified as decision support. The healthcare provider targeted for most clinician reminder interventions is primary care clinicians / general practitioners. Subgroups of patients may be targeted by clinician reminder interventions e.g. patients with comorbid diabetes.

Cross-sectional studies have demonstrated that electronic medical records which include automatic calculation of BMI can improve clinician documentation and treatment of obesity (Bordowitz et al., 2007; Rattay et al., 2009).

Schriefer et al. (2009) conducted a RCT of a computerised BMI prompt on diagnosis and treatment of adult obesity in 846 obese patients of 37 family physicians. Patients were randomly

assigned to have a BMI chart prompt placed in their electronic medical record or not. The prompt led to higher rates of diagnosis of obesity (17% versus 11%) and to increased referral for diet and / or exercise treatment (14% versus 7% and 12% versus 7% respectively). Weight change was not assessed.

Included study

- Flodgren et al. (2010) conducted a meta-analysis of six studies involving 1,324 patients and 246 health professionals that examined interventions to change the behaviour of health professionals to promote weight reduction in adults with excess body weight. Clinician reminders were provided that consisted of computerised medical system reminders that recommended the doctor take 'corrective action' when certain weight criteria were exceeded. Reminders were demonstrated to change general practitioners' practice and result in a significant reduction in weight among male patients (-11.2 kg; 95% CI, 1.7 to 20.7 kg) but not female patients (-1.3 kg; 95% CI, -4.1 to 6.7).

Summary

Limited available evidence suggests that interventions that include clinician reminders may improve the diagnosis of obesity and referral of patients for care, and may also increase weight reduction achieved by adult males.

Facilitated relay of clinical information

Facilitated relay of clinical information to clinicians refers to the collection and transmission of clinical information from patients to clinicians by means other than the existing medical record.

Included studies

- Tsai et al. (2009), in a meta-analysis of ten clinical trials with 24 intervention arms, described comparison between written educational material provided to the GP alone or combined with facilitated relay of clinical information to the GP by a counsellor involved in the patient's care. Weight losses achieved over 6 months were 1 kg in the education alone group and 4.3 kg in the education plus facilitated relay of clinical information group.
- Christian et al. (2008) conducted a RCT with 310 participants with type 2 diabetes mellitus (mean BMI 35.4 kg/m2) that compared nutrition and physical activity counselling with health education pamphlets over 12 months. Participants first completed a computer-based assessment of their motivational readiness to increase physical activity and make dietary changes ('stage of change'). The computer system generated a report for the patient's primary care physician that included a summary of the findings of the patient assessment and patient-specific counselling recommendations. The patient also received feedback from the assessment. Weight decreased 0.2 kg in the intervention group and increased 1.4 kg in the control group.

Summary

Limited available evidence suggests that interventions that include facilitated relay of clinical information may be associated with improved anthropometric outcomes in adults with obesity with or without type 2 diabetes.

Financial interventions

Directed at the provider

No included studies assessed financial incentives directed at the provider as a tool for improving anthropometric outcomes.

Cross-sectional survey data from Australian general practitioners suggest that lack of financial incentive is an obstacle to managing childhood obesity and that financial incentives for diagnosis and management may improve childhood obesity care (McMeniman et al., 2011). Other data from focus groups conducted with primary care clinicians suggest that financial incentives would not be more likely to encourage providers to manage obesity in their patients (Forman-Hoffman et al., 2006).

Directed at the patient

Incentives directed at patients have been assessed in numerous studies. Incentives may consist of financial or non-financial rewards (e.g. gym memberships) that may be paid for achievement of program goals such as attendance at program sessions, or may be provided contingent on successful outcomes being achieved (e.g. behaviour change and / or changes in anthropometry).

Included studies

- Collins et al. (2007) conducted a meta-analysis of eight out of 116 included studies that assessed lifestyle interventions in the management of overweight and obese adolescents. Monetary incentives were provided to the patient for attendance and for either weight loss or for change in calorie intake. Those who received monetary rewards for weight loss were more likely to significantly reduce % overweight at six months than those who received rewards for change in calorie intake (weight loss of 12% of body weight in the intervention group versus 6.2% in the control group).
- Paul-Ebhohimhen et al. (2008) conducted a meta-analysis of nine RCTs in 890 participants of behavioural treatment of obesity that used financial incentives as a reward for weight loss. At up to 30 months of follow-up there was no significant difference in weight loss in groups with and without the use of financial incentives. Further sub-group analysis according to the mode of delivery of the incentive and the amount of incentives suggested that larger financial incentives were more successful than smaller amounts. At 12 months, the use of financial incentives of monetary equivalents < 1.2% of personal disposable income (PDI) were associated with no difference in weight change (WMD 0.0kg; 95% CI, -1.5 to 1.6) compared with amounts > 1.2% PDI (WMD -1.1 kg; 95% CI, -3.1 to 0.9).

Summary

Monetary incentives may improve weight loss in adolescents with overweight and obesity. In adults weight loss is not improved with financial incentives. However, there is a trend towards the effectiveness of incentives increasing as the size of the reward increases.

Organisation of care

This category includes interventions that predominantly involve changes in organizational systems, such as changes in skill mix, the introduction of multidisciplinary teams or in the setting or site of service delivery.

Provider oriented

1. Team changes

Team changes involve adding a team member to an existing team caring for a patient and expanding or revising the professional roles of health care providers (e.g. nurses playing a more active role in monitoring patients or adjusting medications).

Included studies

In paediatric patients the following included studies provided data regarding team changes.

- DeMattia et al. (2007) performed a meta-analysis of 12 intervention studies in children or adolescents with a mean age between 3.9 and 14.2 years that aimed to limit sedentary behaviours. Specialty clinic and primary care interventions were compared. All reduced sedentary behaviour and improved BMI. Two out of three specialty clinic interventions and the single primary care intervention resulted in reduced BMI compared with control groups.
- Kelly et al. (2008) conducted a systematic review of 16 RCTs involving 1,025 participants aged between 12 and 20 years, followed up for up to 24 months that assessed the impact of lifestyle interventions on weight change. All participants were at least 10% above average weight for height. There were four interventions led by a psychologist, three by a physical education teacher, two by a dietitian and one by a paediatrician. Two interventions were delivered by a dietitian and psychologist and fitness professional working as a team and one intervention was delivered by a psychologist and dietitian working as a team. There were no significant differences in whether the intervention was likely to be successful according to the type of leader of the intervention.
- Sargent et al. (2011) conducted a systematic review of 17 studies in 3,086 children and adolescents that assessed the components of primary care interventions to treat paediatric overweight and obesity. In eight of the 17 studies, positive changes in anthropometry were observed. The following anthropometric changes were observed: reduction of body weight between 4.0 kg and 7.4 kg; reduction in BMI between 0.8 kg/m2 and 3.3 kg/m2; and reduction in BMI z-score between 0.10 and 0.11. Nurses were involved in participant assessment and delivery of control conditions in two studies. No successful interventions were delivered by a nurse. Interventions involving medical professionals (general practitioner or community paediatrician) or allied health professionals alone or together were positively associated with reduction in anthropometric measures and lifestyle behaviours.

In adults, team changes were assessed.

- Flodgren et al. (2010) conducted a meta-analysis of 6 studies involving 1,324 patients and 246 health professionals that examined interventions to change the behaviour of health professionals to promote weight reduction in adults with excess body weight. Care provided by a dietitian or doctor-dietitian team was found to produce greater weight reduction (WMD 5.6 kg and 6.7 kg respectively) than standard care provided by doctors alone.
- Parikh et al. (2010) conducted a RCT of a peer-led intervention to promote weight loss in 99 adults (mean age 48 years with a BMI > 25 kg/m2). Lay leaders provided simple, actionable messages that focussed on enhancing self-efficacy to make lifestyle changes. The intervention was provided over ten weeks in eight 1.5 hour group workshops.

Compared with wait list controls, participants in the intervention group lost more weight at 12 months (3.3 kg versus 1.1 kg; $p < 0.01$).

- Schmitz et al. (2007) conducted a RCT with 164 female participants (mean age 36 years, mean BMI 29.4 kg/m2) to assess the impact of strength training on weight loss. Fitness trainers made weekly reminder calls to participants who had not completed two sessions. Two hours of free childcare per session were provided. After the first 16 weeks, trainers led booster sessions every 12 weeks, during which new exercises were introduced. Otherwise, participants exercised unsupervised. The fitness trainers were available by phone or e-mail and at the gym. Other intervention components included semi-annual social gatherings, a study website, and a monthly newsletter. Control group participants received written information about national physical activity guidelines. At two years participants in the intervention group reduced body fat by 3.7% (SD 1.0%) and control group by 0.1% (SD 1.0%).
- Ter Bogt et al. (2009) conducted a RCT with 457 adult participants (BMI 25 to 40 kg/m2) with hypertension and / or dyslipidaemia that compared a nurse practitioner (NP) and general practitioner (GP) intervention delivered in primary care. The intervention group received four individual visits to the NP (each 15 to 60 minutes long) and one feedback session by telephone from the NP. This intervention was guided with the use of computer decision support software. The control group received usual care from their GP. After 12 months there were more weight losers and stabilisers in the NP group than in the GP group (77% versus 65%; $P < 0.05$). Mean weight change was -1.9% (SD 4.9) in the NP group and -0.9% (SD 4.9) in the GP-UC group ($p < 0.05$). Significant reductions also occurred in waist circumference (-2.4 cm (SD 7.1) in the NP group and by 1.2 cm (SD 5.9) in the control group).
- Tsai et al. (2009) conducted a meta-analysis of ten trials with 24 intervention arms in adults with obesity. Counselling provided by a registered dietitian was compared with counselling provided by primary care nurses or doctors. At one year, weight loss achieved in both groups was similar: 3.4 kg in the dietitian group and 3.5 kg in the primary care nurse / doctor group. Tsai et al. also demonstrated that counselling provided by primary care physicians was effective in assisting patients to lose, and maintain lost, weight. Patients who received primary care counselling lost an average of 1.4 kg, compared with control group participants who gain an average of 0.3 kg at six months.

The type of intervention being provided influences the success of the team changes.

- Paul-Ebhohimhen et al. (2009) conducted a meta-analysis of five RCTs that compared group with individual treatments for adult obesity. Dietitian-led and psychologist-led interventions were compared. Comparing group to individual treatment in the dietitian-led groups gave a non-significant difference at 12 months (WMD -1.0 kg; 95% CI, -2.5 to 0.6). Psychologist-led group treatment resulted in a statistically significant greater weight reduction at 12 months than individual psychologist treatment (WMD -3.1 kg; 95% CI, -5.5 to -0.6).

Summary

Studies included in this review demonstrate the following:

- interventions provided by medical and allied health professionals successfully achieve improvements in anthropometry in both paediatric and adult patients

- medical and allied health professionals can successfully deliver lifestyle interventions that consist of nutrition, physical activity and behavioural components
- Included studies support the delivery of nurse practitioner-led and fitness professional-led weight reduction interventions in adults but there is insufficient evidence in paediatric groups
- lay-led weight reduction interventions may be successful in adults

2. Multidisciplinary teams

Multidisciplinary teams are described as 'a team comprising diverse health care professionals who communicate regularly about the care of a defined group of patients and participate in that care on a continuing basis'[12].

Included studies

Numerous studies included in this review delivered weight loss interventions using multidisciplinary teams. In adults:

- Flodgren et al. (2010) conducted a meta-analysis of six studies involving 1,324 patients and 246 health professionals that examined interventions to change the behaviour of health professionals to promote weight reduction in adults with excess body weight. Care provided by a dietitian or doctor-dietitian team was found to produce greater weight reduction (WMD 5.6 kg and 6.7 kg respectively) than standard care provided by doctors alone.
- Tsai et al. conducted a meta-analysis of ten studies to examine behavioural weight loss interventions provided in primary care settings. Findings showed that the use of physician counselling for obesity was enhanced with the inclusion of other health professionals in the team caring for the patient. Weight losses increased from between 0.1kg and 2.3 kg with individual care to between 4.3 kg and 7.7 kg with multidisciplinary care.

In paediatric patients, the following included studies utilised multidisciplinary teams:

- De Mattia et al. (2007) performed a meta-analysis of 12 intervention studies in children or adolescents that aimed to limit sedentary behaviours. Multidisciplinary approaches were more effective than individual approaches in paediatric patients in included studies. Heterogeneity of data did not enable pooled estimates of effect to be calculated.
- Savoye et al. (2007) conducted a RCT involving 209 participants aged 8 to 16 years with a mean BMI of 35.8 kg/m2 that assessed the impact of diet, physical activity and behaviour modification on BMI and metabolic indicators over 12 months. The weekly nutrition component was delivered by a multidisciplinary team that consisted of a dietitian, social worker and exercise physiologist. Control group participants received usual care from a clinician, involving 6-monthly appointments. Participants who received the multidisciplinary intervention reduced BMI by 1.7 kg/m2 (CI; -2.3 to -1.1) whereas those who received the control intervention increased BMI by 1.6 kg/m2 (CI; 0.8 to 2.3).

[12] Wagner E. The role of patient care teams in chronic disease management. BMJ 2000; 320:569-72.

Summary

Multidisciplinary teams need expertise in, and understanding of, the medical and psychosocial needs of patients with obesity, young people and their families. The effectiveness of multidisciplinary teams appears to improve when they involve the usual health care provider. Although multidisciplinary care is usually delivered to patients individually, care can be delivered simultaneously to groups of patients. Elements of multidisciplinary care can be delivered face-to-face, by telephone, by mail and through internet-based technologies.

Included studies did not separate the effects of multidisciplinary care from other elements of the intervention, such as the frequency of contact between providers and patients, or the advice and support provided to patients by providers. It is therefore not possible from included studies to distinguish the independent contribution of multidisciplinary versus individually-delivered care in assisting patients to lose weight.

3. Case management

Although definitions are not universal, case management is generally accepted to refer to a system for coordinating diagnosis, treatment and / or ongoing patient management by a person or a multidisciplinary team in collaboration with, or supplementary to, the general practitioner.

Studies included in this review did not include assessment of case management per se, however the majority of included studies involved the coordinated delivery of multiple intervention components by one or more health care providers. Therefore, across included studies case management approaches have been used extensively and specific analyses are not feasible.

A range of providers can perform case management, including general practitioners, dietitians, psychologists, nurses and fitness industry providers.

Although case management is usually performed by an individual case manager, a number of people who each have specific delegated tasks to perform can perform case management for the patient. Studies comparing the effectiveness of case management provided by different professions are insufficient for conclusions to be drawn regarding the relative differences between professions. However, it has been observed across studies that case management of paediatric patients requires different skills and expertise than for adult patients. These include skills in the diagnosis of overweight and obesity, in goal setting in paediatric patients, skills in the delivery of family and / or parental therapy, patient and family education, specific knowledge in nutrition and physical activity counselling for paediatric patients, skills in counselling regarding reducing sedentary behaviours, differences in behavioural approaches and differences in prescribing practices and patient monitoring.

Patient oriented

1. Group versus individual

Lifestyle interventions may be delivered via individual, group or mixed approaches. Across studies included in this review, both individual and group approaches have been trialled. Specific comparative analysis of group versus individual approaches was the subject of a number of studies included in this review.

Included studies

- Seo and Sa (2008), in a meta-analysis of 24 controlled clinical trials, demonstrated that use of both individual and group approaches appears to be more effective than a group

approach alone in reducing body weight in adults (effect sizes 0.4 versus 0.08). Mean weight losses achieved were approximately 3.5 kg.

- Paul-Ebhohimhen et al. (2009) conducted a meta-analysis of five RCTs that compared group with individual treatments for adult obesity. Significantly greater weight loss at 12 months was found in group-based compared with individual treatments (WMD -1.4 kg; 95% CI, -2.7 to -0.1).

Summary

Evidence from included studies demonstrates that group-based, individual and mixed approaches can all be effective in reducing body weight in adults.

2. Indirect delivery of intervention to patient

In paediatric patients family involvement is a particularly effective strategy for reducing BMI. Family involvement may also facilitate weight reduction in adults.

Included studies

2.1 Mixed paediatric cohorts

- Li et al. (2008) conducted a systematic review of 22 school-based intervention studies (16 RCTs and 6 controlled clinical trials) involving over 6,997 participants. There were 17 studies that were conducted among overweight and / or obese Chinese children aged between 3 and 19 years. Parental involvement was described in two included studies. BMI decreased in one study and did not decrease in the other. Pooled estimates of weight change not calculated.
- McGovern et al. (2008) conducted a meta-analysis of RCTs that assessed the efficacy of treatments for paediatric obesity. Effect sizes were calculated. Effect sizes for combined diet and physical activity interventions that targeted children versus parents were -0.17 (95% CI, -0.40 to 0.05) versus -0.64 (95% CI, -0.88 to -0.39).
- Oude-Luttikhuis et al. (2009) conducted a meta-analysis of 64 studies that appraised lifestyle and pharmacological interventions for weight loss in paediatric patients. In children less than 12 years of age, parent-focussed lifestyle interventions were more effective than standard care in reducing BMI z-score at six months (effect size -0.06; 95% CI, -0.12 to -0.01) but non-significant by 12 months (effect size -0.04; 95% CI, -0.12 to 0.04). Comparisons between behavioural programs addressed to mother and child or to mothers only demonstrated no difference in weight status between groups by nine months post intervention. In children 12 years and older, family-based intensive lifestyle modification decreased BMI 3.3 kg/m2 (95% CI, -3.2 to -3.4) compared with a control condition at 12 months of follow-up.
- Sargent et al. (2011) conducted a systematic review of 17 studies in 3,086 children and adolescents that assessed the components of primary care interventions to treat paediatric overweight and obesity. In eight of the 17 studies, positive changes in anthropometry were observed. Each category of agent-of-change (child only, child and parent, parent only) was associated with effective outcomes. Higher parental involvement appeared to be incorporated into interventions targeting younger children with higher adiposity. The following anthropometric changes were observed: reduction of body weight between 4.0 kg and 7.4 kg; reduction in BMI between 0.8 kg/m2 and 3.3 kg/m2; and reduction in BMI z-score between 0.10 and 0.11.

2.2 Children

- Okely et al. (2010) compared parent-centred with child-centred lifestyle therapy in 165 participants aged eight years old (BMI 24.4 to 25.2kg/m2). The parent intervention focussed on diet and the child intervention on physical activity. All groups received ten weekly face-to-face sessions followed by three monthly relapse-prevention phone calls up to 12 months post-intervention. The mean reduction in BMI z-score at 12 months in the parent group was -0.4 (95% CI, -0.5 to 0.3), in the child group was -0.2 (95% CI, -0.1 to -0.3) and in the combined intervention group (parent + child) was -0.3 (95% CI, -0.2 to -0.4).
- Golley et al. (2007) conducted a RCT that evaluated the relative effectiveness of parenting skills training as a key strategy for the treatment of overweight children. There were 111 parents of overweight pre-pubertal children (aged 6 to 9 years) assigned to parenting skills, parenting plus intensive lifestyle intervention or a wait list control. After 12 months, the BMI z-score of the child was reduced by 10% with parenting skills plus lifestyle intervention versus 5% with parenting skills alone and 5% with wait list control.
- Hughes et al. (2008) conducted a RCT with 134 children aged 5 to 11 years that assessed a family-centred counselling and behavioural therapy program to modify diet, physical activity and sedentary behaviour compared with standard care. After 12 months the median BMI z-score decreased in both groups (intervention = -0.07; 95% CI, -0.32 to -0.04 versus control = -0.19; 95% CI, -0.31 to -0.02). There were no significant differences between the two groups in BMI reduction.
- Kalarchian et al. (2009) conducted a RCT with 192 children aged 8 to 12 years (BMI ≥ 97th centile) who participated independently in parent and child group and individual behaviour therapy and lifestyle coaching that focussed on calorie control, increased physical activity and reduced sedentary behaviour. The control group received brief advice only. After 18 months the intervention was associated with a 1.2% decrease in child percent overweight compared with 0.2% reduction in the control group. ($p = 0.62$).
- Kalavainen et al. (2007) conducted a RCT that compared family-based group treatment with routine counselling in 70 participants aged 7 to 9 years with a weight for height > 115%. The family-centred group program included diet, physical activity and reduction in sedentary behaviour components. The parents received the program intervention. The control group received a brief intervention and written advice. The intervention resulted in a loss of weight for height at six months of 7%, compared with a loss of 2% in the control group. Six months after the program had finished % weight loss was 3% in the intervention group compared with a gain of 2% in the control group.

2.3 Adolescents

- Kelly et al. (2008) conducted a systematic review of 16 RCTs involving 1,025 participants aged between 12 and 20 years and followed up for up to 24 months that assessed the impact of lifestyle interventions on weight change. All participants were at least 10% above average weight for height. There were 13 interventions that involved a parental component. Parental involvement was associated with greater weight reductions in five of these not associated in six, and in the remaining two between group differences were not reported. In studies where weight reduction was achieved, adolescent patients randomly assigned to a behavioural program with parental participation reduced BMI

more than those who did not (Effect Size range 0.24 to 0.51) at up to 15 months follow-up.

2.4 Adults

- Seo and Sa (2008) demonstrated that involving family members of adults with obesity from minority backgrounds improved weight loss (effect size 0.34; 95% CI, 0.18 to 0.50).

Summary

Studies included in this review demonstrate the following:

- in paediatric patients, targeting the child, the parent or both the child and parent can result in improvements in anthropometry
- targeting lifestyle treatment to the parent or the parent and child appears more effective than targeting the child alone
- parental involvement in treatment of children with overweight or obesity increases the likelihood of improvements in anthropometry in most included studies whereas parental involvement in the treatment of adolescents increases the likelihood of improvements in anthropometry in some included studies
- limited evidence suggests that involving family members of adults with obesity from minority backgrounds improves weight loss

Structural

1. Setting of service delivery

Weight loss interventions can be delivered across a range of service delivery settings. Comparisons between different settings were the subject of a number of included studies in this review.

Included studies

1.1 Paediatric participants

- De Mattia et al. (2007) conducted a meta-analysis of 12 intervention studies in children or adolescents that aimed to limit sedentary behaviours. Health setting and school-based / pre-school-based interventions were compared. All reduced sedentary behaviour and improved BMI overall. Two out of three specialty clinic interventions and the single primary care intervention resulted in reduced BMI compared with control groups. All three school-based interventions and the single pre-school-based intervention resulted in BMI reduction compared with control groups. In the pre-school intervention BMI reduction did not achieve statistical significance.
- Kelly et al. (2008) conducted a systematic review of 16 RCTs involving 1,025 participants aged between 12 and 20 years and followed up for up to 24 months that assessed the impact of lifestyle interventions on weight change. All participants were at least 10% above average weight for height. There were 11 interventions conducted in a health or hospital clinic, three conducted in a school, one in the home and one that was church-based. Across clinic-based interventions, there were five studies where participants reduced BMI compared with control, five where participants did not reduce BMI and one intervention where between group differences were not reported. In school-based interventions, BMI reduction compared with controls intervention was reported in one

study, participants did not reduce BMI in a second study, and between group differences were not reported in the third study. Participants in the home-based intervention reduced BMI compared with controls but not participants in the church-based intervention.

- Li et al. (2008) conducted a systematic review of 22 school-based intervention studies (16 RCTs and 6 controlled clinical trials) involving over 6,997 participants. There were 17 studies that were conducted among overweight and / or obese Chinese children aged between 3 and 19 years. The majority of studies focussed on improving the level of knowledge, physical activity levels and / or diet of overweight children and adolescents. Four studies used an intervention that focussed on health education, two on health education and physical activity, seven on health education, physical activity and diet, three on physical activity alone and the remaining six on physical activity and diet. Four studies included a psychologist to encourage behaviour change. Two studies also modified the school environment to facilitate lifestyle change. In nine studies BMI improved and in two studies BMI did not improve. Pooled estimates of weight change not calculated.
- Oude Luttikhuis et al. (2009) conducted a meta-analysis of 64 studies that appraised lifestyle and pharmacological interventions for weight loss in paediatric patients. In children less than 12 years of age, school-based family therapy was not found to increase weight loss relative to conventional therapy or a control group without intervention at 18 months follow-up. In children 12 years of age and over, a school-based activity program did not result in greater improvements in BMI z-score than no intervention by six months follow-up. Point estimates of weight changes and WMD were not provided for either comparison.
- Sargent et al. (2011) conducted a systematic review of 17 studies in 3,086 children and adolescents that assessed the components of primary care interventions to treat paediatric overweight and obesity. In eight of the 17 studies, positive changes in anthropometry were observed. Settings where positive outcomes were achieved included community primary care setting (n = 2), health centre (n = 3), school (n = 2) and hospital outpatients (delivered by primary care provider) (n = 1). The following anthropometric changes were observed: reduction of body weight between 4.0 kg and 7.4 kg; reduction in BMI between 0.8 kg/m2 and 3.3 kg/m2; and reduction in BMI z-score between 0.10 and 0.11. There were no significant differences in the setting where effective and ineffective interventions were delivered.
- Johnston et al. (2010) conducted a RCT in 60 children aged between 10 and 14 years (BMI > 85th centile) that assessed a school-based weight maintenance program with 2 years follow-up. The intervention consisted of an intensive, instructor-led lifestyle intervention that focussed on increasing healthy eating and physical activity using behavioural strategies individualised to the participant. The intervention group also received snacks that enhanced fruit and vegetable consumption and worked with schools on providing an environment that supported healthy eating and physical activity. The control group participants received a parent-guided manual that described a 12 week program to promote child weight loss and long-term maintenance of changes. Children in the intervention group significantly reduced their BMI z-scores relative to the control group (-0.2 versus 0.0).
- Plachta-Danielzik et al. (2007) conducted a RCT with 1,764 children aged six years and followed for four years. An intervention program was delivered to children and parents that incorporated messages about increased fruit and vegetable intake, reduced fat

intake, being physically active at least one hour a day and decreasing television viewing to less than one hour a day. Lessons were provided to children over two to three weeks within the second term of the first school year. Methods of delivery included nutrition fairy tales, interactive games and healthy breakfast preparation. After each unit, running games were offered for 20 minutes on the schoolyard. Parents received education at a parental school meeting. The odds ratio of remission of overweight in the intervention compared with control group was 2.5 (95% CI, 0.9 to 7.2); the odds ratio of remission of obesity in intervention versus control group was 1.7 (95% CI, 0.4 to 6.9).

1.2 Adult participants

- Groeneveld et al. (2010) conducted a RCT involving 816 adult construction industry workers in The Netherlands that assessed the impact of a motivational interviewing-based lifestyle intervention on weight change over 12 months. Mean BMI at baseline was 28.8 kg/m2 in the intervention group and 28.2 kg/m2 in control group. The intervention group lost weight and BMI by 12 months (-0.9 kg/m2 and -0.4 kg/m2 respectively) and the control group gained weight and BMI (0.9 kg/m2 and 0.3 kg/m2 respectively).

Summary

- Effective weight loss interventions can be delivered in schools, hospital clinics, general practice, other community health settings and in workplaces.
- Nutrition, physical activity and behavioural interventions can be delivered across all settings.
- No one setting is clearly superior to any other for the delivery of weight loss interventions.

2. Method of service delivery

The mode of delivery of the weight loss intervention may influence the efficacy of the intervention. Many individuals now access the internet for information, and computer-tailored behavioural interventions have been explored as a possible weight loss intervention strategy.

Included studies

2.1 Computer – paediatric participants

- Nguyen et al. (2011) conducted a systematic review of nine studies in which children and / or adolescents with obesity interacted with electronic interventions delivered as adjunct or sole interventions for the treatment of obesity and / or obesity-related behaviours. One study was conducted with children and eight were conducted with adults. There were insufficient data to determine the impact of electronic interventions on BMI in children. In adolescents, interventions that included an electronic component were associated with reductions in BMI of 0.43 kg/m2 and reductions in BMI z-score of 0.08 to 0.09 kg/m2 over up to two years of follow-up.
- Oude-Luttikhuis et al. (2009) included data from an internet-based behavioural modification program for teenage girls. At 12 months of follow-up BMI reduction in the internet group was 1.4 kg/m2 (95% CI, -0.4 to -2.3) greater with the internet weight loss intervention than with an internet-based control intervention.

2.2 Computer – adult participants

- Arem & Irwin (2011) conducted a systematic review of nine RCTs that assessed weight loss interventions delivered via the internet. Study participants were aged between 34 and 54 years and had a mean BMI between 29 and 34.6 kg/m2. Intention to treat analysis demonstrated placebo subtracted weight loss ranging between < 1kg and 4.9 kg across studies. The in-person or intensive weight loss programs followed by internet-based maintenance were the only studies that met weight loss goals of 5%.
- Neve et al. (2010) conducted a meta-analysis of 18 RCTs that assessed weight loss or maintenance interventions delivered via the internet. The analysis explored which components of web-based interventions are associated with greater weight change and lower attrition rates. Across studies, web-based education resulted in mean weight losses of between 1.3 and 2.6 kg at up to 12 months follow-up. When accompanied by face-to-face or email counselling, mean weight loss increased to between 4.6 and 7 kg at up to 12 months.
- Christian et al. (2008) conducted a RCT with 310 participants with type 2 diabetes mellitus (mean BMI 35.4 kg/m2) that compared nutrition and physical activity counselling with health education pamphlets over 12 months. Participants first completed a computer-based assessment of their motivational readiness to increase physical activity and make dietary changes ('stage of change'). On completion, the computer system generated an individualised, tailored assessment of readiness to change and participant-identified barriers to lifestyle change. The computer system also generated a companion report for the patient's primary care physician that included a summary of the findings of the patient assessment and patient-specific counselling recommendations. Weight decreased 0.2 kg in the intervention group and increased 1.4 kg in the control group.
- McConnon et al. (2007) conducted a RCT with 221 adult participants with a BMI of ≥ 30 who received an internet-based lifestyle intervention or usual care for weight reduction. The website provided advice, tools and information to support behaviour change and supported self-management. Automatic generic emails were generated if participants did not visit the website regularly. After 12 months the internet group lost 1.3 kg and the usual care group lost 1.9 kg.
- Ryan et al. (2010) conducted a RCT with 390 participants of non-surgical approaches delivered in primary care for adult patients with a BMI between 40 and 60 kg/m2. The intervention group received a 900 kcal liquid diet, group behavioural counselling, lifestyle instructions and pharmacotherapy (sibutramine, orlistat or diethylpriopion). The usual care group had instruction in an internet weight management program. The internet program was based on the Mayo Clinic Weight Management Website. After two years, 31% of intervention participants achieved a 5% weight loss and 7% achieved a 20% weight loss or more. In the usual care group, 9% achieved 5% weight loss and 1% achieved a 20% weight loss.

2.3 Telephone

Studies have also explored the use of mobile telephones to support behaviour change in weight loss interventions.

- Flodgren et al. (2010) conducted a meta-analysis of six studies involving 1,324 patients and 246 health professionals that examined interventions to change the behaviour of health professionals to promote weight reduction in adults with excess body weight. Care

delivered by telephone or mail was compared with care delivered face to face. There were no significant differences in between-group weighted mean differences. Point estimates of weight lost in each group were not provided.

- Haapala et al. (2009) conducted a RCT with 125 participants aged 25 to 44 years (BMI 25 to 36 kg/m2) that investigated the effectiveness of a mobile phone-operated weight loss program. The intervention group received text-based advice regarding dietary intake and physical activity based on an internet lifestyle diary kept by the participant. By 12 months the experimental group lost more weight than the control group (4.5 kg (SD 5) versus 1.1 kg (SD 5.8).

Summary

Across included studies in this review the following were observed:

- technology has been successfully used to augment the face-to-face delivery of multi-component weight loss interventions in adolescents and adults
- evidence does not support the use of technology as a replacement for face-to-face delivery of care for weight loss
- technology can be used to deliver patient education, to provide reminders to patients for certain aspects of their care, to facilitate behaviour change, to facilitate relay of clinical information to health care providers and as a self-management tool

Long-term weight management

Strategies to maintain weight reduction in the long-term have been the subject of numerous studies included in this review.

Included studies

1.1 Adults – Lifestyle

Weight regain is common after weight loss that is achieved with lifestyle interventions. Weight loss is maximal at six to 12 months. Regardless of the degree of initial weight loss, most weight is regained within a two year period and by five years the majority of people are at their pre-intervention body weight.

- Dansinger et al. (2007) conducted a meta-analysis of 46 trials assessing the effect of dietary counselling compared with usual care on BMI in adults. Maximum treatment effect of 6% reduction in body weight was observed at 12 months. Weight regain of approximately 0.02 to 0.03 BMI units per month occurred up to five years.
- Cooper et al. (2010) conducted a RCT with 150 participants (age 20 to 60 years; mean BMI 34.7 kg/m2) that compared cognitive behaviour therapy (CBT) and behaviour therapy (BT) with a control condition (guided self-help - GSH) over three years of follow-up. At 24 weeks the mean percentage weight losses were 6.7%, 11.3% and 10.0% respectively in the GSH, BT, and CBT conditions. At 1-year follow-up, those who had lost weight at the end of treatment had regained, overall, almost half the weight that they had lost (median regain of weight lost, 43.5% in BT and 58.0% in CBT) and at 3-year follow-up they had regained almost all the weight lost (89.8% regain in BT; 88.6% regain in CBT).

- Martin et al. (2008) conducted a RCT with 137 low income female participants with a BMI ≥ 25 kg/m2 that received a behavioural intervention delivered by primary care physicians which focussed on weight loss and subsequent weight maintenance or received standard care. Primary care physicians delivered five physician-counselled office visits on a monthly basis. A single, 15-minute, protocol-driven weight maintenance session was delivered by the primary care physician to each intervention group participant at month six. The weight change of intervention participants at 18 months was -0.5 ± 3.3 kg and of control group participants was 0.07 ± 3.8 kg. Maximal weight loss was observed at month nine (-1.5 kg versus 0.6 kg) before weight was regained.
- Schmitz et al. (2007) conducted a RCT with 164 female participants (mean age 36 years, mean BMI 29.4 kg/m2) to assess the impact of strength training on weight loss. Intervention group participants received gym-based strength training supervised by fitness trainers for 16 weeks. During the maintenance phase, trainers led booster sessions every 12 weeks during which new exercises were introduced. Participants otherwise exercised unsupervised during the maintenance phase. Control group participants received written information about national physical activity guidelines. At two years participants in the intervention group reduced body fat by 3.7% (SD 1.0%) and control group participants by 0.1% (SD 1.0%).
- Stahre et al. (2007) conducted a RCT with 54 female participants (mean age 49 years; mean BMI 36.6 kg/m2) that examined the impact of a cognitive and psychoeducational treatment program on weight loss and maintenance. This was compared with a control group who were provided with health education. After a ten week intervention period, participants entered a weight maintenance phase. Weight maintenance involved periodic re-weighing but no other intervention. At 18 months after the intervention, mean weight loss was 5.9 kg (SD 5.4) in the intervention and 0.3 kg (SD 4.3) in the control group. Maximum weight loss occurred at six months in the intervention group (10.5 kg) and immediately after the ten week intervention (0.7 kg) in the control group.

Computer-based interventions can be used to assist with weight maintenance. Available evidence suggests that weight maintenance achieved with face-to-face interventions and internet-based interventions is similar.

- Neve et al. (2010) conducted a meta-analysis of 18 RCTs that assessed weight loss or maintenance interventions delivered via the internet. At up to two years of follow-up maintenance of weight loss was better with face-to-face interventions than with web-based interventions (WMD 1.9 kg; 95% CI, -7.3 to 3.5).
- Cussler et al. (2008) conducted a RCT in 135 women that compared a weight maintenance intervention delivered via the internet with self-directed weight maintenance after a 4 month weight loss program. The intervention group used the internet to gain information and to complete logs concerning their weight, diet and exercise progress. After 12 months the internet and control groups had regained 0.4 kg (SD 5) and 0.6 kg (SD 4) respectively.
- Svetkey et al. (2008) conducted a RCT with 1,032 participants that compared a weight maintenance program based on personal contact with an approach that was based on internet-based maintenance therapy. Participants were adults with a mean age of 55.6 years and a mean entry weight of 96.7 kg. During an initial 6-month lifestyle program, mean weight loss was 8.5 kg (range 4.0 to 30.3 kg). Participants were then randomised to the maintenance groups. At 30 months, weight regain did not differ

between the interactive technology-based (5.2 kg) and self-directed groups (5.5 kg; mean difference -0.3 kg; 95% CI, -1.2 to 0.6 kg; P = 0.51); however, weight regain was lower in the interactive technology-based than in the self-directed group at 18 months (mean difference, -1.1 kg; 95% CI, -1.9 to -0.4 kg; P = 0.003) and at 24 months (mean difference, -0.9 kg; 95% CI, -1.7 to -0.02 kg; P = 0.04).

1.2 Adults – Pharmacotherapy

Pharmacotherapy can be used for weight maintenance. Lifestyle interventions that are combined with pharmacotherapy result in less weight regain than lifestyle interventions alone. However, by ten years follow-up, most weight that was lost has been regained, regardless of whether weight was lost by lifestyle intervention or pharmacotherapy.

- Franz et al. (2007) conducted a meta-analysis of 80 clinical trials with a minimum of one year follow-up in order to determine types of interventions that contribute to weight loss success long-term. A mean weight loss of 5 to 8.5 kg (5% to 9% of body weight) was observed in the first 6 months of lifestyle interventions. By 12 months this weight loss had reduced to 4.5 to 7.5 kg. At two years net weight loss had reduced further to three to four kg. No further weight regain was observed at four years. In comparison, lifestyle interventions in conjunction with pharmacotherapy resulted in better weight maintenance – at 2 years net weight loss was 2 to 5 kg greater than with lifestyle alone.
- Knowler et al. (2009) conducted a RCT including 2,766 participants (age > 25 years; BMI > 24 or > 22 kg/m2 in Asians) that assessed the impact of metformin and non-intensive lifestyle advice (group 1) versus intensive lifestyle intervention (group 2) or non-intensive lifestyle advice alone (group 3) on body weight in people with prediabetes. Maximum weight loss occurred at 12 months in the intensive lifestyle intervention group (mean weight loss = 7kg) and the metformin group (mean weight loss = 2.5 kg). The non-intensive lifestyle advice group did not lose weight. After 12 months, participants entered a weight maintenance phase. This consisted of a 16-session lifestyle program followed by provision of three-monthly educational sessions to reinforce the original weight loss and lifestyle goals. Participants randomised to metformin also continued their medication during the maintenance phase. Participants randomised to the intensive lifestyle group also received four group sessions a year to reinvigorate their self-management behaviours. Weight was gradually regained after the 12 month intervention phase. The intensive lifestyle group 2 kg less at ten years than they did at baseline and the metformin group weighed 2.5 kg less at ten years than at baseline. The placebo group weighed 1 kg less at 10 years than they did at baseline.
- Padwal et al. (2003) (same data as Rucker et al. 2007) conducted a systematic review and meta-analysis of 30 RCTs involving 19,889 adult participants with an average BMI of 35 to 36 kg/m2 that assessed the impact of orlistat (16 studies, 10,631 participants), sibutramine (10 studies, 2,623 participants) and rimonabant (not reported here) on weight and BP change over four years of follow-up. The majority of intervention and control group participants received an initial one to six month hypocaloric diet that generally comprised 30% of calories from fat, 50% from carbohydrates and 20% from protein. After this, participants entered a weight maintenance phase. During the weight maintenance phase, diets differed between trials - overall an increase in calories of approximately 200 to 300 kcal/day was provided if patients were still losing weight and no increase was provided if patients were no longer losing weight. Orlistat was associated with a weight loss of 2.9 kg (95% CI, -2.5 to -3.2 kg) more than hypocaloric diet alone;

sibutramine was associated with a weight loss of 4.2 kg (95% CI, -3.6 to -4.7 kg) more than hypocaloric diet alone. Mean weight loss in participants receiving orlistat ranged between 3.3 kg and 10.3 kg; sibutramine ranged between 4.1 kg and 10.7 kg; and hypocaloric diet alone ranged between 0.5 kg gain and 8.5 kg loss over the four years.

- Turk et al. (2009) conducted a systematic review of 42 studies in 9,740 adults that investigated the internet, very-low-calorie diet, pharmacotherapy, behavioural strategies and physical activity strategies for weight maintenance after 5% initial weight loss. Weight-loss maintenance treatment with orlistat or sibutramine and dietary modification, diets that create an energy deficit, and behavioural therapies that include problem-solving, peer support and increased participant contact were more likely to be effective in reducing weight regain after weight-loss treatment. Pooled estimates of weight maintenance effect were not provided.

In participants with Class III obesity, pharmacotherapy can assist people to maintain weight losses of approximately 10% of their pre-intervention body weight at two years follow-up.

- Ryan et al. (2010) conducted a RCT with 390 participants of non-surgical approaches delivered in primary care for adult patients with a BMI between 40 and 60 kg/m2. The intervention group received a 900 kcal liquid diet, group behavioural counselling, lifestyle instructions and pharmacotherapy (sibutramine, orlistat or diethylpriopion). The usual care group had instruction in an internet weight management program. From months 8 to 24 a weight maintenance approach was used. Weight loss medications and one daily meal replacement were continued; monthly group sessions were conducted; treatments were employed pragmatically as needed, including a repeated low calorie liquid diet in 4 to 12 week episodes, novel dietary approaches (high-protein/low-carbohydrate diet, the Dietary Approaches to Stop Hypertension (DASH) diet, low glycemic load diet), and physical activity. After two years, 31% of intervention participants achieved a 5% weight loss and 7% achieved a 20% weight loss or more. In the usual care group, 9% achieved 5% weight loss and 1% achieved a 20% weight loss. Maximal weight loss was achieved at week 38 – a median of 15.5% in the intervention group and 0.9% in the usual care group. By year two weight regain had occurred – median weight loss was 9.6% in the intervention group and 0% in the usual care group compared with baseline.

1.3 Adults – Surgery

In participants with Class III obesity, bariatric surgery is associated with less weight regain than lifestyle or pharmacotherapy. Weight loss appears to be greatest in year one after surgery but continues for two to three years. After this, weight regain appears to occur. However, a weight loss of at least 16% can be maintained at up to ten years follow-up.

- Padwal et al. (2011) conducted a meta-analysis of 31 RCTs involving 2,619 patients (mean age 30 to 48 years; mean BMI 42 to 58 kg/m2) that compared bariatric surgery with lifestyle management over up to five years of follow-up. Compared with lifestyle management alone, differences in BMI from baseline at year one and year two with adjustable gastric banding were -2.4 kg/m2 at year one and -6.1 kg/m2 at year two.
- Buchwald et al. (2009) conducted a meta-analysis of 621 studies which were predominantly case series of bariatric surgery, including in patients with type 2 diabetes. There were 135,246 participants with a mean age of 40.2 years and a mean BMI at baseline of 47.9 kg/m2. Approximately 22% had type 2 diabetes and 10.5% had undergone previous bariatric surgical procedures. Weight loss with bariatric surgery was 38.2 kg at year one and 42.9 kg at year two.

- Garb et al. (2009) conducted a meta-analysis of studies assessing bariatric surgery for the treatment of class III obesity in adults. Laparoscopic gastric bypass (LGB) was associated with a larger weight reduction than laparoscopic adjustable gastric banding (LAGB). LGB resulted in reduction of excess body weight at one, two and three years of 62%, 70% and 71%; LAGB resulted in reductions of 43%, 50% and 55% in comparison.
- Picot et al. (2009) (data also reported in Colquitt et al. 2009) systematically reviewed 26 studies (23 RCTs and 3 cohort studies) conducted in 5,766 adults with mean BMI across primary studies of between 30 and 60 kg/m2. One included study, the SOS study, reported data at ten years follow-up. The % weight change in participants who had received surgery was -16% at ten years (SD 12.1). A weight regain of 7.6% was observed over time - from a maximal weight loss of 23.4% at two years to 16% at ten years.

1.4 Adults with prediabetes

- Dale et al. (2008) conducted a RCT involving 79 adult participants (mean age 45 to 48 years) with prediabetes that assessed the impact of diet and exercise on anthropometry. For the first four months, participants received a lifestyle intervention that consisted of weekly visits for detailed diet and exercise advice from an experienced dietitian and physical activity instructor. In the maintenance phase of the intervention, participants were reviewed at 8, 12 and 24 months. At 8 and 12 months diet and exercise were discussed and participants were encouraged to maintain lifestyle changes. By two years, weight change in the intervention and control groups was -1 versus -0.8 kg; waist circumference was -1 versus -2 cm and BMI was -0.7 versus -0.8 kg/m2.

1.5 Adults with type 2 diabetes

- The Look AHEAD study (Belalcazar et al., 2010; Pi Sunyer et al. 2007; Wing et al., 2010b) investigated changes in body weight and CVD risk factors with intensive lifestyle interventions (ILI) versus patient education in people with excess body weight and type 2 diabetes. Participants in the ILI group were seen weekly for the first six months, three times a month for the second six months and monthly for the next three years (with telephone or email contact between each monthly appointment). At maintenance visits, participants were weighed, self-monitoring records were reviewed and behavioural advice was provided. The patient education group received three group sessions a year that focussed on diet, physical activity and social support. Across 5,145 participants aged between 45 and 74 years with a BMI > 25 kg/m2 (or >27 kg/m2 if taking insulin), ILI was associated with an 8.6% reduction in weight at 12 months compared with 0.7% reduction with patient education. At four years of follow-up participants in ILI had greater percent weight losses than those in the patient education group (-6.2% versus -0.1%).
- As described above, Buchwald et al. (2009) conducted a meta-analysis of 621 studies which were predominantly case series of bariatric surgery, including in patients with type 2 diabetes. Weight loss with bariatric surgery was 38.2 kg at year one and 42.9 kg at year two.
- Christian et al. (2008) conducted a RCT with 310 participants with type 2 diabetes mellitus (mean BMI 35.4 kg/m2) that compared nutrition and physical activity counselling with health education pamphlets over 12 months. After the three month intervention, participants in the intervention group visited their primary care physician every three

months for motivational counselling. At 12 months weight had decreased by 0.2 kg in the intervention group and increased by 1.4 kg in the control group.

1.6 Children and adolescents

- Okely et al. (2010) compared parent-centred with child-centred lifestyle therapy in 165 participants aged 8 years old (BMI 24.4 to 25.2 kg/m2). The parent intervention focussed on diet and the child intervention on physical activity. All groups received ten weekly face-to-face sessions followed by three monthly relapse-prevention phone calls to 12 months post-intervention. The relapse prevention program consisted of monthly (for three months) telephone review by a trained facilitator of goals set by parents. The mean reductions in BMI z-score at 6 and 12 months in the parent group were 0.3 and 0.4; in the child group were 0.2 and 0.2; and in the combined intervention group (parent + child) were 0.3 and 0.3.
- Whitlock et al. (2010), in an analysis of 20 studies in paediatric patients (aged 4 to 18 years) found that evidence of treatment maintenance is limited in behavioural intervention trials, and virtually not existent in trials of pharmacological treatments. Multi-component interventions that included behaviour therapy were associated with BMI or weight change improvement over 48 months and for at least 12 months since the intervention ended. Observational studies not included in the review but discussed in the findings suggest that approximately 30% to 39% of paediatric patients who receive multi-component weight loss interventions are no longer obese in adulthood.
- Wifley et al. (2007) conducted a RCT with 150 paediatric participants aged 7 to 12 years (20% to 100% overweight) to assess efficacy of maintenance treatment approaches for childhood overweight. All participants first received a five month weight loss treatment that focussed on dietary modification, physical activity increases and behaviour change skills. Participants were then randomised to either weight maintenance by behavioural skills maintenance (BSM), social facilitation maintenance (SFM) or no intervention control. BSM is a family-based, cognitive-behavioural approach that emphasises self-regulation behaviours and relapse prevention. SFM helps parents facilitate child peer networks that support healthy eating and physical activity. Both BSM and SFM were delivered as 16 weekly sessions. The weight loss intervention resulted in reduction in BMI z-score of 0.22 (SD 0.17). The BSM and SFM interventions resulted in improved weight maintenance relative to the controls at two years follow-up. Mean changes in BMI z-score were -0.04 (BSM), -0.04 (SFM) and 0.05 (control).

Summary – adults

- Weight regain is common after weight loss, regardless of whether the weight was lost through lifestyle interventions, pharmacotherapy and / or surgery.
- Weight lost by lifestyle interventions is usually regained by five years and weight loss by pharmacotherapy is usually regained by ten years.
- Weight regain to pre-intervention weight occurs regardless of whether the participant has overweight or class I, II or III obesity, and in participants with normal blood sugar, prediabetes and type 2 diabetes.
- Surgery is the only intervention to result in maintenance of weight losses at ten years of at least 10% of body weight.

- Some research suggests that a higher percentage weight loss is significantly associated with a higher percentage of weight regain (Weiss et al., 2007). However, studies included in this review and a systematic review of 22 intervention studies by Barte et al. (2010) suggest that weight maintenance does not depend on the degree of initial weight loss.

Summary – children and adolescents

- Available studies suggest that multi-component interventions that include behavioural components can result in maintenance of BMI reductions at two years follow-up.
- Observational studies suggest that 30% to 39% of paediatric patients who receive multi-component weight loss interventions are no longer obese in adulthood.

Transitional care

Transition of adolescents between paediatric and adult services has been the subject of research across a range of chronic illness affecting adolescents. Transition to adult medical care is defined by the Society of Adolescent Medicine as 'the purposeful, planned movement of adolescents and young adults with chronic physical and medical conditions from child-centred to adult-oriented health care systems'. The goals of transition are to provide health care that is:

- coordinated;
- uninterrupted;
- developmentally appropriate; and
- comprehensive.

Transitional care of adolescents with obesity has not been the subject of extensive study. As there are significant differences in the approach to care between children and adult's services, this evidence gap is important in considering optimal delivery of multi-component interventions to paediatric patients. Children's services are generally configured to focus on the whole family whereas the adult sectors take an individual approach. Further, adult services expect a much greater degree of independence from young people and encourage communication without parents being present. Adolescents may experience difficulty adapting to this type of relationship, particularly when their chronic disease has resulted in long-standing relationships with paediatric providers.

Impact of various interventions on weight reduction

Data presented in Questions 1 and 2 demonstrate that effectiveness of interventions in reducing body weight varies significantly across intervention types. The hierarchy of effectiveness can be summarised as follows (Table 8):

Table 8: Hierarchy of effectiveness of weight loss interventions in adults

Summary of effect	Intervention
Most effective (consistently > 10% weight loss across studies; weight loss likely to be maintained > 5 years)	Bariatric surgery
Moderately effective (>10% weight loss	Combined pharmacotherapy and lifestyle change

across some but not all studies; weight loss maintained > 5 years in some but not all participants)	
Least effective (>10% weight loss in few studies; weight loss not likely to be maintained in participants)	Lifestyle change alone

Within the lifestyle therapies group, a variety of different approaches to lifestyle modification can be prescribed. The strength of evidence for lifestyle therapies and their impact on weight loss from studies included in this review and described in Questions 1 and 2 can be summarised as follows (Table 9):

Table 9: Strength of evidence for lifestyle therapy and weight loss in adults

Strength of effect	**Intervention**
Most effective (most likely to result in weight loss; most likely to be associated with sustained weight loss)	Combining dietary change with improved physical activity Reducing total energy intake (variety of means) Energy deficit of 500 – 700 kcal/day
Somewhat effective (results in weight loss in some studies; evidence regarding association with sustained weight loss less well defined)	Increasing intake of low energy-dense foods (especially fruit / vegetables) Reducing intake of sweetened beverages High protein diets Mediterranean diet pattern Limiting number of high energy - dense snacks Reduced time spent in sedentary behaviour
Insufficient evidence or inconsistent effects	Increased incidental or occupational physical activity Exercise in the absence of dietary change

Bariatric surgery

Bariatric surgery results in the largest and most sustained weight loss in adults and adolescents with Class II or Class III obesity. However, weight regain after a bariatric surgical procedure occurs in the majority of patients.

The extent of the initial weight loss and the degree and rapidity of weight regain varies according to the specific bariatric procedure. The meta-analysis of randomised trials conducted by Padwal et al. (2011) included 31 RCTs involving 2,619 patients (mean age 30 to 48 yrs; mean BMI levels 42 to 58 kg/m^2). As compared with standard care, mean differences in BMI levels from baseline at year one (15 trials; 1,103 participants) were as follows:

- Predominantly malabsorptive procedures

    - jejunoileal bypass [-11.4 kg/m^2]
    - biliopancreatic diversion [-11.2 kg/m^2]
- Mixed procedures
    - mini-gastric bypass [-11.3 kg/m^2]
    - Roux-en-Y gastric bypass [-9.0 kg/m^2]
- Predominantly restrictive procedures
    - sleeve gastrectomy [-10.1 kg/m^2]
    - vertical banded gastroplasty [-6.4 kg/m^2]
    - horizontal gastroplasty [-5.0 kg/m^2]
    - adjustable gastric banding [-2.4 kg/m^2]

These data demonstrate that weight losses are greatest with malabsorptive procedures and lowest with restrictive procedures. Adjustable gastric banding is substantially less effective than other bariatric surgical procedures but is also associated with fewer serious adverse effects.

Published RCTs comparing surgery with non-surgical weight loss

There have been two studies published more than 20 years ago (DOP 1979; Andersen 1984), three studies published since 1997 in the peer reviewed literature (Mingrone 2002; O'Brien 2006; Dixon 2008) and one study published in a conference abstract (Heindorff et al., 1997) that are RCTs comparing bariatric surgery with nonsurgical approaches. The two RCTs published prior to 2002 compared jejunoileal bypass and horizontal gastroplasty to medical treatment; these procedures are not usually performed in contemporary bariatric surgical management of obesity (Table 10).

- Mingrone et al. (2002) conducted a RCT with 79 patients (age: 30 to 45 years, mean BMI 48 kg/m^2) that compared outcomes in a diet group with those in a group undergoing BPD. After one year participants in the diet group lost 6% of their initial body weight, compared with an average loss of 34% and 28% with BPD in males and females respectively.
- O'Brien et al. (2006) compared intensive medical management with LAGB in 80 adults with a BMI between 30 and 35 kg/m^2. At two years, mean weight loss in the medical and surgical groups was 6% and 22% respectively.
- O'Brien et al. (2010) conducted a RCT with 50 participants (age 14 to 18 years, BMI >35 kg/m^2) randomised to LAGB or lifestyle therapy and followed for two years. Surgery group reduced weight by 34.6 kg and lifestyle was associated with reduction in weight of three kg.
- Dixon et al. (2008) conducted a RCT with 60 participants (mean age 47 years; mean BMI 37 kg/m^2) that compared the impacts of lifestyle modification with LAGB surgery in patients with type 2 diabetes. The surgery group reduced body weight by 21.1 kg and the lifestyle group reduced body weight by 1.5 kg.
- Heindorff et al. (1997) conducted a RCT with 16 participants (age 21 to 43 years, BMI 40 to 56 kg/m^2) randomised to either LAGB or diet and followed for 40 weeks. Patients in the surgery group lost 26 kg (SE 2) whereas those in the diet group increased in weight by 1 kg (SE 2).

Table 10: RCTs comparing surgical with non-surgical weight loss

	Sample characteristics	Intervention	Duration of follow-up	Findings	Adverse events	Comorbid conditions
Dixon 2008	60 obese patients (BMI > 30 and < 40) with recently diagnosed (< 2 years) type 2 diabetes	Conventional diabetes therapy with a focus on weight loss by lifestyle change vs laparoscopic adjustable gastric banding with conventional diabetes care	2 years	Of the 60 patients enrolled, 55 (92%) completed the two year follow-up. Surgical and conventional-therapy groups lost a mean (SD) of 20.7% (8.6%) and 1.7% (5.2%) of weight, respectively, at two years.	One surgical patient developed superficial wound infection, two developed gastric pouch enlargement, three had revisional procedures during follow-up.	Remission of type 2 diabetes was achieved by 73% in the surgical group and 13% in the conventional therapy group.
Heindorff 1997	16 patients (7 female, 9 male) aged 21 to 43 years, BMI 40 to 56	Diet or laparoscopic adjustable gastric band	40 weeks	The operative group lost 26 kg (SE 2) and the diet group gained 1 kg (SD 2).	Two patient experienced perforation of the stomach.	Nil reported by authors
Mingrone 2002	79 morbidly obese subjects (27 men and 52 women; age: 30-45 years, mean BMI 48)	Diet protocol (20 kcal / kg fat-free mass (FFM); 55% carbohydrates, 30% fat, and 15% proteins) or biliopancreatic diversion	1 year	After one year, men and women in the diet group lost an average of 6.2% and 5.8% of initial body weight, respectively, compared with an average loss of 34.3% and 28%, respectively, in the BPD group.	Not reported	Disease endpoints not reported by authors
O'Brien 2010	50 adolescents between 14 and 18 years BMI >35	Supervised lifestyle intervention or gastric banding	2 years	24 of 25 patients in the gastric banding group and 18 of 25 in lifestyle group completed the study. 21 (84%) in the gastric banding	eight operations were required in seven patients for revisional procedures during	At entry, 36% in the LAGB group and 40% in the lifestyle group had metabolic syndrome. At 24

				and three (12%) in the lifestyle groups lost more than 50% of excess weight.	follow-up	months, none of the gastric banding group had the metabolic syndrome compared with 22% of the lifestyle group.
O'Brien 2006	80 adults aged 20 to 50 years with mild to moderate obesity (BMI, 30 kg/m^2 to 35 kg/m^2) from the general community	Very-low-calorie diets, pharmacotherapy, and lifestyle change or laparoscopic adjustable gastric band	2 years	The surgical group had a mean of 21.6% (95% CI, -19.3% to -23.9%) of initial weight lost and the nonsurgical group had a loss of 5.5% (CI, -3.2% to -7.9%) of initial weight. The metabolic syndrome was initially present in 15 (38%) patients in each group and was present in 8 (24%) nonsurgical patients and 1 (3%) surgical patient at the completion of the study.	18% experienced adverse events; 13% received operative revisions over the follow-up period	Metabolic syndrome was initially present in 38% of patients in each group. At study completion 3% of surgical patients and 24% of non-surgical patients had the metabolic syndrome.

Other data regarding the outcomes of bariatric surgery are predominantly derived from case studies and case series involving a single surgeon or institution. These data have many limitations. Surgical components such as pouch size and limb length as well as the type of surgical procedure performed vary over time within and among surgical centres, and parameters used to define diagnosis, improvement, resolution, or cure of selected comorbid diseases have not been standardized. There is an inherent selection bias in the majority of studies, as people who present to surgeons for bariatric surgery often vary in sociodemographic status compared with those not accessing surgery. Further, follow-up and reporting of patients included in case series follow-up publications are often incomplete and are poorly reported, which increases selection bias.

The Swedish Obese Subjects (SOS) Study (non-RCT)

The majority of systematic reviews and meta-analyses of bariatric surgery that were included in this review cited data from the Swedish Obese Subjects (SOS) study. The SOS study is a large, non-randomized intervention trial comparing weight loss outcomes in a group of matched surgical and non-surgical subjects has reported 10-year and 15-year outcome data. There were 4,047 subjects enrolled and followed to two years; 1,471 surgical participants and 1,444 conventional treatment participants consented to be followed up to 20 years. Subjects were aged between 37 and 60 years and had a BMI > 34 (males) / 38 (females). Overall, 1,369 participants underwent banded gastroplasty, 376 participants underwent LGB / LAGB and 265 participants underwent gastric bypass.

The SOS study currently provides the highest quality evidence available regarding long-term impacts of bariatric surgery on body weight, morbidity and mortality. Results demonstrate patterns of initial weight loss and subsequent weight regain over time with different forms of bariatric surgery (Sjostrom et al. 2007). Surgery is significantly more effective in reducing weight than no intervention or non-surgical interventions (combined in the control group).

Figure 5: SOS weight change over time

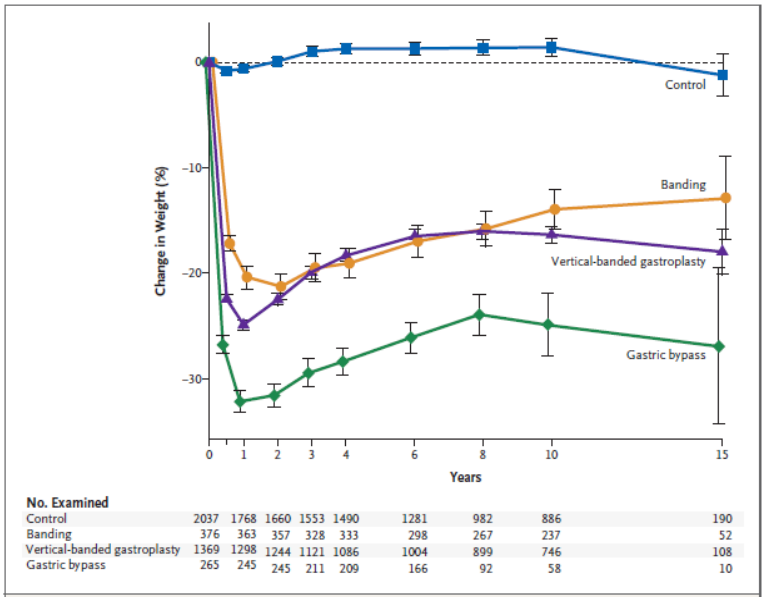


Figure 1. **Mean Percent Weight Change during a 15-Year Period in the Control Group and the Surgery Group, According to the Method of Bariatric Surgery.**

Patients experience different weight trajectories over time depending on their bariatric surgical procedure. Gastric bypass surgery produced the greatest long-term weight loss (25% ± 11%), followed by vertical banded gastroplasty (17% ± 11%) and fixed or variable banding procedures (13% ± 13%).

Of note, the mean weight of patients in the SOS study who received a banding procedure has not reached a plateau but is still increasing. Therefore, based on the highest quality evidence available to date, the net impact of laparoscopic procedures has not been established but is likely to be in the order of 10% to 12% based on SOS data (Figure 5).

The findings of the RCTs described above and the SOS study are consistent with meta-analyses of available bariatric surgical data (Buchwald et al. 2009; Colquitt 2005, Maggard 2005 and Snow 2005).

SOS Study and cardio-metabolic profile

The following changes in cardiometabolic variables were observed in the surgery versus conventional therapy groups of the SOS cohort at two and ten years of follow-up.

Table 2. Percentage Changes in Weight, Anthropometric Variables, Risk Factors, and Energy Intake at 2 and 10 Years.*

Variable	Changes at 2 Yr†			Changes at 10 Yr†			Changes at 10 Yr in Surgery Subgroups		
	Control Group (N=1660)	Surgery Group (N=1845)	Difference (95% CI)	Control Group (N=627)	Surgery Group (N=641)	Difference (95% CI)	Banding (N=156)	Vertical Banded Gastroplasty‡ (N=451)	Gastric Bypass‡ (N=34)
	percent			*percent*				*percent*	
Weight	0.1	−23.4	22.2 (21.6 to 22.8)§	1.6	−16.1	16.3 (14.9 to 17.6)§	−13.2	−16.5¶	−25.0§
Height	−0.01	−0.06	0.06 (0.02 to 0.10)¶	−0.3	−0.3	−0.01 (−0.12 to 0.10)	−0.2	−0.3	−0.8§
BMI	0.1	−23.3	22.1 (21.5 to 22.7)§	2.3	−15.7	16.5 (15.1 to 17.8)§	−12.8	−16.0¶	−23.8§
Waist	0.2	−16.9	16.0 (15.4 to 16.5)§	2.8	−10.1	11.3 (10.3 to 12.4)§	−7.6	−10.2¶	−19.3§
Systolic blood pressure	0.5	−4.4	2.8 (2.1 to 3.6)§	4.4	0.5	1.1 (−0.3 to 2.6)	2.1	0.4	−4.7
Diastolic blood pressure	0.3	−5.2	3.2 (2.4 to 3.9)§	−2.0	−2.6	−2.3 (−3.5 to −1.0)§	−1.4	−2.5	−10.4‖
Pulse pressure	3.2	0.6	−0.5 (−2.3 to 1.3)	18.0	10.8	3.5 (0.1 to 6.9)¶	13.8	10.1	6.3
Glucose	5.1	−13.6	16.6 (15.0 to 18.3)§	18.7	−2.5	18.4 (14.7 to 22.1)§	−0.8	−2.5	−10.0
Insulin	10.3	−46.2	51.4 (48.0 to 54.8)§	12.3	−28.2	30.3 (23.9 to 36.6)§	−25.3	−27.2	−54.0§
Uric acid	−0.4	−14.9	13.5 (12.5 to 14.6)§	3.9	−6.2	8.8 (6.4 to 11.1)§	−5.2	−6.1	−12.3
Triglycerides	6.3	−27.2	29.9 (27.4 to 32.5)§	2.2	−16.3	14.8 (10.4 to 19.1)§	−18.0	−14.9	−28.0¶
HDL cholesterol	3.5	22.0	−18.7 (−20.1 to −17.3)§	10.8	24.0	−13.6 (−16.5 to −10.6)§	20.4	23.5	47.5¶
Total cholesterol	0.1	−2.9	1.0 (0.1 to 1.9)¶	−6.0	−5.4	−2.0 (−0.2 to −3.8)¶	−5.0	−5.0	−12.6§
Energy intake	−2.8	−28.6	19.1 (16.0 to 22.2)§	−1.0	−20.7	11.6 (8.1 to 15.0)§	−19.7	−21.6	−12.6

* Data are for all subjects who completed 2 and 10 years of the study and are independent of diagnosis and medications at or after baseline. The changes within each treatment group are unadjusted, whereas the differences between the groups in the changes have been adjusted for sex, age, body-mass index (BMI), and the baseline level of the respective variable. CI denotes confidence interval, and HDL high-density lipoprotein.
† For values within each group, minus signs denote decreases; for differences between the groups, minus signs denote smaller reductions or (in the case of HDL cholesterol) larger increases in the surgical group than in the control group.
‡ P values are for the comparison with the banding subgroup.
§ P<0.001.
¶ P<0.05.
‖ P<0.10.

After two and ten years subjects in the surgical arm of the SOS study had a lower incidence of and greater recovery rate from hypertriglyceridemia than controls. The incidence of low levels of HDL (< 39 mg/dL) was less common in this group at two years but not after ten years. No significant difference was noted between groups with regard to the incidence of elevated total cholesterol at either two or ten years. After ten years, the subjects who had undergone gastric bypass had greater improvements in triglycerides (28.0% versus 18.0% decrease), total cholesterol (12.6% versus 5.0% decrease), and HDL levels (47.5% versus 20.4% increase) than those who had gastric banding.

Diabetes

Numerous uncontrolled and a limited number of controlled studies demonstrate improvement or resolution of type 2 diabetes in many patients who receive bariatric surgery. Improvements include decreased HbA1c, reduced fasting blood glucose and reductions in the use of diabetes medications.

Buchwald et al. (2009) found resolution or improvement of diabetes in 86% of all subjects in their meta-analysis. After bariatric surgery, mean blood concentrations of HbA1c, fasting glucose, and fasting insulin decreased by 2.4%, 71.5 mg/dL, and 17.3 µIU/mL respectively (in patients with type 2 diabetes mellitus or impaired glucose tolerance). Diabetes resolved in 99% of subjects after BPD or duodenal switch, in 84% after gastric bypass, in 72% after gastroplasty, and in 48% after gastric banding. HbA1c decreased 3% after gastric bypass versus 1% after gastric banding.

Compared with controls, subjects in the surgical group of the SOS study had a lower incidence of diabetes mellitus at both two years (OR 0.14; 95% CI, 0.08 to 0.24) and ten years (OR 0.25; 95% CI, 0.17 to 0.38). Recovery from diabetes occurred more often in the surgical group than in the control group at these time points (OR at two years = 8.4 [95% CI, 5.7 to 12.5]; OR at 10 years = 3.5 [95% CI, 1.6 to 7.3]). At ten years, gastric bypass patients had greater improvements in

mean blood glucose and insulin values than patients who underwent gastric banding procedures or vertical banded gastroplasty.

These findings add to the growing evidence that bariatric surgery is a viable treatment for some patients with diabetes. However, a significant problem with studies of bariatric surgery is the inability to assess the long-term benefits of bariatric surgery in diabetes because of high attrition rates and short duration of follow-up of participants. Participants are, by definition, self-selected. The impact of this selection bias on the generalisability of findings to other patient groups with diabetes is unknown. Further, studies generally do not specify the criteria used to define 'diabetes resolution', making comparability of findings between studies limited.

Adolescents and cardiometabolic profile

O'Brien et al. (2010) demonstrated the following changes in cardiovascular risk endpoints at 2 years in participants receiving LAGB or lifestyle therapy.

	LAGB (SD)	Lifestyle (SD)
WC (cm)	-28.2 (12.4)	-3.5 (14.6)
SBP (mmHg)	-12.5 (17.6)	-20.3 (21.7)
DBP (mmHg)	-6.0 (9.4)	-6.9 (12.5)
Glucose (mg/dL)	-6.8 (20)	2.8 (9)
Triglycerides (mg/dL)	-52 (38)	-32 (83)

There are no longer term data available from high quality studies that assess the impact of bariatric surgery on cardio-metabolic outcomes in adolescent patients.

Mechanism of action of bariatric surgery

The mechanisms of long-term weight loss following bariatric surgery are yet to be determined. Evidence suggests that the surgical manipulations (i.e. the small gastric pouch with / without exclusion of duodenum and proximal jejunum) are insufficient to account for the resulting body weight lost (Cummings et al., 2004; Vincent et al., 2008). In fact, postoperative changes in metabolic profile have been shown to occur before weight is actually lost for some surgical procedures, and changes in eating behaviour and appetite may be more related to altered responses to gut hormones than the anatomical changes the surgery creates (Batterham et al., 2003; LeRoux et al., 2007).

It is therefore difficult to establish whether improvement in comorbid conditions with bariatric surgery are due to the weight loss per se or due to the different changes in hormone balance, metabolism, pressure dynamics and mechanics that each type of bariatric surgery produces. This is an important point to highlight. Because bariatric surgery is not just one procedure but represents a range of different surgical procedures, targeting the 'right procedure to the right patient' requires an understanding of how effective each procedure is at inducing positive changes in the patient's cardio-metabolic profile, not just how much weight they will lose.

Mortality

The impact of bariatric surgery on long-term mortality is favourable. Flum and Dellinger (2004) conducted a retrospective cohort study of more than 66,000 patients who had undergone gastric bypass in the US. At 15-year follow-up, the surgical cohort had 27% fewer deaths than the cohort of obese subjects who did not undergo bariatric surgery (11% of surgical subjects died versus 16% in the non-surgical group). Vlassov (2005) identified a 5-year mortality rate of 0.7% for bariatric patients versus 6.2% for the control group. The SOS study also established long-term mortality as a primary end point. There were 101 / 2,010 deaths in the surgical group

compared with 129 / 2,037 in the conventional treatment group. The following trend in mortality was observed over 16 years of follow-up.

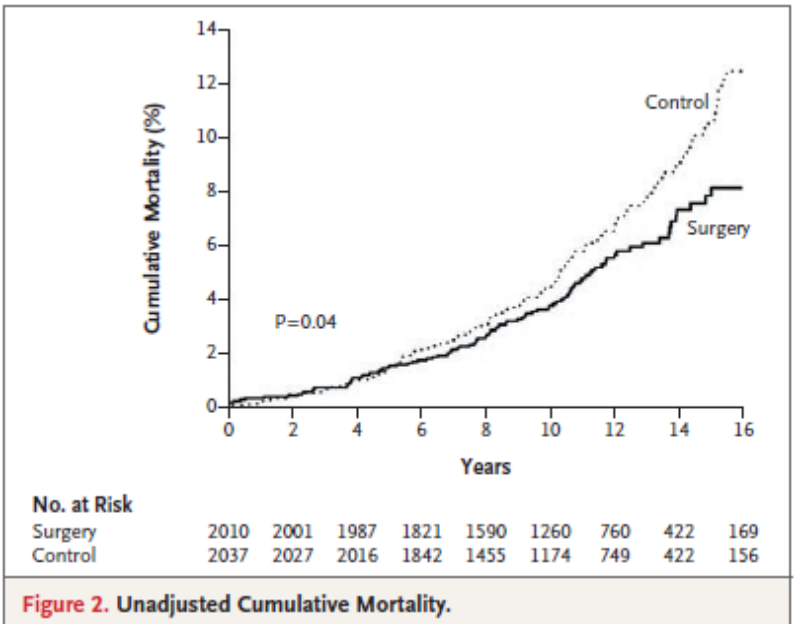


Figure 2. Unadjusted Cumulative Mortality.

Some caution is needed in interpretation of results because outcomes from the medical community at large may not be equal to those of surgical 'centres of excellence.'

Adverse events

Complications from bariatric surgery have been reported across numerous studies.

The Longitudinal Assessment of Bariatric Surgery 1 (LABS-1), a prospective, multicentre observational study that assessed 30-day complication rates in 4,776 patients undergoing primary bariatric surgical procedures (LABS, 2009). The overall rate of death was 0.3%, and 4.1% of the patients had major complications.

All the bariatric surgeons in this study were "LABS-certified" as being highly skilled and the operations were performed in high-volume bariatric centres. Hence, the LABS-1 data may represent a best-case scenario that may not be widely reproducible.

The LABS-1 study also compared the safety of three procedures: the laparoscopic and open approaches to Roux-en-Y gastric bypass and laparoscopic adjustable gastric banding. The 30-day composite end point — death, serious complications, reintervention, or prolonged hospitalization — occurred in 1.0% of patients who underwent laparoscopic adjustable gastric banding, in 4.8% who underwent laparoscopic gastric bypass, and in 7.8% who underwent open gastric bypass.

Colquitt et al. (2009), in a systematic review of surgical studies, conducted a detailed analysis of complications and additional procedures associated with different forms of bariatric surgery. RCTs of LAGB versus non-surgical treatment reported operative re-intervention (13%), laparoscopic revision (10%), port infection (2.6%) and acute cholecystitis (2.6%) as the main complications affecting surgical patients. The SOS study data demonstrate the following complications: operative death (0.25%), perioperative complications (13%), infection (2.1%), pulmonary symptoms (6.2%), thromboembolism (0.8%) and bleeding (0.9%). As these results were achieved in surgical 'centres of excellence', the generalisability of findings to other surgical centres is unknown.

Treadwell et al. (2008) reports the results of a meta-analysis of studies of bariatric surgery for paediatric obesity in patients aged up to 21 years (average patient age 16.8 years). For LAGB, band slippage and micronutrient deficiency were the most frequently reported complications, with sporadic cases of band erosion, port / tube dysfunction, hiatus hernia, wound infection and pouch dilation. For RYGB, more severe complications were documented, including pulmonary

embolism, shock, intestinal obstruction, postoperative bleeding, staple line leak and severe malnutrition. Deaths were reported as associated with Roux-en-Y gastric bypass and BPD. There is potential for bariatric surgery to interfere with physical growth and / or sexual maturation. Only one study was identified by the authors that formally evaluated the growth of patients after surgery. The authors of this study consider the data inconclusive. Compared with adults, paediatric patients may have lower levels of compliance with postsurgical dietary regimens and dietary supplements. One study identified by the authors assessed compliance and demonstrated that 13% of paediatric patients continued taking nutritional supplements as instructed.

Summary

Bariatric surgery is more effective than other treatment options in achieving significant weight loss in adult and adolescent patients with obesity. In adults, all classes of obesity are improved with various bariatric surgical types; in adolescents, available data from high quality research shows improvements in Class II and III obesity with LAGB. There are no high quality data available regarding the indications for bariatric surgery in children and the long-term impacts when bariatric surgery is performed.

Weight regain after bariatric surgery occurs regardless of the bariatric surgical type. Achieving long-term weight loss therefore requires weight maintenance strategies to be applied after bariatric surgery has been performed.

Bariatric surgery is associated with significant short-term improvements in some cardio-metabolic risk factors and in short-term resolution of metabolic syndrome and newly developed (< 2 years) type 2 diabetes. However, data from over ten years or greater duration follow-up suggest that these benefits are not maintained long-term. Numerous unanswered questions remain regarding the role of bariatric surgery in managing type 2 diabetes in particular:

- Bariatric surgery is not one but multiple procedures. Which procedure is suited to which patient characteristics is still a matter of intense debate. After placement of an adjustable gastric band, improvements in glycaemic control are dependent on weight loss, and patients might not see appreciable improvements in glycaemic control for some time (Dixon et al. 2008). In contrast, patients who receive Roux-en-Y gastric bypass may experience improved glycaemic control before any weight loss occurs (Nannipieri et al., 2011).
- It is not clear when in the patient's diabetes illness trajectory bariatric surgery is most successful in improving or resolving type 2 diabetes. Available data suggest that patients with the shortest duration (< 5 years) and the mildest form (diet controlled) of type 2 diabetes have the greatest likelihood of resolution of diabetes (Schauer et al., 2003).
- When bariatric surgery does result in resolution of type 2 diabetes, it is not clear what the duration of effectiveness is or what monitoring, if any, should be performed for recurrence of type 2 diabetes in patients who have experienced disease resolution.

Complications of bariatric surgery affect a significant proportion of surgical patients. Patients need to be informed of the morbidity and mortality risks of surgery, and the possibility that re-operation will be required at some stage, including for device removal with LAGB.

Data from the SOS study suggest that, although laparoscopic procedures are currently considered the safest bariatric procedure, restrictive procedures might be the best option for patients who require substantial and durable weight loss.

Until high-quality, controlled trials are completed, appropriateness criteria (based on age, BMI, and the severity of obesity-related comorbidities) may be used to guide the careful selection of patients who may potentially benefit from bariatric surgery.

Complementary and nutritional interventions

Complementary medicines and nutritional supplements can also be used to treat overweight and obesity in paediatric and adult age groups.

There were four meta-analyses and one RCT that were included in this review and are described below. Studies assessed acupuncture, green tea catechins, chitosan and calcium supplementation. Acupuncture, green tea catechins (in conjunction with caffeine) and chitosan have clinically small impacts on body weight. Calcium and green tea catechins alone (in the absence of caffeine) have no impact on body weight.

In addition, Hasani-Ranjbar et al. (2009) reviewed 19 studies (17 RCTs and two uncontrolled clinical studies) conducted in humans that assessed the impacts of herbal preparations on body weight. Studies were generally short in duration (eight weeks or less). The review did not report quantitative changes in body composition, only direction of change in body composition, and did not assess the quality of included studies. The reviewers concluded that Cissus quadrangularis, Sambucus nigra, Asparagus officinalis, Garcinia atroviridis, Slimax, ephedra and caffeine were associated with reductions in body weight.

Included studies

Acupuncture is used in complementary and alternative medicine to reduce body weight. Cho et al. (2009) conducted a meta-analysis of 31 RCTs in 3,013 patients to assess evidence for reduction of body weight. Compared with lifestyle therapy control, acupuncture was associated with a reduction in body weight of 1.7 kg (95% CI, -0.5 to -2.9). Classical acupuncture treatment resulted in greater weight reduction (-2.2 kg; 95% CI, -0.5 to -3.8) than acupressure (-1.6 kg; 95% CI -4.2 to 7.4) or electroacupuncture (-1.2 kg; 95% CI, -0.7 to -3.1). Although the reviewers found that acupuncture is an effective treatment for obesity, poor methodological quality of trials limited the strength of the evidence.

Green tea catechins (GTCs) with or without caffeine have been studied in RCTs for their effect on anthropometric measures and have yielded conflicting results. Phung et al. (2010) conducted a meta-analysis of 15 RCTs in 1,243 patients that assessed the impact of GTCs on anthropometric variables. GTCs with caffeine decreased BMI (-0.6; 95% CI, -0.7 to -0.4), body weight (-1.4 kg; 95% CI, -1.7 to -1.1) and WC (-1.9 cm; 95% CI, -2.8 to -1.0) compared with caffeine alone. GTC ingestion with caffeine also significantly decreased body weight (-0.4 kg; 95% CI, -0.7 to -0.2) when compared with a caffeine-free control. Studies that evaluated GTCs without concomitant caffeine administration did not show benefits on any of the assessed anthropometric endpoints.

Chitosan, a deacetylated chitin, is a dietary supplement reported to decrease body weight. It is widely available over the counter worldwide and although evaluated in a number of trials its efficacy remains in dispute. Jull et al. (2007) conducted a meta-analysis of 15 RCTs in 1,219 adult participants that assessed the effects of chitosan as a treatment for overweight and obesity. Chitosan preparations result in a significantly greater weight loss (weighted mean difference -1.7 kg; 95% CI -2.1 to -1.3) compared with placebo. However, mean trial duration was only 8.3 weeks. Long-term impacts of chitosan therapy on body weight are not estimable.

To test the hypothesis that calcium supplementation can prevent weight gain in persons who are overweight or obese, Yanovski et al. (2009) conducted a RCT with 340 overweight (BMI 25 to <30 kg/m^2) and obese (BMI 30 kg/m^2) adults with a mean age of 38.8 years. Participants received calcium carbonate (elemental calcium 1,500 mg/d) (n = 170) or placebo (n = 170) with meals for two years. There were no statistically or clinically significant differences between the calcium and placebo groups in change in body weight (difference 0.02 kg; 95% CI, -1.6 to

1.7 kg). Winzenberg et al. (2007) conducted a meta-analysis of RCTs that assessed calcium supplementation in children. There were no statistically significant effects of calcium supplementation on weight (0.1 kg; 95% CI, -0.3 to 0.6), height (0.2 cm; 95% CI, -0.3 to 0.7) or body fat (SMD, +0.04; 95% CI, -0.08 to 0.15).

Weight loss and pregnancy

Excessive body weight during pregnancy is associated with a number of adverse health consequences for both the infant and mother. Complications of pregnancy such as pre-eclampsia and gestational diabetes, and poor outcomes including instrumental deliveries, haemorrhage, infection and longer duration of hospital stay, 3rd and 4th degree tears, neonatal intensive care and neonatal trauma occur more commonly in pregnant mothers with excess body weight. Their offspring also experience higher rates of obesity in childhood and adulthood, and greater rates of chronic disease in childhood (Heslehurst et al., 2008).

Women may be at risk of overweight or obesity post-pregnancy. A meta-analysis by Schmitt et al. (2007) of 25 studies found that mean body weight usually declines within the first year postpartum. Data on body weight later than 12 months suggests a re-increase in body weight from this time point. As these are lifestyle-related rather than biological reasons for an increase in body weight after one year postpartum, the authors suggest weight regain after 12 months is most likely to be lifestyle-related.

As a criterion for inclusion of studies in this review was duration of intervention greater than 12 months, the majority of obesity management studies conducted with pregnant women were not included in the general review. However, there were 34 studies that were identified through the systematic search and coding process described in the methods at the beginning of this report. The results of these studies are described narratively for the purposes of reporting key findings from systematic reviews / meta-analyses and RCTs published since 2007.

Identified studies

Evidence regarding the impact of dietary and physical activity counselling provided in pregnancy remains unclear. Kramer (1996) conducted a systematic review of studies that assessed the effects of low-energy diets in pregnancy. Three studies involving 266 women were reported. Energy / protein restriction led to a significant reduction in weekly maternal weight gain and in birth weight but had no clear effect on either pregnancy-induced hypertension or pre-eclampsia. Dodd et al. (2010) conducted a subsequent systematic review of antenatal interventions for overweight or obese pregnant women that assessed the impact of dietary and physical activity interventions on excess weight gain. There were no statistically significant differences identified between women who received an antenatal intervention and those who did not for the large-for-gestational-age infant outcome (three studies; 366 women; risk ratio 2.02; 95% CI 0.84, 4.86) or mean gestational weight gain (four studies; 416 women; weighted mean difference 3.10 kg; 95% CI 8.32, 2.13). There were no statistically significant differences identified for other reported outcomes.

Subsequent to searches being conducted in the Dodd review, a RCT published by Asbee et al. (2009) demonstrated that lifestyle counselling results in significantly less weight than routine prenatal care (28.7 ± 12.5 lb compared with 35.6 ± 15.5 lb, P = .01). Routine prenatal care was associated with significantly more cesarean deliveries due to "failure to progress" (routine prenatal care 58.3% compared with lifestyle counseling 25.0%, P = .02). In contrast, Guelinckx et al. (2010) conducted a RCT that assessed the impacts of lifestyle interventions on gestational

weight gain in pregnant women with obesity and found no effect of lifestyle interventions on weight gain.

Jeffries et al. (2009) conducted an Australian RCT to determine if regular weight measurement throughout pregnancy affected gestational weight gain. In the study population, there was a trend to less weight gain in the intervention group. The women in the intervention group experienced a mean (SD) per-week weight gain of 0.44 (0.17) kg compared with those in the control group, who gained 0.46 (0.16) kg/week (mean difference, 0.02 kg/week; 95% CI, - 0.02 to 0.07 kg/week).

The impact of aerobic or resistance exercise on gestation weight gain in the absence of dietary change is uncertain. Streuling et al. (2011) conducted a meta-analysis of seven RCTs in non-obese pregnant women and found less gestational weight gain with physical activity compared with controls. However, RCTs conducted in pregnant women with obesity suggest that exercise is not associated with significant reductions in gestational weight gain, nor does it appear to prevent the development of gestational diabetes mellitus (Barakat et al., 2009; Callaway et al., 2010). However, light resistance exercise does not appear to have adverse effects on the newborn's body size or overall health (Barakat et al. 2009) and may therefore be combined with nutritional interventions for prevention of excess weight gain.

The 2009 weight gain recommendations from the Institute of Medicine (IOM 2009, figure 6) encourage weight gain appropriate to good fetal development but acknowledge obese women should attempt to moderate weight gain during pregnancy to avoid contributing to obstetric complications. Fetal nutrition is a priority but pregnancy cannot be seen as a time of unrestrained eating and little exercise.

Figure 6: IOM Weight gain during pregnancy recommendation

If your prepregnancy BMI was	You should gain
Less than 18.5 kg/m^2	12.5 to 18 kg
18.5 to 24.9 kg/m^2	11.5 to 16 kg
25 to 29.9 kg/m^2	7 to 11.5 kg
Above 30 kg/m^2	5 to 9 kg

After pregnancy, extended breastfeeding is recommended. Infants who are breastfed for at least six months are less likely to gain excessive weight and develop obesity later in life (Campbell et al., 2010).

Weight loss and Indigenous Australian study participants

Studies included in this review did not report assessment of weight loss interventions in Aboriginal or Torres Strait Islander populations. There is very limited data regarding the effectiveness of lifestyle, pharmacological or surgical interventions in Indigenous groups.

A systematic review of the literature conducted by the NSW Centre for Overweight and Obesity (COO) appraised evidence for effective weight reduction interventions in Aboriginal and Torres Strait Islander populations (2005). Only four studies were identified that specifically measured weight or waist circumference as an outcome variable. Virtually all health programs involving lifestyle changes that may positively impact overweight and obesity were conducted in rural or

remote Aboriginal communities yet the majority of Aboriginal and Torres Strait Islanders live in urban regions and this is where the prevalence of obesity is highest. However, as Aboriginal and Torres Strait Islander peoples live in urban, rural and remote locations, programs need to be developed that are accessible, culturally appropriate and relevant to people in each of these areas.

- Weight loss was achieved in the Healthy Weight Program in Queensland (Dunn and Dewis, 2001), but this was only measured at completion of the eight week program.
- Egger et al. (1999) assessed the effectiveness of a men's waist loss program ("GutBuster' modified for Indigenous men) over 12 months in 47 men in the Torres Strait. Average weight losses achieved were 3.3 kg and waist losses were 4 cm.
- Rowley et al. (2000) (Looma healthy lifestyle program)[13] assessed the sustainability and effectiveness of a community-directed program for primary and secondary prevention of obesity in 245 participants in an Aboriginal community in Western Australia. Involvement in diet and / or exercise strategies was not associated with sustained weight loss. However, dietary intake and physical activity improved. In paediatric community members, an integrated program of improved diet, health education and regular exercise was associated with improved diet quality and lower rates of excess body weight than the broader Australian Aboriginal community.
- O'Dea (1984), in a seminal study in north-west Australia found that in traditional country living off the land metabolic control in diabetes and vascular risk factors improved and weight reduction was observed.

No studies were identified in this systematic review that could provide an update to the COO review. O'Dea et al. (2007) highlights the opportunities for practical intervention in responding to the linked problems of obesity and type 2 diabetes. A systematic approach to improving the nutritional status of infants, improved maternal and child health, changes in food supply, increased opportunities for physical activity and health promotion are advocated. These actions need to be underpinned by initiatives to address social disadvantage.

[13] Australian Indigenous Health InfoNet. Looma Healthy Lifestyle Program. Available at: http://www.healthinfonet.ecu.edu.au/key-resources/programs-projects?pid=614

References

Included studies

1. Afshinnia, F., T. Wilt, et al. (2010). "Weight loss and proteinuria: systematic review of clinical trials and comparative cohorts." Nephrol Dial Transplant 25(4): 1173-1183.
2. Arem, H. & M. Irwin (2011). “A review of web-based weight loss interventions in adults.” Obesity Reviews 12(5): e236-43.
3. Aucott, L., H. Rothnie, et al. (2009) "Long-term weight loss from lifestyle intervention benefits blood pressure: a systematic review (Provisional abstract)." Hypertension 54(4): 756-762.
4. Azadbakht, L., P. Mirmiran, et al. (2007). "Better dietary adherence and weight maintenance achieved by a long-term moderate-fat diet." Br J Nutr 97(2): 399-404.
5. Belalcazar, L., D. Reboussin, et al. (2010). "A 1-year lifestyle intervention for weight loss in individuals with type 2 diabetes reduces high C-reactive protein levels and identifies metabolic predictors of change: from the Look AHEAD (Action for Health in Diabetes) study." Diabetes Care 33(11): 2297-2303.
6. Blaine, B., J. Rodman, et al. (2007). "Weight loss treatment and psychological well-being: a review and meta-analysis." J Health Psychol 12(1): 66-82.
7. Bosch-Capblanch, X., K. Abba, et al. (2007) "Contracts between patients and healthcare practitioners for improving patients' adherence to treatment, prevention and health promotion activities." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD004808.pub3.
8. Buchwald, H., R. Estok, et al. (2009) "Weight and type 2 diabetes after bariatric surgery: systematic review and meta-analysis (Structured abstract)." American Journal of Medicine 122(3): 248-256.
9. Campbell, P., M. Wener, et al. (2008). "Effect of exercise on in vitro immune function: a 12-month randomized, controlled trial among postmenopausal women." J Appl Physiol 104(6): 1648-1655.
10. Chavez-Tapia, C., I. Tellez-Avila, et al. (2010) "Bariatric surgery for non-alcoholic steatohepatitis in obese patients." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD007340.pub2.
11. Cheskin, L., A. Mitchell, et al. (2008). "Efficacy of meal replacements versus a standard food-based diet for weight loss in type 2 diabetes: a controlled clinical trial." Diabetes Educ 34(1): 118-127.
12. Cho, S. H., J. S. Lee, et al. (2009) "Acupuncture for obesity: a systematic review and meta-analysis (Structured abstract)." International Journal of Obesity 33(2): 183-196.
13. Christensen, R., E. Bartels, et al. (2007) "Effect of weight reduction in obese patients diagnosed with knee osteoarthritis: a systematic review and meta-analysis (Structured abstract)." Annals of the Rheumatic Diseases 66(4): 433-439.
14. Christensen, R., P. Kristensen, et al. (2007) "Efficacy and safety of the weight-loss drug rimonabant: a meta-analysis of randomised trials (Structured abstract)." Lancet 370(9600): 1706-1713.

15. Christian, J., D. Bessesen, et al. (2008). "Clinic-based support to help overweight patients with type 2 diabetes increase physical activity and lose weight." Arch Intern Med 168(2): 141-146.

16. Collins, C., J. Warren, et al. (2007) "Systematic review of interventions in the management of overweight and obese children which include a dietary component (Structured abstract)." International Journal of Evidence-Based Healthcare 5(1): 2-53.

17. Colquitt, J., J. Picot, et al. (2009) "Surgery for obesity." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD003641.pub3.

18. Cooper, Z., H. Doll, D. Hawker, et al. (2010). "Testing a new cognitive behavioural treatment for obesity: A randomized controlled trial with three-year follow-up." Behavioral Research and Therapy 48(8): 706-13.

19. Curioni, C. and C. André (2006) "Rimonabant for overweight or obesity." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD006162.pub2.

20. Curioni, C., C. André, et al. (2006) "Weight reduction for primary prevention of stroke in adults with overweight or obesity." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD006062.pub2.

21. Cussler, E., P. Teixeira, et al. (2008). "Maintenance of weight loss in overweight middle-aged women through the Internet." Obesity (Silver Spring) 16(5): 1052-1060.

22. Czernichow, S., C. Lee, et al. (2010) "Efficacy of weight loss drugs on obesity and cardiovascular risk factors in obese adolescents: a meta-analysis of randomized controlled trials (Provisional abstract)." Obesity Reviews 11(8): 150-158.

23. Dale, K., J. Mann, et al. (2008). "Sustainability of lifestyle changes following an intensive lifestyle intervention in insulin resistant adults: Follow-up at 2-years." Asia Pac J Clin Nutr 18(1): 114-120.

24. Daniels, S., B. Long, et al. (2007). "Cardiovascular effects of sibutramine in the treatment of obese adolescents: results of a randomized, double-blind, placebo-controlled study." Pediatrics 120(1): e147-157.

25. Dansinger, M., A. Tatsioni, et al. (2007). "Meta-analysis: the effect of dietary counseling for weight loss." Ann Intern Med 147(1): 41-50.

26. De Groot, N., J. Burgerhart, et al. (2009) "Systematic review: the effects of conservative and surgical treatment for obesity on gastro-oesophageal reflux disease (Provisional abstract)." Alimentary Pharmacology and Therapeutics 30(11-12): 1091-1102.

27. de Jong, J., M. Besselink, et al. (2010) "Effects of adjustable gastric banding on gastroesophageal reflux and esophageal motility: a systematic review (Structured abstract)." Obesity Reviews 11(4): 297-305.

28. DeMattia, L., L. Lemont, et al. (2007) "Do interventions to limit sedentary behaviours change behaviour and reduce childhood obesity: a critical review of the literature (Structured abstract)." Obesity Reviews 8(1): 69-81.

29. Dixon, J., P. O'Brien, et al. (2008). "Adjustable gastric banding and conventional therapy for type 2 diabetes: a randomized controlled trial." JAMA 299(3): 316-323.

30. Eliasson, B., S. Gudbjornsdottir, et al. (2007). "Weight loss and metabolic effects of topiramate in overweight and obese type 2 diabetic patients: randomized double-blind placebo-controlled trial." Int J Obes (Lond) 31(7): 1140-1147.

31. Fernandes, M., A. Atallah, et al. (2007). "Intragastric balloon for obesity." Cochrane Database Syst Rev(1): CD004931.

32. Flodgren, G., K. Deane, et al. (2010). "Interventions to change the behaviour of health professionals and the organisation of care to promote weight reduction in overweight and obese people." Cochrane Database Syst Rev(3): CD000984.

33. Ford, A., C. Bergh, P. Sodersten, et al. (2010). “Treatment of childhood obesity by retraining eating behaviour: randomised controlled trial.” BMJ 340: b5388.

34. Foster, G., K. Borradaile, et al. (2009). "A randomized study on the effect of weight loss on obstructive sleep apnea among obese patients with type 2 diabetes: the Sleep AHEAD study." Arch Intern Med 169(17): 1619-1626.

35. Franz, M., J. Van Wormer, et al. (2007) "Weight-loss outcomes: a systematic review and meta-analysis of weight-loss clinical trials with a minimum 1-year follow-up (Provisional abstract)." Journal of the American Dietetic Association 107(10): 1755-1767.

36. Fried, M., G. Ribaric, et al. (2010) "Metabolic surgery for the treatment of type 2 diabetes in patients with BMI <35 kg/m^2: an integrative review of early studies (Provisional abstract)." Obesity Surgery 20(6): 776-790.

37. Galani, C. and H. Schneider (2007) "Prevention and treatment of obesity with lifestyle interventions: review and meta-analysis (Provisional abstract)." International Journal of Public Health 52(6): 348-359.

38. Garb, J., G. Welch, et al. (2009) "Bariatric surgery for the treatment of morbid obesity: a meta-analysis of weight loss outcomes for laparoscopic adjustable gastric banding and laparoscopic gastric bypass (Provisional abstract)." Obesity Surgery 19(10): 1447-1455.

39. Golley, R., A. Magarey, et al. (2007). "Twelve-month effectiveness of a parent-led, family-focused weight-management program for prepubertal children: a randomized, controlled trial." Pediatrics 119(3): 517-525.

40. Greenburg, D., C. Lettieri, A. Eliasson (2009). “Effects of surgical weight loss on measures of obstructive sleep apnea: a meta-analysis.” American Journal of Medicine 122(6): 535-42.

41. Greenway, F., K. Fujioka, et al. (2010). "Effect of naltrexone plus bupropion on weight loss in overweight and obese adults (COR-I): a multicentre, randomised, double-blind, placebo-controlled, phase 3 trial." Lancet 376(9741): 595-605.

42. Groeneveld, I., K. Proper, et al. (2010). "Sustained body weight reduction by an individual-based lifestyle intervention for workers in the construction industry at risk for cardiovascular disease: results of a randomized controlled trial." Prev Med 51(3-4): 240-246.

43. Haapala, I., N. Barengo, et al. (2009). "Weight loss by mobile phone: a 1-year effectiveness study." Public Health Nutr 12(12): 2382-2391.

44. Hemmingsson, E., J. Udden, et al. (2009). "Increased physical activity in abdominally obese women through support for changed commuting habits: a randomized clinical trial." Int J Obes (Lond) 33(6): 645-652.

45. Horvath, K., K. Jeitler, et al. (2008). "Long-term effects of weight-reducing interventions in hypertensive patients: systematic review and meta-analysis." Arch Intern Med 168(6): 571-580.

46. Hughes, A., L. Stewart, et al. (2008). "Randomized, controlled trial of a best-practice individualized behavioral program for treatment of childhood overweight: Scottish Childhood Overweight Treatment Trial (SCOTT)." Pediatrics 121(3): e539-546.

47. Huisman, S., V. De Gucht, et al. (2009). "The effect of weight reduction interventions for persons with type 2 diabetes: a meta-analysis from a self-regulation perspective." Diabetes Educ 35(5): 818-835.

48. Ilanne-Parikka, P., J. Eriksson, et al. (2008). "Effect of lifestyle intervention on the occurrence of metabolic syndrome and its components in the Finnish Diabetes Prevention Study." Diabetes Care 31(4): 805-807.

49. Imaz, I., C. Martinez-Cervell, et al. (2008) "Safety and effectiveness of the intragastric balloon for obesity: a meta-analysis (Structured abstract)." Obesity Surgery 18(7): 841-846.

50. Jacob, S., M. Rabbia, et al. (2009). "Orlistat 120 mg improves glycaemic control in type 2 diabetic patients with or without concurrent weight loss." Diabetes Obes Metab 11(4): 361-371.

51. James, W., I. Caterson, et al. (2010). "Effect of sibutramine on cardiovascular outcomes in overweight and obese subjects." N Engl J Med 363(10): 905-917.

52. Janssen, I. and A. LeBlanc (2010) "Systematic review of the health benefits of physical activity and fitness in school-aged children and youth (Provisional abstract)." International Journal of Behavioral Nutrition and Physical Activity (7):40.

53. Jenkinson, C., M. Doherty, et al. (2009). "Effects of dietary intervention and quadriceps strengthening exercises on pain and function in overweight people with knee pain: randomised controlled trial." BMJ 339: b3170.

54. Johnston, C., C. Tyler, et al. (2010). "Effects of a school-based weight maintenance program for Mexican-American children: results at 2 years." Obesity (Silver Spring) 18(3): 542-547.

55. Jull, A., C. Ni Mhurchu, et al. (2008). "Chitosan for overweight or obesity." Cochrane Database Syst Rev(3): CD003892.

56. Kalarchian, M., M. Levine, et al. (2009). "Family-based treatment of severe pediatric obesity: randomized, controlled trial." Pediatrics 124(4): 1060-1068.

57. Kalavainen, M., M. Korppi, et al. (2007). "Clinical efficacy of group-based treatment for childhood obesity compared with routinely given individual counseling." Int J Obes (Lond) 31(10): 1500-1508.

58. Kelly, S. and B. Mazurek Melnyk (2008) "Systematic review of multicomponent interventions with overweight middle adolescents: implications for clinical practice and research (Structured abstract)." Worldviews on Evidence-Based Nursing 5(3): 113-135.

59. Keranen, A., M. Savolainen, et al. (2009). "The effect of eating behavior on weight loss and maintenance during a lifestyle intervention." Prev Med 49(1): 32-38.

60. Knowler, W., S. Fowler, et al. (2009). "10-year follow-up of diabetes incidence and weight loss in the Diabetes Prevention Program Outcomes Study." Lancet 374(9702): 1677-1686.

61. Li, M., S. Li, et al. (2008) "A systematic review of school-based intervention studies for the prevention or reduction of excess weight among Chinese children and adolescents (Structured abstract)." Obesity Reviews 9(6): 548-559.

62. Littman, A., M. Vitiello, et al. (2007). "Sleep, ghrelin, leptin and changes in body weight during a 1-year moderate-intensity physical activity intervention." Int J Obes (Lond) 31(3): 466-475.

63. Madsen, E., A. Rissanen, et al. (2008). "Weight loss larger than 10% is needed for general improvement of levels of circulating adiponectin and markers of inflammation in obese subjects: a 3-year weight loss study." Eur J Endocrinol 158(2): 179-187.

64. Manini, T., A. Newman, et al. (2010). "Effects of exercise on mobility in obese and nonobese older adults." Obesity (Silver Spring) 18(6): 1168-1175.

65. Martin, P., G. Dutton, et al. (2008). "Weight loss maintenance following a primary care intervention for low-income minority women." Obesity (Silver Spring) 16(11): 2462-2467.

66. McCallum, Z., M. Wake, et al. (2007). "Outcome data from the LEAP (Live, Eat and Play) trial: a randomized controlled trial of a primary care intervention for childhood overweight/mild obesity." Int J Obes (Lond) 31(4): 630-636.

67. McConnon, A., S. Kirk, et al. (2007). "The Internet for weight control in an obese sample: results of a randomised controlled trial." BMC Health Serv Res 7: 206.

68. McGovern, L., J. Johnson, R. Paulo, et al. “Treatment of pediatric obesity: a systematic review and meta-analysis of randomised trials.” Journal of Clinical Endocrinology and Metabolism 93(12): 4600-05.

69. Moran, L., S. Hutchison, et al. (2011) "Lifestyle changes in women with polycystic ovary syndrome." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD007506.pub2.

70. Morey, M., D. Snyder, et al. (2009). "Effects of home-based diet and exercise on functional outcomes among older, overweight long-term cancer survivors: RENEW: a randomized controlled trial." JAMA 301(18): 1883-1891.

71. Navaneethan, S., H. Yehnert, et al. (2009) "Weight loss interventions in chronic kidney disease: a systematic review and meta-analysis (Structured abstract)." Clinical Journal of The American Society of Nephrology 4(10): 1565-1574.

72. Neovius, M., K. Johansson, et al. (2008) "Head-to-head studies evaluating efficacy of pharmaco-therapy for obesity: a systematic review and meta-analysis (Structured abstract)." Obesity Reviews 9(5): 420-427.

73. Neve, M., P. Morgan, et al. (2010). "Effectiveness of web-based interventions in achieving weight loss and weight loss maintenance in overweight and obese adults: a systematic review with meta-analysis." Obes Rev 11(4): 306-321.

74. Nguyen, B., K. Kornman, L. Baur (2011). “A review of electronic interventions for prevention and treatment of overweight and obesity in young people.” Obesity Reviews 12(5): e298-314.

75. Nield, L., H. Moore, et al. (2007) "Dietary advice for treatment of type 2 diabetes mellitus in adults." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD004097.pub4.

76. Nieuwenhuis-Ruifrok, A., W. Kuchenbecker, et al. (2009). "Insulin sensitizing drugs for weight loss in women of reproductive age who are overweight or obese: systematic review and meta-analysis." Hum Reprod Update 15(1): 57-68.

77. Nissen, S., S. Nicholls, et al. (2008). "Effect of rimonabant on progression of atherosclerosis in patients with abdominal obesity and coronary artery disease: the STRADIVARIUS randomized controlled trial." JAMA 299(13): 1547-1560.

78. Norris, S., L. Zhang, et al. (2005) "Long-term non-pharmacological weight loss interventions for adults with type 2 diabetes mellitus." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD004095.pub2.

79. Norris, S., L. Zhang, et al. (2005) "Long-term non-pharmacological weight loss interventions for adults with prediabetes." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD005270.

80. Norris, S., L. Zhang, et al. (2005) "Pharmacotherapy for weight loss in adults with type 2 diabetes mellitus." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD004096.pub2.

81. O'Brien, P., S. Sawyer, C. Laurie, et al. (2010). “Laparoscopic adjustable gastric banding in severely obese adolescents: a randomized trial.” JAMA 303(6): 519-26.

82. Okely, A., C. Collins, et al. (2010). "Multi-site randomized controlled trial of a child-centered physical activity program, a parent-centered dietary-modification program, or both in overweight children: the HIKCUPS study." J Pediatr 157(3): 388-394, 394 e381.

83. Oude Luttikhuis, H., L. Baur, et al. (2009). "Interventions for treating obesity in children." Cochrane Database Syst Rev(1): CD001872.

84. Padwal, R., S. Klarenbach, N. Wiebe, et al. (2011). “Bariatric surgery: a systematic review and network meta-analysis of randomized trials.” Obesity Reviews 12(8): 602-21.

85. Padwal, R., D. Rucker, et al. (2003) "Long-term pharmacotherapy for obesity and overweight." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD004094.pub2.

86. Parikh, P., E. Simon, et al. (2010). "Results of a pilot diabetes prevention intervention in East Harlem, New York City: Project HEED." Am J Public Health 100 Suppl 1: S232-239.

87. Paul-Ebhohimhen, V. and A. Avenell (2008) "Systematic review of the use of financial incentives in treatments for obesity and overweight (Structured abstract)." Obesity Reviews 9(4): 355-367.

88. Paul-Ebhohimhen, V. and A. Avenell (2009). "A systematic review of the effectiveness of group versus individual treatments for adult obesity." Obes Facts 2(1): 17-24.

89. Phung, O. J., W. L. Baker, et al. (2010) "Effect of green tea catechins with or without caffeine on anthropometric measures: a systematic review and meta-analysis (Provisional abstract)." American Journal of Clinical Nutrition 91(1): 73-81.

90. Pi-Sunyer, X., G. Blackburn, et al. (2007). "Reduction in weight and cardiovascular disease risk factors in individuals with type 2 diabetes: one-year results of the look AHEAD trial." Diabetes Care 30(6): 1374-1383.

91. Picot, J., J. Jones, et al. (2009) "The clinical effectiveness and cost-effectiveness of bariatric (weight loss) surgery for obesity: a systematic review and economic evaluation (Brief record)." Health Technology Assessment 13(41): 1-190.

92. Plachta-Danielzik, S., S. Pust, et al. (2007). "Four-year follow-up of school-based intervention on overweight children: the KOPS study." Obesity (Silver Spring) 15(12): 3159-3169.

93. Pontiroli, A. and A. Morabito (2011). "Long-term prevention of mortality in morbid obesity through bariatric surgery. a systematic review and meta-analysis of trials performed with gastric banding and gastric bypass." Ann Surg 253(3): 484-487.

94. Potteiger, J., E. Kirk, et al. (2008). "Changes in resting metabolic rate and substrate oxidation after 16 months of exercise training in overweight adults." Int J Sport Nutr Exerc Metab 18(1): 79-95.

95. Proietto, J., A. Rissanen, J. Harp, et al. (2010). “A clinical trial assessing the safety and efficiacy of the CB1R inverse agonist taranabant in obese and overweight patients: low dose study.” International Journal of Obesity 34(8): 1243-54.

96. Provencher, V., C. Begin, et al. (2009). "Health-At-Every-Size and eating behaviors: 1-year follow-up results of a size acceptance intervention." J Am Diet Assoc 109(11): 1854-1861.

97. Reis, L., W. Favaro, et al. (2010). "Erectile dysfunction and hormonal imbalance in morbidly obese male is reversed after gastric bypass surgery: a prospective randomized controlled trial." Int J Androl 33(5): 736-744.

98. Richardson, C., T. Newton, et al. (2008). "A meta-analysis of pedometer-based walking interventions and weight loss." Ann Fam Med 6(1): 69-77.

99. Rucker, D., R. Padwal, et al. (2007). "Long term pharmacotherapy for obesity and overweight: updated meta-analysis." BMJ 335(7631): 1194-1199.

100. Ryan, D., W. Johnson, et al. (2010). "Nonsurgical weight loss for extreme obesity in primary care settings: results of the Louisiana Obese Subjects Study." Arch Intern Med 170(2): 146-154.

101. Sargent, G., L. Pilotto, L Baur, (2011). “Components of primary care interventions to treat childhood overweight and obesity: a systematic review of effect.” Obesity Reviews 12(5): e219-35.

102. Savoye, M., M. Shaw, et al. (2007). "Effects of a weight management program on body composition and metabolic parameters in overweight children: a randomized controlled trial." JAMA 297(24): 2697-2704.

103. Schmitz, K., P. Hannan, et al. (2007). "Strength training and adiposity in premenopausal women: strong, healthy, and empowered study." Am J Clin Nutr 86(3): 566-572.

104. Seo, D. and J. Sa (2008). "A meta-analysis of psycho-behavioral obesity interventions among US multiethnic and minority adults." Prev Med 47(6): 573-582.

105. Shaw, K., H. Gennat, et al. (2006) "Exercise for overweight or obesity." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD003817.pub3.

106. Shaw, K., P. O'Rourke, et al. (2005) "Psychological interventions for overweight or obesity." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD003818.pub2.

107. Shea, M., D. Houston, et al. (2010). "The effect of randomization to weight loss on total mortality in older overweight and obese adults: the ADAPT Study." J Gerontol A Biol Sci Med Sci 65(5): 519-525.

108. Siebenhofer, A., K. Horvath, et al. (2009) "Long-term effects of weight-reducing drugs in hypertensive patients." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD007654.pub2.

109. Silva, M., P. Vieira, et al. (2010). "Using self-determination theory to promote physical activity and weight control: a randomized controlled trial in women." J Behav Med 33(2): 110-122.

110. Smith, S., N. Weissman, et al. (2010). "Multicenter, placebo-controlled trial of lorcaserin for weight management." N Engl J Med 363(3): 245-256.

111. Stahre, L., B. Tarnell, et al. (2007). "A randomized controlled trial of two weight-reducing short-term group treatment programs for obesity with an 18-month follow-up." Int J Behav Med 14(1): 48-55.

112. Svendsen, M., M. Helgeland, et al. (2009). "The long-term influence of orlistat on dietary intake in obese subjects with components of metabolic syndrome." J Hum Nutr Diet 22(1): 55-63.

113. Svetkey, L., V. Stevens, P. Brantley, et al. (2008). “Comparison of strategies for sustaining weight loss: the weight loss maintenance randomized controlled trial.” JAMA 299(10): 1139-48.

114. Teixeira, P., M. Silva, et al. (2010). "Mediators of weight loss and weight loss maintenance in middle-aged women." Obesity (Silver Spring) 18(4): 725-735.

115. ter Bogt, N., W. Bemelmans, et al. (2009). "Preventing weight gain: one-year results of a randomized lifestyle intervention." Am J Prev Med 37(4): 270-277.

116. Thomas, D., E. Elliott, et al. (2006) "Exercise for type 2 diabetes mellitus." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD002968.pub2.

117. Treadwell, J., F. Sun, et al. (2008). "Systematic review and meta-analysis of bariatric surgery for pediatric obesity." Ann Surg 248(5): 763-776.

118. Tsai, A. and T. Wadden (2009) "Treatment of obesity in primary care practice in the United States: a systematic review (Structured abstract)." Journal of General Internal Medicine 24(9): 1073-1079.

119. Tuomilehto, H., J. Seppa, et al. (2009). "Lifestyle intervention with weight reduction: first-line treatment in mild obstructive sleep apnea." Am J Respir Crit Care Med 179(4): 320-327.

120. Turk, M., K. Yang, M. Hravnak, et al. (2009). “Randomised clinical trials of weight loss maintenance: a review.” Journal of Cardiovascular Nursing 24(1): 58-80.

121. Uusitupa, M., M. Peltonen, et al. (2009). "Ten-year mortality and cardiovascular morbidity in the Finnish Diabetes Prevention Study--secondary analysis of the randomized trial." PLoS One 4(5): e5656.

122. Van Gaal, L., A. Scheen, et al. (2008). "Long-term effect of CB1 blockade with rimonabant on cardiometabolic risk factors: two year results from the RIO-Europe Study." Eur Heart J 29(14): 1761-1771.

123. Villareal, D., S. Chode, et al. (2011). "Weight loss, exercise, or both and physical function in obese older adults." N Engl J Med 364(13): 1218-1229.

124. Villareal, D., K. Shah, et al. (2008). "Effect of weight loss and exercise therapy on bone metabolism and mass in obese older adults: a one-year randomized controlled trial." J Clin Endocrinol Metab 93(6): 2181-2187.

125. Viner, R., Y. Hsia, et al. (2010). "Efficacy and safety of anti-obesity drugs in children and adolescents: systematic review and meta-analysis." Obes Rev 11(8): 593-602.

126. Wake, M., L. Baur, et al. (2009). "Outcomes and costs of primary care surveillance and intervention for overweight or obese children: the LEAP 2 randomised controlled trial." BMJ 339: b3308.

127. Whitlock, E., E. O'Connor, et al. (2008) "Effectiveness of weight management programs in children and adolescents (Structured abstract)." Agency for Healthcare Research and Quality, 100.

128. Whitlock, E., E. O'Connor, et al. (2010a) "Effectiveness of primary care interventions for weight management in children and adolescents: an updated, targeted systematic review for the USPSTF (Structured abstract)." Agency for Healthcare Research and Quality, 1.

129. Whitlock, E., E. O'Connor, et al. (2010b). "Effectiveness of weight management interventions in children: a targeted systematic review for the USPSTF." Pediatrics 125(2): e396-418.

130. Wilfley, D., R. Stein, et al. (2007). "Efficacy of maintenance treatment approaches for childhood overweight: a randomized controlled trial." JAMA 298(14): 1661-1673.

131. Wilson, D., S. Abrams, et al. (2010). "Metformin extended release treatment of adolescent obesity: a 48-week randomized, double-blind, placebo-controlled trial with 48-week follow-up." Arch Pediatr Adolesc Med 164(2): 116-123.

132. Wing, R. (2010). "Long-term effects of a lifestyle intervention on weight and cardiovascular risk factors in individuals with type 2 diabetes mellitus: four-year results of the Look AHEAD trial." Arch Intern Med 170(17): 1566-1575.

133. Wing, R., D. West, et al. (2010). "Effect of weight loss on urinary incontinence in overweight and obese women: results at 12 and 18 months." J Urol 184(3): 1005-1010.

134. Winzenberg, T., K. Shaw, et al. (2007) "Calcium supplements in healthy children do not affect weight gain, height, or body composition (Provisional abstract)." Obesity 15(7): 1789-1798.

135. Witham, M. and A. Avenell (2010) "Interventions to achieve long-term weight loss in obese older people: a systematic review and meta-analysis (Provisional abstract)." Age and Ageing 39(2): 176-184.

136. Yanovski, J. A., S. J. Parikh, et al. (2009). "Effects of calcium supplementation on body weight and adiposity in overweight and obese adults: a randomized trial." Ann Intern Med 150(12): 821-829, W145-826.

Excluded studies

1. Aasheim, E. T., S. Bjorkman, et al. (2009). "Vitamin status after bariatric surgery: a randomized study of gastric bypass and duodenal switch." Am J Clin Nutr 90(1): 15-22.

2. Abrams, S. A., I. J. Griffin, et al. (2007). "Effect of probiotic supplementation and calcium intake on body mass index." J Pediatr 151(3): 293-298.

3. Ackermann, R. T., S. L. Edelstein, et al. (2009). "Changes in health state utilities with changes in body mass in the Diabetes Prevention Program." Obesity (Silver Spring) 17(12): 2176-2181.

4. Ades, P. A., P. D. Savage, et al. (2009). "High-calorie-expenditure exercise: a new approach to cardiac rehabilitation for overweight coronary patients." Circulation 119(20): 2671-2678.

5. Akers, J. D., P. A. Estabrooks, et al. (2010). "Translational research: bridging the gap between long-term weight loss maintenance research and practice." J Am Diet Assoc 110(10): 1511-1522, 1522 e1511-1513.

6. Albu, J. B., L. K. Heilbronn, et al. (2010). "Metabolic changes following a 1-year diet and exercise intervention in patients with type 2 diabetes." Diabetes 59(3): 627-633.

7. Alhassan, S., S. Kim, et al. (2008). "Dietary adherence and weight loss success among overweight women: results from the A to Z weight loss study." Int J Obes (Lond) 32(6): 985-991.

8. Alvarez-Jimenez, M., S. E. Hetrick, et al. (2008). "Non-pharmacological management of antipsychotic-induced weight gain: systematic review and meta-analysis of randomised controlled trials." Br J Psychiatry 193(2): 101-107.

9. Alvarez-Jimenez, M., O. Martinez-Garcia, et al. (2010). "Prevention of antipsychotic-induced weight gain with early behavioural intervention in first-episode psychosis: 2-year results of a randomized controlled trial." Schizophr Res 116(1): 16-19.

10. Amorim Adegboye, A., M. Linne, et al. (2007) "Diet or exercise, or both, for weight reduction in women after childbirth." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD005627.pub2.

11. An, J. Y., L. L. Hayman, et al. (2009) "Web-based weight management programs for children and adolescents: a systematic review of randomized controlled trial studies (Structured abstract)." Advances in Nursing Science, 222-240.

12. Anderson, L. M., T. A. Quinn, et al. (2009) "The effectiveness of worksite nutrition and physical activity interventions for controlling employee overweight and obesity: a systematic review (Structured abstract)." American Journal of Preventive Medicine, 340-357.

13. Angrisani, L., P. P. Cutolo, et al. (2009). "Laparoscopic adjustable gastric banding with truncal vagotomy versus laparoscopic adjustable gastric banding alone: interim results of a prospective randomized trial." Surg Obes Relat Dis 5(4): 435-438.

14. Angrisani, L., M. Lorenzo, et al. (2007). "Laparoscopic adjustable gastric banding versus Roux-en-Y gastric bypass: 5-year results of a prospective randomized trial." Surg Obes Relat Dis 3(2): 127-132; discussion 132-123.

15. Arceo-Olaiz, R., M. N. Espana-Gomez, et al. (2008). "Maximal weight loss after banded and unbanded laparoscopic Roux-en-Y gastric bypass: a randomized controlled trial." Surg Obes Relat Dis 4(4): 507-511.

16. Aronne, L. J., S. Tonstad, et al. (2010). "A clinical trial assessing the safety and efficacy of taranabant, a CB1R inverse agonist, in obese and overweight patients: a high-dose study." Int J Obes (Lond) 34(5): 919-935.

17. Ashley, J. M., H. Herzog, et al. (2007). "Nutrient adequacy during weight loss interventions: a randomized study in women comparing the dietary intake in a meal replacement group with a traditional food group." Nutr J 6: 12.

18. Astrup, A., F. L. Greenway, et al. (2007). "Randomized controlled trials of the D1/D5 antagonist ecopipam for weight loss in obese subjects." Obesity (Silver Spring) 15(7): 1717-1731.

19. Aubertin-Leheudre, M., C. Lord, et al. (2007). "Effect of 6 months of exercise and isoflavone supplementation on clinical cardiovascular risk factors in obese postmenopausal women: a randomized, double-blind study." Menopause 14(4): 624-629.

20. Ayala, G. X., J. P. Elder, et al. (2010). "Longitudinal intervention effects on parenting of the Aventuras para Ninos study." Am J Prev Med 38(2): 154-162.

21. Baker Philip, R. A., P. Francis Daniel, et al. (2011) "Community wide interventions for increasing physical activity." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD008366.pub2.

22. Barnard, N. D., J. Cohen, et al. (2009). "A low-fat vegan diet and a conventional diabetes diet in the treatment of type 2 diabetes: a randomized, controlled, 74-wk clinical trial." Am J Clin Nutr 89(5): 1588S-1596S.

23. Barnard, N. D., L. Gloede, et al. (2009). "A low-fat vegan diet elicits greater macronutrient changes, but is comparable in adherence and acceptability, compared with a more conventional diabetes diet among individuals with type 2 diabetes." J Am Diet Assoc 109(2): 263-272.

24. Bathrellou, E., M. Yannakoulia, et al. (2010). "Parental involvement does not augment the effectiveness of an intense behavioral program for the treatment of childhood obesity." Hormones (Athens) 9(2): 171-175.

25. Bayer, O., R. von Kries, et al. (2009). "Short- and mid-term effects of a setting based prevention program to reduce obesity risk factors in children: a cluster-randomized trial." Clin Nutr 28(2): 122-128.

26. Bea, J. W., E. C. Cussler, et al. (2010). "Resistance training predicts 6-yr body composition change in postmenopausal women." Med Sci Sports Exerc 42(7): 1286-1295.

27. Benedict, M. A. and D. Arterburn (2008) "Worksite-based weight loss programs: a systematic review of recent literature (Structured abstract)." American Journal of Health Promotion, 408-416.

28. Bergstrom, I., C. Lombardo, et al. (2009). "Physical training decreases waist circumference in postmenopausal borderline overweight women." Acta Obstet Gynecol Scand 88(3): 308-313.

29. Berteus Forslund, H., S. Klingstrom, et al. (2008). "Should snacks be recommended in obesity treatment? A 1-year randomized clinical trial." Eur J Clin Nutr 62(11): 1308-1317.

30. Bertoni, A. G., J. M. Clark, et al. (2008). "Suboptimal control of glycemia, blood pressure, and LDL cholesterol in overweight adults with diabetes: the Look AHEAD Study." J Diabetes Complications 22(1): 1-9.

31. Bessler, M., A. Daud, et al. (2007). "Prospective randomized trial of banded versus nonbanded gastric bypass for the super obese: early results." Surg Obes Relat Dis 3(4): 480-484; discussion 484-485.

32. Black, M. M., E. R. Hager, et al. (2010). "Challenge! Health promotion/obesity prevention mentorship model among urban, black adolescents." Pediatrics 126(2): 280-288.

33. Bo, S., G. Ciccone, et al. (2007). "Effectiveness of a lifestyle intervention on metabolic syndrome. A randomized controlled trial." J Gen Intern Med 22(12): 1695-1703.

34. Bradshaw, A. J., C. C. Horwath, et al. (2010). "Non-dieting group interventions for overweight and obese women: what predicts non-completion and does completion improve outcomes?" Public Health Nutr 13(10): 1622-1628.

35. Brantley, P., L. Appel, et al. (2008). "Design considerations and rationale of a multi-center trial to sustain weight loss: the Weight Loss Maintenance Trial." Clin Trials 5(5): 546-556.

36. Bravata, D. M., C. Smith-Spangler, et al. (2007) "Using pedometers to increase physical activity and improve health: a systematic review (Structured abstract)." JAMA, 2296-2304.

37. Brehm, B. J., B. L. Lattin, et al. (2009). "One-year comparison of a high-monounsaturated fat diet with a high-carbohydrate diet in type 2 diabetes." Diabetes Care 32(2): 215-220.

38. Brethauer, S. A., J. P. Hammel, et al. (2009) "Systematic review of sleeve gastrectomy as staging and primary bariatric procedure (Structured abstract)." Surgery for Obesity and Related Diseases, 469-475.

39. Brinkworth, G. D., J. D. Buckley, et al. (2010). "Renal function following long-term weight loss in individuals with abdominal obesity on a very-low-carbohydrate diet versus high-carbohydrate diet." J Am Diet Assoc 110(4): 633-638.

40. Brinkworth, G. D., J. D. Buckley, et al. (2009). "Long-term effects of a very low-carbohydrate diet and a low-fat diet on mood and cognitive function." Arch Intern Med 169(20): 1873-1880.

41. Brinkworth, G. D., M. Noakes, et al. (2009). "Long-term effects of a very-low-carbohydrate weight loss diet compared with an isocaloric low-fat diet after 12 mo." Am J Clin Nutr 90(1): 23-32.

42. Brodney Folse, S., L. Falzon, et al. (2009) "Computer-based interventions for weight loss or weight maintenance in overweight or obese people." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD007675.

43. Brown, T., A. Avenell, et al. (2009) "Systematic review of long-term lifestyle interventions to prevent weight gain and morbidity in adults (Provisional abstract)." Obesity Reviews, 627-638.

44. Brown, T. and C. Summerbell (2009) "Systematic review of school-based interventions that focus on changing dietary intake and physical activity levels to prevent childhood obesity: an update to the obesity guidance produced by the National Institute for Health and Clinical Excellence (Structured abstract)." Obesity Reviews, 110-141.

45. Buckley Brian, S., C. Byrne Mary, et al. (2010) "Service organisation for the secondary prevention of ischaemic heart disease in primary care." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD006772.pub2.

46. Burke, L. E., A. G. Hudson, et al. (2007). "Effects of a vegetarian diet and treatment preference on biochemical and dietary variables in overweight and obese adults: a randomized clinical trial." Am J Clin Nutr 86(3): 588-596.

47. Burke, L. E., M. A. Styn, et al. (2009). "SMART trial: A randomized clinical trial of self-monitoring in behavioral weight management-design and baseline findings." Contemp Clin Trials 30(6): 540-551.

48. Burke, L. E., M. Warziski, et al. (2008). "A randomized clinical trial of a standard versus vegetarian diet for weight loss: the impact of treatment preference." Int J Obes (Lond) 32(1): 166-176.

49. Burke, V., L. J. Beilin, et al. (2008). "Moderators and mediators of behaviour change in a lifestyle program for treated hypertensives: a randomized controlled trial (ADAPT)." Health Educ Res 23(4): 583-591.

50. Burrows, T., J. M. Warren, et al. (2008). "Impact of a child obesity intervention on dietary intake and behaviors." Int J Obes (Lond) 32(10): 1481-1488.

51. Burrows, T., J. M. Warren, et al. (2010). "The impact of a child obesity treatment intervention on parent child-feeding practices." Int J Pediatr Obes 5(1): 43-50.

52. Cabassa, L. J., J. M. Ezell, et al. (2010) "Lifestyle interventions for adults with serious mental illness: a systematic literature review (Provisional abstract)." Psychiatric Services, 774-782.

53. Camhi, S. M., M. L. Stefanick, et al. (2010). "Metabolic syndrome and changes in body fat from a low-fat diet and/or exercise randomized controlled trial." Obesity (Silver Spring) 18(3): 548-554.

54. Campbell, K. L., P. T. Campbell, et al. (2008). "No reduction in C-reactive protein following a 12-month randomized controlled trial of exercise in men and women." Cancer Epidemiol Biomarkers Prev 17(7): 1714-1718.

55. Carels, R. A., L. Darby, et al. (2007). "Using motivational interviewing as a supplement to obesity treatment: a stepped-care approach." Health Psychol 26(3): 369-374.

56. Carr, L. J., R. T. Bartee, et al. (2009). "Eight-month follow-up of physical activity and central adiposity: results from an Internet-delivered randomized control trial intervention." J Phys Act Health 6(4): 444-455.

57. Carrel, A. L., R. R. Clark, et al. (2007). "School-based fitness changes are lost during the summer vacation." Arch Pediatr Adolesc Med 161(6): 561-564.

58. Carty, C. L., C. Kooperberg, et al. (2011). "Low-fat dietary pattern and change in body-composition traits in the Women's Health Initiative Dietary Modification Trial." Am J Clin Nutr 93(3): 516-524.

59. Castaneda-Gonzalez, L., R. Camberos-Solis, et al. (2010) "Long-term randomized clinical trials of pharmacological treatment of obesity: systematic review (Structured abstract)." Colombia Medica, 17-25.

60. Cercato, C., V. A. Roizenblatt, et al. (2009). "A randomized double-blind placebo-controlled study of the long-term efficacy and safety of diethylpropion in the treatment of obese subjects." Int J Obes (Lond) 33(8): 857-865.

61. Chaston, T. B. and J. B. Dixon (2008). "Factors associated with percent change in visceral versus subcutaneous abdominal fat during weight loss: findings from a systematic review." Int J Obes (Lond) 32(4): 619-628.

62. Chaston, T. B., J. B. Dixon, et al. (2007) "Changes in fat-free mass during significant weight loss: a systematic review (Structured abstract)." International Journal of Obesity, 743-750.

63. Chen, L., L. J. Appel, et al. (2009). "Reduction in consumption of sugar-sweetened beverages is associated with weight loss: the PREMIER trial." Am J Clin Nutr 89(5): 1299-1306.

64. Chua, S. D., Jr., S. P. Messier, et al. (2008). "Effect of an exercise and dietary intervention on serum biomarkers in overweight and obese adults with osteoarthritis of the knee." Osteoarthritis Cartilage 16(9): 1047-1053.

65. Church, T. S., C. P. Earnest, et al. (2010). "Exercise without weight loss does not reduce C-reactive protein: the INFLAME study." Med Sci Sports Exerc 42(4): 708-716.

66. Clifton, P. M., J. B. Keogh, et al. (2008). "Long-term effects of a high-protein weight-loss diet." Am J Clin Nutr 87(1): 23-29.

67. Collins, C. E., P. J. Morgan, et al. (2010). "Evaluation of a commercial web-based weight loss and weight loss maintenance program in overweight and obese adults: a randomized controlled trial." BMC Public Health 10: 669.

68. Csendes, A., F. Maluenda, et al. (2009). "A prospective randomized study comparing patients with morbid obesity submitted to laparotomic gastric bypass with or without omentectomy." Obes Surg 19(4): 490-494.

69. Dale, K. S., K. A. McAuley, et al. (2009). "Determining optimal approaches for weight maintenance: a randomized controlled trial." CMAJ 180(10): E39-46.

70. Das, S. K., C. H. Gilhooly, et al. (2007). "Long-term effects of 2 energy-restricted diets differing in glycemic load on dietary adherence, body composition, and metabolism in CALERIE: a 1-y randomized controlled trial." Am J Clin Nutr 85(4): 1023-1030.

71. Das, S. K., E. Saltzman, et al. (2009). "Low or moderate dietary energy restriction for long-term weight loss: what works best?" Obesity (Silver Spring) 17(11): 2019-2024.

72. Davis, A. M., R. L. James, et al. (2011). "The use of TeleMedicine in the treatment of paediatric obesity: feasibility and acceptability." Matern Child Nutr 7(1): 71-79.

73. Davis, N. J., N. Tomuta, et al. (2009). "Comparative study of the effects of a 1-year dietary intervention of a low-carbohydrate diet versus a low-fat diet on weight and glycemic control in type 2 diabetes." Diabetes Care 32(7): 1147-1152.

74. de Koning, L., A. T. Merchant, et al. (2007). "Waist circumference and waist-to-hip ratio as predictors of cardiovascular events: meta-regression analysis of prospective studies." Eur Heart J 28(7): 850-856.

75. de Lemos, H. P., Jr., A. N. Atallah, et al. (2008). "Can sibutramine alter systemic blood pressure in obese patients? Systematic review and meta-analysis." Sao Paulo Med J 126(6): 342-346.

76. Delbridge, E. A., L. A. Prendergast, et al. (2009). "One-year weight maintenance after significant weight loss in healthy overweight and obese subjects: does diet composition matter?" Am J Clin Nutr 90(5): 1203-1214.

77. Derosa, G., P. Maffioli, et al. (2010). "Orlistat and L-carnitine compared to orlistat alone on insulin resistance in obese diabetic patients." Endocr J 57(9): 777-786.

78. Diaz, R. G., J. Esparza-Romero, et al. (2010). "Lifestyle intervention in primary care settings improves obesity parameters among Mexican youth." J Am Diet Assoc 110(2): 285-290.

79. Dixon, A. N., G. Valsamakis, et al. (2008). "Effect of the orlistat on serum endotoxin lipopolysaccharide and adipocytokines in South Asian individuals with impaired glucose tolerance." Int J Clin Pract 62(7): 1124-1129.

80. Dixon, J. B., B. J. Strauss, et al. (2007). "Changes in body composition with weight loss: obese subjects randomized to surgical and medical programs." Obesity (Silver Spring) 15(5): 1187-1198.

81. Duggins, M., P. Cherven, et al. (2010). "Impact of family YMCA membership on childhood obesity: a randomized controlled effectiveness trial." J Am Board Fam Med 23(3): 323-333.

82. Duke S., S. Colagiuri, et al. (2009) "Individual patient education for people with type 2 diabetes mellitus." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD005268.pub2.

83. Dyson, P. A., S. Beatty, et al. (2010). "An assessment of low-carbohydrate or low-fat diets for weight loss at 2 year's follow-up." Diabet Med 27(3): 363-364.

84. Early, J. L., C. M. Apovian, et al. (2007). "Sibutramine plus meal replacement therapy for body weight loss and maintenance in obese patients." Obesity (Silver Spring) 15(6): 1464-1472.

85. Ebbeling, C. B., M. M. Leidig, et al. (2007). "Effects of a low-glycemic load versus low-fat diet in obese young adults: a randomized trial." JAMA 297(19): 2092-2102.

86. Elhayany, A., A. Lustman, et al. (2010). "A low carbohydrate Mediterranean diet improves cardiovascular risk factors and diabetes control among overweight patients with type 2 diabetes mellitus: a 1-year prospective randomized intervention study." Diabetes Obes Metab 12(3): 204-209.

87. Ello-Martin, J. A., L. S. Roe, et al. (2007). "Dietary energy density in the treatment of obesity: a year-long trial comparing 2 weight-loss diets." Am J Clin Nutr 85(6): 1465-1477.

88. Enwald, H. P. and M. L. Huotari (2010) "Preventing the obesity epidemic by second generation tailored health communication: an interdisciplinary review (Provisional abstract)." Journal of Medical Internet Research.

89. Epstein, L. H., R. A. Paluch, et al. (2008). "Increasing healthy eating vs. reducing high energy-dense foods to treat pediatric obesity." Obesity (Silver Spring) 16(2): 318-326.

90. Epstein, L. H., J. N. Roemmich, et al. (2008). "A randomized trial of the effects of reducing television viewing and computer use on body mass index in young children." Arch Pediatr Adolesc Med 162(3): 239-245.

91. Espeland, M. A., G. A. Bray, et al. (2009). "Describing patterns of weight changes using principal components analysis: results from the Action for Health in Diabetes (Look AHEAD) research group." Ann Epidemiol 19(10): 701-710.

92. Estabrooks, P. A., J. A. Shoup, et al. (2009). "Automated telephone counseling for parents of overweight children: a randomized controlled trial." Am J Prev Med 36(1): 35-42.

93. Fabbrini, E., R. A. Tamboli, et al. (2010). "Surgical removal of omental fat does not improve insulin sensitivity and cardiovascular risk factors in obese adults." Gastroenterology 139(2): 448-455.

94. Fabricatore, A. N., T. A. Wadden, et al. (2007). "The role of patients' expectations and goals in the behavioral and pharmacological treatment of obesity." Int J Obes (Lond) 31(11): 1739-1745.

95. Faith, M. S., K. R. Fontaine, et al. (2007) "Toward the reduction of population obesity: macrolevel environmental approaches to the problems of food, eating, and obesity (Provisional abstract)." Psychological Bulletin, 205-226.

96. Faulconbridge, L. F., T. A. Wadden, et al. (2009). "Changes in symptoms of depression with weight loss: results of a randomized trial." Obesity (Silver Spring) 17(5): 1009-1016.

97. Faulkner, G., T. Cohn, et al. (2007). "Interventions to reduce weight gain in schizophrenia." Cochrane Database Syst Rev(1): CD005148.

98. Fernald, L. C., P. J. Gertler, et al. (2008). "Role of cash in conditional cash transfer programmes for child health, growth, and development: an analysis of Mexico's Oportunidades." Lancet 371(9615): 828-837.

99. Fitzgibbon, M. L., M. Stolley, et al. (2008). "Obesity Reduction Black Intervention Trial (ORBIT): design and baseline characteristics." J Womens Health (Larchmt) 17(7): 1099-1110.

100. Fontana, L., D. T. Villareal, et al. (2007). "Calorie restriction or exercise: effects on coronary heart disease risk factors. A randomized, controlled trial." Am J Physiol Endocrinol Metab 293(1): E197-202.

101. Fontbonne, A., I. Diouf, et al. (2009). "Effects of 1-year treatment with metformin on metabolic and cardiovascular risk factors in non-diabetic upper-body obese subjects with mild glucose anomalies: a post-hoc analysis of the BIGPRO1 trial." Diabetes Metab 35(5): 385-391.

102. Forsberg, K. A., T. Bjorkman, et al. (2010). "Influence of a lifestyle intervention among persons with a psychiatric disability: a cluster randomised controlled trail on symptoms, quality of life and sense of coherence." J Clin Nurs 19(11-12): 1519-1528.

103. Foster, G. D., B. Linder, et al. (2010). "A school-based intervention for diabetes risk reduction." N Engl J Med 363(5): 443-453.

104. Foster, G. D., S. Sherman, et al. (2008). "A policy-based school intervention to prevent overweight and obesity." Pediatrics 121(4): e794-802.

105. Foster, G. D., H. R. Wyatt, et al. (2010). "Weight and metabolic outcomes after 2 years on a low-carbohydrate versus low-fat diet: a randomized trial." Ann Intern Med 153(3): 147-157.

106. Francis, M., S. S. Nichols, et al. (2010). "The effects of a school-based intervention programme on dietary intakes and physical activity among primary-school children in Trinidad and Tobago." Public Health Nutr 13(5): 738-747.

107. Franks, P. W., K. A. Jablonski, et al. (2008). "Assessing gene-treatment interactions at the FTO and INSIG2 loci on obesity-related traits in the Diabetes Prevention Program." Diabetologia 51(12): 2214-2223.

108. Fraser, A., R. Abel, et al. (2008). "A modified Mediterranean diet is associated with the greatest reduction in alanine aminotransferase levels in obese type 2 diabetes patients: results of a quasi-randomised controlled trial." Diabetologia 51(9): 1616-1622.

109. French, S. A., L. J. Harnack, et al. (2010). "Worksite environment intervention to prevent obesity among metropolitan transit workers." Prev Med 50(4): 180-185.

110. Fujimoto, W. Y., K. A. Jablonski, et al. (2007). "Body size and shape changes and the risk of diabetes in the diabetes prevention program." Diabetes 56(6): 1680-1685.

111. Galletly, C. L. and L. E. Murray (2009) "Managing weight in persons living with severe mental illness in community settings: a review of strategies used in community interventions (Provisional abstract)." Issues in Mental Health Nursing, 660-668.

112. Gao, Y., S. Griffiths, et al. (2007) "Community-based interventions to reduce overweight and obesity in China: a systematic review of the Chinese and English literature (Structured abstract)." Journal of Public Health, 436-448.

113. Gardner, C. D., A. Kiazand, et al. (2007). "Comparison of the Atkins, Zone, Ornish, and LEARN diets for change in weight and related risk factors among overweight premenopausal women: the A TO Z Weight Loss Study: a randomized trial." JAMA 297(9): 969-977.

114. Gilhooly, C. H., S. K. Das, et al. (2008). "Use of cereal fiber to facilitate adherence to a human caloric restriction program." Aging Clin Exp Res 20(6): 513-520.

115. Gilles, A., M. Cassano, et al. (2008). "Comparing active pediatric obesity treatments using meta-analysis." J Clin Child Adolesc Psychol 37(4): 886-892.

116. Goetzel, R. Z., E. C. Roemer, et al. (2010). "Second-year results of an obesity prevention program at the Dow Chemical Company." J Occup Environ Med 52(3): 291-302.

117. Golan, R., D. Schwarzfuchs, et al. (2010). "Halo effect of a weight-loss trial on spouses: the DIRECT-Spouse study." Public Health Nutr 13(4): 544-549.

118. Gold, B. C., S. Burke, et al. (2007). "Weight loss on the web: A pilot study comparing a structured behavioral intervention to a commercial program." Obesity (Silver Spring) 15(1): 155-164.

119. Goldner, W. S., J. A. Stoner, et al. (2009). "Finding the optimal dose of vitamin D following Roux-en-Y gastric bypass: a prospective, randomized pilot clinical trial." Obes Surg 19(2): 173-179.

120. Goodpaster, B. H., J. P. Delany, et al. (2010). "Effects of diet and physical activity interventions on weight loss and cardiometabolic risk factors in severely obese adults: a randomized trial." JAMA 304(16): 1795-1802.

121. Gorin, A. A., A. Marinilli Pinto, et al. (2007). "Failure to meet weight loss expectations does not impact maintenance in successful weight losers." Obesity (Silver Spring) 15(12): 3086-3090.

122. Gorin, A. A., H. M. Niemeier, et al. (2008). "Binge eating and weight loss outcomes in overweight and obese individuals with type 2 diabetes: results from the Look AHEAD trial." Arch Gen Psychiatry 65(12): 1447-1455.

123. Gorin, A. A., R. R. Wing, et al. (2008). "Weight loss treatment influences untreated spouses and the home environment: evidence of a ripple effect." Int J Obes (Lond) 32(11): 1678-1684.

124. Gravante, G., A. Araco, et al. (2007). "Laparoscopic adjustable gastric bandings: a prospective randomized study of 400 operations performed with 2 different devices." Arch Surg 142(10): 958-961.

125. Gripeteg, L., J. Torgerson, et al. (2010). "Prolonged refeeding improves weight maintenance after weight loss with very-low-energy diets." Br J Nutr 103(1): 141-148.

126. Guh, D. P., W. Zhang, et al. (2009). "The incidence of co-morbidities related to obesity and overweight: a systematic review and meta-analysis." BMC Public Health 9: 88.

127. Harris, K. C., L. K. Kuramoto, et al. (2009) "Effect of school-based physical activity interventions on body mass index in children: a meta-analysis (Structured abstract)." CMAJ: Canadian Medical Association Journal, 719-180.

128. Hasani-Ranjbar, S., N. Nayebi, et al. (2009) "A systematic review of the efficacy and safety of herbal medicines used in the treatment of obesity (Structured abstract)." World Journal of Gastroenterology, 3073-3085.

129. Hilbert, A., B. E. Saelens, et al. (2007). "Pretreatment and process predictors of outcome in interpersonal and cognitive behavioral psychotherapy for binge eating disorder." J Consult Clin Psychol 75(4): 645-651.

130. Hingle, M. D., T. M. O'Connor, et al. (2010) "Parental involvement in interventions to improve child dietary intake: a systematic review (Structured abstract)." Preventive Medicine, 103-111.

131. Hoeger, K., K. Davidson, et al. (2008). "The impact of metformin, oral contraceptives, and lifestyle modification on polycystic ovary syndrome in obese adolescent women in two randomized, placebo-controlled clinical trials." J Clin Endocrinol Metab 93(11): 4299-4306.

132. Hollander, P. (2007). "Endocannabinoid blockade for improving glycemic control and lipids in patients with type 2 diabetes mellitus." Am J Med 120(2 Suppl 1): S18-28; discussion S29-32.

133. Holme, I., A. T. Hostmark, et al. (2007). "ApoB but not LDL-cholesterol is reduced by exercise training in overweight healthy men. Results from the 1-year randomized Oslo Diet and Exercise Study." J Intern Med 262(2): 235-243.

134. Hope, A. A., S. K. Kumanyika, et al. (2010). "Changes in Health-Related Quality of Life among African-Americans in a lifestyle weight loss program." Qual Life Res 19(7): 1025-1033.

135. Howard, B. V., J. D. Curb, et al. (2010). "Low-fat dietary pattern and lipoprotein risk factors: the Women's Health Initiative Dietary Modification Trial." Am J Clin Nutr 91(4): 860-874.

136. Huang, J. S., G. J. Norman, et al. (2007). "Body image and self-esteem among adolescents undergoing an intervention targeting dietary and physical activity behaviors." J Adolesc Health 40(3): 245-251.

137. Hudon, C., M. Fortin, et al. (2008) "Single risk factor interventions to promote physical activity among patients with chronic diseases: systematic review (Structured abstract)." Canadian Family Physician, 1130-1137.

138. Hunter, G. R., D. W. Brock, et al. (2010). "Exercise training prevents regain of visceral fat for 1 year following weight loss." Obesity (Silver Spring) 18(4): 690-695.

139. Hursel, R., W. Viechtbauer, et al. (2009). "The effects of green tea on weight loss and weight maintenance: a meta-analysis." Int J Obes (Lond) 33(9): 956-961.

140. Ibanez, L., A. Lopez-Bermejo, et al. (2010). "Low-dose pioglitazone, flutamide, metformin plus an estro-progestagen for non-obese young women with polycystic ovary syndrome: increasing efficacy and persistent safety over 30 months." Gynecol Endocrinol 26(12): 869-873.

141. Jacobs, D. R., Jr., D. Sluik, et al. (2009). "Association of 1-y changes in diet pattern with cardiovascular disease risk factors and adipokines: results from the 1-y randomized Oslo Diet and Exercise Study." Am J Clin Nutr 89(2): 509-517.

142. Jaime, P. C. and K. Lock (2009) "Do school based food and nutrition policies improve diet and reduce obesity? (Structured abstract)." Preventive Medicine, 45-53.

143. Jakicic, J. M., B. H. Marcus, et al. (2008). "Effect of exercise on 24-month weight loss maintenance in overweight women." Arch Intern Med 168(14): 1550-1559; discussion 1559-1560.

144. Jakicic, J. M., S. A. Jaramillo, et al. (2009). "Effect of a lifestyle intervention on change in cardiorespiratory fitness in adults with type 2 diabetes: results from the Look AHEAD Study." Int J Obes (Lond) 33(3): 305-316.

145. Jeffery, R. W., R. L. Levy, et al. (2009). "A comparison of maintenance-tailored therapy (MTT) and standard behavior therapy (SBT) for the treatment of obesity." Prev Med 49(5): 384-389.

146. Jelalian, E., E. E. Lloyd-Richardson, et al. (2010). "Behavioral weight control treatment with supervised exercise or peer-enhanced adventure for overweight adolescents." J Pediatr 157(6): 923-928 e921.

147. Jendle, J., M. A. Nauck, et al. (2009). "Weight loss with liraglutide, a once-daily human glucagon-like peptide-1 analogue for type 2 diabetes treatment as monotherapy or added to metformin, is primarily as a result of a reduction in fat tissue." Diabetes Obes Metab 11(12): 1163-1172.

148. Jiang, J., X. Xia, et al. (2007). "The effects of a 3-year obesity intervention in schoolchildren in Beijing." Child Care Health Dev 33(5): 641-646.

149. Johansson, K., K. Neovius, et al. (2009). "Discontinuation due to adverse events in randomized trials of orlistat, sibutramine and rimonabant: a meta-analysis." Obes Rev 10(5): 564-575.

150. Johansson, K., J. Sundstrom, et al. (2010). "Long-term changes in blood pressure following orlistat and sibutramine treatment: a meta-analysis." Obes Rev 11(11): 777-791.

151. Johnson, S. S., A. L. Paiva, et al. (2008). "Transtheoretical model-based multiple behavior intervention for weight management: effectiveness on a population basis." Prev Med 46(3): 238-246.

152. Jorde, R., M. Sneve, et al. (2008). "Effects of vitamin D supplementation on symptoms of depression in overweight and obese subjects: randomized double blind trial." J Intern Med 264(6): 599-609.

153. Jorde, R., M. Sneve, et al. (2010). "No improvement in cardiovascular risk factors in overweight and obese subjects after supplementation with vitamin D3 for 1 year." J Intern Med 267(5): 462-472.

154. Kalter-Leibovici, O., N. Younis-Zeidan, et al. (2010). "Lifestyle intervention in obese Arab women: a randomized controlled trial." Arch Intern Med 170(11): 970-976.

155. Kanekar, A. and M. Sharma (2008). "Meta-analysis of school-based childhood obesity interventions in the U.K. and U.S." Int Q Community Health Educ 29(3): 241-256.

156. Karamanakos, S. N., K. Vagenas, et al. (2008). "Weight loss, appetite suppression, and changes in fasting and postprandial ghrelin and peptide-YY levels after Roux-en-Y gastric bypass and sleeve gastrectomy: a prospective, double blind study." Ann Surg 247(3): 401-407.

157. Katz, D. L., M. O'Connell, et al. (2008). "Strategies for the prevention and control of obesity in the school setting: systematic review and meta-analysis." Int J Obes (Lond) 32(12): 1780-1789.

158. Katzer, L., A. J. Bradshaw, et al. (2008). "Evaluation of a "nondieting" stress reduction program for overweight women: a randomized trial." Am J Health Promot 22(4): 264-274.

159. Kawashima, H., H. Takase, et al. (2008). "One-year ad libitum consumption of diacylglycerol oil as part of a regular diet results in modest weight loss in comparison with consumption of a triacylglycerol control oil in overweight Japanese subjects." J Am Diet Assoc 108(1): 57-66.

160. Kelishadi, R., M. Hashemipour, et al. (2008). "Short- and long-term relationships of serum ghrelin with changes in body composition and the metabolic syndrome in prepubescent obese children following two different weight loss programmes." Clin Endocrinol (Oxf) 69(5): 721-729.

161. Kelley, G. A. and K. S. Kelley (2007). "Aerobic exercise and lipids and lipoproteins in children and adolescents: a meta-analysis of randomized controlled trials." Atherosclerosis 191(2): 447-453.

162. Kelley, G. A. and K. S. Kelley (2008). "Effects of aerobic exercise on non-high-density lipoprotein cholesterol in children and adolescents: a meta-analysis of randomized controlled trials." Prog Cardiovasc Nurs 23(3): 128-132.

163. Keogh, J. B., N. D. Luscombe-Marsh, et al. (2007). "Long-term weight maintenance and cardiovascular risk factors are not different following weight loss on carbohydrate-restricted diets high in either monounsaturated fat or protein in obese hyperinsulinaemic men and women." Br J Nutr 97(2): 405-410.

164. Kerr, J., K. Patrick, et al. (2008). "Randomized control trial of a behavioral intervention for overweight women: impact on depressive symptoms." Depress Anxiety 25(7): 555-558.

165. Kim, Y., J. Pike, et al. (2010). "Telephone intervention promoting weight-related health behaviors." Prev Med 50(3): 112-117.

166. Kumanyika, S. K., T. A. Wadden, et al. (2009). "Trial of family and friend support for weight loss in African American adults." Arch Intern Med 169(19): 1795-1804.

167. Lapointe, A., S. J. Weisnagel, et al. (2010). "Comparison of a dietary intervention promoting high intakes of fruits and vegetables with a low-fat approach: long-term effects on dietary intakes, eating behaviours and body weight in postmenopausal women." Br J Nutr 104(7): 1080-1090.

168. Larsen, T. M., S. Dalskov, et al. (2010). "The Diet, Obesity and Genes (Diogenes) Dietary Study in eight European countries - a comprehensive design for long-term intervention." Obes Rev 11(1): 76-91.

169. Layman, D. K., E. M. Evans, et al. (2009). "A moderate-protein diet produces sustained weight loss and long-term changes in body composition and blood lipids in obese adults." J Nutr 139(3): 514-521.

170. Levy, R. L., R. W. Jeffery, et al. (2010). "Maintenance-tailored therapy vs. standard behavior therapy for 30-month maintenance of weight loss." Prev Med 51(6): 457-459.

171. Livhits, M., C. Mercado, et al. (2010). "Exercise following bariatric surgery: systematic review." Obes Surg 20(5): 657-665.

172. Lopez-Jimenez, F., C. O. Wu, et al. (2008). "Weight change after myocardial infarction--the Enhancing Recovery in Coronary Heart Disease patients (ENRICHD) experience." Am Heart J 155(3): 478-484.

173. Lowe, M. R., K. A. Tappe, et al. (2008). "The effect of training in reduced energy density eating and food self-monitoring accuracy on weight loss maintenance." Obesity (Silver Spring) 16(9): 2016-2023.

174. Maayan, L., J. Vakhrusheva, et al. (2010). "Effectiveness of medications used to attenuate antipsychotic-related weight gain and metabolic abnormalities: a systematic review and meta-analysis." Neuropsychopharmacology 35(7): 1520-1530.

175. MacKay-Lyons, M., M. Thornton, et al. (2010) "Non-pharmacological interventions for preventing secondary vascular events after stroke or transient ischemic attack." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD008656.

176. Marcus, C., G. Nyberg, et al. (2009). "A 4-year, cluster-randomized, controlled childhood obesity prevention study: STOPP." Int J Obes (Lond) 33(4): 408-417.

177. Marinilli Pinto, A., A. A. Gorin, et al. (2008). "Successful weight-loss maintenance in relation to method of weight loss." Obesity (Silver Spring) 16(11): 2456-2461.

178. Mathus-Vliegen, E. M. and L. T. de Wit (2007). "Health-related quality of life after gastric banding." Br J Surg 94(4): 457-465.

179. McCarthy, W. J., A. K. Yancey, et al. (2007). "Fighting cancer with fitness: dietary outcomes of a randomized, controlled lifestyle change intervention in healthy African-American women." Prev Med 44(3): 246-253.

180. McMurray, R. G., S. Bassin, et al. (2009). "Rationale, design and methods of the HEALTHY study physical education intervention component." Int J Obes (Lond) 33 Suppl 4: S37-43.

181. Micco, N., B. Gold, et al. (2007). "Minimal in-person support as an adjunct to internet obesity treatment." Ann Behav Med 33(1): 49-56.

182. Milner P, C., P. Hams Steven, et al. (2008) "Psychosocial interventions for the maintenance of weight loss in obese adults." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD007153.

183. Molenaar, E. A., E. J. van Ameijden, et al. (2010). "Effect of nutritional counselling and nutritional plus exercise counselling in overweight adults: a randomized trial in multidisciplinary primary care practice." Fam Pract 27(2): 143-150.

184. Monninkhof, E. M., M. J. Velthuis, et al. (2009). "Effect of exercise on postmenopausal sex hormone levels and role of body fat: a randomized controlled trial." J Clin Oncol 27(27): 4492-4499.

185. Moore, C. S., A. K. Lindroos, et al. (2010). "Dietary strategy to manipulate ad libitum macronutrient intake, and glycaemic index, across eight European countries in the Diogenes Study." Obes Rev 11(1): 67-75.

186. Mulrow Cynthia, D., E. Chiquette, et al. (2008) "Dieting to reduce body weight for controlling hypertension in adults." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD000484.pub2.

187. Munsch, S., E. Biedert, et al. (2007). "A randomized comparison of cognitive behavioral therapy and behavioral weight loss treatment for overweight individuals with binge eating disorder." Int J Eat Disord 40(2): 102-113.

188. Nackers, L. M., K. M. Ross, et al. (2010). "The association between rate of initial weight loss and long-term success in obesity treatment: does slow and steady win the race?" Int J Behav Med 17(3): 161-167.

189. Nagamia, S., A. Pandian, et al. (2007). "The role of quinapril in the presence of a weight loss regimen: endothelial function and markers of obesity in patients with the metabolic syndrome." Prev Cardiol 10(4): 204-209.

190. Nkansah, N., M. Garala, et al. (2007) "Orlistat for the prevention of cardiovascular diseases in overweight or obese individuals." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD006692.

191. Orozco Leonardo, J., M. Buchleitner Ana, et al. (2008) "Exercise or exercise and diet for preventing type 2 diabetes mellitus." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD003054.pub3.

192. Park, H. A., J. S. Lee, et al. (2007). "Effects of weight control during the menopausal transition on bone mineral density." J Clin Endocrinol Metab 92(10): 3809-3815.

193. Pasarica, M., J. J. Zachwieja, et al. (2007). "Effect of growth hormone on body composition and visceral adiposity in middle-aged men with visceral obesity." J Clin Endocrinol Metab 92(11): 4265-4270.

194. Phelan, S., T. A. Wadden, et al. (2007). "Impact of weight loss on the metabolic syndrome." Int J Obes (Lond) 31(9): 1442-1448.

195. Protani, M., M. Coory, et al. (2010). "Effect of obesity on survival of women with breast cancer: systematic review and meta-analysis." Breast Cancer Res Treat 123(3): 627-635.

196. Racette, S. B., S. S. Deusinger, et al. (2009). "Worksite Opportunities for Wellness (WOW): effects on cardiovascular disease risk factors after 1 year." Prev Med 49(2-3): 108-114.

197. Reas, D. L. and C. M. Grilo (2008). "Review and meta-analysis of pharmacotherapy for binge-eating disorder." Obesity (Silver Spring) 16(9): 2024-2038.

198. Reinehr, T., M. Dobe, et al. (2010). "Obesity in disabled children and adolescents: an overlooked group of patients." Dtsch Arztebl Int 107(15): 268-275.

199. Renehan, A. G., M. Tyson, et al. (2008). "Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies." Lancet 371(9612): 569-578.

200. Richelsen, B., S. Tonstad, et al. (2007). "Effect of orlistat on weight regain and cardiovascular risk factors following a very-low-energy diet in abdominally obese patients: a 3-year randomized, placebo-controlled study." Diabetes Care 30(1): 27-32.

201. Rimmer, J. H., A. Rauworth, et al. (2009). "A randomized controlled trial to increase physical activity and reduce obesity in a predominantly African American group of women with mobility disabilities and severe obesity." Prev Med 48(5): 473-479.

202. Rock, C. L., S. W. Flatt, et al. (2010). "Effect of a free prepared meal and incentivized weight loss program on weight loss and weight loss maintenance in obese and overweight women: a randomized controlled trial." JAMA 304(16): 1803-1810.

203. Sacher, P. M., M. Kolotourou, et al. (2010). "Randomized controlled trial of the MEND program: a family-based community intervention for childhood obesity." Obesity (Silver Spring) 18 Suppl 1: S62-68.

204. Sacks, F. M., G. A. Bray, et al. (2009). "Comparison of weight-loss diets with different compositions of fat, protein, and carbohydrates." N Engl J Med 360(9): 859-873.

205. Salas-Salvado, J., J. Fernandez-Ballart, et al. (2008). "Effect of a Mediterranean diet supplemented with nuts on metabolic syndrome status: one-year results of the PREDIMED randomized trial." Arch Intern Med 168(22): 2449-2458.

206. Salcedo Aguilar, F., V. Martinez-Vizcaino, et al. (2010). "Impact of an after-school physical activity program on obesity in children." J Pediatr 157(1): 36-42 e33.

207. Salmon, J., K. Ball, et al. (2008). "Outcomes of a group-randomized trial to prevent excess weight gain, reduce screen behaviours and promote physical activity in 10-year-old children: switch-play." Int J Obes (Lond) 32(4): 601-612.

208. Salmon, J., M. L. Booth, et al. (2007) "Promoting physical activity participation among children and adolescents (Structured abstract)." Epidemiologic Reviews, 144-159.

209. Saquib, N., L. Natarajan, et al. (2008). "The impact of a long-term reduction in dietary energy density on body weight within a randomized diet trial." Nutr Cancer 60(1): 31-38.

210. Sari, R., E. Eray, et al. (2010). "Comparison of the effects of sibutramine versus sibutramine plus metformin in obese women." Clin Exp Med 10(3): 179-184.

211. Schirmer, M. A. and S. D. Phinney (2007). "Gamma-linolenate reduces weight regain in formerly obese humans." J Nutr 137(6): 1430-1435.

212. Scozzari, G., E. Farinella, et al. (2009). "Laparoscopic adjustable silicone gastric banding versus laparoscopic vertical banded gastroplasty in morbidly obese patients: long-term results of a prospective randomized controlled clinical trial." Obes Surg 19(8): 1108-1115.

213. Selwyn, A. P. (2007). "Weight reduction and cardiovascular and metabolic disease prevention: clinical trial update." American Journal of Cardiology 100(12A): 33P-37p.

214. Sen, A., K. L. Jen, et al. (2007). "Baseline leptin levels predict change in leptin levels during weight loss in obese breast cancer survivors." Breast J 13(2): 180-186.

215. Seo, D. C. and J. Sa (2010). "A meta-analysis of obesity interventions among U.S. minority children." J Adolesc Health 46(4): 309-323.

216. Shai, I., D. Schwarzfuchs, et al. (2008). "Weight loss with a low-carbohydrate, Mediterranean, or low-fat diet." N Engl J Med 359(3): 229-241.

217. Shi, X., S. Karmali, et al. (2010) "A review of laparoscopic sleeve gastrectomy for morbid obesity (Provisional abstract)." Obesity Surgery, 1171-1177.

218. Shrewsbury, V. A., J. O'Connor, et al. (2009). "A randomised controlled trial of a community-based healthy lifestyle program for overweight and obese adolescents: the Loozit study protocol." BMC Public Health 9: 119.

219. Sichieri, R., A. S. Moura, et al. (2007). "An 18-mo randomized trial of a low-glycemic-index diet and weight change in Brazilian women." Am J Clin Nutr 86(3): 707-713.

220. Siegel, J. M., M. L. Prelip, et al. (2010). "A worksite obesity intervention: results from a group-randomized trial." Am J Public Health 100(2): 327-333.

221. Simon, G. E., P. Rohde, et al. (2010). "Association between change in depression and change in weight among women enrolled in weight loss treatment." Gen Hosp Psychiatry 32(6): 583-589.

222. Singh, A. S., A. P. M. J. Chin, et al. (2009). "Dutch obesity intervention in teenagers: effectiveness of a school-based program on body composition and behavior." Arch Pediatr Adolesc Med 163(4): 309-317.

223. Small, L., D. Anderson, et al. (2007) "Prevention and early treatment of overweight and obesity in young children: a critical review and appraisal of the evidence (Structured abstract)." Pediatric Nursing, 149-152.

224. Smith, S. R., L. J. Aronne, et al. (2008). "Sustained weight loss following 12-month pramlintide treatment as an adjunct to lifestyle intervention in obesity." Diabetes Care 31(9): 1816-1823.

225. Sneve, M., Y. Figenschau, et al. (2008). "Supplementation with cholecalciferol does not result in weight reduction in overweight and obese subjects." Eur J Endocrinol 159(6): 675-684.

226. Soderlund, A., A. Fischer, et al. (2009) "Physical activity, diet and behaviour modification in the treatment of overweight and obese adults: a systematic review (Structured abstract)." Perspectives in Public Health, 132-142.

227. Sovik, T. T., O. Taha, et al. (2010). "Randomized clinical trial of laparoscopic gastric bypass versus laparoscopic duodenal switch for superobesity." Br J Surg 97(2): 160-166.

228. Stefano, S. C., J. Bacaltchuk, et al. (2008) "Antidepressants in short-term treatment of binge eating disorder: systematic review and meta-analysis (Structured abstract)." Eating Behaviors, 129-136.

229. Strasser, B., U. Siebert, et al. (2010). "Resistance training in the treatment of the metabolic syndrome: a systematic review and meta-analysis of the effect of resistance training on metabolic clustering in patients with abnormal glucose metabolism." Sports Med 40(5): 397-415.

230. Summerbell C, D., C. Cameron, et al. (2008) "Advice on low-fat diets for obesity." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD003640.pub2.

231. Svendsen, M., A. Rissanen, et al. (2008). "Effect of orlistat on eating behavior among participants in a 3-year weight maintenance trial." Obesity (Silver Spring) 16(2): 327-333.

232. Swenson, B. R., A. Saalwachter Schulman, et al. (2007). "The effect of a low-carbohydrate, high-protein diet on post laparoscopic gastric bypass weight loss: a prospective randomized trial." J Surg Res 142(2): 308-313.

233. Szajewska, H. and M. Ruszczynski (2010) "Systematic review demonstrating that breakfast consumption influences body weight outcomes in children and adolescents in Europe (Provisional abstract)." Critical Reviews in Food Science and Nutrition, 113-119.

234. Tanumihardjo, S. A., A. R. Valentine, et al. (2009). "Strategies to increase vegetable or reduce energy and fat intake induce weight loss in adults." Exp Biol Med (Maywood) 234(5): 542-552.

235. Tate, D. F., R. W. Jeffery, et al. (2007). "Long-term weight losses associated with prescription of higher physical activity goals. Are higher levels of physical activity protective against weight regain?" Am J Clin Nutr 85(4): 954-959.

236. Teng, L. and J. Barnes (2007) "Chinese herbal medicines for weight loss." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD006381.

237. Thomas, D., J. Elliott Elizabeth, et al. (2007) "Low glycaemic index or low glycaemic load diets for overweight and obesity." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD005105.pub2.

238. Thorpe, M. P., E. H. Jacobson, et al. (2008). "A diet high in protein, dairy, and calcium attenuates bone loss over twelve months of weight loss and maintenance relative to a conventional high-carbohydrate diet in adults." J Nutr 138(6): 1096-1100.

239. Tice, J. A., L. Karliner, et al. (2008) "Gastric banding or bypass: a systematic review comparing the two most popular bariatric procedures (Structured abstract)." American Journal of Medicine, 885-893.

240. Topol, E. J., M. G. Bousser, et al. (2010). "Rimonabant for prevention of cardiovascular events (CRESCENDO): a randomised, multicentre, placebo-controlled trial." Lancet 376(9740): 517-523.

241. Trolle, B., A. Flyvbjerg, et al. (2007). "Efficacy of metformin in obese and non-obese women with polycystic ovary syndrome: a randomized, double-blinded, placebo-controlled cross-over trial." Hum Reprod 22(11): 2967-2973.

242. Tuah Nik, A. A., B. Kaur, et al. (2009) "Transtheoretical model for dietary and physical exercise modification in weight loss management for overweight and obese adults." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD008066.

243. Tuomilehto, H., M. Peltonen, et al. (2009). "Sleep duration, lifestyle intervention, and incidence of type 2 diabetes in impaired glucose tolerance: The Finnish Diabetes Prevention Study." Diabetes Care 32(11): 1965-1971.

244. Turner-McGrievy, G. M., N. D. Barnard, et al. (2007). "A two-year randomized weight loss trial comparing a vegan diet to a more moderate low-fat diet." Obesity (Silver Spring) 15(9): 2276-2281.

245. Tuthill, A., A. Quinn, et al. (2007). "A prospective randomized controlled trial of lifestyle intervention on quality of life and cardiovascular risk score in patients with obesity and type 2 diabetes." Diabetes Obes Metab 9(6): 917-919.

246. Van Cauwenberghe, E., L. Maes, et al. (2010) "Effectiveness of school-based interventions in Europe to promote healthy nutrition in children and adolescents: systematic review of published and 'grey' literature (Structured abstract)." British Journal of Nutrition, 781-797.

247. Vazquez, G., S. Duval, et al. (2007). "Comparison of body mass index, waist circumference, and waist/hip ratio in predicting incident diabetes: a meta-analysis." Epidemiol Rev 29: 115-128.

248. Vissers, D., A. Verrijken, et al. (2010). "Effect of long-term whole body vibration training on visceral adipose tissue: a preliminary report." Obes Facts 3(2): 93-100.

249. Volpe, S. L., H. Kobusingye, et al. (2008). "Effect of diet and exercise on body composition, energy intake and leptin levels in overweight women and men." J Am Coll Nutr 27(2): 195-208.

250. Wadden, T. A., D. S. West, et al. (2009). "One-year weight losses in the Look AHEAD study: factors associated with success." Obesity (Silver Spring) 17(4): 713-722.

251. Wang, X., M. F. Lyles, et al. (2008). "Weight regain is related to decreases in physical activity during weight loss." Med Sci Sports Exerc 40(10): 1781-1788.

252. Warren, M. and K. H. Schmitz (2009). "Safety of strength training in premenopausal women: musculoskeletal injuries from a two-year randomized trial." Am J Health Promot 23(5): 309-314.

253. Warziski, M. T., S. M. Sereika, et al. (2008). "Changes in self-efficacy and dietary adherence: the impact on weight loss in the PREFER study." J Behav Med 31(1): 81-92.

254. Weigel, C., K. Kokocinski, et al. (2008). "Childhood obesity: concept, feasibility, and interim results of a local group-based, long-term treatment program." J Nutr Educ Behav 40(6): 369-373.

255. Weinheimer, E. M., L. P. Sands, et al. (2010) "A systematic review of the separate and combined effects of energy restriction and exercise on fat-free mass in middle-aged and older adults: implications for sarcopenic obesity (Provisional abstract)." Nutrition Reviews, 375-388.

256. West, D. S., V. DiLillo, et al. (2007). "Motivational interviewing improves weight loss in women with type 2 diabetes." Diabetes Care 30(5): 1081-1087.

257. West, D. S., T. Elaine Prewitt, et al. (2008). "Weight loss of black, white, and Hispanic men and women in the Diabetes Prevention Program." Obesity (Silver Spring) 16(6): 1413-1420.

258. Whigham, L. D., A. C. Watras, et al. (2007). "Efficacy of conjugated linoleic acid for reducing fat mass: a meta-analysis in humans." Am J Clin Nutr 85(5): 1203-1211.

259. Wikstrand, I., J. Torgerson, et al. (2010). "Very low calorie diet (VLCD) followed by a randomized trial of corset treatment for obesity in primary care." Scand J Prim Health Care 28(2): 89-94.

260. Wilfley, D. E., T. L. Tibbs, et al. (2007). "Lifestyle interventions in the treatment of childhood overweight: a meta-analytic review of randomized controlled trials." Health Psychol 26(5): 521-532.

261. Williams, P. G., S. J. Grafenauer, et al. (2008) "Cereal grains, legumes, and weight management: a comprehensive review of the scientific evidence (Provisional abstract)." Nutrition Reviews, 171-182.

262. Williamson, D. A., S. D. Anton, et al. (2010). "Early behavioral adherence predicts short and long-term weight loss in the POUNDS LOST study." J Behav Med 33(4): 305-314.

263. Williamson, D. A., C. K. Martin, et al. (2008). "Is caloric restriction associated with development of eating-disorder symptoms? Results from the CALERIE trial." Health Psychol 27(1 Suppl): S32-42.

264. Williamson, D. A., J. Rejeski, et al. (2009). "Impact of a weight management program on health-related quality of life in overweight adults with type 2 diabetes." Arch Intern Med 169(2): 163-171.

265. Wilson, G. T., D. E. Wilfley, et al. (2010). "Psychological treatments of binge eating disorder." Arch Gen Psychiatry 67(1): 94-101.

266. Wing, R. R., D. F. Tate, et al. (2007). "STOP regain: are there negative effects of daily weighing?" J Consult Clin Psychol 75(4): 652-656.

267. Wing, R. R., D. S. West, et al. (2010). "Effect of weight loss on urinary incontinence in overweight and obese women: results at 12 and 18 months." J Urol 184(3): 1005-1010.

268. Woo, J., M. M. Sea, et al. (2007). "Effectiveness of a lifestyle modification programme in weight maintenance in obese subjects after cessation of treatment with Orlistat." J Eval Clin Pract 13(6): 853-859.

269. Wu, T., X. Gao, et al. (2009). "Long-term effectiveness of diet-plus-exercise interventions vs. diet-only interventions for weight loss: a meta-analysis." Obes Rev 10(3): 313-323.

270. Wycherley, T. P., G. D. Brinkworth, et al. (2010). "Long-term effects of weight loss with a very low carbohydrate and low fat diet on vascular function in overweight and obese patients." J Intern Med 267(5): 452-461.

271. Xu, T., X. Li, et al. (2008). "Effect of diacylglycerol on body weight: a meta-analysis." Asia Pac J Clin Nutr 17(3): 415-421.

272. Yang, P., Y. Zhou, et al. (2009). "Overweight, obesity and gastric cancer risk: results from a meta-analysis of cohort studies." Eur J Cancer 45(16): 2867-2873.

273. Yang, X. R., J. Chang-Claude, et al. (2011). "Associations of breast cancer risk factors with tumor subtypes: a pooled analysis from the Breast Cancer Association Consortium studies." J Natl Cancer Inst 103(3): 250-263.

274. Yankura, D. J., M. B. Conroy, et al. (2008). "Weight regain and health-related quality of life in postmenopausal women." Obesity (Silver Spring) 16(10): 2259-2265.

275. Yates, T., M. Davies, et al. (2009). "Effectiveness of a pragmatic education program designed to promote walking activity in individuals with impaired glucose tolerance: a randomized controlled trial." Diabetes Care 32(8): 1404-1410.

276. Yates, T., M. J. Davies, et al. (2010). "The effect of increased ambulatory activity on markers of chronic low-grade inflammation: evidence from the PREPARE programme randomized controlled trial." Diabet Med 27(11): 1256-1263.

277. Young, K. M., J. J. Northern, et al. (2007). "A meta-analysis of family-behavioral weight-loss treatments for children." Clin Psychol Rev 27(2): 240-249.

278. Yuen, A., Y. Sugeng, et al. (2010) "Lifestyle and medication interventions for the prevention or delay of type 2 diabetes mellitus in prediabetes: a systematic review of randomised controlled trials (Provisional abstract)." Australian and New Zealand Journal of Public Health, 172-178.

279. Zittermann, A., S. Frisch, et al. (2009). "Vitamin D supplementation enhances the beneficial effects of weight loss on cardiovascular disease risk markers." Am J Clin Nutr 89(5): 1321-1327.

Other references

1. Ainsworth, B., W. Haskell, S. Herrmann, et al. (2011). “Compendium of Physical Activities: a second update of codes and MET values. Medicine and Science in Sports and Exercise (advanced online publication).

2. Andersen T, O Backer, K Stokholm et al. Randomized trial of diet and gastroplasty compared with diet alone in morbid obesity. N Engl J Med. 1984;310:352-356.

3. Asbee, S. M., T. R. Jenkins, et al. (2009). "Preventing excessive weight gain during pregnancy through dietary and lifestyle counseling: a randomized controlled trial." Obstet Gynecol 113(2 Pt 1): 305-312.

4. Atlantis, E., M Baker. (2008). “Obesity effects on depression: systematic review of epidemiological studies.” International Journal of Obesity 32: 881-91.

5. Aucott, L., A. Poobalan, W. Smith, et al. (2005). “Effects of weight loss in overweight / obese individuals and long-term hypertension outcomes: a systematic review.” Hypertension 45: 1035.

6. Australian Indigenous Health InfoNet. Looma Healthy Lifestyle Program. Available at: http://www.healthinfonet.ecu.edu.au/key-resources/programs-projects?pid=614

7. Barakat, R., A. Lucia, et al. (2009). "Resistance exercise training during pregnancy and newborn's birth size: a randomised controlled trial." Int J Obes (Lond) 33(9): 1048-1057.

8. Barte, J., N. Ter Bogt, R. Bogers, et al. (2010). “Maintenance of weight loss after lifestyle interventions for overweight and obesity, a systematic review.” Obesity Reviews 11: 899-906.

9. Batterham, R., M. Cohen S. Ellis et al. (2003). Inhibition of food intake in obese subjects by peptide YY3–36. N Engl J Med 349(10), 941–948.

10. Beuther, D., and E. Sutherland. (2007). “Overweight, obesity and incident asthma: a meta-analysis of prospective epidemiologic studies.” American Journal of Respiratory and Critical Care Medicine 175: 661-6.

11. Bond, M., K. Wyatt, J. Lloyd, et al. (2011). “Systematic review of the effectiveness of weight management schemes for the under fives.” Obesity Reviews 12: 242-53.

12. Bordowitz, R., K. Morland, D. Reich (2007). “The use of an electronic medical record to improve documentation and treatment of obesity.” Family Medicine 39: 274-9.

13. Cabassa, L., J. Ezell, R. Lewis (2010). “Lifestyle interventions for adults with serious mental illness: a systematic literature review.” Psychiatric Services 61: 774-82.

14. Callaway, L. K., P. B. Colditz, et al. (2010). "Prevention of gestational diabetes: feasibility issues for an exercise intervention in obese pregnant women." Diabetes Care 33(7): 1457-1459.

15. Calle, E., M. Thun, J. Petrelli, et al. (1999). “Body mass index and mortality in a prospective cohort of US adults.” New England Journal of Medicine 341: 1097.

16. Cameron, A., D. Magliano, D. Dunstan, et al. (2011). “A bi-directional relationship between obesity and health-related quality of life: evidence from the longitudinal AusDiab study.” International Journal of Obesity 10 May 2011.

17. Campbell, F. Messina, J., Johnson, M. et al. (2010). “Systematic review of dietary and / or physical activity interventions for weight management in pregnancy.” University of Sheffield. Available at: http://www.nice.org.uk/nicemedia/live/11977/47497/47497.pdf. Accessed: 5 September 2011.

18. Carter, P., B. Taylor, S. Williams, et al. (2011). “Longitudinal analysis of sleep in relation to BMI and body fat in children: the FLAME study.” BMJ 342: 2712.

19. Chan, G., C. Chen. (2009). “Musculoskeletal effects of obesity.” Current Opinions in Pediatrics 21: 65-70.

20. Cummings, D., J. Overduin, K, Foster-Schubert. (2004). Gastric bypass for obesity: mechanisms of weight loss and diabetes resolution. J. Clin. Endocrinol. Metab. 89 2608–2615.

21. Daniels, S., M. Jacobson, B. McCrindle, et al. (2009). “American Heart Association Childhood Obesity Research Summit: Executive Summary.” Circulation 119: 2114-23.

22. Davos, C. W. Doehner, M. Rauchhaus, et al. (2003). “Body mass and survival in patients with chronic heart failure without cachexia: the importance of obesity.” Journal of Cardiac Failure 9: 29.

23. Dixon, J., B., L., Chapman et al (1999). “Marked improvement in asthma after Lap-Band surgery for morbid obesity”. Obes Surg. 1999 Aug;9(4):385-9.

24. Dodd, J. M., R. M. Grivell, et al. (2010). "Antenatal interventions for overweight or obese pregnant women: a systematic review of randomised trials." BJOG 117(11): 1316-1326.

25. DOP. Randomised trial of jejunoilieal bypass versus medical treatment in morbid obesity: the Danish Obesity Project. Lancet. 1979;2:1255-1258.

26. Dunn, S., E. Dewis. (2001). “Healthy Weight Program evaluation, Queensland 1996-1999.” Aboriginal and Islander Health Worker Journal 25: 26-28.

27. Egger, G., G. Fisher, S. Piers, et al. (1999). “Abdominal obesity reduction in Indigenous men.” International Journal of Obesity and Related Metabolic Disorders 1999; 23: 564-9.

28. Eliassen, A., G. Colditz, B. Rossner, et al. (2006). “Adult weight change and risk of postmenopausal breast cancer.” JAMA 296: 193-201.

29. Eilat-Adar, S., M. Eldar et al. (2005). “Association of intentional changes in body weight with coronary heart disease event rates in overweight subjects who have an additional coronary risk factor”. Am J Epidemiol. 2005 Feb 15: 161(4):352-8.

30. Eneli, I., T. Skybo, C. Camargo. (2008). “Weight loss and asthma: a systematic review”. Thorax 63: 671-76.

31. Ewertz, M., M. Jensen, K. Gunnarsdottir, et al. (2011). Effect of obesity on prognosis after early-stage breast cancer. Journal of Clinical Oncology 29: 25-31.

32. Eyles, H. & C. Mhurchu (2009). “Does tailoring make a difference? A systematic review of the long-term effectiveness of tailored nutrition education for adults.” Nutrition Reviews 67: 464-80.

33. Flum, D., E. Dellinger. Impact of gastric bypass operation on survival: a population-based analysis. J Am Coll Surg. 2004;199:543-551.

34. Ford, E. (2005). The epidemiology of obesity and asthma. Journal of Allergy and Clinical Immunology 115: 897-909.

35. Forman-Hoffman, V., A. Little, T. Wahls (2006). “Barriers to obesity management: a pilot study of primary care clinicians.” BMC Family Practice 7: 35.

36. Foster, G., S. Taylor, S. Eldridge, et al. (2009). “Self-management education programmes by lay leaders for people with chronic conditions.” Cochrane Library of Systematic Reviews. DOI: 10.1002/14651858.CD005108.pub2

37. Franz, M. (2007). “The dilemma of weight loss in diabetes.” Diabetes Spectrum 20: 133-6.

38. Gariepy, G., D. Nitka, N. Schmitz. (2010). “The association between obesity and anxiety disorders in the population: a systematic review and meta-analysis.” International Journal of Obesity 34: 407-19.

39. Garrison, R., W. Castelli. (1985). “Weight and thirty-year mortality of men in the Framingham Study.” Annals of Internal Medicine 103: 1006.

40. Goldstein, B., R. Scalia. (2004). “A novel adipokine linking adipocytes and vascular function.” Journal of Clinical Endocrinology and Metabolism 89: 2563-8.

41. Gregg, E., R. Gerzoff, T. Thompson, et al. (2004). “Trying to lose weight, losing weight, and 9-year mortality in overweight U.S. adults with diabetes.” Diabetes Care 27:657-62.

42. Guelinckx, I., R. Devlieger, et al. (2010). "Effect of lifestyle intervention on dietary habits, physical activity, and gestational weight gain in obese pregnant women: a randomized controlled trial." Am J Clin Nutr 91(2): 373-380.

43. Guh, D., W. Zhang, N. Bansback, et al. (2009). “The incidence of co-morbidities related to obesity and overweight: a systematic review and meta-analysis.” BMC Public Health 9:88.

44. Hammoud, A., M. Gibson, C. Peterson, et al. (2008). “Impact of male obesity on infertility: a critical review of the current literature.” Fertility and Sterility 90: 897-904.

45. Heindorff H., K. Hougaard et al (1997). “Laparoscopic adjustable gastric band increases weight loss compared to dietary treatment: A randomized study” (abstract). Obes Surg. 7(4):300–1.

46. Heslehurst, N., H. Simpson, et al. (2008). "The impact of maternal BMI status on pregnancy outcomes with immediate short-term obstetric resource implications: a meta-analysis." Obes Rev 9(6): 635-683.

47. Hunskaar, S. (2008). “A systematic review of overweight and obesity as risk factors and targets for clinical intervention for urinary incontinence in women.” Neurourology and Urodynamics 27: 749-57.

48. IARC (2002). “IARC Handbooks of Cancer Prevention: Weight Control and Physical Activity.” Vol. 6, International Agency for Research on Cancer: Lyon, France.

49. IOM (2009). Institute of Medicine: Weight gain during pregnancy: Reexamining the Guidelines. Available at: http://www.iom.edu/Reports/

50. Jacobson, D. & B. Gance-Cleveland (2011). “A systematic review of primary healthcare provider education and training using the Chronic Care Model for childhood obesity.” Obesity Reviews 12: e244-56.

51. Jeffries, K., A. Shub, et al. (2009). "Reducing excessive weight gain in pregnancy: a randomised controlled trial." Med J Aust 191(8): 429-433.

52. John, B., S. Irukulla, A. Abulafi, et al. (2006). “Systematic review: adipose tissue, obesity and gastrointestinal diseases.” Alimentary Pharmacology and Therapeutics 23: 1511-23.

53. Karlsson, E., M. Beck (2010). “The burden of obesity on infectious disease.” Experimental Biology and Medicine 235: 1412-24.

54. Kenchaiah, S., J. Evans, D. Levy, et al. (2002). “Obesity and the risk of heart failure.” New England Journal of Medicine 347: 305.

55. King, D., R. Glasgow, D. Toobert et al. (2010). Self-efficacy, problem solving and social environmental support are associated with diabetes self-management behaviours. Journal of Behavioural Medicine 23: 559.

56. Kirk, S., T. Penney, T. McHugh, et al. (2011). “Effective weight management practice: a review of the lifestyle intervention evidence.” International Journal of Obesity 1-8.

57. Knowler, W., E. Barrett-Connor, S. Fowler, et al. (2002). “Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin.” New England Journal of Medicine 346: 393-403.

58. Kolotkin, R., J. Norquist, R. Crosby, et al. (2009). “One-year health-related quality of life outcomes in weight loss trial participants: comparison of three measures.” Health and Quality of Life Outcomes 7: 53.

59. Koning, L., A. Merchant, J. Pogue, et al. (2007). “Waist circumference and waist-to-hip ratio as predictors of cardiovascular events: meta-regression analysis of prospective studies.” European Heart Journal 28: 850-6.

60. Kramer Michael, S. (1996) Energy/protein restriction for high weight-for-height or weight gain during pregnancy. Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD000080

61. Larrson, U., J. Karlsson, M. Sullivan. (2002). “Impact of overweight and obesity on health-related quality of life: a Swedish population study.” International Journal of Obesity 26: 417-24.

62. Lavie, C., R. Milani, H. Ventura. (2009). “Obesity and cardiovascular disease.” Journal of the American College of Cardiology 53: 1925-32.

63. Le Roux, C., R. Welbourn, M. Werling et al (2007). Gut hormones as mediators of appetite and weight loss after Roux-en-Y gastric bypass. Ann. Surg. 246(5), 780–785.

64. The Longitudinal Assessment of Bariatric Surgery (LABS) Consortium. (2009). Perioperative safety in the longitudinal assessment of bariatric surgery. N Engl J Med 361:445-454.

65. Lopez-Jiminez, F., C. Wu, X. Tian, et al. (2008). “Weight change after myocardial infarction – the ENRICHD experience.” American Heart Journal 155: 478-84.

66. MacGregor, A. & R. Greenberg (1999). “Effect of surgically induced weight loss on asthma in the morbidly obese.” Obesity Surgery 3: 15-21.

67. Maggard M, L Shugarman, M Suttorp et al. Meta-analysis: surgical treatment of obesity. Ann Intern Med. 2005;142:547-559.

68. Manson, J., W. Willett, M. Stampfer, et al. (1995). “Body weight and mortality among women.” New England Journal of Medicine 333: 677.

69. McElroy, S., R. Kotwal, S. Malhotra, et al. (2004). “Are mood disorders and obesity related?” Journal of Clinical Psychiatry 65: 634-51.

70. McMeniman, E., R. Moore, M. Yelland et al. (2011). “Childhood obesity: how do Australian general practitioners feel about managing this growing health problem?” Australian Journal of Primary Health 17: 60-5.

71. Mingrone, G., A. Greco, A. Gianacaterini et al. Sex hormone-binding globulin levels and cardiovascular risk factors in morbidly obese subjects before and after weight reduction induced by diet or malabsorptive surgery. Atherosclerosis. 2002;161:455-462.

72. Moore, L., A. Visioni, M. Quershi, et al. (2005). “Weight loss in overweight adults and the long-term risk of hypertension: the Framingham study.” Archives of Internal Medicine 165: 1298.

73. Moulin, C., I, Marguti, J. Peron, et al. (2009). “Impact of adiposity on immunological parameters.” Arq Bras Endocrinol Metabol 53: 183-9.

74. Musso, G., R. Gambino, F. De Michieli, et al. (2003). “Dietary habits and their relations to insulin resistance and postprandial lipemia in non-alcoholic steatohepatitis.” Hepatology 37: 909-16.

75. Nannipieri, M., A. Mari, M. Anselmino et al. The role of (beta) cell function and insulin sensitivity in the remission of type 2 diabetes after gastric bypass surgery. Journal of Clinical Endocrinology and Metabolism 2011; 96: E1372-9.

76. Obligado, S. and D. Goldfarb (2008). “The association of nephrolithiasis with hypertension and obesity: a review.” American Journal of Hypertension 21: 257-64.

77. O'Brien, P. E., T. McPhail, et al (2006). “Systematic review of medium-term weight loss after bariatric operations.” Obes Surg. 2006 Aug;16(8):1032-40.

78. O’Dea, K., K. Rowley, A. Brown. (2007). “Diabetes in Indigenous Australians: possible ways forward.” MJA 186: 494-5.

79. O’Dea, K. (1984). Diabetes 33: 596-603; after: O’Dea K. (1992). “Diabetes in Australian aborigines: impact of the western diet and lifestyle.” Journal of Internal Medicine 232: 103-117.

80. Ogden, C., S. Yanovski, M. Carroll, et al. (2007). “The epidemiology of obesity.” Gastroenterology 132: 2087-102.

81. Pasquali, R., L. Patton, A. Gambineri (2007). “Obesity and infertility.” Current Opinion in Endocrinology, Diabetes and Obesity 14: 482-7.

82. Pettman, T., G. Misan, K. Owen et al. (2008). “Self-management for obesity and cardio-metabolic fitness: description and evaluation of the lifestyle modification program of a randomised controlled trial.” International Journal of Behavioural Nutrition and Physical Activity 5: 53.

83. Poobalan, A., l. Aucott, W. Smith, et al. (2007). “Long-term eight loss effects on all cause mortality in overweight / obese populations.” Obesity Reviews 8: 503-13.

84. Pottie, P., Presle, N. et al (2006). “Obesity and osteoarthritis: more complex than predicted!” Ann Rheum Dis. 2006 November; 65(11): 1403–1405.

85. Rattay, K., M. Ramakrishnan, A. Atkinson, et al. (2009). “Use of electronic medical record system to support primary care recommendations to prevent, identify and manage childhood obesity.” Pediatrics 123: s100-7.

86. Reilly, J., E. Methven, Z. McDowell, et al. (2003). “Health consequences of obesity.” Archives of Disease in Childhood 88: 748-52.

87. Reilly, J., J. Kelly, et al. (2010) “Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: systematic review.” Int J Obes: 1-8.

88. Rejeski, W. A. Marsh, E. Chmelo et al. (2010). “Obesity, intentional weight loss and physical disability in older adults.” Obesity Reviews 11: 671-85.

89. Renehan, A., M. Tyson, M. Egger, et al., (2008). “Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies.” The Lancet 371: 569-78.

90. Rodriguez, C., S. Freedland, A. Deka et al. (2007). “Body mass index, weight change, and risk of prostate cancer in the Cancer Prevention Study II Nutrition Cohort.” Cancer Epidemiol Biomarkers Prev 16: 63–69.

91. Rowley, K., M. Daniel, K. Skinner, et al. (2000). “Effectiveness of a community-directed ‘healthy lifestyle’ program in a remote Australian aboriginal community.” Australian and New Zealand Journal of Public Health 2000; 24: 136-44.

92. Sanderson, K., G. Patton, C. McKercher, et al. (2011). “Overweight and obesity in childhood and risk of mental disorder: a 20-year cohort study.” Australian and New Zealand Journal of Psychiatry 45: 384-92.

93. Schauer, P., B. Burguera, S. Ikramuddin et al. Effect of laparoscopic Roux-En Y gastric bypass on type 2 diabetes mellitus. Annals of Surgery 2003; 238: 467-85.

94. Schmitt, N. M., W. K. Nicholson, et al. (2007). "The association of pregnancy and the development of obesity - results of a systematic review and meta-analysis on the natural history of postpartum weight retention." Int J Obes (Lond) 31(11): 1642-1651.

95. Schriefer, S., S. Landis, D. Turbow, et al. (2009). “Effect of a computerised body mass index prompt on diagnosis and treatment of adult obesity.” Family Medicine 41: 502-7.

96. Scott, K., M. R. Bruffaerts, et al. (2008). “Obesity and Mental Disorders in the General Population: Results from the World Mental Health Surveys.” Int J Obes (Lond). January; 32(1): 192–200.

97. Scottish Intercollegiate Guidelines Network (SIGN). (2003). “Management of obstructive sleep apnoea / hypopnoea syndrome in adults.” SIGN, Royal College of Physicians, Edinburgh.

98. Simonsen, M., Y. Hundrup, E. Obel, et al. (2008). “Intentional weight loss and mortality among initially healthy men and women.” Nutrition Reviews 66: 375-86.

99. Sjostrom L, A Lindroos, M Peltonen et al. Lifestyle, diabetes, and cardiovascular risk factors 10 years after bariatric surgery. N Engl J Med. 2004;351:2683-2693.

100. Snow V, P Barry, N Fitterman et al. Clinical Efficacy Assessment Subcommittee of the American College of Physicians. Pharmacologic and surgical management of obesity in primary care: a clinical practice guideline from the American College of Physicians. Ann Intern Med. 2005;142:525-531.

101. Streuling, I., A. Beyerlein, et al. (2011). "Physical activity and gestational weight gain: a meta-analysis of intervention trials." BJOG 118(3): 278-284.

102. Sullivan, M. et al. (1993). “Swedish obese subjects (SOS) – an intervention study of obesity. Baseline evaluation of health and psychosocial functioning in the first 1743

subjects examined." International Journal of Obesity and Related Metabolic Disorders 17: 503-12.

103. Uretsky, S., F. Messerli, S. Bangalore, et al. (2007). "Obesity paradox in patients with hypertension and coronary artery disease." American Journal of Medicine 120: 863.

104. Vincent, H., K. Vincent, K. Lamb (2010). "Obesity and mobility disability in the older adult." Obesity Reviews 11: 568-79.

105. Vincent RP, Le Roux CW (2008) Changes in gut hormones after bariatric surgery. Clin Endocrinology (Oxf) 69(2): 173-179.

106. Vlassov V. Long-term outcome of bariatric surgery. N Engl J Med. 2005;352:1495-1496.

107. Walker, L., A. Hill. (2009). "Obesity: The role of child mental health services." Child and Adolescent Mental Health 14: 114–20.

108. Wang, Y., X. Chen, Y. Song, et al. (2008a). "Association between obesity and kidney disease: a systematic review and meta-analysis." Kidney International 73: 19-33.

109. Wang, F., P. Veugelers. (2008b). "Self-esteem and cognitive development in the era of the childhood obesity epidemic." Obesity Reviews 9: 615-23.

110. Wearing, S., E. Hennig, N. Byrne, et al. (2006). "Musculoskeletal disorders associated with obesity: a biomechanical perspective. Obesity Reviews 7: 239-50.

111. Weiss, E., D. Galuska, L. Kettel Khan, et al. (2007). "Weight regain in US adults who experienced substantial weight loss, 1999-2002." American Journal of Preventive Medicine 33: 34-40.

112. Williamson, D., E. Pamuk, M. Thun, et al. (1995). "Prospective study of intentional weight loss and mortality in never-smoking overweight US white women aged 40 to 64 years." American Journal of Epidemiology 141: 1128.

113. Williamson, D., T. Thompson, M. Thun, et al. (2000). "Intentional weight loss and mortality among overweight individuals with diabetes." Diabetes Care 23: 1499-504.

114. Wolin, K. and G. Colditz. (2008). "Can weight loss prevent cancer?" British Journal of Cancer 99: 995-9.

115. World Cancer Research Fund American Institute for Cancer Research (WCRF/AICR). (2007). "Food, Nutrition and Physical Activity, and the Prevention of Cancer: a Global Perspective." Washington, USA.

116. Wright, M., E., S. Chang et al (2007). "Prospective study of adiposity and weight change in relation to prostate cancer incidence and mortality". Cancer. 2007 Feb 15;109(4):675-84.

117. Yusuf, E., R. G. Nelissen et al (2010). "Association between weight or body mass index and hand osteoarthritis: a systematic review". Ann Rheum Dis. 2010 Apr;69(4):761-5.

Table of Excluded Studies

Study Citation	Reason for Exclusion
Aasheim, E. T., S. Bjorkman, et al. (2009). "Vitamin status after bariatric surgery: a randomized study of gastric bypass and duodenal switch." Am J Clin Nutr 90(1): 15-22.	Control group does not enable intervention effect to be estimated
Abrams, S. A., I. J. Griffin, et al. (2007). "Effect of prebiotic supplementation and calcium intake on body mass index." J Pediatr 151(3): 293-298.	Not an intervention type that is the subject of this review
Ackermann, R. T., S. L. Edelstein, et al. (2009). "Changes in health state utilities with changes in body mass in the Diabetes Prevention Program." Obesity (Silver Spring) 17(12): 2176-2181.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Ades, P. A., P. D. Savage, et al. (2009). "High-calorie-expenditure exercise: a new approach to cardiac rehabilitation for overweight coronary patients." Circulation 119(20): 2671-2678.	Point estimates and confidence intervals unable to be reliably extracted
Akers, J. D., P. A. Estabrooks, et al. (2010). "Translational research: bridging the gap between long-term weight loss maintenance research and practice." J Am Diet Assoc 110(10): 1511-1522, 1522 e1511-1513.	Not a meta-analysis, systematic review or randomised controlled trial
Albu, J. B., L. K. Heilbronn, et al. (2010). "Metabolic changes following a 1-year diet and exercise intervention in patients with type 2 diabetes." Diabetes 59(3): 627-633.	Duplicate publication; no comparison group
Alhassan, S., S. Kim, et al. (2008). "Dietary adherence and weight loss success among overweight women: results from the A TO Z weight loss study." Int J Obes (Lond) 32(6): 985-991.	Control group does not enable intervention effect to be estimated
Alvarez-Jimenez, M., S. E. Hetrick, et al. (2008). "Non-pharmacological management of antipsychotic-induced weight gain: systematic review and meta-analysis of randomised controlled trials." Br J Psychiatry 193(2): 101-107.	Medical cause of obesity

Alvarez-Jimenez, M., O. Martinez-Garcia, et al. (2010). "Prevention of antipsychotic-induced weight gain with early behavioural intervention in first-episode psychosis: 2-year results of a randomized controlled trial." Schizophr Res 116(1): 16-19.	Medical cause of obesity
Amorim Adegboye Amanda, R., M. Linne Yvonne, et al. (2007) "Diet or exercise, or both, for weight reduction in women after childbirth." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD005627.pub2.	Pregnancy-associated weight loss study
An, J. Y., L. L. Hayman, et al. (2009) "Web-based weight management programs for children and adolescents: a systematic review of randomized controlled trial studies (Structured abstract)." Advances in Nursing Science, 222-240.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Anderson, L. M., T. A. Quinn, et al. (2009) "The effectiveness of worksite nutrition and physical activity interventions for controlling employee overweight and obesity: a systematic review (Structured abstract)." American Journal of Preventive Medicine, 340-357.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Angrisani, L., P. P. Cutolo, et al. (2009). "Laparoscopic adjustable gastric banding with truncal vagotomy versus laparoscopic adjustable gastric banding alone: interim results of a prospective randomized trial." Surg Obes Relat Dis 5(4): 435-438.	Control group does not enable intervention effect to be estimated
Angrisani, L., M. Lorenzo, et al. (2007). "Laparoscopic adjustable gastric banding versus Roux-en-Y gastric bypass: 5-year results of a prospective randomized trial." Surg Obes Relat Dis 3(2): 127-132; discussion 132-123.	Control group does not enable intervention effect to be estimated
Arceo-Olaiz, R., M. N. Espana-Gomez, et al. (2008). "Maximal weight loss after banded and unbanded laparoscopic Roux-en-Y gastric bypass: a randomized controlled trial." Surg Obes Relat Dis 4(4): 507-511.	Control group does not enable intervention effect to be estimated
Aronne, L. J., S. Tonstad, et al. (2010). "A clinical trial assessing the safety and efficacy of taranabant, a CB1R inverse agonist, in obese and overweight patients: a high-dose study." Int J Obes (Lond) 34(5): 919-935.	Trial discontinued prematurely

Ashley, J. M., H. Herzog, et al. (2007). "Nutrient adequacy during weight loss interventions: a randomized study in women comparing the dietary intake in a meal replacement group with a traditional food group." Nutr J 6: 12.	Control group does not enable intervention effect to be estimated
Astrup, A., F. L. Greenway, et al. (2007). "Randomized controlled trials of the D1/D5 antagonist ecopipam for weight loss in obese subjects." Obesity (Silver Spring) 15(7): 1717-1731.	Trial discontinued prematurely
Aubertin-Leheudre, M., C. Lord, et al. (2007). "Effect of 6 months of exercise and isoflavone supplementation on clinical cardiovascular risk factors in obese postmenopausal women: a randomized, double-blind study." Menopause 14(4): 624-629.	Control group received weight loss intervention
Ayala, G. X., J. P. Elder, et al. (2010). "Longitudinal intervention effects on parenting of the Aventuras para Ninos study." Am J Prev Med 38(2): 154-162.	Weight change data not reported
Baker Philip, R. A., P. Francis Daniel, et al. (2011) "Community wide interventions for increasing physical activity." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD008366.pub2.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Barnard, N. D., J. Cohen, et al. (2009). "A low-fat vegan diet and a conventional diabetes diet in the treatment of type 2 diabetes: a randomized, controlled, 74-wk clinical trial." Am J Clin Nutr 89(5): 1588S-1596S.	Control group does not enable intervention effect to be estimated
Barnard, N. D., L. Gloede, et al. (2009). "A low-fat vegan diet elicits greater macronutrient changes, but is comparable in adherence and acceptability, compared with a more conventional diabetes diet among individuals with type 2 diabetes." J Am Diet Assoc 109(2): 263-272.	Duplicate publication
Bathrellou, E., M. Yannakoulia, et al. (2010). "Parental involvement does not augment the effectiveness of an intense behavioral program for the treatment of childhood obesity." Hormones (Athens) 9(2): 171-175.	Control group does not enable intervention effect to be estimated

Bayer, O., R. von Kries, et al. (2009). "Short- and mid-term effects of a setting based prevention program to reduce obesity risk factors in children: a cluster-randomized trial." Clin Nutr 28(2): 122-128.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Bea, J. W., E. C. Cussler, et al. (2010). "Resistance training predicts 6-yr body composition change in postmenopausal women." Med Sci Sports Exerc 42(7): 1286-1295.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Benedict, M. A. and D. Arterburn (2008) "Worksite-based weight loss programs: a systematic review of recent literature (Structured abstract)." American Journal of Health Promotion, 408-416.	Participants in primary studies not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Bergstrom, I., C. Lombardo, et al. (2009). "Physical training decreases waist circumference in postmenopausal borderline overweight women." Acta Obstet Gynecol Scand 88(3): 308-313.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Berteus Forslund, H., S. Klingstrom, et al. (2008). "Should snacks be recommended in obesity treatment? A 1-year randomized clinical trial." Eur J Clin Nutr 62(11): 1308-1317.	Control group does not enable intervention effect to be estimated
Bertoni, A. G., J. M. Clark, et al. (2008). "Suboptimal control of glycemia, blood pressure, and LDL cholesterol in overweight adults with diabetes: the Look AHEAD Study." J Diabetes Complications 22(1): 1-9.	Data published elsewhere
Bessler, M., A. Daud, et al. (2007). "Prospective randomized trial of banded versus nonbanded gastric bypass for the super obese: early results." Surg Obes Relat Dis 3(4): 480-484; discussion 484-485.	Control group does not enable intervention effect to be estimated
Black, M. M., E. R. Hager, et al. (2010). "Challenge! Health promotion/obesity prevention mentorship model among urban, black adolescents." Pediatrics 126(2): 280-288.	Primary prevention study

Bo, S., G. Ciccone, et al. (2007). "Effectiveness of a lifestyle intervention on metabolic syndrome. A randomized controlled trial." J Gen Intern Med 22(12): 1695-1703.	Not all participants receiving intervention were provided with weight loss advice
Bradshaw, A. J., C. C. Horwath, et al. (2010). "Non-dieting group interventions for overweight and obese women: what predicts non-completion and does completion improve outcomes?" Public Health Nutr 13(10): 1622-1628.	Insufficient detail provided regarding weight loss intervention
Brantley, P., L. Appel, et al. (2008). "Design considerations and rationale of a multi-center trial to sustain weight loss: the Weight Loss Maintenance Trial." Clin Trials 5(5): 546-556.	Methodology paper
Bravata, D. M., C. Smith-Spangler, et al. (2007) "Using pedometers to increase physical activity and improve health: a systematic review (Structured abstract)." JAMA, 2296-2304.	Not all participants in primary studies were overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Brehm, B. J., B. L. Lattin, et al. (2009). "One-year comparison of a high-monounsaturated fat diet with a high-carbohydrate diet in type 2 diabetes." Diabetes Care 32(2): 215-220.	Both active and comparison intervention specify the same calorie restriction
Brethauer, S. A., J. P. Hammel, et al. (2009) "Systematic review of sleeve gastrectomy as staging and primary bariatric procedure (Structured abstract)." Surgery for Obesity and Related Diseases, 469-475.	Insufficient detail provided for quality scoring of review
Brinkworth, G. D., J. D. Buckley, et al. (2010). "Renal function following long-term weight loss in individuals with abdominal obesity on a very-low-carbohydrate diet versus high-carbohydrate diet." J Am Diet Assoc 110(4): 633-638.	Control group does not enable intervention effect to be estimated
Brinkworth, G. D., J. D. Buckley, et al. (2009). "Long-term effects of a very low-carbohydrate diet and a low-fat diet on mood and cognitive function." Arch Intern Med 169(20): 1873-1880.	Control group does not enable intervention effect to be estimated

Brinkworth, G. D., M. Noakes, et al. (2009). "Long-term effects of a very-low-carbohydrate weight loss diet compared with an isocaloric low-fat diet after 12 mo." Am J Clin Nutr 90(1): 23-32.	Control group does not enable intervention effect to be estimated
Brodney Folse, S., L. Falzon, et al. (2009) "Computer-based interventions for weight loss or weight maintenance in overweight or obese people." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD007675.	Protocol statement only
Brown, T., A. Avenell, et al. (2009) "Systematic review of long-term lifestyle interventions to prevent weight gain and morbidity in adults (Provisional abstract)." Obesity Reviews, 627-638.	Body weight data for participants in primary studies not reported
Brown, T. and C. Summerbell (2009) "Systematic review of school-based interventions that focus on changing dietary intake and physical activity levels to prevent childhood obesity: an update to the obesity guidance produced by the National Institute for Health and Clinical Excellence (Structured abstract)." Obesity Reviews, 110-141.	Primary prevention study
Buckley Brian, S., C. Byrne Mary, et al. (2010) "Service organisation for the secondary prevention of ischaemic heart disease in primary care." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD006772.pub2.	Medical cause of obesity
Burke, L. E., A. G. Hudson, et al. (2007). "Effects of a vegetarian diet and treatment preference on biochemical and dietary variables in overweight and obese adults: a randomized clinical trial." Am J Clin Nutr 86(3): 588-596.	Control group does not enable intervention effect to be estimated
Burke, L. E., M. A. Styn, et al. (2009). "SMART trial: A randomized clinical trial of self-monitoring in behavioral weight management-design and baseline findings." Contemp Clin Trials 30(6): 540-551.	No weight change data reported
Burke, L. E., M. Warziski, et al. (2008). "A randomized clinical trial of a standard versus vegetarian diet for weight loss: the impact of treatment preference." Int J Obes (Lond) 32(1): 166-176.	No control intervention

Burke, V., L. J. Beilin, et al. (2008). "Moderators and mediators of behaviour change in a lifestyle program for treated hypertensives: a randomized controlled trial (ADAPT)." Health Educ Res 23(4): 583-591.	Weight loss data resulting from intervention not provided
Burrows, T., J. M. Warren, et al. (2008). "Impact of a child obesity intervention on dietary intake and behaviors." Int J Obes (Lond) 32(10): 1481-1488.	No weight change data reported
Burrows, T., J. M. Warren, et al. (2010). "The impact of a child obesity treatment intervention on parent child-feeding practices." Int J Pediatr Obes 5(1): 43-50.	No weight change data reported
Cabassa, L. J., J. M. Ezell, et al. (2010) "Lifestyle interventions for adults with serious mental illness: a systematic literature review (Provisional abstract)." Psychiatric Services, 774-782.	Medical cause of obesity
Camhi, S. M., M. L. Stefanick, et al. (2010). "Metabolic syndrome and changes in body fat from a low-fat diet and/or exercise randomized controlled trial." Obesity (Silver Spring) 18(3): 548-554.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Campbell, K. L., P. T. Campbell, et al. (2008). "No reduction in C-reactive protein following a 12-month randomized controlled trial of exercise in men and women." Cancer Epidemiol Biomarkers Prev 17(7): 1714-1718.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Carels, R. A., L. Darby, et al. (2007). "Using motivational interviewing as a supplement to obesity treatment: a stepped-care approach." Health Psychol 26(3): 369-374.	Control group does not enable intervention effect to be estimated
Carr, L. J., R. T. Bartee, et al. (2009). "Eight-month follow-up of physical activity and central adiposity: results from an Internet-delivered randomized control trial intervention." J Phys Act Health 6(4): 444-455.	No control to 12 months
Carrel, A. L., R. R. Clark, et al. (2007). "School-based fitness changes are lost during the summer vacation." Arch Pediatr Adolesc Med 161(6): 561-564.	No control to 12 months

Carty, C. L., C. Kooperberg, et al. (2011). "Low-fat dietary pattern and change in body-composition traits in the Women's Health Initiative Dietary Modification Trial." Am J Clin Nutr 93(3): 516-524.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Castaneda-Gonzalez, L., R. Camberos-Solis, et al. (2010) "Long-term randomized clinical trials of pharmacological treatment of obesity: systematic review (Structured abstract)." Colombia Medica, 17-25.	Study methods inadequately described; methods for calculation of pooled estimates not described
Cercato, C., V. A. Roizenblatt, et al. (2009). "A randomized double-blind placebo-controlled study of the long-term efficacy and safety of diethylpropion in the treatment of obese subjects." Int J Obes (Lond) 33(8): 857-865.	Control participants received active intervention
Chaston, T. B. and J. B. Dixon (2008). "Factors associated with percent change in visceral versus subcutaneous abdominal fat during weight loss: findings from a systematic review." Int J Obes (Lond) 32(4): 619-628.	Fat-free mass the subject of the review
Chaston, T. B., J. B. Dixon, et al. (2007) "Changes in fat-free mass during significant weight loss: a systematic review (Structured abstract)." International Journal of Obesity, 743-750.	Details of weight range of participants in primary studies not provided
Chen, L., L. J. Appel, et al. (2009). "Reduction in consumption of sugar-sweetened beverages is associated with weight loss: the PREMIER trial." Am J Clin Nutr 89(5): 1299-1306.	Intervention / control comparisons not reported in outcomes data
Chua, S. D., Jr., S. P. Messier, et al. (2008). "Effect of an exercise and dietary intervention on serum biomarkers in overweight and obese adults with osteoarthritis of the knee." Osteoarthritis Cartilage 16(9): 1047-1053.	Biomarker study
Church, T. S., C. P. Earnest, et al. (2010). "Exercise without weight loss does not reduce C-reactive protein: the INFLAME study." Med Sci Sports Exerc 42(4): 708-716.	Insufficient duration of follow-up

Clifton, P. M., J. B. Keogh, et al. (2008). "Long-term effects of a high-protein weight-loss diet." Am J Clin Nutr 87(1): 23-29.	Control group does not enable intervention effect to be estimated
Collins, C. E., P. J. Morgan, et al. (2010). "Evaluation of a commercial web-based weight loss and weight loss maintenance program in overweight and obese adults: a randomized controlled trial." BMC Public Health 10: 669.	Outcomes data not provided
Csendes, A., F. Maluenda, et al. (2009). "A prospective randomized study comparing patients with morbid obesity submitted to laparotomic gastric bypass with or without omentectomy." Obes Surg 19(4): 490-494.	Control group does not enable intervention effect to be estimated
Dale, K. S., K. A. McAuley, et al. (2009). "Determining optimal approaches for weight maintenance: a randomized controlled trial." CMAJ 180(10): E39-46.	Control group does not enable intervention effect to be estimated
Das, S. K., C. H. Gilhooly, et al. (2007). "Long-term effects of 2 energy-restricted diets differing in glycemic load on dietary adherence, body composition, and metabolism in CALERIE: a 1-y randomized controlled trial." Am J Clin Nutr 85(4): 1023-1030.	Control group does not enable intervention effect to be estimated
Das, S. K., E. Saltzman, et al. (2009). "Low or moderate dietary energy restriction for long-term weight loss: what works best?" Obesity (Silver Spring) 17(11): 2019-2024.	Control group does not enable intervention effect to be estimated
Davis, A. M., R. L. James, et al. (2011). "The use of TeleMedicine in the treatment of paediatric obesity: feasibility and acceptability." Matern Child Nutr 7(1): 71-79.	Control group does not enable intervention effect to be estimated
Davis, N. J., N. Tomuta, et al. (2009). "Comparative study of the effects of a 1-year dietary intervention of a low-carbohydrate diet versus a low-fat diet on weight and glycemic control in type 2 diabetes." Diabetes Care 32(7): 1147-1152.	Control group does not enable intervention effect to be estimated
de Koning, L., A. T. Merchant, et al. (2007). "Waist circumference and waist-to-hip ratio as predictors of cardiovascular events: meta-regression analysis of prospective studies." Eur Heart J 28(7): 850-856.	Not weight loss studies

de Lemos, H. P., Jr., A. N. Atallah, et al. (2008). "Can sibutramine alter systemic blood pressure in obese patients? Systematic review and meta-analysis." Sao Paulo Med J 126(6): 342-346.	Weight loss data not presented
Delbridge, E. A., L. A. Prendergast, et al. (2009). "One-year weight maintenance after significant weight loss in healthy overweight and obese subjects: does diet composition matter?" Am J Clin Nutr 90(5): 1203-1214.	Control group does not enable intervention effect to be estimated
Derosa, G., P. Maffioli, et al. (2010). "Orlistat and L-carnitine compared to orlistat alone on insulin resistance in obese diabetic patients." Endocr J 57(9): 777-786.	Control group does not enable intervention effect to be estimated
Diaz, R. G., J. Esparza-Romero, et al. (2010). "Lifestyle intervention in primary care settings improves obesity parameters among Mexican youth." J Am Diet Assoc 110(2): 285-290.	Control group participants received active intervention
Dixon, A. N., G. Valsamakis, et al. (2008). "Effect of the orlistat on serum endotoxin lipopolysaccharide and adipocytokines in South Asian individuals with impaired glucose tolerance." Int J Clin Pract 62(7): 1124-1129.	Control group participants received active intervention
Dixon, J. B., B. J. Strauss, et al. (2007). "Changes in body composition with weight loss: obese subjects randomized to surgical and medical programs." Obesity (Silver Spring) 15(5): 1187-1198.	Control group does not enable intervention effect to be estimated
Duggins, M., P. Cherven, et al. (2010). "Impact of family YMCA membership on childhood obesity: a randomized controlled effectiveness trial." J Am Board Fam Med 23(3): 323-333.	Control group does not enable intervention effect to be estimated
Duke S., S. Colagiuri, et al. (2009) "Individual patient education for people with type 2 diabetes mellitus." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD005268.pub2.	Not weight loss intervention in overweight / obese participants
Dyson, P. A., S. Beatty, et al. (2010). "An assessment of low-carbohydrate or low-fat diets for weight loss at 2 year's follow-up." Diabet Med 27(3): 363-364.	Control group does not enable intervention effect to be estimated

Early, J. L., C. M. Apovian, et al. (2007). "Sibutramine plus meal replacement therapy for body weight loss and maintenance in obese patients." Obesity (Silver Spring) 15(6): 1464-1472.	Control group participants received active intervention
Ebbeling, C. B., M. M. Leidig, et al. (2007). "Effects of a low-glycemic load versus low-fat diet in obese young adults: a randomized trial." JAMA 297(19): 2092-2102.	Control group does not enable intervention effect to be estimated
Elhayany, A., A. Lustman, et al. (2010). "A low carbohydrate Mediterranean diet improves cardiovascular risk factors and diabetes control among overweight patients with type 2 diabetes mellitus: a 1-year prospective randomized intervention study." Diabetes Obes Metab 12(3): 204-209.	Control group does not enable intervention effect to be estimated
Ello-Martin, J. A., L. S. Roe, et al. (2007). "Dietary energy density in the treatment of obesity: a year-long trial comparing 2 weight-loss diets." Am J Clin Nutr 85(6): 1465-1477.	Control group participants received active intervention
Enwald, H. P. and M. L. Huotari (2010) "Preventing the obesity epidemic by second generation tailored health communication: an interdisciplinary review (Provisional abstract)." Journal of Medical Internet Research.	Primary prevention study
Epstein, L. H., R. A. Paluch, et al. (2008). "Increasing healthy eating vs. reducing high energy-dense foods to treat pediatric obesity." Obesity (Silver Spring) 16(2): 318-326.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Epstein, L. H., J. N. Roemmich, et al. (2008). "A randomized trial of the effects of reducing television viewing and computer use on body mass index in young children." Arch Pediatr Adolesc Med 162(3): 239-245.	Control group participants received active intervention
Espeland, M. A., G. A. Bray, et al. (2009). "Describing patterns of weight changes using principal components analysis: results from the Action for Health in Diabetes (Look AHEAD) research group." Ann Epidemiol 19(10): 701-710.	Weight change data published elsewhere

Estabrooks, P. A., J. A. Shoup, et al. (2009). "Automated telephone counseling for parents of overweight children: a randomized controlled trial." Am J Prev Med 36(1): 35-42.	Control group participants received active intervention
Fabbrini, E., R. A. Tamboli, et al. (2010). "Surgical removal of omental fat does not improve insulin sensitivity and cardiovascular risk factors in obese adults." Gastroenterology 139(2): 448-455.	Control group participants received active intervention
Fabricatore, A. N., T. A. Wadden, et al. (2007). "The role of patients' expectations and goals in the behavioral and pharmacological treatment of obesity." Int J Obes (Lond) 31(11): 1739-1745.	No control group
Faith, M. S., K. R. Fontaine, et al. (2007) "Toward the reduction of population obesity: macrolevel environmental approaches to the problems of food, eating, and obesity (Provisional abstract)." Psychological Bulletin, 205-226.	Narrative review of literature
Faulconbridge, L. F., T. A. Wadden, et al. (2009). "Changes in symptoms of depression with weight loss: results of a randomized trial." Obesity (Silver Spring) 17(5): 1009-1016.	Control group does not enable intervention effect to be estimated
Faulkner, G., T. Cohn, et al. (2007). "Interventions to reduce weight gain in schizophrenia." Cochrane Database Syst Rev(1): CD005148.	Medical cause of obesity
Fernald, L. C., P. J. Gertler, et al. (2008). "Role of cash in conditional cash transfer programmes for child health, growth, and development: an analysis of Mexico's Oportunidades." Lancet 371(9615): 828-837.	No individual level weight data; participants not all overweight or obese at group level
Fitzgibbon, M. L., M. Stolley, et al. (2008). "Obesity Reduction Black Intervention Trial (ORBIT): design and baseline characteristics." J Womens Health (Larchmt) 17(7): 1099-1110.	Follow-up weight or secondary outcomes data not reported
Fontana, L., D. T. Villareal, et al. (2007). "Calorie restriction or exercise: effects on coronary heart disease risk factors. A randomized, controlled trial." Am J Physiol Endocrinol Metab 293(1): E197-202.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight

Fontbonne, A., I. Diouf, et al. (2009). "Effects of 1-year treatment with metformin on metabolic and cardiovascular risk factors in non-diabetic upper-body obese subjects with mild glucose anomalies: a post-hoc analysis of the BIGPRO1 trial." Diabetes Metab 35(5): 385-391.	Not weight loss intervention
Forsberg, K. A., T. Bjorkman, et al. (2010). "Influence of a lifestyle intervention among persons with a psychiatric disability: a cluster randomised controlled trail on symptoms, quality of life and sense of coherence." J Clin Nurs 19(11-12): 1519-1528.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Foster, G. D., B. Linder, et al. (2010). "A school-based intervention for diabetes risk reduction." N Engl J Med 363(5): 443-453.	Randomisation at group level; medical causes of obesity not excluded
Foster, G. D., S. Sherman, et al. (2008). "A policy-based school intervention to prevent overweight and obesity." Pediatrics 121(4): e794-802.	Control group does not enable intervention effect to be estimated
Foster, G. D., H. R. Wyatt, et al. (2010). "Weight and metabolic outcomes after 2 years on a low-carbohydrate versus low-fat diet: a randomized trial." Ann Intern Med 153(3): 147-157.	Individual level data not provided; medical causes of obesity not excluded
Francis, M., S. S. Nichols, et al. (2010). "The effects of a school-based intervention programme on dietary intakes and physical activity among primary-school children in Trinidad and Tobago." Public Health Nutr 13(5): 738-747.	Randomisation at group level; groups not equivalent in weight measures
Franks, P. W., K. A. Jablonski, et al. (2008). "Assessing gene-treatment interactions at the FTO and INSIG2 loci on obesity-related traits in the Diabetes Prevention Program." Diabetologia 51(12): 2214-2223.	Weight outcomes not reported for participants as a whole
Fraser, A., R. Abel, et al. (2008). "A modified Mediterranean diet is associated with the greatest reduction in alanine aminotransferase levels in obese type 2 diabetes patients: results of a quasi-randomised controlled trial." Diabetologia 51(9): 1616-1622.	≥12 month weight loss data not provided

French, S. A., L. J. Harnack, et al. (2010). "Worksite environment intervention to prevent obesity among metropolitan transit workers." Prev Med 50(4): 180-185.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Fujimoto, W. Y., K. A. Jablonski, et al. (2007). "Body size and shape changes and the risk of diabetes in the diabetes prevention program." Diabetes 56(6): 1680-1685.	Not all participants were overweight or obese
Galletly, C. L. and L. E. Murray (2009) "Managing weight in persons living with severe mental illness in community settings: a review of strategies used in community interventions (Provisional abstract)." Issues in Mental Health Nursing, 660-668.	Insufficient description of weight loss intervention
Gao, Y., S. Griffiths, et al. (2007) "Community-based interventions to reduce overweight and obesity in China: a systematic review of the Chinese and English literature (Structured abstract)." Journal of Public Health, 436-448.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Gardner, C. D., A. Kiazand, et al. (2007). "Comparison of the Atkins, Zone, Ornish, and LEARN diets for change in weight and related risk factors among overweight premenopausal women: the A TO Z Weight Loss Study: a randomized trial." JAMA 297(9): 969-977.	Control group does not enable intervention effect to be estimated
Gilhooly, C. H., S. K. Das, et al. (2008). "Use of cereal fiber to facilitate adherence to a human caloric restriction program." Aging Clin Exp Res 20(6): 513-520.	Less than 52 weeks including follow-up; Control group does not enable intervention effect to be estimated
Gilles, A., M. Cassano, et al. (2008). "Comparing active pediatric obesity treatments using meta-analysis." J Clin Child Adolesc Psychol 37(4): 886-892.	Treatment-treatment comparisons only
Goetzel, R. Z., E. C. Roemer, et al. (2010). "Second-year results of an obesity prevention program at the Dow Chemical Company." J Occup Environ Med 52(3): 291-302.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Golan, R., D. Schwarzfuchs, et al. (2010). "Halo effect of a weight-loss trial on spouses: the DIRECT-Spouse study." Public Health Nutr 13(4): 544-549.	Control group does not enable intervention effect to be estimated

Gold, B. C., S. Burke, et al. (2007). "Weight loss on the web: A pilot study comparing a structured behavioral intervention to a commercial program." Obesity (Silver Spring) 15(1): 155-164.	Control group does not enable intervention effect to be estimated
Goldner, W. S., J. A. Stoner, et al. (2009). "Finding the optimal dose of vitamin D following Roux-en-Y gastric bypass: a prospective, randomized pilot clinical trial." Obes Surg 19(2): 173-179.	Control group does not enable intervention effect to be estimated
Goodpaster, B. H., J. P. Delany, et al. (2010). "Effects of diet and physical activity interventions on weight loss and cardiometabolic risk factors in severely obese adults: a randomized trial." JAMA 304(16): 1795-1802.	Intervention provided to intervention and comparison groups the same at 12 months
Gorin, A. A., A. Marinilli Pinto, et al. (2007). "Failure to meet weight loss expectations does not impact maintenance in successful weight losers." Obesity (Silver Spring) 15(12): 3086-3090.	Weight change reported for participants as a whole and not for intervention and comparison groups separately
Gorin, A. A., H. M. Niemeier, et al. (2008). "Binge eating and weight loss outcomes in overweight and obese individuals with type 2 diabetes: results from the Look AHEAD trial." Arch Gen Psychiatry 65(12): 1447-1455.	Participants did not receive weight loss intervention
Gorin, A. A., R. R. Wing, et al. (2008). "Weight loss treatment influences untreated spouses and the home environment: evidence of a ripple effect." Int J Obes (Lond) 32(11): 1678-1684.	Previously reported data for participants as a whole
Gravante, G., A. Araco, et al. (2007). "Laparoscopic adjustable gastric bandings: a prospective randomized study of 400 operations performed with 2 different devices." Arch Surg 142(10): 958-961.	Control group does not enable intervention effect to be estimated
Gripeteg, L., J. Torgerson, et al. (2010). "Prolonged refeeding improves weight maintenance after weight loss with very-low-energy diets." Br J Nutr 103(1): 141-148.	Control group does not enable intervention effect to be estimated

Guh, D. P., W. Zhang, et al. (2009). "The incidence of co-morbidities related to obesity and overweight: a systematic review and meta-analysis." BMC Public Health 9: 88.	No weight loss interventions
Harris, K. C., L. K. Kuramoto, et al. (2009) "Effect of school-based physical activity interventions on body mass index in children: a meta-analysis (Structured abstract)." CMAJ: Canadian Medical Association Journal, 719-180.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Hasani-Ranjbar, S., N. Nayebi, et al. (2009) "A systematic review of the efficacy and safety of herbal medicines used in the treatment of obesity (Structured abstract)." World Journal of Gastroenterology, 3073-3085.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Hilbert, A., B. E. Saelens, et al. (2007). "Pretreatment and process predictors of outcome in interpersonal and cognitive behavioral psychotherapy for binge eating disorder." J Consult Clin Psychol 75(4): 645-651.	Medical cause of obesity not excluded; Control group does not enable intervention effect to be estimated
Hingle, M. D., T. M. O'Connor, et al. (2010) "Parental involvement in interventions to improve child dietary intake: a systematic review (Structured abstract)." Preventive Medicine, 103-111.	Weight status of children in primary studies not reported
Hoeger, K., K. Davidson, et al. (2008). "The impact of metformin, oral contraceptives, and lifestyle modification on polycystic ovary syndrome in obese adolescent women in two randomized, placebo-controlled clinical trials." J Clin Endocrinol Metab 93(11): 4299-4306.	Medical cause of obesity
Hollander, P. (2007). "Endocannabinoid blockade for improving glycemic control and lipids in patients with type 2 diabetes mellitus." Am J Med 120(2 Suppl 1): S18-28; discussion S29-32.	Insufficient details provided for quality scoring; loss to follow-up not described
Holme, I., A. T. Hostmark, et al. (2007). "ApoB but not LDL-cholesterol is reduced by exercise training in overweight healthy men. Results from the 1-year randomized Oslo Diet and Exercise Study." J Intern Med 262(2): 235-243.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight

Hope, A. A., S. K. Kumanyika, et al. (2010). "Changes in Health-Related Quality of Life among African-Americans in a lifestyle weight loss program." Qual Life Res 19(7): 1025-1033.	Weight loss data provided for participants as a whole and not for intervention groups
Howard, B. V., J. D. Curb, et al. (2010). "Low-fat dietary pattern and lipoprotein risk factors: the Women's Health Initiative Dietary Modification Trial." Am J Clin Nutr 91(4): 860-874.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Huang, J. S., G. J. Norman, et al. (2007). "Body image and self-esteem among adolescents undergoing an intervention targeting dietary and physical activity behaviors." J Adolesc Health 40(3): 245-251.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Hudon, C., M. Fortin, et al. (2008) "Single risk factor interventions to promote physical activity among patients with chronic diseases: systematic review (Structured abstract)." Canadian Family Physician, 1130-1137.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Hunter, G. R., D. W. Brock, et al. (2010). "Exercise training prevents regain of visceral fat for 1 year following weight loss." Obesity (Silver Spring) 18(4): 690-695.	Control group does not enable intervention effect to be estimated
Hursel, R., W. Viechtbauer, et al. (2009). "The effects of green tea on weight loss and weight maintenance: a meta-analysis." Int J Obes (Lond) 33(9): 956-961.	Weight status of subjects in primary studies not reported
Ibanez, L., A. Lopez-Bermejo, et al. (2010). "Low-dose pioglitazone, flutamide, metformin plus an estro-progestagen for non-obese young women with polycystic ovary syndrome: increasing efficacy and persistent safety over 30 months." Gynecol Endocrinol 26(12): 869-873.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Jacobs, D. R., Jr., D. Sluik, et al. (2009). "Association of 1-y changes in diet pattern with cardiovascular disease risk factors and adipokines: results from the 1-y randomized Oslo Diet and Exercise Study." Am J Clin Nutr 89(2): 509-517.	Weight change of participants in intervention and control group not provided separately

Jaime, P. C. and K. Lock (2009) "Do school based food and nutrition policies improve diet and reduce obesity? (Structured abstract)." Preventive Medicine, 45-53.	Weight loss of participants in primary studies not reported
Jakicic, J. M., B. H. Marcus, et al. (2008). "Effect of exercise on 24-month weight loss maintenance in overweight women." Arch Intern Med 168(14): 1550-1559; discussion 1559-1560.	Control group does not enable intervention effect to be estimated
Jakicic, J. M., S. A. Jaramillo, et al. (2009). "Effect of a lifestyle intervention on change in cardiorespiratory fitness in adults with type 2 diabetes: results from the Look AHEAD Study." Int J Obes (Lond) 33(3): 305-316.	Study assessed relationship between cardiorespiratory fitness and lifestyle intervention
Jeffery, R. W., R. L. Levy, et al. (2009). "A comparison of maintenance-tailored therapy (MTT) and standard behavior therapy (SBT) for the treatment of obesity." Prev Med 49(5): 384-389.	Control group does not enable intervention effect to be estimated
Jelalian, E., E. E. Lloyd-Richardson, et al. (2010). "Behavioral weight control treatment with supervised exercise or peer-enhanced adventure for overweight adolescents." J Pediatr 157(6): 923-928 e921.	Control group does not enable intervention effect to be estimated
Jendle, J., M. A. Nauck, et al. (2009). "Weight loss with liraglutide, a once-daily human glucagon-like peptide-1 analogue for type 2 diabetes treatment as monotherapy or added to metformin, is primarily as a result of a reduction in fat tissue." Diabetes Obes Metab 11(12): 1163-1172.	12 month study had no placebo group
Jiang, J., X. Xia, et al. (2007). "The effects of a 3-year obesity intervention in schoolchildren in Beijing." Child Care Health Dev 33(5): 641-646.	Weight change in overweight and obese individuals in intervention and control groups not reported
Johansson, K., K. Neovius, et al. (2009). "Discontinuation due to adverse events in randomized trials of orlistat, sibutramine and rimonabant: a meta-analysis." Obes Rev 10(5): 564-575.	Weight loss data not provided
Johansson, K., J. Sundstrom, et al. (2010). "Long-term changes in blood pressure following orlistat and sibutramine treatment: a meta-analysis." Obes Rev 11(11): 777-791.	Weight loss data not provided

Johnson, S. S., A. L. Paiva, et al. (2008). "Transtheoretical model-based multiple behavior intervention for weight management: effectiveness on a population basis." Prev Med 46(3): 238-246.	Unable to quality score as insufficient detail; point estimate and confidence intervals for change in overweight and obesity not provided
Jorde, R., M. Sneve, et al. (2008). "Effects of vitamin D supplementation on symptoms of depression in overweight and obese subjects: randomized double blind trial." J Intern Med 264(6): 599-609.	No weight loss intervention
Jorde, R., M. Sneve, et al. (2010). "No improvement in cardiovascular risk factors in overweight and obese subjects after supplementation with vitamin D3 for 1 year." J Intern Med 267(5): 462-472.	No weight loss intervention
Kalter-Leibovici, O., N. Younis-Zeidan, et al. (2010). "Lifestyle intervention in obese Arab women: a randomized controlled trial." Arch Intern Med 170(11): 970-976.	Control group does not enable intervention effect to be estimated
Kanekar, A. and M. Sharma (2008). "Meta-analysis of school-based childhood obesity interventions in the U.K. and U.S." Int Q Community Health Educ 29(3): 241-256.	Obesity prevention study
Karamanakos, S. N., K. Vagenas, et al. (2008). "Weight loss, appetite suppression, and changes in fasting and postprandial ghrelin and peptide-YY levels after Roux-en-Y gastric bypass and sleeve gastrectomy: a prospective, double blind study." Ann Surg 247(3): 401-407.	Control group does not enable intervention effect to be estimated
Katz, D. L., M. O'Connell, et al. (2008). "Strategies for the prevention and control of obesity in the school setting: systematic review and meta-analysis." Int J Obes (Lond) 32(12): 1780-1789.	Subjects not overweight or obese
Katzer, L., A. J. Bradshaw, et al. (2008). "Evaluation of a "nondieting" stress reduction program for overweight women: a randomized trial." Am J Health Promot 22(4): 264-274.	Control group does not enable intervention effect to be estimated
Kawashima, H., H. Takase, et al. (2008). "One-year ad libitum consumption of diacylglycerol oil as part of a regular diet results in modest weight loss in comparison with consumption of a triacylglycerol control oil in overweight Japanese subjects." J Am Diet Assoc 108(1): 57-66.	Weight loss intervention not one of the types of intervention included in this review

Kelishadi, R., M. Hashemipour, et al. (2008). "Short- and long-term relationships of serum ghrelin with changes in body composition and the metabolic syndrome in prepubescent obese children following two different weight loss programmes." Clin Endocrinol (Oxf) 69(5): 721-729.	Control group does not enable intervention effect to be estimated
Kelley, G. A. and K. S. Kelley (2007). "Aerobic exercise and lipids and lipoproteins in children and adolescents: a meta-analysis of randomized controlled trials." Atherosclerosis 191(2): 447-453.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Kelley, G. A. and K. S. Kelley (2008). "Effects of aerobic exercise on non-high-density lipoprotein cholesterol in children and adolescents: a meta-analysis of randomized controlled trials." Prog Cardiovasc Nurs 23(3): 128-132.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Keogh, J. B., N. D. Luscombe-Marsh, et al. (2007). "Long-term weight maintenance and cardiovascular risk factors are not different following weight loss on carbohydrate-restricted diets high in either monounsaturated fat or protein in obese hyperinsulinaemic men and women." Br J Nutr 97(2): 405-410.	Control group does not enable intervention effect to be estimated
Kerr, J., K. Patrick, et al. (2008). "Randomized control trial of a behavioral intervention for overweight women: impact on depressive symptoms." Depress Anxiety 25(7): 555-558.	Weight loss data not reported
Kim, Y., J. Pike, et al. (2010). "Telephone intervention promoting weight-related health behaviors." Prev Med 50(3): 112-117.	Insufficient duration of follow-up
Kumanyika, S. K., T. A. Wadden, et al. (2009). "Trial of family and friend support for weight loss in African American adults." Arch Intern Med 169(19): 1795-1804.	Control group does not enable intervention effect to be estimated
Lapointe, A., S. J. Weisnagel, et al. (2010). "Comparison of a dietary intervention promoting high intakes of fruits and vegetables with a low-fat approach: long-term effects on dietary intakes, eating behaviours and body weight in postmenopausal women." Br J Nutr 104(7): 1080-1090.	Control group does not enable intervention effect to be estimated

Larsen, T. M., S. Dalskov, et al. (2010). "The Diet, Obesity and Genes (Diogenes) Dietary Study in eight European countries - a comprehensive design for long-term intervention." Obes Rev 11(1): 76-91.	No weight change data provided for 12 month follow-up of participants
Layman, D. K., E. M. Evans, et al. (2009). "A moderate-protein diet produces sustained weight loss and long-term changes in body composition and blood lipids in obese adults." J Nutr 139(3): 514-521.	Control group does not enable intervention effect to be estimated
Levy, R. L., R. W. Jeffery, et al. (2010). "Maintenance-tailored therapy vs. standard behavior therapy for 30-month maintenance of weight loss." Prev Med 51(6): 457-459.	Control group does not enable intervention effect to be estimated
Livhits, M., C. Mercado, et al. (2010). "Exercise following bariatric surgery: systematic review." Obes Surg 20(5): 657-665.	Meta-analysis performed that combined data from primary studies that were of different study types and appraising different types of weight loss interventions in order to generate a single point estimate
Lopez-Jimenez, F., C. O. Wu, et al. (2008). "Weight change after myocardial infarction--the Enhancing Recovery in Coronary Heart Disease patients (ENRICHD) experience." Am Heart J 155(3): 478-484.	No weight loss intervention
Lowe, M. R., K. A. Tappe, et al. (2008). "The effect of training in reduced energy density eating and food self-monitoring accuracy on weight loss maintenance." Obesity (Silver Spring) 16(9): 2016-2023.	Control group does not enable intervention effect to be estimated
Maayan, L., J. Vakhrusheva, et al. (2010). "Effectiveness of medications used to attenuate antipsychotic-related weight gain and metabolic abnormalities: a systematic review and meta-analysis." Neuropsychopharmacology 35(7): 1520-1530.	Medical cause of obesity
MacKay-Lyons, M., M. Thornton, et al. (2010) "Non-pharmacological interventions for preventing secondary vascular events after stroke or transient ischemic attack." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD008656.	Protocol statement only

Marcus, C., G. Nyberg, et al. (2009). "A 4-year, cluster-randomized, controlled childhood obesity prevention study: STOPP." Int J Obes (Lond) 33(4): 408-417.	Data for overweight / obese participants not presented separately to participants with normal body weight
Marinilli Pinto, A., A. A. Gorin, et al. (2008). "Successful weight-loss maintenance in relation to method of weight loss." Obesity (Silver Spring) 16(11): 2456-2461.	12 month weight change data for controls not provided
Mathus-Vliegen, E. M. and L. T. de Wit (2007). "Health-related quality of life after gastric banding." Br J Surg 94(4): 457-465.	Controls not randomly assigned
McCarthy, W. J., A. K. Yancey, et al. (2007). "Fighting cancer with fitness: dietary outcomes of a randomized, controlled lifestyle change intervention in healthy African-American women." Prev Med 44(3): 246-253.	Data for overweight / obese participants not presented separately to participants with normal body weight
McMurray, R. G., S. Bassin, et al. (2009). "Rationale, design and methods of the HEALTHY study physical education intervention component." Int J Obes (Lond) 33 Suppl 4: S37-43.	Methodological paper
Micco, N., B. Gold, et al. (2007). "Minimal in-person support as an adjunct to internet obesity treatment." Ann Behav Med 33(1): 49-56.	Control group does not enable intervention effect to be estimated
Milner P, C., P. Hams Steven, et al. (2008) "Psychosocial interventions for the maintenance of weight loss in obese adults." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD007153.	Protocol statement only
Molenaar, E. A., E. J. van Ameijden, et al. (2010). "Effect of nutritional counselling and nutritional plus exercise counselling in overweight adults: a randomized trial in multidisciplinary primary care practice." Fam Pract 27(2): 143-150.	Control group does not enable intervention effect to be estimated
Monninkhof, E. M., M. J. Velthuis, et al. (2009). "Effect of exercise on postmenopausal sex hormone levels and role of body fat: a randomized controlled trial." J Clin Oncol 27(27): 4492-4499.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight

Moore, C. S., A. K. Lindroos, et al. (2010). "Dietary strategy to manipulate ad libitum macronutrient intake, and glycaemic index, across eight European countries in the Diogenes Study." Obes Rev 11(1): 67-75.	Weight change data not provided
Mulrow Cynthia, D., E. Chiquette, et al. (2008) "Dieting to reduce body weight for controlling hypertension in adults." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD000484.pub2.	Review no longer available as withdrawn from Cochrane library
Munsch, S., E. Biedert, et al. (2007). "A randomized comparison of cognitive behavioral therapy and behavioral weight loss treatment for overweight individuals with binge eating disorder." Int J Eat Disord 40(2): 102-113.	Control group does not enable intervention effect to be estimated
Nackers, L. M., K. M. Ross, et al. (2010). "The association between rate of initial weight loss and long-term success in obesity treatment: does slow and steady win the race?" Int J Behav Med 17(3): 161-167.	Control group does not enable intervention effect to be estimated
Nagamia, S., A. Pandian, et al. (2007). "The role of quinapril in the presence of a weight loss regimen: endothelial function and markers of obesity in patients with the metabolic syndrome." Prev Cardiol 10(4): 204-209.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Nkansah, N., M. Garala, et al. (2007) "Orlistat for the prevention of cardiovascular diseases in overweight or obese individuals." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD006692.	Protocol statement only
Orozco Leonardo, J., M. Buchleitner Ana, et al. (2008) "Exercise or exercise and diet for preventing type 2 diabetes mellitus." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD003054.pub3.	Not all participants of primary studies were overweight or obese
Park, H. A., J. S. Lee, et al. (2007). "Effects of weight control during the menopausal transition on bone mineral density." J Clin Endocrinol Metab 92(10): 3809-3815.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight

Pasarica, M., J. J. Zachwieja, et al. (2007). "Effect of growth hormone on body composition and visceral adiposity in middle-aged men with visceral obesity." J Clin Endocrinol Metab 92(11): 4265-4270.	Not an intervention type that was the subject of this review
Phelan, S., T. A. Wadden, et al. (2007). "Impact of weight loss on the metabolic syndrome." Int J Obes (Lond) 31(9): 1442-1448.	Control group does not enable intervention effect to be estimated
Protani, M., M. Coory, et al. (2010). "Effect of obesity on survival of women with breast cancer: systematic review and meta-analysis." Breast Cancer Res Treat 123(3): 627-635.	Not a weight loss intervention
Racette, S. B., S. S. Deusinger, et al. (2009). "Worksite Opportunities for Wellness (WOW): effects on cardiovascular disease risk factors after 1 year." Prev Med 49(2-3): 108-114.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Reas, D. L. and C. M. Grilo (2008). "Review and meta-analysis of pharmacotherapy for binge-eating disorder." Obesity (Silver Spring) 16(9): 2024-2038.	Medical cause of obesity
Reinehr, T., M. Dobe, et al. (2010). "Obesity in disabled children and adolescents: an overlooked group of patients." Dtsch Arztebl Int 107(15): 268-275.	Medical causes of obesity not excluded
Renehan, A. G., M. Tyson, et al. (2008). "Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies." Lancet 371(9612): 569-578.	No weight loss interventions reviewed
Richelsen, B., S. Tonstad, et al. (2007). "Effect of orlistat on weight regain and cardiovascular risk factors following a very-low-energy diet in abdominally obese patients: a 3-year randomized, placebo-controlled study." Diabetes Care 30(1): 27-32.	Control group participants received active intervention
Rimmer, J. H., A. Rauworth, et al. (2009). "A randomized controlled trial to increase physical activity and reduce obesity in a predominantly African American group of women with mobility disabilities and severe obesity." Prev Med 48(5): 473-479.	Control group does not enable intervention effect to be estimated

Rock, C. L., S. W. Flatt, et al. (2010). "Effect of a free prepared meal and incentivized weight loss program on weight loss and weight loss maintenance in obese and overweight women: a randomized controlled trial." JAMA 304(16): 1803-1810.	Control group does not enable intervention effect to be estimated
Sacher, P. M., M. Kolotourou, et al. (2010). "Randomized controlled trial of the MEND program: a family-based community intervention for childhood obesity." Obesity (Silver Spring) 18 Suppl 1: S62-68.	Control group participants on active intervention by 12 month follow-up
Sacks, F. M., G. A. Bray, et al. (2009). "Comparison of weight-loss diets with different compositions of fat, protein, and carbohydrates." N Engl J Med 360(9): 859-873.	Control group does not enable intervention effect to be estimated
Salas-Salvado, J., J. Fernandez-Ballart, et al. (2008). "Effect of a Mediterranean diet supplemented with nuts on metabolic syndrome status: one-year results of the PREDIMED randomized trial." Arch Intern Med 168(22): 2449-2458.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Salcedo Aguilar, F., V. Martinez-Vizcaino, et al. (2010). "Impact of an after-school physical activity program on obesity in children." J Pediatr 157(1): 36-42 e33.	Weight change in overweight / obese participants not reported
Salmon, J., K. Ball, et al. (2008). "Outcomes of a group-randomized trial to prevent excess weight gain, reduce screen behaviours and promote physical activity in 10-year-old children: switch-play." Int J Obes (Lond) 32(4): 601-612.	Impact of intervention on overweight / obese participants not reported separately
Salmon, J., M. L. Booth, et al. (2007) "Promoting physical activity participation among children and adolescents (Structured abstract)." Epidemiologic Reviews, 144-159.	Weight change in overweight / obese participants not reported separately
Saquib, N., L. Natarajan, et al. (2008). "The impact of a long-term reduction in dietary energy density on body weight within a randomized diet trial." Nutr Cancer 60(1): 31-38.	Impact of intervention on participants with excess body weight not reported separately
Sari, R., E. Eray, et al. (2010). "Comparison of the effects of sibutramine versus sibutramine plus metformin in obese women." Clin Exp Med 10(3): 179-184.	Control group does not enable intervention effect to be estimated

Schirmer, M. A. and S. D. Phinney (2007). "Gamma-linolenate reduces weight regain in formerly obese humans." J Nutr 137(6): 1430-1435.	Not an intervention type that was the subject of this review
Scozzari, G., E. Farinella, et al. (2009). "Laparoscopic adjustable silicone gastric banding versus laparoscopic vertical banded gastroplasty in morbidly obese patients: long-term results of a prospective randomized controlled clinical trial." Obes Surg 19(8): 1108-1115.	Control group does not enable intervention effect to be estimated
Selwyn, A. P. (2007). "Weight reduction and cardiovascular and metabolic disease prevention: clinical trial update." American Journal of Cardiology 100(12A): 33P-37p.	Review not systematic
Sen, A., K. L. Jen, et al. (2007). "Baseline leptin levels predict change in leptin levels during weight loss in obese breast cancer survivors." Breast J 13(2): 180-186.	Participants may have medical confounder contributing to weight change
Seo, D. C. and J. Sa (2010). "A meta-analysis of obesity interventions among U.S. minority children." J Adolesc Health 46(4): 309-323.	Impact of intervention on participants with excess body weight not reported separately
Shai, I., D. Schwarzfuchs, et al. (2008). "Weight loss with a low-carbohydrate, Mediterranean, or low-fat diet." N Engl J Med 359(3): 229-241.	Control group does not enable intervention effect to be estimated
Shi, X., S. Karmali, et al. (2010) "A review of laparoscopic sleeve gastrectomy for morbid obesity (Provisional abstract)." Obesity Surgery, 1171-1177.	Insufficient detail provided in methods for quality assessment
Shrewsbury, V. A., J. O'Connor, et al. (2009). "A randomised controlled trial of a community-based healthy lifestyle program for overweight and obese adolescents: the Loozit study protocol." BMC Public Health 9: 119.	Methodology paper
Sichieri, R., A. S. Moura, et al. (2007). "An 18-mo randomized trial of a low-glycemic-index diet and weight change in Brazilian women." Am J Clin Nutr 86(3): 707-713.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Siegel, J. M., M. L. Prelip, et al. (2010). "A worksite obesity intervention: results from a group-randomized trial." Am J Public Health 100(2): 327-333.	Impact of intervention on participants with excess body weight not reported separately

Simon, G. E., P. Rohde, et al. (2010). "Association between change in depression and change in weight among women enrolled in weight loss treatment." Gen Hosp Psychiatry 32(6): 583-589.	Control group does not enable intervention effect to be estimated
Singh, A. S., A. P. M. J. Chin, et al. (2009). "Dutch obesity intervention in teenagers: effectiveness of a school-based program on body composition and behavior." Arch Pediatr Adolesc Med 163(4): 309-317.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Small, L., D. Anderson, et al. (2007) "Prevention and early treatment of overweight and obesity in young children: a critical review and appraisal of the evidence (Structured abstract)." Pediatric Nursing, 149-152.	Review not systematic
Smith, S. R., L. J. Aronne, et al. (2008). "Sustained weight loss following 12-month pramlintide treatment as an adjunct to lifestyle intervention in obesity." Diabetes Care 31(9): 1816-1823.	Control group does not enable intervention effect to be estimated
Sneve, M., Y. Figenschau, et al. (2008). "Supplementation with cholecalciferol does not result in weight reduction in overweight and obese subjects." Eur J Endocrinol 159(6): 675-684.	Control group does not enable intervention effect to be estimated
Soderlund, A., A. Fischer, et al. (2009) "Physical activity, diet and behaviour modification in the treatment of overweight and obese adults: a systematic review (Structured abstract)." Perspectives in Public Health, 132-142.	Insufficient detail provided in methods for quality assessment
Sovik, T. T., O. Taha, et al. (2010). "Randomized clinical trial of laparoscopic gastric bypass versus laparoscopic duodenal switch for superobesity." Br J Surg 97(2): 160-166.	Control group does not enable intervention effect to be estimated
Stefano, S. C., J. Bacaltchuk, et al. (2008) "Antidepressants in short-term treatment of binge eating disorder: systematic review and meta-analysis (Structured abstract)." Eating Behaviors, 129-136.	Medical cause of obesity

Strasser, B., U. Siebert, et al. (2010). "Resistance training in the treatment of the metabolic syndrome: a systematic review and meta-analysis of the effect of resistance training on metabolic clustering in patients with abnormal glucose metabolism." Sports Med 40(5): 397-415.	Impact of intervention on participants with excess body weight not reported separately
Summerbell C, D., C. Cameron, et al. (2008) "Advice on low-fat diets for obesity." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD003640.pub2.	Review withdrawn from Cochrane library
Svendsen, M., A. Rissanen, et al. (2008). "Effect of orlistat on eating behavior among participants in a 3-year weight maintenance trial." Obesity (Silver Spring) 16(2): 327-333.	Weight change reported in separate publication
Swenson, B. R., A. Saalwachter Schulman, et al. (2007). "The effect of a low-carbohydrate, high-protein diet on post laparoscopic gastric bypass weight loss: a prospective randomized trial." J Surg Res 142(2): 308-313.	Control group does not enable intervention effect to be estimated
Szajewska, H. and M. Ruszczynski (2010) "Systematic review demonstrating that breakfast consumption influences body weight outcomes in children and adolescents in Europe (Provisional abstract)." Critical Reviews in Food Science and Nutrition, 113-119.	Subject of review was obesity prevention and not treatment
Tanumihardjo, S. A., A. R. Valentine, et al. (2009). "Strategies to increase vegetable or reduce energy and fat intake induce weight loss in adults." Exp Biol Med (Maywood) 234(5): 542-552.	Control group does not enable intervention effect to be estimated
Tate, D. F., R. W. Jeffery, et al. (2007). "Long-term weight losses associated with prescription of higher physical activity goals. Are higher levels of physical activity protective against weight regain?" Am J Clin Nutr 85(4): 954-959.	Control group does not enable intervention effect to be estimated
Teng, L. and J. Barnes (2007) "Chinese herbal medicines for weight loss." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD006381.	Protocol statement for review only
Thomas, D., J. Elliott Elizabeth, et al. (2007) "Low glycaemic index or low glycaemic load diets for overweight and obesity." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD005105.pub2.	Control group does not enable intervention effect to be estimated

Thorpe, M. P., E. H. Jacobson, et al. (2008). "A diet high in protein, dairy, and calcium attenuates bone loss over twelve months of weight loss and maintenance relative to a conventional high-carbohydrate diet in adults." J Nutr 138(6): 1096-1100.	Control group does not enable intervention effect to be estimated
Tice, J. A., L. Karliner, et al. (2008) "Gastric banding or bypass: a systematic review comparing the two most popular bariatric procedures (Structured abstract)." American Journal of Medicine, 885-893.	Control group does not enable intervention effect to be estimated
Topol, E. J., M. G. Bousser, et al. (2010). "Rimonabant for prevention of cardiovascular events (CRESCENDO): a randomised, multicentre, placebo-controlled trial." Lancet 376(9740): 517-523.	Weight change data not provided
Trolle, B., A. Flyvbjerg, et al. (2007). "Efficacy of metformin in obese and non-obese women with polycystic ovary syndrome: a randomized, double-blinded, placebo-controlled cross-over trial." Hum Reprod 22(11): 2967-2973.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Tuah Nik, A. A., B. Kaur, et al. (2009) "Transtheoretical model for dietary and physical exercise modification in weight loss management for overweight and obese adults." Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD008066.	Protocol statement for review only
Tuomilehto, H., M. Peltonen, et al. (2009). "Sleep duration, lifestyle intervention, and incidence of type 2 diabetes in impaired glucose tolerance: The Finnish Diabetes Prevention Study." Diabetes Care 32(11): 1965-1971.	Weight change data reported elsewhere
Turner-McGrievy, G. M., N. D. Barnard, et al. (2007). "A two-year randomized weight loss trial comparing a vegan diet to a more moderate low-fat diet." Obesity (Silver Spring) 15(9): 2276-2281.	Control group does not enable intervention effect to be estimated
Tuthill, A., A. Quinn, et al. (2007). "A prospective randomized controlled trial of lifestyle intervention on quality of life and cardiovascular risk score in patients with obesity and type 2 diabetes." Diabetes Obes Metab 9(6): 917-919.	Insufficient duration of follow-up

Van Cauwenberghe, E., L. Maes, et al. (2010) "Effectiveness of school-based interventions in Europe to promote healthy nutrition in children and adolescents: systematic review of published and 'grey' literature (Structured abstract)." British Journal of Nutrition, 781-797.	Primary prevention of obesity
Vazquez, G., S. Duval, et al. (2007). "Comparison of body mass index, waist circumference, and waist/hip ratio in predicting incident diabetes: a meta-analysis." Epidemiol Rev 29: 115-128.	No weight loss intervention
Vissers, D., A. Verrijken, et al. (2010). "Effect of long-term whole body vibration training on visceral adipose tissue: a preliminary report." Obes Facts 3(2): 93-100.	Controls not randomly assigned
Volpe, S. L., H. Kobusingye, et al. (2008). "Effect of diet and exercise on body composition, energy intake and leptin levels in overweight women and men." J Am Coll Nutr 27(2): 195-208.	Control group does not enable intervention effect to be estimated
Wadden, T. A., D. S. West, et al. (2009). "One-year weight losses in the Look AHEAD study: factors associated with success." Obesity (Silver Spring) 17(4): 713-722.	Duplicate publication
Wang, X., M. F. Lyles, et al. (2008). "Weight regain is related to decreases in physical activity during weight loss." Med Sci Sports Exerc 40(10): 1781-1788.	Control group does not enable intervention effect to be estimated
Warren, M. and K. H. Schmitz (2009). "Safety of strength training in premenopausal women: musculoskeletal injuries from a two-year randomized trial." Am J Health Promot 23(5): 309-314.	No weight loss intervention
Warziski, M. T., S. M. Sereika, et al. (2008). "Changes in self-efficacy and dietary adherence: the impact on weight loss in the PREFER study." J Behav Med 31(1): 81-92.	Control group does not enable intervention effect to be estimated
Weigel, C., K. Kokocinski, et al. (2008). "Childhood obesity: concept, feasibility, and interim results of a local group-based, long-term treatment program." J Nutr Educ Behav 40(6): 369-373.	Insufficient information provided for quality scoring
Weinheimer, E. M., L. P. Sands, et al. (2010) "A systematic review of the separate and combined effects of energy restriction and exercise on fat-free mass in middle-aged and older adults: implications for sarcopenic obesity (Provisional abstract)." Nutrition Reviews, 375-388.	Insufficient information provided for quality scoring

West, D. S., V. DiLillo, et al. (2007). "Motivational interviewing improves weight loss in women with type 2 diabetes." Diabetes Care 30(5): 1081-1087.	All participants received active intervention
West, D. S., T. Elaine Prewitt, et al. (2008). "Weight loss of black, white, and Hispanic men and women in the Diabetes Prevention Program." Obesity (Silver Spring) 16(6): 1413-1420.	Duplicate publication
Whigham, L. D., A. C. Watras, et al. (2007). "Efficacy of conjugated linoleic acid for reducing fat mass: a meta-analysis in humans." Am J Clin Nutr 85(5): 1203-1211.	Not an intervention type that was the subject of this review
Wikstrand, I., J. Torgerson, et al. (2010). "Very low calorie diet (VLCD) followed by a randomized trial of corset treatment for obesity in primary care." Scand J Prim Health Care 28(2): 89-94.	Not an intervention type that was the subject of this review
Wilfley, D. E., T. L. Tibbs, et al. (2007). "Lifestyle interventions in the treatment of childhood overweight: a meta-analytic review of randomized controlled trials." Health Psychol 26(5): 521-532.	Insufficient information provided for quality scoring
Williams, P. G., S. J. Grafenauer, et al. (2008) "Cereal grains, legumes, and weight management: a comprehensive review of the scientific evidence (Provisional abstract)." Nutrition Reviews, 171-182.	Review not systematic
Williamson, D. A., S. D. Anton, et al. (2010). "Early behavioral adherence predicts short and long-term weight loss in the POUNDS LOST study." J Behav Med 33(4): 305-314.	Not appropriate control group
Williamson, D. A., C. K. Martin, et al. (2008). "Is caloric restriction associated with development of eating-disorder symptoms? Results from the CALERIE trial." Health Psychol 27(1 Suppl): S32-42.	Weight change data published elsewhere
Williamson, D. A., J. Rejeski, et al. (2009). "Impact of a weight management program on health-related quality of life in overweight adults with type 2 diabetes." Arch Intern Med 169(2): 163-171.	Control group does not enable intervention effect to be estimated

Wilson, G. T., D. E. Wilfley, et al. (2010). "Psychological treatments of binge eating disorder." Arch Gen Psychiatry 67(1): 94-101.	Medical cause of obesity
Wing, R. R., D. F. Tate, et al. (2007). "STOP regain: are there negative effects of daily weighing?" J Consult Clin Psychol 75(4): 652-656.	Weight change data not reported
Wing, R. R., D. S. West, et al. (2010). "Effect of weight loss on urinary incontinence in overweight and obese women: results at 12 and 18 months." J Urol 184(3): 1005-1010.	Duplicate publication
Woo, J., M. M. Sea, et al. (2007). "Effectiveness of a lifestyle modification programme in weight maintenance in obese subjects after cessation of treatment with Orlistat." J Eval Clin Pract 13(6): 853-859.	All participants received active treatment
Wu, T., X. Gao, et al. (2009). "Long-term effectiveness of diet-plus-exercise interventions vs. diet-only interventions for weight loss: a meta-analysis." Obes Rev 10(3): 313-323.	Participants of primary studies not all overweight / obese
Wycherley, T. P., G. D. Brinkworth, et al. (2010). "Long-term effects of weight loss with a very low carbohydrate and low fat diet on vascular function in overweight and obese patients." J Intern Med 267(5): 452-461.	Control group does not enable intervention effect to be estimated
Xu, T., X. Li, et al. (2008). "Effect of diacylglycerol on body weight: a meta-analysis." Asia Pac J Clin Nutr 17(3): 415-421.	Not an intervention type that was the subject of this review
Yang, P., Y. Zhou, et al. (2009). "Overweight, obesity and gastric cancer risk: results from a meta-analysis of cohort studies." Eur J Cancer 45(16): 2867-2873.	No weight loss intervention
Yang, X. R., J. Chang-Claude, et al. (2011). "Associations of breast cancer risk factors with tumor subtypes: a pooled analysis from the Breast Cancer Association Consortium studies." J Natl Cancer Inst 103(3): 250-263.	No weight loss intervention

Yankura, D. J., M. B. Conroy, et al. (2008). "Weight regain and health-related quality of life in postmenopausal women." Obesity (Silver Spring) 16(10): 2259-2265.	No control for maintenance phase
Yates, T., M. Davies, et al. (2009). "Effectiveness of a pragmatic education program designed to promote walking activity in individuals with impaired glucose tolerance: a randomized controlled trial." Diabetes Care 32(8): 1404-1410.	Weight change data not reported
Yates, T., M. J. Davies, et al. (2010). "The effect of increased ambulatory activity on markers of chronic low-grade inflammation: evidence from the PREPARE programme randomized controlled trial." Diabet Med 27(11): 1256-1263.	Participants not all overweight / obese; data for overweight / obese participants not presented separately to participants with normal body weight
Young, K. M., J. J. Northern, et al. (2007). "A meta-analysis of family-behavioral weight-loss treatments for children." Clin Psychol Rev 27(2): 240-249.	Unable to quality score: not stated if primary studies were RCTs, details of primary studies not provided
Yuen, A., Y. Sugeng, et al. (2010) "Lifestyle and medication interventions for the prevention or delay of type 2 diabetes mellitus in prediabetes: a systematic review of randomised controlled trials (Provisional abstract)." Australian and New Zealand Journal of Public Health, 172-178.	Not stated if participants in primary studies were overweight / obese
Zittermann, A., S. Frisch, et al. (2009). "Vitamin D supplementation enhances the beneficial effects of weight loss on cardiovascular disease risk markers." Am J Clin Nutr 89(5): 1321-1327.	Not an intervention type that was the subject of this review

Systematic reviews and meta-analyses

Afshinnia 2010

Characteristics of the study	
Study Citation	Afshinnia F, Wilt TJ, Duval S, Esmaeili A & Ibrahim HN 2010, 'Weight loss and proteinuria: systematic review of clinical trials and comparative cohorts', Nephrol Dial Transplant, vol.25, no.4, pp.1173-83.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	Trials of weight loss interventions that examined the association between weight loss in overweight (body mass index (BMI) >25 kg/m^2) or obese (BMI >30 kg/m^2) adults with proteinuria and markers of impaired renal function. Randomized and non-randomized controlled clinical trials and single-arm trials of weight loss interventions including physical exercise therapy, anti-obesity agents, bariatric surgery and dietary weight loss by restriction of carbohydrate and fat which reported proteinuria or urinary albumin and weight or BMI at baseline and after interventions were sought. Studies that involved patients with chronic conditions associated with non-intentional weight loss, elite athletes; and studies with urinary protein measurements within 24 hours after exercise were excluded.
Types of participants sought	Obese or overweight adults (> 18 years of age) with proteinuria and markers of impaired renal function
Types of intervention	Dietary restriction (fat and carbohydrate), exercise, anti-obesity medications and / or bariatric surgery. Exercise was defined as moderate to intense physical activity with at least 1.8 metabolic equivalents for a minimum duration of 15 min/day for at least two days/week for a minimum of one month. Anti-obesity agents were defined as any Food and Drug Administration approved agents of noradrenergic or

	selective serotonin reuptake inhibitors approved for weight loss, lipase inhibitors, suppressors of appetite and any other compounds primarily approved for other indications but which have been used in trials to show their anti-obesity effects for a minimum of at least four weeks.	
Types of outcomes measured	Primary outcomes were change in severity of urinary albumin excretion or proteinuria. Secondary outcomes were change in creatinine clearance, change in GFR and / or change in the rate of progression of CKD. Outcome variables were measured at least 12 weeks after the start of interventions. Trials with an intervention period as short as four weeks were included only if they had at least a three-month run-in period prior to interventions to minimize the effect of confounding by acute changes unrelated to true weight loss.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	B	Non-RCTs included
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 13 studies There were four randomized clinical trials and one non-randomized clinical trial; and eight prospective cohort interventions (including single-arm trials, uncontrolled-arm trials and controlled trials with no follow-up in the control group).	
N and characteristics of participants	N =522 participants All participants were adults ≥18 years with a BMI >25 kg/m^2; gender was not specified Mean age of participants across studies was between 31.4 years (SD 6.9) and 60 years (SD 3.8)	

	Mean BMI across studies was between 30.8 (SD 3.0) and 48.0 (SD 2.4)
Duration of follow-up	Trial duration, including follow-up, across trials was between 16 and 104 weeks (including run-in period)
Overall findings	Mean weight change across included studies varied widely, from -2.2 kg to -58.8 kg. Pooled estimate not provided. Level of mean BMI change across included studies was between -2.2 to -7.3 kg/m^2. Pooled estimate not provided. Change in proteinuria was -1.7g (95% CI, -0.7 to -2.6). Change in microalbuminuria was -13.9 mg (95% CI, -10.6 to -17.1). Meta-regression demonstrated that each 1 kg weight loss was associated with 110 mg (95%CI, -60 to -160 mg) decrease in proteinuria and 1.1 mg (95% CI, -0.5 to -2.4 mg) decrease in microalbuminuria. The decrease was observed across different designs and methods of weight loss. Surgical weight loss methods were associated with a greater reduction in creatinine clearance (mL/min) than non-surgical methods (-23.7 (95% CI, -36.1, -11.4) versus 0.5 (95% CI, -11.5, 12.4) respectively).
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	The patient populations of different studies were heterogeneous and at different stages of disease. To overcome this, two strategies were used. Firstly, studies with similar patient populations and severity of disease at baseline were pooled together and analyses of patients with gross proteinuria and microalbuminuria performed separately. Secondly, within each category of studies with similar kidney function, meta-regression analysis was applied to further investigate the sources of heterogeneity including variability in baseline characteristics. Other limitations include the open-label nature of interventions, short duration of follow-up and inability to detect change in the trend of progression of CKD which needs larger sample size, longer follow-up and maintenance of weight loss. The inclusion of non-randomized and uncontrolled follow-up interventions results in inclusion of low-quality

	evidence for estimating the decrease of urinary protein. The amount of decline in proteinuria with each 1 kg weight loss is likely to be an underestimate due to the presence of a significant proportion of patients with normal range microalbuminuria at baseline in surgical studies, which contributes to an underestimation of effect of size by diluting the net pooled effect in the total number of patients. Data regarding the influence of weight on GFR is scarce. There are no data on the effect of weight loss on the progression to CKD. Further research is required to determine the impact of weight loss on clinical renal outcomes. The generalisability of the findings is therefore limited to a subgroup of relatively healthy patients with mild to moderate CKD and no history of congestive heart failure.

Arem 2011

Characteristics of the study	
Study Citation	Arem H & Irwin M 2011, 'A review of web-based weight loss interventions in adults', Obes Rev, vol.12, no.5, pp.e236-43.
Study Design	Systematic review
Methods	
Types of studies sought	Studies to be included in this review were subject to the following criteria (i) RCTs; (ii) adult population; (iii) primary endpoint of weight loss or weight maintenance; (iv) overweight or obese population; (v) website or web-based programming as a primary focus of the intervention. Only two studies in this original search matched the criteria, so further study inclusion was based on the bibliographic references of the papers found in the original search.

	Studies of pilot testing, behavioural strategies, targeting those with a particular disease, and aspects of design and implementation apart from weight change were excluded. Studies with endpoints other than weight reduction or weight maintenance were excluded. Intervention delivery through mobile technologies such as podcasting or cellular phones was also excluded so as to lessen variability in intervention tools.	
Types of participants sought	Adult participants with overweight or obesity	
Types of intervention	Website or web-based programming as a primary focus of the intervention	
Types of outcomes measured	Weight change, change in anthropometric measures	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	C	No quality score or pooled estimates No assessment of methodological quality Heterogeneity not explored
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 9 studies All included studies were RCTs.	
N and characteristics of participants	N = 4,282 participants Study populations had an average age of 34 to 54 years. Participants were between 50% and 100% female, and	

	mean BMI between 29 kg/m^2 and 34.6 kg/m^2. The percentage of non-Hispanic Caucasian participants ranged from 50% to 95%, although two studies did not report race or ethnicity.
Duration of follow-up	Study duration ranged from 3 to 18 months.
Overall findings	The reviewed studies show intervention results ranging from no weight loss to a mean weight loss of 7.6 kg. Intention to treat analysis demonstrated placebo subtracted weight loss varied from less than 1 kg to 4.9 kg.
Compliance with treatment	Nearly all of the studies noted weak adherence through minimal use of internet resources and high rates of attrition.
Adverse events	Not stated.
Notes	It is difficult to draw a definitive conclusion on the potential impact of internet-based weight loss as study methods are highly variable between papers, low adherence was recorded and not all studies include a control group. Those interventions including an active weight loss component followed by online dynamic, tailored material and self-reporting showed greater retention and may have more promise for inducing significant weight loss. The in-person or intensive weight loss programs followed by internet-based maintenance were the only studies that met weight loss goals of 5%.

Aucott 2009

Characteristics of the study	
Study Citation	Aucott L, Rothnie H, McIntyre L, Thapa M, Waweru C & Gray D 2009, 'Long-term weight loss from lifestyle intervention benefits blood pressure?: a systematic review', Hypertension, vol.54, no.4, pp.756-62.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	The authors sought studies reporting weight change and blood pressure changes that were clinical trials (CTs) (including RCTs), controlled before and after studies (CBAs), and cohort studies (including interrupted time series) published between 1990 and 2008. Criteria for inclusion were a ≥ 2 year follow-up; lifestyle interventions for weight loss (dietary, exercise, behavioral, or environmental); recording of changes in blood pressure of participants; and adult participants (18 to 65 years at recruitment). Studies were excluded if participants had a mean baseline BMI >35kg/m^2, or had eating disorders, were pregnant, or were severely mentally or physically handicapped. Although there were no language restrictions, studies with ethnic groups not relevant to a United Kingdom setting were excluded along with small studies (< 50 participants per subgroup at recruitment or < 20 at follow up).
Types of participants sought	Adults (18-65 years) with mean baseline BMI of > 25 and ≤ 35 kg/m^2
Types of intervention	Lifestyle interventions for weight loss (dietary, exercise, behavioural, or environmental).
Types of outcomes measured	Blood pressure changes and weight change by all measures reported by the authors of primary studies.

Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	B	Non-RCTs included
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 16 studies Eight clinical trials or controlled before and after studies (represented by nine articles) and eight cohort studies were included.	
N and characteristics of participants	N = 57,708 participants Single and mixed gender groups, aged 30 to 67 years with a mean baseline BMI of ≤35 kg/m^2	
Duration of follow-up	Studies had between 24 and 72 months follow-up	
Overall findings	Weight change across studies was between -11 to +4 kg; BMI change across studies was between -0.1 to -10.4 kg/m^2. Pooled estimates were not calculated. Blood pressure change across controlled trials was - systolic blood pressure (SBP) -15 mmHg to +4 mmHg change; diastolic blood pressure (DBP) -5 mmHg to +2.2 mmHg. BP across all studies (including cohort studies) was – SBP -13 mmHg to +6.1 mmHg, DBP -7 mmHg to +2.2 mmHg. A 5 kg weight loss was equivalent to a 5.6 mmHg drop in SBP of participants in studies with follow-up < 36 months; there were insufficient studies with follow-up of > 36 months for longer term effects of weight change on blood pressure to be assessed.	

Compliance with treatment	Not stated
Adverse events	Not stated
Notes	SBP changes demonstrated a 1 kg:1 mmHg relationship, but only for follow-up periods of 2 to 3 years. No quantifiable relationship between weight and DBP difference was found, possibly because of small weight losses, differing weight status responses, or because pharmacologically controlled hypertension masked weight loss influences. This review was not able to adequately account for confounders such as medication, salt reduction, duration of contact, or even weight category itself.

Blaine 2007

Characteristics of the study	
Study Citation	Blaine BE, Rodman J & Newman JM 2007, 'Weight loss treatment and psychological well-being: a review and meta-analysis', J Health Psychol, vol.12, no.1, pp.66-82.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	Published studies of any study type that examined the short- and long-term effects of weight loss treatment on weight, depression and self-esteem. Articles published in peer-reviewed journals in the English language, with human subjects in an adult age-group were sought. Articles that tested treatments expressly to reduce binge eating or depression that observed weight loss or gain as a side-effect were excluded.
Types of participants sought	Adults with excess body weight by any measure that could be converted to an effect size.
Types of intervention	Studies evaluating a psychotherapy-based or drug / surgery based weight loss intervention were included.

Types of outcomes measured	Effect size statistics were calculated from body weight, depression and self-esteem measures used in primary studies in order to enable comparisons between studies to be conducted using a single measure.	
Quality of study	Rating	Comments
Level of evidence	I[$]	[$]Reference list suggests only 1 included study was a RCT (Samsa et al. 2001).
Study quality rating*	C	Heterogeneity not assessed Between study differences not explored No quality scoring of studies
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 117 studies Types of studies not reported in full by authors.	
N and characteristics of participants	N = 4,574 participants. There were 914 participants across included drugs / surgery studies and 3,660 participants across included psychotherapy studies. Adults were between 21 and 60 years of age with a BMI between 25 and 57 kg/m^2. Mean percentage of female participants across included studies was 86.3%. NB: The pre-treatment mean BMI of participants in the drugs / surgery studies was 44.5 kg/m^2 and in the psychotherapy studies was 34 kg/m^2.	
Duration of follow-up	Duration of studies ranged from 1 to 86 months (including follow-up).	

Overall findings	The drugs / surgery (DS) studies pooled weight change was -50.3 lb (SD 40.3) across studies. The psychotherapy (PT) studies pooled weight change was -13.2 lb (SD 12) across studies. DS treatments produced a moderately sized and statistically significant reduction in depression, equivalent to 3.7 BDI (Beck Depression Inventory) points (no variance estimate provided). PT treatments were not as effective, producing a smaller and non-significant effect that was the equivalent of 2.7 BDI points (no variance estimate provided). At follow-up, DS treatments produce a larger effect on depression, equivalent to a 5.0 BDI point reduction from pre-treatment, whereas the effect of PT treatment effect remained the same (no variance estimate provided). Weight loss treatment effects on self-esteem remain steady at short- and long-term measures, even though most samples show some weight regain in that period. PT treatments produced moderate-to-large increases in self-esteem (g = 0.66 to 0.67); this effect was almost twice the size of the DS treatment effect (g = 0.35 to 0.46). The effect in studies whose treatment produced large weight loss (g = 1.18) was nearly double the size of the treatment effect on self-esteem in studies whose treatment produced small or no weight loss (g = 0.62).
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	Although both types of weight loss treatment reduced depression, DS compared with PT treatments were almost twice as effective for reducing long-term depression. However, the significantly greater pre-treatment BMI of participants in the DS studies is a source of bias influencing interpretation of results. The conclusions of this review are subject to other limitations. Subjects in included studies were mainly obese-to-very obese females in their early 40s. Although weight loss treatment did not produce any more positive responses in women than men in this review, the comparison is compromised by the small proportion of men in most of the reviewed samples.

g=effect size

Bosch-Capblanch 2007

Characteristics of the study	
Study Citation	Bosch-Capblanch X, Abba K, Prictor M & Garner P 2007, 'Contracts between patients and healthcare practitioners for improving patients' adherence to treatment, prevention and health promotion activities', Cochrane Database Syst Rev, no.2, pp.CD004808.
Study Design	Systematic review
Methods	
Types of studies sought	RCTs comparing the effects of contracts between healthcare practitioners and patients or their carers on patient adherence. Patient adherence could be applied to diagnostic procedures, therapeutic regimens or any health promotion or illness prevention initiatives. Contracts had to specify at least one activity to be observed and a commitment of adherence to it. Trials comparing contracts with routine care or any other intervention.
Types of participants sought	Participants could be patients or their carers. Participants could be of any gender and age, with any health condition and in any health setting.
Types of intervention	Contracts concerning treatment, prevention and health promotion activities aimed at improving patients' adherence. Contracts included any verbal or written statement specifying at least one treatment, prevention or health promotion activity to be observed, and a commitment of adherence to it. Contracts could take place between healthcare practitioners or services and patients or their carers, between patients and their carers, or between patients themselves (self-commitment). Contracts could relate to any diagnostic procedure, therapeutic regimen, rehabilitation measure, general health advice, referral instruction, or any other activity or combination of activities

	involved in the management of patients. Explicit rewards (like tokens, cash or social benefits) may or may not have been present. Self-management was included, providing that self-management appears to be supported by any form of contracting. The control was any intervention (such as instructions, education, incentives or reminders) or combination of interventions, aimed at improving patients' adherence; or no intervention. Multifaceted interventions were included, if a given modality of contract was present in the intervention but not in the control group. The authors excluded studies comparing different modalities of contracts.
Types of outcomes measured	The primary outcomes included: Patients' adherence or change in behaviour related to adherence. Secondary outcomes included: Patients' participation in the contractual process and degree of shared decision making where alternative treatment options were present, assessed through qualitative statements or scales. Outcomes of agreed aims stated in the contracts, both for patients and healthcare practitioners. Patients' satisfaction with the contracting process assessed either qualitatively or through scales. Healthcare practitioners' observance of contract terms and appraisal of the contracting process. Health status measures: all outcomes consistent with, or relevant to, the aims/specifications of contracts. Harms associated with adhering to proposed treatment or health promotion activity. Costs or savings incurred by patients, healthcare practitioners, services or other institutions derived from adherence or non-adherence to healthcare activities. Denial or deferral of treatment. A post-hoc outcome related to the utilisation of health services.

Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 30 studies All studies were RCTs. Median sample size per group was 21. Trials evaluated contracts in addiction (10 trials), hypertension (4 trials), weight control (3 trials) and a variety of other areas (13 trials). Twenty-five trials (83%) had co-interventions. It was not always clear whether an intervention was part of the contract arrangement, or was actually a co-intervention. Co-interventions included: counselling/education/instructions (18 trials); training (skills or behaviours) (11 trials); reminders (four trials); group support/treatment (two trials); monitoring or recording of medication taken, problems related to taking medication (two trials); and goal setting (one trial).	
N and characteristics of participants	N = 4,691 participants Participants in all trials were receiving care for a disease or who were targets for preventive interventions. In 13 trials they were recruited from the health system; 11 trials recruited participants using adverts, two trials used both methods, and another trial recruited college students. The recruitment method was not described in one trial.	

	The median number of participants per group was 21 (interquartile range 24 subjects). All participants were adults except in: one trial of overweight children; one trial of children with asthma; one trial screening for tuberculosis where the age of participants ranged from five to 76 years; and one trial of adolescents treated for latent tuberculosis, aged 11 to 19. Fourteen trials (47%) compared two groups, eight trials (27%) had three groups, five trials (17%) had four groups, one trial (3%) had five groups and two (7%) trials had six groups.
Duration of follow-up	Duration of follow-up was not reported. Loss to follow up was less than 20% (rated as 'adequate') in 19 trials, more than 20% (rated as 'inadequate') in four trials, and could not be determined in the other seven trials.
Overall findings	Fifteen trials reported at least one outcome that showed statistically significant differences favouring the contracts group, six trials reported at least one outcome that showed differences favouring the control group and 26 trials reported at least one outcome without differences between groups. Three trials addressed contract interventions for overweight participants. In the first trial participants in the contracts group lost more weight than those in the control groups, both at the end of treatment (-11.3 pounds in the intervention group compared with -9.5 and +0.5 pounds in the control groups), and at eight weeks follow-up (-7.9 pounds in the intervention group compared with -5.0 and +3.6 pounds in the control groups). In the second trial there were three groups: contracts, supervised exercise and minimal contact. Outcomes were measured at 12 weeks and 12 months. When data from the contract and supervised exercise groups were pooled, people in these groups lost significantly more weight than those in the minimal care group. For those participants who completed the treatments, mean weight losses were respectively 8.1 pounds (contracts), 11 pounds (supervised exercise) and 4.6 pounds (minimal contact) ($P < 0.05$) (see Analysis 2.1). For longer term follow-up (12 months), mean weight losses were 4.3 pounds (contracts), 10.6 pounds (supervised exercise) and 4.2 pounds (minimal contact) ($P < 0.05$). (See Analysis 2.2). This trial also collected data on the self-reported helpfulness of the treatment: for this outcome there were no statistically significant differences between the contract group and the supervised exercise group. In the third trial there were no statistically significant differences between the four groups for any of the outcomes: mean weight loss, percentage of excess weight loss and weight reduction index.

Compliance with treatment	Effects on adherence were not detected when measured over longer periods. Three trials addressed contract interventions for overweight people. However, none of the three trials reported adherence outcomes.
Adverse events	Not stated
Notes	There was limited evidence that contracts can potentially contribute to improving adherence, but there was insufficient evidence from large, good quality studies to routinely recommend contracts for improving adherence to treatment or preventive health regimens.

Buchwald 2009

Characteristics of the study	
Study Citation	Buchwald H, Estok R, Fahrbach K, Banel D, Jensen MD, Pories WJ, Bantle JP & Sledge I 2009, 'Weight and type 2 diabetes after bariatric surgery: systematic review and meta-analysis', Am J Med, vol.122, no.3, pp.248-256 e5.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	An update of the authors' 2004 systematic review and meta-analysis. Clinical studies of bariatric surgical procedures published in English between January 1, 1990 and April 30, 2006 were sought. Studies needed to report changes in clinical manifestations of type 2 diabetes after bariatric surgery.
Types of participants sought	Adult patients that underwent any of the above bariatric surgery procedures for weight loss.

	Inclusion criteria for age, gender and BMI not specified.	
Types of intervention	The following bariatric surgical procedures: gastric banding, gastroplasty, gastric bypass, and biliopancreatic diversion (BPD) / duodenal switch procedures.	
Types of outcomes measured	Insulin levels, glycosylated haemoglobin (HbA1c), fasting glucose levels, percentage whose diabetes resolved.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	B	Non-RCTs included. Between study differences not explored
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 621 studies These included 29 RCTs, 49 non-RCTs (prospective), 60 comparative retrospective studies, 187 prospective uncontrolled case series (UCS), 266 single-arm retrospective studies, 25 observational and two case-control studies.	
N and characteristics of participants	N = 135,246 participants At baseline the mean age of the patients was 40.2 years with a range of 16 to 65 years and the mean BMI was 47.9 kg/m^2. Approximately 80% of the patients were female, and approximately 10.5% had undergone previous bariatric surgical procedures. Of the overall population, 22.3% had type 2 diabetes.	
Duration of follow-up	Studies analysed for two time periods: less than and greater than two years, including follow-up.	

<table>
<tr><td>Overall findings</td><td>
<table>
<tr><th>Change in parameter</th><th>Total</th><th>Gastric banding</th><th>Gastroplasty</th><th>Gastric bypass</th><th>BPD / duodenal switch</th></tr>
<tr><td>Weight (kg)</td><td>-38.5 (-40.1 to -36.6)</td><td>-32.0 (-35.1 to -28.8)</td><td>-36.1 (-39.8 to -32.4)</td><td>-44.7 (-48.4 to -41.0)</td><td>-43.5 (-47.5 to -39.5)</td></tr>
<tr><td>BMI</td><td>-14.0 (-14.5 to -13.4)</td><td>-10.6 (-11.4 to -9.9)</td><td>-13.8 (-14.9 to -12.8)</td><td>-16.3 (-17.1 to -15.6)</td><td>-18.7 (-21.2 to -16.3)</td></tr>
<tr><td>% diabetes resolved</td><td>78.1%</td><td>56.7%</td><td>79.7%</td><td>80.3%</td><td>95.1%</td></tr>
<tr><td>Insulin[$]</td><td>-98.0 (-146.7 to -49.3)</td><td>-99.6 (-312.5 to +113.3)</td><td>NR</td><td>-40.2 (-76.1 to -4.3)</td><td>-125.0 (-139.6 to -110.4)</td></tr>
<tr><td>HbA1c[$]</td><td>-2.1 (-2.6 to -1.6)</td><td>-1.4 (-3.2 to +0.4)</td><td>NR</td><td>-2.2 (-2.7 to -1.7)</td><td>NR</td></tr>
<tr><td>Fasting glucose[$]</td><td>-4.4 (-5.3 to -3.5)</td><td>-2.5 (-5.8 to +0.8)</td><td>NR</td><td>-3.9 (-5.0 to -2.9)</td><td>-5.4 (-6.7 to -4.1)</td></tr>
</table>
[$] patients with diabetes only; NR = not reported

In the studies reporting only diabetic patients, 82% of patients had resolution of the clinical and laboratory manifestations of diabetes in the first two years after surgery, and 62% remained free of diabetes more than two years after surgery.</td></tr>
<tr><td>Compliance with treatment</td><td>Not stated</td></tr>
<tr><td>Adverse events</td><td>Information on non-fatal adverse effects of the bariatric surgery procedures was heterogenous, sparse and poorly reported in primary studies. As a result, meta-analytic evaluation or systematic meaningful review of adverse events was not possible.</td></tr>
</table>

Notes	This review summarizes the available evidence on the effect of bariatric surgery on type 2 diabetes. Weight loss and diabetes resolution were greatest for patients undergoing BPD / duodenal switch, followed by gastric bypass, and least for banding procedures. Insulin levels declined significantly postoperatively, as did HbA1c and fasting glucose values. Weight and diabetes parameters showed little difference at < 2 and ≥ 2 years. This study demonstrated that bariatric surgery is associated with resolution of clinical indicators for type 2 diabetes, including serum insulin levels, HbA1c and fasting blood glucose levels.

Chavez-Tapia 2010

Characteristics of the study	
Study Citation	Chavez-Tapia NC, Tellez-Avila FI, Barrientos-Gutierrez T, Mendez-Sanchez N, Lizardi-Cervera J & Uribe M 2010, 'Bariatric surgery for non-alcoholic steatohepatitis in obese patients', Cochrane Database Syst Rev, no.1, pp.CD007340.
Study Design	Systematic review
Methods	
Types of studies sought	RCTs were sought that assessed the impacts of bariatric surgery on non-alcoholic steatohepatitis (NASH). Any bariatric procedure versus no intervention, placebo (sham procedure), or other interventions in patients with NASH regardless of language or blinding was sought. Other study types were to be considered for the review if no RCTs were identified. To assess the intervention potential harm, available non-randomised studies were to be included to analyse reported adverse events.
Types of participants sought	Participants of any age, sex, or ethnic origin with overweight or obesity (defined as BMI > 25 kg/m^2) and NASH diagnosed by liver histology according to the following criteria: Liver steatosis and two of the following three histological features: (1) necroinflammatory foci with mononuclear cells and / or neutrophils; (2) ballooning degeneration of hepatocytes with or without Mallory bodies; and (3) pericellular fibrosis, persistent elevation of

	aminotransferases to 1.5 times normal for more than six months, and exclusion of other liver diseases (e.g. alcoholic, autoimmune, cholestatic, viral, or metabolic liver diseases).	
Types of intervention	Bariatric procedures including: Roux-en-Y gastric bypass (RYGB), gastric banding, vertical banded gastroplasty (VBG), duodenal switch, biliopancreatic diversion (BPD), isolated intestinal bypass, and gastrectomy. Co-interventions were to be allowed only if equally received in the intervention groups.	
Types of outcomes measured	Primary outcome measures included: (1) All-cause mortality: number of deaths irrespective of cause at maximal follow-up. (2) Surgical-related mortality and surgical-related morbidity. (3) Hepatic-related mortality and hepatic-related morbidity. (4) Cardiovascular-related mortality and cardiovascular-related morbidity. (5) Histological response (number of patients without histological improvement in the degree of fatty liver infiltration, inflammation, and fibrosis) based on any score systems or their modifications. Secondary outcome measures included: (1) Changes in body weight (assessed as BMI, fat mass, fat-free mass). (2) Biochemical response (serum activity of aspartate aminotransferase, alanine aminotransferase, alkaline phosphatases, gamma glutamyl-transpeptidase, serum total bilirubin, and ferritin). (3) Metabolic response (according to the number of elements of metabolic syndrome). (4) Cytokine response (serum levels of leptin, adiponectin, resistin, tumour necrosis factor alpha, interleukin 6, interleukin 1, transforming growth factor beta, monocyte chemoattractant protein, free fatty acids, vascular endothelial growth factor, plasminogen activator inhibitor, etc).	
Quality of study	Rating	Comments
Level of evidence	III-2	
Study quality rating*	B	No RCTs identified

Magnitude of effect rating**	Low	Inconsistent effect
Relevance of evidence rating***	Medium	
Results of study		
N and type of studies	N = 21 studies No RCTs were identified. There were 21 prospective or retrospective cohort studies that were analysed. Of these, 15 were prospective, five were retrospective and one study used a retrospective and prospective cohort. The most common procedure was RYGB (13 studies) followed by laparoscopic adjustable gastric band (LAGB) (six studies).	
N and characteristics of participants	N = 1,548 participants Mean BMI ranged from 31 ± 8 kg/m^2 to 58 ± 4 kg/m^2. Mean age ranged from 36 ± 11 to 49 ± 9 years.	
Duration of follow-up	The period of follow-up ranged from one to five years; during this follow-up period two studies performed more than one biopsy after bariatric surgery; the remainder of studies performed one biopsy.	
Overall findings	Improvement of liver function tests was reported in 11 studies; in another seven studies at least one of the components of the metabolic syndrome improved. There were 18 studies that reported a significant improvement in the degree of steatosis, 11 reported improvement in histological markers of inflammation, and six showed some improvement in fibrosis scores. In four studies some deterioration in the degree of fibrosis was described.	
Compliance with treatment	Not stated	
Adverse events	Adverse events was defined as any untoward medical occurrence not necessarily having a causal relationship with the treatment or long-term nutrient deficiencies secondary to bariatric surgery as described in the trials (e.g. iron,	

	vitamin B12, vitamin D, calcium, protein and fat-soluble vitamin, and thiamine deficiency). The studies included in this review did not directly report adverse event rates after bariatric surgery. However, two trials reported histological score deterioration in a small percentage of patients: similarly, two studies reported NASH global scores deterioration and four studies reported an increase in hepatic fibrosis. Fourteen other studies did not report any adverse events.
Notes	In the current review, the authors attempted to evaluate the efficacy and safety of bariatric surgery in NASH treatment in obese patients. Despite the comprehensive search, they were not able to find any randomised trials. The lack of randomised clinical trials to demonstrate the beneficial or harmful effects of bariatric surgery procedures as a therapeutic approach for patients with NASH meant the authors were unable to reach any firm conclusions. Despite positive results observed in cohort studies, due to their high risk of bias and the potential risk for worsening in fibrosis scores, the authors conclude that bariatric surgery needs to be assessed in randomised clinical trials.

Cho 2009

Characteristics of the study	
Study Citation	Cho SH, Lee JS, Thabane L & Lee J 2009, 'Acupuncture for obesity: a systematic review and meta-analysis', Int J Obes (Lond), vol.33, no.2, pp.183-96.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs that compared acupuncture or its variants with a control group, which included no treatment, placebo treatment, pharmacological or non-pharmacological treatments, to assess the efficacy of acupuncture on obesity and weight loss. No restriction was imposed on studies with respect to blinding and the type of design such as parallel or crossover. Also, no language restriction was made for selecting studies.

Types of participants sought	Participants of all ages, including children, defined as overweight / obese by any BMI-based measure at baseline. Pregnant women and patients with serious medical conditions, such as drug-induced obesity, were excluded.	
Types of intervention	Clinical trials evaluating all forms of acupuncture treatments, specifically, classical acupuncture, electro-acupuncture, laser acupuncture, acupressure and acupoint, were included. Studies that assessed the combined effect of acupuncture with other therapies (for example, acupuncture and massage therapy or acupuncture and moxibustion therapy) were excluded because the purpose of this review was to assess the effects of acupuncture alone on obesity or weight loss. Trials that compared different forms of acupuncture to each other were also excluded. Types of control interventions considered in this review included no treatment (wait-listed or treatment as usual), placebo-controlled (sham acupuncture, minimal acupuncture or non-invasively controlled), pharmacological treatment (standard medication to treat obesity) or non-pharmacological interventions (such as dietary or physical activity interventions).	
Types of outcomes measured	The primary outcome was change in weight (absolute or percentage scales) or change in BMI. Secondary outcomes assessed were frequency of adverse events which included bleeding in ears, mild ecchymosis, abdominal discomfort and other mild effects such as dry mouth, headaches, sleepiness, hypertension, palpitations and dizziness.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	B	Baseline anthropometric not described in detail
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 31 studies	

	Two trials were double-blinded and six trials were single-blinded. Among 26 trials that did not report the randomisation procedure, 20 (77%) scored the lowest with respect to methodological quality.
N and characteristics of participants	N = 3,013 participants Participant ages ranged from 13 to 62 years.
Duration of follow-up	Not stated
Overall findings	Compared with lifestyle therapy control, acupuncture was associated with a reduction in body weight of 1.7 kg (95% CI, 0.5 to 2.9). Classical acupuncture treatment resulted in greater weight reduction (-2.2 kg; 95% CI, -0.5 to -3.8) than acupressure (-1.6 kg; 95% CI -4.2 to 7.4) or electroacupuncture (-1.2 kg; 95% CI, -0.7 to -3.1).
Compliance with treatment	Not stated
Adverse events	Among studies observing adverse events, four RCTs reported minimal adverse events, whereas two RCTs reported no adverse events, compared with appropriate control groups. One study reported three adverse events, namely, redness, pain or discomfort, and bleeding in ears in auricular acupuncture group compared to none in placebo group, although their frequencies were not statistically different. Another study reported no major adverse event; however, mild ecchymosis (N = 2) and abdominal discomfort after electro-acupuncture treatment (N = 1) was observed. A third study reported a case of inter-current illness and discomfort in a placebo group, whereas a fourth study reported mild adverse effects, such as dry mouth, headaches, sleepiness, hypertension, palpitations and dizziness, up to 16.7% in the acupuncture group, compared with 42.9% in a group receiving medication.
Notes	This review suggests that acupuncture may have a positive impact on body weight in people with obesity. However, conclusions are limited by the poor methodological quality of trials reviewed.

Christensen 2007

Characteristics of the study		
Study Citation	Christensen R, Kristensen PK, Bartels EM, Bliddal H & Astrup A 2007, 'Efficacy and safety of the weight-loss drug rimonabant: a meta-analysis of randomised trials', Lancet, vol.370, no.9600, pp.1706-13.	
Study Design	Systematic review and meta-analysis	
Methods		
Types of studies sought	Double-blind RCTs using rimonabant for weight loss in overweight or obese participants were eligible for inclusion. Included studies had a placebo control group. There was no limitation on language.	
Types of participants sought	Patients with BMI levels ≥ 30 kg/m^2 or ≥ 27 kg/m^2 plus one or more obesity-related comorbidity.	
Types of intervention	Rimonabant versus placebo	
Types of outcomes measured	Outcome measures included weight loss, blood glucose levels and blood lipids. The efficacy outcomes were the difference in mean weight change and the number of individuals achieving at least 10% weight reduction handled as a dichotomous responder criterion.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	

Results of study	
N and type of studies	N = 4 studies Double-blind, RCTs that compared 20 mg per day rimonabant with placebo.
N and characteristics of participants	N = 105 participants Up to 81% of participants were female; 10 to 18% were smokers and between 33% and 78% were diagnosed as having metabolic syndrome. The mean age ranged from 44.7 to 55.4 years and mean BMI from 33.9 to 37.3 kg/m^2.
Duration of follow-up	The length of the trials varied from 12 to 24 months. However, all the studies published detailed statistics after one year of treatment. No follow-ups were reported after discontinuation of active treatment, thus any weight regain could not be assessed.
Overall findings	Patients given rimonabant had a 4.7 kg (95% CI 4.1 to 5.3 kg; p < 0.0001) greater weight reduction after one year than did those given placebo. Rimonabant caused significantly more adverse events than did placebo (OR = 1.4; p = 0.0007; number needed to harm = 25 individuals [95% CI 17 to 58]), and 1·4 times more serious adverse events (OR = 1.4; p = 0.03; number needed to harm = 59 [27 to 830]). Patients given rimonabant were 2.5 times more likely to discontinue the treatment because of depressive mood disorders than were those given placebo (OR = 2.5; p = 0.01; number needed to harm = 49 [19 to 316]). Furthermore, anxiety caused more patients to discontinue treatment in rimonabant groups than in placebo groups (OR = 3.0; p = 0.03; number needed to harm = 166 [47 to 316]).
Compliance with treatment	Not stated
Adverse events	The investigators concluded that rimonabant was generally well tolerated with mild and transient side-effects. However, the individual trials showed trends to increases in depressed mood, depression and severe adverse events. Furthermore, because patients with serious mental illness were excluded from the trials, the estimates of the potential psychiatric side-effects of the drug are conservative. Rimonabant was assessed by the US Food and Drug Administration (FDA), and coinciding with the submission of this paper, the FDA’s Advisory Committee

	unanimously concluded that more detailed safety information about rimonabant in larger patient numbers over the long term was needed before the drug could be approved.
Notes	Patients who were allocated to rimonabant were much more likely to achieve a 10% weight reduction after one year compared with those allocated to placebo. The authors assessed the effect of rimonabant on psychiatric events with a focus on mood and depression. Findings suggest that 20 mg per day rimonabant increased the risk of psychiatric adverse events i.e. depressed mood disorders and anxiety.

Christensen 2007b

Characteristics of the study	
Study Citation	Christensen R, Bartels EM, Astrup A & Bliddal H 2007, 'Effect of weight reduction in obese patients diagnosed with knee osteoarthritis: a systematic review and meta-analysis', Ann Rheum Dis, vol.66, no.4, pp.433-9.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs assessing the association between weight loss achieved by lifestyle interventions (diet / exercise / psychological interventions) and symptoms associated with knee osteoarthritis (OA).
Types of participants sought	Participants were females and / or males with an explicitly stated diagnosis of OA of the knee. In case of studies reporting a patient population of mixed clinical characteristics (e.g. both hip and knee OA), the subgroup results from knee OA only had to be extractable to fulfill the inclusion criteria.
Types of intervention	Any intervention where a weight change was reported explicitly, whether it was intentional or unintentional, was accepted. The weight change had to be the only difference from the defined control group. Any concomitant

	treatments (medication, exercise, behavioral therapies, etc) had to be identical in the treated and the control group, ensuring that any clinical benefits were caused by a difference in change of body weight, independently of any possible interactions that might have influenced the outcome of OA.	
Types of outcomes measured	The Outcome Measures for Arthritis Clinical Trials III outcome variables were considered for analysis: pain, self-reported disability and patient global evaluation. Secondary outcomes were ‘‘weight change’’ from baseline reported as mean weight loss (in kg or %).	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	B	Search strategy not specified Harms not reported
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 4 studies Four RCTs including five intervention / control groups met the inclusion criteria for the final meta-analysis.	
N and characteristics of participants	N = 454 participants Mean age of participants across studies ranged from 63 to 69 years; mean BMI was ≥ 29 kg/m^2 in all studies. There were ≥ 70% participants who were female across studies.	
Duration of follow-up	Duration of studies varied from six weeks to 18 months.	
Overall findings	Effect sizes (ES) were calculated[$]. The pooled weight change of participants was -6.1 kg (-4.7 to -7.6). ES for pain	

	and physical disability were 0.20 (95% CI, 0 to 0.39) and 0.23 (95% CI, 0.04 to 0.42) respectively. Meta-regression analysis showed that disability could be significantly improved when weight was reduced over 5% (ES = 0.34). A 10% weight loss was associated with an ES of 0.67 for disability improvement. Pain reduction was unable to be predicted using meta-regression analysis.
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	This study presents evidence-based estimates from a meta-analysis to support the use of weight-loss regimens in the clinical management of OA in clinical rheumatology. The authors conclude that by recommending overweight patients with knee OA reduce their body weight by at least 7.5% the patients would experience moderate clinical improvement in disability. A 10% weight reduction will result in a moderate-to-large clinical improvement in disability.

[$] Effect size can be interpreted as follows: ES = 0.2 is a small effect; ES = 0.5 is a moderate effect; ES > 0.8 is a large effect (Cochrane Collaboration. Analysing and presenting results. Cochrane Handbook for Systematic Reviews of Interventions).

Collins 2007

Characteristics of the study	
Study Citation	Collins CE, Warren JM, Neve M, McCoy P & Stokes B 2007, 'Systematic review of interventions in the management of overweight and obese children which include a dietary component', Int J Evid Based Healthc, vol.5, no.1, pp.2-53.
Study Design	Systematic review and meta-analysis

Methods	
Types of studies sought	Studies that evaluated the effectiveness of nutrition or dietary interventions for treating obesity or overweight in children and adolescents. RCTs, and other study designs including pre- and post-trials, longitudinal studies, cohort (both retrospective and prospective) or case–control studies, or time series. Published and unpublished literature in the English language from 1975 to 2003. Programs that involved the family or were directed exclusively at parents of overweight or obese children and adolescents. Studies were excluded from the analyses if they did not report numbers of participants or standard deviations (SDs) were of poor methodological quality or did not meet the inclusion criteria.
Types of participants sought	Participants aged < 18 years and defined as overweight or obese by a valid measure of overweight / obesity. Participants could be free living or be attending obesity clinical units, community programs, camps, schools or one-off programs.
Types of intervention	Interventions that were delivered by a nutritionist or any health professional in a variety of settings (e.g., one-to-one, groups, obesity clinics, commercial programs, train-the-trainer, community groups, gyms, schools, or via the Internet or email). The focus of the interventions was diet and could include any of following treatment arms: physical activity, sedentary behaviour modifications, or cognitive behavioural therapy. Interventions included the following prescribed diets: Traffic Light (or Stoplight) diet, or a variation of IT, food or calorie exchange programs, American Dietetic Association Exchange Program, The Prudent Diet, Shapedown, and national dietary guidelines.
Types of outcomes measured	BMI, BMI percentile, percentage overweight for age, waist measurements, body composition (e.g. % body fat, % lean body mass or skin folds).

Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	Pooled estimates not provided
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 116 publications There were 49 articles that described 37 RCTs, the remaining 67 were observational studies. Meta-analyses were performed on eight studies that included both a dietary intervention component and an adequate control group, and on four studies that had follow-up data.	
N and characteristics of participants	N ≥ 8,200 participants The total number of participants across RCTs was approximately 2,200 subjects; the total number of participants across non-RCTs was approximately 6,000 participants. Participant age ranged from one to 17 years.	
Duration of follow-up	Duration of intervention, including follow-up, ranged from six weeks to five years.	
Overall findings	Meta-analysis was performed on the subset of RCTs that included both a dietary component and a control group (no intervention, waiting list, or usual care). The degree of weight change was -1.82 kg (95% CI, -2.40 to -1.23). Percentage-ideal body weight reduced from 154.2% (SD 15.3) to 125.2% (SD 36.1) and BMI reduced by an average of 2.6 kg/m^2 (no variance provided) in studies with follow-up periods of > 1 year.	
Compliance with treatment	There were very few studies that reported either adherence to the dietary recommendations or prescription or the actual changes in diet from pre- to post-intervention.	

Adverse events	None stated
Notes	There was a high degree of heterogeneity between studies and this made comparisons between studies problematic. Although significant reductions in relative weight have been achieved in many studies, the quality, range of outcome measures, time frames for interventions, follow-up lengths, retention rates and analytic approaches, limit the conclusions that can be drawn. Many studies were poorly designed and had no or only minimal follow up. The details of the dietary intervention were often inadequately described and dietary outcomes rarely reported, making repetition of the studies difficult. Which diet approach is appropriate for use in specific age groups, associated with optimal adherence, and is most effective could not be assessed by meta-analysis due to a lack of high quality RCTs with which to conduct analyses.

Colquitt 2009

Characteristics of the study	
Study Citation	Colquitt JL, Picot J, Loveman E & Clegg AJ 2009, 'Surgery for obesity', Cochrane Database Syst Rev, no.2, pp.CD003641.
Study Design	Systematic review
Methods	
Types of studies sought	RCTs comparing different surgical procedures, and RCTs, controlled clinical trials and prospective cohort studies comparing surgery with non-surgical management (medical management or no treatment) for obesity. Studies were only included if they reported measurements after a minimum follow-up of one year. Studies published in any language were included.

Types of participants sought	Adults with a BMI of 30 or over.	
Types of intervention	Included interventions were: comparisons of surgical procedures in current use, performed either as open procedures or laparoscopically; surgical procedures versus usual care (no treatment or medical management, e.g. very low calorie diet (VLCD)); and open surgery compared with laparoscopic surgery for the same procedure. Excluded interventions included: comparisons of variations of surgical techniques rather than different procedures; jejunoileal bypass procedures because they are no longer recommended in Europe and the US due to unacceptably high morbidity and mortality; horizontal gastroplasty, vertical gastroplasty (not banded) and banded gastroplasty that is not adjustable.	
Types of outcomes measured	Primary outcomes: measures of weight change, fat change or fat distribution change (for example waist-hip ratio); quality of life; obesity related co-morbidities (for example diabetes, hypertension). Secondary outcomes: mortality (perioperative and total); adverse effects (for example perioperative morbidity such as staple line breakdown and wound infection, gastrointestinal disturbances, reoperations); revision rates (reversal or conversions to normal or other procedures).	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	B	Non-RCTs included Point estimates not provided where data could be combined
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 26 studies The 26 studies included three RCTs and three prospective cohort studies that compared surgery with non-surgical	

	management, and 20 RCTs that compared different bariatric procedures. The RCTs comparing different surgical procedures included comparisons of various types of gastric bypass, vertical banded gastroplasty (VBG), adjustable gastric banding and isolated sleeve gastrectomy (SG), performed with open or laparoscopic surgery. Gastric bypass (usually RYGB) and VBG were the most commonly investigated procedures and formed the majority of the evidence base. Comparisons of open versus laparoscopic surgery for gastric bypass (four RCTs), VBG (one RCT) and adjustable gastric banding (one RCT) were also assessed. Several different measures of weight change were reported by the studies, namely BMI, change in BMI, weight, weight loss, percent weight loss, percent excess weight loss, fat mass, fat free mass, percent ideal body weight and proportion of 'successes'. Some of the studies did not report measures of variability such as CIs or SDs. Quality of life was reported in five studies (three RCTs and two cohort studies) and co-morbidities were reported by eight studies (seven RCTs and one cohort study).
N and characteristics of participants	N = unable to extract The individual study sample size ranged from 20 to 4,047 participants. The majority of participants in the studies were female and were aged between 32 and 49 years. Most studies included participants with morbid obesity, and where this was described further, a definition of BMI > 40 was commonly used, often with the additional criteria of BMI > 35 or 37 with comorbid disease. However, one study included participants with BMI > 35, and one study included men and women with a BMI ≥ 34 and 38, respectively. An upper limit of BMI of 50, 55 or 60 was also specified by some studies.
Duration of follow-up	The minimum duration of follow-up for inclusion in this review was 12 months, and most studies followed participants for 12, 24 or 36 months. A number of studies had longer follow-up periods. The longest follow-up was for 10 years.
Overall findings	Weight loss with surgery versus non-surgical interventions: Surgery led to greater weight loss than non-surgical management in participants with obesity. Losses varied according to the surgical method used and across included studies. Pooled estimates of weight loss were not provided. Surgical interventions led to greater improvements in co-morbidities than non-surgical interventions. Higher

	remission rates of type 2 diabetes, metabolic syndrome, hypertension, hypertriglyceridaemia, hypercholesterolaemia and hyperuricaemia were observed. In those without comorbidities at baseline, the incidence of diabetes, hypertriglyceridaemia and hyperuricaemia (but not hypercholesterolaemia) was statistically significantly lower in the surgical cohort than the control cohort during follow-up. Pooled estimates of changes in secondary outcomes were not provided. Quality of life improved more with LAGB than non-surgical management in one RCT, that reported quality of life data. One cohort study showed that after 3.2 years there were no significant differences between those who had received surgery and those who had not. The other cohort study reported that all health-related quality of life (HRQoL) measures were improved at 10 years compared with baseline for the surgery group, but not for all participants in the non-surgical group.
Compliance with treatment	The authors found that the majority of the studies included in this review did not provide details regarding patient compliance with lifestyle and diet modifications.
Adverse events	Mortality, complications and additional procedures were discussed for surgery versus non-surgical interventions. The commonly reported adverse events associated with the non-surgical interventions were intolerance to prescribed medications such as orlistat and metformin, or intolerance to a VLCD or meal replacement. A complication of rapid weight loss, which was observed following non-surgical and surgical interventions, was cholecystitis which occurred in a greater proportion of people receiving conventional therapy than those receiving LAGB in the single RCT that reported this outcome. However a cohort study reported that after two years obesity surgery statistically significantly increased the incidence of cholelithiasis and cholecystectomies in men, but that there was no difference in the incidence of these events among women. The large cohort study reported cumulative overall mortality during a period of up to 16 years (mean 10.9 years follow-up).The hazard ratio of the surgery group compared with the control group was 0.76 ([95% CI 0.59 to 0.99] P = 0.04). There were 101 (5%) deaths in the surgery group and 129 deaths (6.3%) in the control group. The most common causes of death were cancer (surgery 29 cases, control 47 cases), sudden death (surgery 20 cases, control 14 cases) and myocardial infarction (surgery 13 cases, control 25 cases).
Notes	Surgery resulted in greater weight loss than conventional treatment in moderate as well as severe obesity. Reductions in comorbidities, such as diabetes and hypertension, also occurred. Improvements in HRQoL occurred after two years, but effects at ten years were less clear. Surgery was associated with complications, such as

	pulmonary embolism, and some postoperative deaths occurred. Five different bariatric procedures were assessed, but some comparisons were assessed by just one trial. The limited evidence suggested that weight loss following gastric bypass was greater than VBG or adjustable gastric banding, but similar to isolated SG and banded gastric bypass. Isolated SG appeared to result in greater weight loss than adjustable gastric banding. Evidence comparing VBG with adjustable gastric banding was inconclusive. Data on the comparative safety of the bariatric procedures was limited. Weight loss and quality of life were similar between open and laparoscopic surgery. Conversion from laparoscopic to open surgery can occur. In summary, surgery was more effective than conventional management. Certain procedures produce greater weight loss, but data was limited. The evidence on safety was even less clear. Due to limited evidence and poor quality of the trials, caution is required when interpreting comparative safety and effectiveness.

Curioni 2006

Characteristics of the study	
Study Citation	Curioni C, Andre C & Veras R 2006, 'Weight reduction for primary prevention of stroke in adults with overweight or obesity', Cochrane Database Syst Rev, no.4, pp.CD006062.
Study Design	Systematic review
Methods	
Types of studies sought	The authors searched for RCTs comparing any intervention for weight reduction (single or combined) with placebo or no intervention in overweight or obese people and that included stroke endpoints or outcomes data.
Types of participants sought	Studies including adults (≥18 years) diagnosed as overweight (BMI 25 to 29.9 kg/m^2) or obese (BMI ≥ 30 kg/m^2). Studies with pregnant women as sole participants were excluded. The diagnostic criteria for stroke were not considered as an inclusion or exclusion criterion, but eventual differences were to be explored in a sensitivity analysis.

Types of intervention	RCTs comparing any intervention for weight reduction with placebo or no intervention. Any concomitant interventions to control other cardiovascular risk factors, such as medication, were required to be identical in both groups. Trials were to be included only if follow-up in the randomisation phase continued for at least one year.	
Types of outcomes measured	Primary outcomes measured included: incidence of first stroke; all-cause mortality; health-related quality of life (ideally measured by a validated instrument). Secondary outcomes measured included: adverse effects; costs; sequelae of stroke; incidence of recurrent stroke; incidence of diverse stroke types (ischaemic, haemorrhagic and unknown cause); other vascular endpoints (e.g., fatal stroke, coronary heart disease, vascular death).	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	No RCTs found
Magnitude of effect rating**	Low	
Relevance of evidence rating***	Low	
Results of study		
N and type of studies	N = 0 studies, no trials were found in the literature for inclusion in this review.	
N and characteristics of participants	N = 0 participants	
Duration of follow-up	Not applicable	
Overall findings	There were no results to be reported.	
Compliance with treatment	Not applicable	

Adverse events	Not applicable
Notes	Obesity seems to be associated with an increased risk of stroke and it has been suggested that weight loss may lead to a reduction of stroke occurrence. However, this hypothesis is not based on strong scientific evidence resulting from randomised controlled clinical trials. This systematic review identified the need for well-designed, adequately-powered RCTs assessing the effects of weight reduction in persons with overweight or obesity on stroke occurrence.

Curioni 2006b

Characteristics of the study	
Study Citation	Curioni C & Andre C 2006, 'Rimonabant for overweight or obesity', Cochrane Database Syst Rev, no.4, pp.CD006162.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs comparing the effects of rimonabant with placebo or other weight loss interventions. There were no language restrictions for either searching or trial inclusion.
Types of participants sought	Participants ≥ 18 years of age. Participants defined as overweight or obese at baseline. Studies were excluded if they included children, pregnant women, or patients with serious medical conditions.
Types of intervention	Interventions eligible for inclusion in the review included: rimonabant versus placebo; rimonabant plus other interventions such as diet or exercise versus placebo plus the same intervention;

	rimonabant versus any other pharmacological intervention; rimonabant versus a non-pharmacological intervention. Timing of outcome assessment (duration of the intervention) was divided into: short-term (four weeks to 24 weeks of treatment); medium-term (more than 24 weeks to 12 months of treatment); and long-term (more than 12 months of treatment).	
Types of outcomes measured	Primary outcomes included: change in weight measures (BMI), waist circumference or hip / waist circumference, other anthropometric measures); morbidity; and adverse effects of treatment. Secondary outcomes included: all-cause mortality; change in risk factors (blood pressure, lipid profile and HbA1c); HRQoL; and costs.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 4 studies All four studies were RCTs published in English. All trials were multicentric. All trials had a run-in as a single blind period before the randomisation. The duration of the intervention was 24 months for one study and 12 months for the other three studies. The intervention received was placebo, 5 mg of rimonabant or 20 mg of rimonabant once daily in addition to a mild hypocaloric diet (600 kcal/day deficit).	

N and characteristics of participants	N = 6,625 participants Participants were ≥ 18 years of age. Participants had a BMI > 27 kg/m² and < 5 kg variation in body weight within the three months before study entry. All studies included a mixture of male and female subjects.
Duration of follow-up	The duration of the intervention was 24 months for one study and 12 months for the other three studies. Duration of follow-up was listed as zero in all four studies.
Overall findings	There was a statistically significant effect of rimonabant on body weight, blood pressure and plasma lipids. Compared with placebo, rimonabant 20 mg produced a 4.9 kg greater reduction in body weight in trials with one-year results (WMD -4.9; 95% CI, -5.3 to -4.5). Rimonabant 5 mg produced a statistically significant reduction in weight (1.3 kg), compared with placebo (WMD 1.3 kg; 95% CI; -1.6 to -0.9). No clinically relevant effects on plasma lipids and blood pressure were found with 5 mg. Comparing the two intervention groups, there was a pooled effect of weight reduction of 3.3 kg for the rimonabant 20 mg group, also excluding one study (WMD -3.3 kg; 95% CI, -3.7 to -2.9). All results were statistically significant (P < 0.0001). Improvements in waist circumference, HDL-cholesterol, triglyceride levels, SBP and DBP were seen with rimonabant 20 mg, compared with placebo: Data from three studies showed evidence of an average reduction in SBP and DBP of 2 mmHg (WMD -2 mmHg; 95% CI, -3 to -1) and 1 mmHg (WMD -1 mmHg; 95% CI, -2 to -0.5) respectively. Pooled data of all studies showed a significant lowering of plasma triglycerides in the rimonabant 20mg group compared with placebo of 19.8 mg/dl (WMD -19.8 mg/dl; 95% CI, -24.1 to -15.6; P < 00001). In the rimonabant 20 mg versus 5 mg comparison the meta-analysis of the same three studies showed a statistically significant average reduction of 19.9 mg/dl (WMD -19.9 mg/dl; 95% CI, -25.4 to -14.4). For HDL-cholesterol, pooled data of all studies of the rimonabant 20 mg versus placebo comparison showed an increase of 3.5 mg/dl in the rimonabant group (WMD 3.5 mg/dl; 95% CI, 3.0 to 4.0).

	For rimonabant 5 mg versus placebo for three studies, there was an increase of 1.3 mg/dl in the rimonabant group (WMD 1.3 mg/dl; 95% CI, 0.3 to 1.9). Comparing the two intervention groups, an average increase of 2.3 mg/dl (WMD 2.3 mg/dl; 95% CI, 1.7 to 3.0) was found, favouring the rimonabant group. All analyses were statistically significant (P < 0.00001). Rimonabant 20 mg caused significantly more adverse effects both of a general and serious nature, especially of nervous system, psychiatric or gastrointestinal origin.
Compliance with treatment	Not reported in primary studies. Attrition rates were approximately 40% at the end of one year.
Adverse events	No study evaluated mortality or costs as an outcome. One study mentioned that there were no deaths in any of the three groups. Another study mentioned that two deaths occurred, one in the placebo group (haemorrhagic cerebrovascular accident, about 2.5 months after randomisation) and one in the rimonabant 20 mg group (uterine adenocarcinoma, two months after randomisation). The other two studies did not describe mortality. Reported adverse events included nausea, dizziness, psychiatric and nervous system disorders and neoplasms. In Europe, rimonabant is contraindicated for patients with severe depression and / or patients who are treated with antidepressive medications. Rimonabant is not recommended for patients with other untreated psychiatric conditions.
Notes	The use of rimonabant after one year produced modest weight loss of approximately 5%.

Czernichow 2010

Characteristics of the study	
Study Citation	Czernichow S, Lee CM, Barzi F, Greenfield JR, Baur LA, Chalmers J, Woodward M & Huxley RR 2010, 'Efficacy of weight loss drugs on obesity and cardiovascular risk factors in obese adolescents: a meta-analysis of randomized controlled trials', Obes Rev, vol.11, no.2, pp.150-8.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	Peer-reviewed studies published in English between November 1988 and August 2008 that fulfilled the following criteria: randomized placebo-controlled trials in overweight / obese children or adolescents (age ≤ 18 years), evaluating the effect of anti-obesity drugs on weight and cardiovascular risk factors with data at baseline and with a minimum of 6-month follow-up.
Types of participants sought	Overweight / obese children or adolescents (age ≤ 18 years)
Types of intervention	Anti-obesity drugs – sibutramine, orlistat and rimonabant
Types of outcomes measured	Studies were included if they had published quantitative estimates and SDs (or standard errors) regarding the association between each weight loss drug and weight, with information on at least one of the following cardiovascular risk factors: total cholesterol, HDL or LDL cholesterol, triglycerides (TG), fasting blood glucose, insulin levels, SBP, DBP or pulse rate. Studies were excluded if they provided only an estimate of effect with no means to calculate the SD or if they lacked a control group. The mean difference for the mean weight, BMI and waist circumference (WC) were also calculated at baseline through to the end of follow-up.

<table>
<tr><th>Quality of study</th><th>Rating</th><th>Comments</th></tr>
<tr><td>Level of evidence</td><td>I</td><td></td></tr>
<tr><td>Study quality rating*</td><td>A</td><td></td></tr>
<tr><td>Magnitude of effect rating**</td><td>Medium</td><td></td></tr>
<tr><td>Relevance of evidence rating***</td><td>High</td><td></td></tr>
<tr><td colspan="3">Results of study</td></tr>
<tr><td>N and type of studies</td><td colspan="2">N = 8 studies
Data from five randomised placebo-controlled trials of sibutramine and three of orlistat were included. There were no trials of rimonabant eligible for inclusion.</td></tr>
<tr><td>N and characteristics of participants</td><td colspan="2">N = 1,391 participants
Sibutramine studies included 770 participants and orlistat studies included 621 participants.
In the sibutramine trials, the age range of participants was 12 to 18 years; all adolescents had a BMI ≥ 30 kg/m^2.
In the orlistat trials, the age range of participants was 10 to 18 years and all had a BMI ≥ 30 kg/m^2.
Gender not reported.</td></tr>
<tr><td>Duration of follow-up</td><td colspan="2">In the sibutramine trials the follow-up was 6 months, with the exception of one trial of 12 months duration. The orlistat trials follow-up ranged from 5 to 15 months.</td></tr>
<tr><td>Overall findings</td><td colspan="2"><table>
<tr><th></th><th>All studies</th><th>Sibutramine only studies</th><th>Orlistat only studies</th></tr>
<tr><td>Weight (kg)</td><td>-5.3 (-7.5 to -3.0)</td><td>-5.3 (-7.2 to -3.5)</td><td>-6.2 (-14.0 to -1.7)</td></tr>
<tr><td>BMI</td><td>-1.9 (-2.7 to -1.1)</td><td>-2.3 (-2.8 to -1.8)</td><td>-1.7 (-3.5 to -0.2)</td></tr>
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<table>
<tr><td></td><td>
<table>
<tr><td>Waist circumference</td><td>-4.7 (-6.5 to -3.0)</td><td>-5.7 (-6.9 to -4.6)</td><td>-1.8 (-3.1 to -0.4)</td></tr>
<tr><td>Total cholesterol</td><td>-0.02 (-0.12, 0.08)</td><td>0.02 (-0.21, 0.25)</td><td>NR</td></tr>
<tr><td>Triglycerides</td><td>-0.3 (-0.8, 0.2)</td><td>-0.5 (-1.1, 0.2)</td><td>NR</td></tr>
<tr><td>HDL</td><td>0.04 (-0.01, 0.09)</td><td>0.07 (0.03, 0.11)</td><td>NR</td></tr>
<tr><td>LDL</td><td>-0.01 (-0.16, 0.14)</td><td>0.04 (-0.25, 0.33)</td><td>NR</td></tr>
<tr><td>Insulin</td><td>-3.6 (-9.5, 2.2)</td><td>-3.6 (-9.5, 2.2)</td><td>NR</td></tr>
<tr><td>SBP</td><td>0.9 (0.02, 1.7)</td><td>1.0 (0.1, 1.9)</td><td>NR</td></tr>
<tr><td>DBP</td><td>0.3 (-2.5, 3.1)</td><td>1.7 (1.0, 2.4)</td><td>NR</td></tr>
</table>
NR=not reported

There was evidence of statistical heterogeneity between the studies (I^2 = 76%) that was no longer apparent after exclusion of trials of orlistat (mean weight decrease = 5.32 kg; I^2 = 38%). Therefore, these were excluded from the analysis of CVD / diabetes outcome measures.
</td></tr>
<tr><td>Compliance with treatment</td><td>Not stated</td></tr>
<tr><td>Adverse events</td><td>In the trials of sibutramine, the overall attrition rate in the treated group was 16.1% (95% CI, 13.0 to 19.2) compared with 24.8% (95% CI, 19.7 to 29.9) in the placebo group. The percentage of withdrawal for any adverse event was 4.9% (23/467) in the treated group vs. 3.1% (7/224) in the placebo group with a corresponding relative risk of 1.6 (95% CI, 0.7 to 3.6).

In trials of orlistat, the overall attrition rate in the treated group was 33.8% (95% CI: 29.2 to 38.4) compared with 29.8% (23.9 to 35.6) in the placebo group. The percentage of withdrawal for any adverse event was 5.5% (22/399) in the treated group vs. 1.4% (3/222) in the placebo group and the corresponding relative risk was 4.1 (95% CI, 1.2 to 13.5).</td></tr>
</table>

Notes	This meta-analysis supports the use of pharmacological intervention in overweight and obese adolescents for purposes of weight loss. Overall, these drugs were associated with an approximate 5 kg weight loss and 5 cm reduction in WC after at least six months of therapy compared with placebo. There was no evidence to indicate that treatment with pharmacological agents was associated with any material improvement in the lipid profile or insulin level with the exception of a small increase in HDL-cholesterol in studies of sibutramine. Conversely, there were suggestions that treatment may be associated with a small increase in BP, but given the limited amount of information upon which this result is based, it should be treated with caution until more data become available.

Dansinger 2007

Characteristics of the study	
Study Citation	Dansinger ML, Tatsioni A, Wong JB, Chung M & Balk EM 2007, 'Meta-analysis: the effect of dietary counselling for weight loss', Ann Intern Med, vol.147, no.1, pp.41-50.
Study Design	Meta-analysis
Methods	
Types of studies sought	RCTs in all languages from January 1997 to July 2006 that identified the effect of counselling interventions on weight and BMI in adults on weight loss studies with a dietary component. RCTs that reported original data on the effect of dietary counselling on body weight or BMI compared with the effect of control interventions. Studies were excluded due to nonrandomized design, lack of a usual care group, if patients were < 18 years, the goal of the intervention was not weight loss, exercise was the only intervention, mean baseline BMI was < 25 kg/m^2, Standard errors (SEs) could not be determined, the interventions lasted fewer than 12 weeks, and effects at a minimum of 16 weeks were not reported.

Types of participants sought	Overweight or obese adults ≥ 18 years with a BMI > 25 kg/m^2 who had participated in a weight loss study with a dietary component and who had received dietary counselling.	
Types of intervention	The focus of the interventions was dietary counselling on body weight or BMI, and included studies with dietary-based weight loss treatment arms. The goal of all 46 dietary counselling studies was weight loss by limiting fat or calorie intake. Increased exercise, in addition to dietary advice, was promoted in 42 study groups. To administer advice, 18 trials primarily used group meetings, 13 used individual meetings, and 11 used a combination of group and individual meetings; three trials used the Internet, and two did not specify the method.	
Types of outcomes measured	The authors extracted or estimated the net change in BMI and the SE of the net change from the reported data.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 46 trials These were 46 RCTs that included 63 treatment groups; 26 of these were diet-based, and 37 were diet and exercise-based.	
N and characteristics of participants	N = ~11,853 participants Approximately 6,386 people participated in dietary counseling–based weight loss interventions and	

	approximately 5,467 people received usual care. Mean age of the participants ranged from 27 to 68 years. Mean BMI ranged from 25 to 40 kg/m^2. Studies included subjects who were healthy (N = 12), had hypertension (N = 12), type 2 diabetes (N = 10), impaired glucose tolerance (N = 5), heart disease (N = 3), dyslipidaemia (N = 2), or other conditions (N =6). Gender was not reported.
Duration of follow-up	Duration of intervention, including follow-up, ranged from three to 60 months.
Overall findings	Primary analysis was meta-analysis of slopes across discrete periods, as data was not independent across time. Total net weight loss during an active intervention is, on average, progressively greater for about six months, with eventual regain after 12 months. During the maintenance phase of the behavioral weight loss programs, the summary estimates of net BMI indicate progressive weight regain over time. At 3, 6, and 12 months of active intervention, studies of participants with diabetes reported about half the net weight loss as did studies that did not include participants with diabetes ($p < 0.001$). At 12 months, during the active phase, participants who also exercised had statistically greater weight loss compared with those who received diet alone, but weight changes were similar in both groups at three and six months. During the maintenance phase, changes in weight were not statistically significantly different across studies, based on type of intervention. RCTs comparing dietary counselling–based weight loss programs with usual care interventions were found to produce a mean net treatment effect of approximately two BMI units (6% of initial body weight [5 kg]) of weight loss at one year. Approximately half of the initial weight loss was typically regained after three years.
Compliance with treatment	Not stated. Across studies, at the analysed time points, the median rate of withdrawal was 15% (interquartile range 8-19%).

Adverse events	Few studies reported information related to adverse events. Three studies reported that there were no adverse events. One 3-year study of an individualized curriculum for diet, exercise, and behavioral modification reported that the rate of musculoskeletal symptoms was highest in the lifestyle intervention group, whereas the rate of gastrointestinal symptoms was lower in this group.
Notes	Dietary, counselling–based weight loss showed modest net weight loss relative to usual care, with diminishing net treatment effects with increasing duration of intervention.

De Groot 2009

Characteristics of the study	
Study Citation	De Groot NL, Burgerhart JS, Van De Meeberg PC, de Vries DR, Smout AJ & Siersema PD 2009, 'Systematic review: the effects of conservative and surgical treatment for obesity on gastro-oesophageal reflux disease', Aliment Pharmacol Ther, vol.30, no.11-12, pp.1091-102.
Study Design	Systematic review
Methods	
Types of studies sought	RCTs, retrospective and prospective observational studies assessing the association between weight reduction interventions and gastro-oesophageal reflux disease (GORD) in participants with overweight or obesity.
Types of participants sought	Participants with obesity (BMI >30 kg/m^2) or overweight (BMI >25 kg/m^2) and either gastro-oesophageal reflux symptoms and / or an established diagnosis of GORD. Data were required regarding GORD symptoms and / or an established diagnosis of GORD. When typical symptoms such as heartburn, regurgitation, epigastric pain or retrosternal pain were recorded, sometimes in

	combination with the atypical symptoms dysphagia and / or postprandial and / or nocturnal cough, these were also regarded as indicative of GORD and these patients were eligible for this study. An established diagnosis was defined as GORD being the outcome of one or more of the following tests: endoscopy (oesophagitis, Barrett's oesophagus) and / or ambulatory oesophageal pH monitoring (positive 24 h recordings).	
Types of intervention	*Diet / lifestyle.* The studies that were included used the following definitions for diet and lifestyle interventions. A VLCD was defined as a diet-containing 420 kcal/day and a low calorie diet (LCD) as a diet containing 1000–1500 kcal/day. A very low-carbohydrate diet had a daily carbohydrate intake of < 20 gm/day. Lifestyle interventions included weight loss programmes aimed at energy restriction, enhancing physical exercise and behavioral modification. *Bariatric surgery*. Bariatric surgical procedures included restrictive procedures, either VBG or LAGB or RYGB. Laparotomic and non-adjustable gastric banding techniques were considered.	
Types of outcomes measured	Primary outcomes were defined as the effect of the weight reduction intervention on GORD, measured by 24-h pH monitoring, manometry, endoscopy and / or radiological techniques, whereas the reduction in reflux symptoms was evaluated by questionnaires. The secondary outcome was weight change measured in kilograms, in percentages of original weight or by BMI.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	C	Year limits of search not stated and no quality scoring of studies Non-RCTs not included Point estimates not provided
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	

Results of study	
N and type of studies	N = 32 studies There were four RCTs, 25 observational studies and three uncontrolled case series.
N and characteristics of participants	N = 2,334 participants The mean BMI at baseline reported in included studies ranged from 23.5 kg/m^2 to 56 kg/m^2. Pooled estimates for the age and gender of participants were not reported.
Duration of follow-up	The duration of follow-up varied from one week to 208 weeks across studies.
Overall findings	Weight change was not reported as a pooled estimate across included studies. No weight change data were provided for diet / lifestyle interventions. Weight reduction with gastric bypass (RYGB) was reported as a mean reduction of 72% of excess body weight (range 69 to 76%); restrictive procedures were associated with a mean BMI decrease from 39.8 to 31.5 kg/m^2 (range 21.8 to 42.0 kg/m^2). The effect of a lifestyle or diet intervention on GORD in overweight and obese patients was evaluated in seven studies. Two studies used a VLCD, one a LCD, one a very low carbohydrate diet and three lifestyle interventions. Four studies demonstrated an improvement in GORD with diet / lifestyle and three found no improvement. Gastric bypass was evaluated in 11 studies. A reduction in weight was observed across all studies; the mean excess weight lost was 72% (range 69 to 76%). Ten studies demonstrated improvement in GORD and one study found no improvement. Restrictive procedures (gastric banding) were evaluated in 20 studies. Mean BMI decreased from 39.8 (23.5 to 56) to 31.5 (21.8 to 42.0) kg/m^2. Seven studies found no effect of restrictive procedures on GORD, three found worsening of GORD, five found improved GORD, and the remaining studies had conflicting results (with improvement in some measures and worsening in others).
Compliance with treatment	Not stated
Adverse events	Not stated

Notes	Diet and lifestyle interventions appear to be beneficial with respect to GORD in some patients. Of all surgical techniques evaluated in this review, gastric bypass is associated with the most consistent improvement in GORD.

De Jong 2010

Characteristics of the study	
Study Citation	de Jong JR, Besselink MG, van Ramshorst B, Gooszen HG & Smout AJ 2010, 'Effects of adjustable gastric banding on gastroesophageal reflux and esophageal motility: a systematic review', Obes Rev, vol.11, no.4, pp.297-305.
Study Design	Systematic review
Methods	
Types of studies sought	Prospective observational studies that assessed the association between adjustable gastric banding and gastro-oesophageal reflux and oesophageal motility. Only studies with adult participants in whom postoperative results were reported in more than 75% of the patients were included. Non-English language and animal studies were excluded.
Types of participants sought	Adult participants in whom pre- and postoperative reflux symptoms; medication use: pre- and postoperatively; pH recordings; manometry; and / or pre-and postoperative oesophagogastroduodenoscopy reporting the grade of oesophagitis.
Types of intervention	Laparoscopic adjustable gastric banding.
Types of outcomes measured	Pre- and post-operative BMI, pH, reflux symptoms, medication use, manometry recordings, and grading of oesophagitis.

Quality of study	Rating	Comments
Level of evidence	III-2	
Study quality rating*	C	Study details not described in detail Quality score not provided and Between study differences not explored
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 20 All prospective non-randomised observational studies.	
N and characteristics of participants	N = 3,307 participants Age range was 16 to 76 years; mean pre-operative BMI across studies was ≥ 42.2 kg/m^2.	
Duration of follow-up	Study duration including follow-up was between six and 59 months.	
Overall findings	BMI decreased by between nine and 18 kg/m^2 across studies. The prevalence of reflux symptoms decreased postoperatively from 32.9% (16 to 57) to 7.7% (0 to 26.9) and medication use from 27.5% (16.0 to 38.5) to 9.5% (3.1 to 19.2). Newly developed reflux symptoms were found in 15% (6.1 to 20.0) of the patients. The percentage of participants with oesophagitis decreased postoperatively from 33.3% (19.4 to 61.6) to 27.0% (2.3 to 60.8). However, newly developed oesophagitis was observed in 22.9% of participants (0 to 38.4). Pathological reflux was found in 55.8% (34.9 to 77.4) of participants preoperatively and postoperatively in 29.4%	

	(0 to 41.7) of participants. Lower esophageal sphincter pressures increased from 12.9 to 16.9 mmHg (11.3 to 21.4). Lower esophageal sphincter relaxation decreased from 100% to 79.7% (58 to 86). The percentage of participants with dysmotility increased from 3.5% (0 to 10) to 12.6% (0 to 25).
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	Adjustable gastric banding was associated with resolution or improvement of reflux symptoms, normalized pH-monitoring results and a decreased oesophagitis in some participants. However, worsening or newly developed reflux symptoms and / or oesophagitis occurred in other participants. Adjustable gastric banding increased lower oesophageal pressure and length, but decreased lower oesophageal relaxation and was associated with an increase in disturbed esophageal peristalsis.

De Mattia 2007

Characteristics of the study	
Study Citation	De Mattia L, Lemont L & Meurer L 2007, 'Do interventions to limit sedentary behaviours change behaviour and reduce childhood obesity? A critical review of the literature', Obes Rev, vol.8, no.1, pp.69-81.
Study Design	Systematic review
Methods	
Types of studies sought	RCTs, controlled clinical trials, comparative studies and multicentre studies. Purely observational cross-sectional and cohort studies were excluded to obtain interventional studies only.

Types of participants sought	Children or adolescents	
Types of intervention	Controlled interventional studies that reduced sedentary behaviour or controlled weight using a reduction in sedentary behaviours, defined as recreational screen time. Multilevel interventions that included a reduction in sedentary behaviour in addition to other modalities (diet, exercise). Studies designed to reduce sedentary behaviour in a natural setting (e.g., at home). Studies of behaviour within a controlled laboratory setting were not considered relevant or generalizable.	
Types of outcomes measured	A measure of sedentary behaviour and weight (e.g. BMI or per cent overweight).	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	B	Point estimates not provided Quality score not reported
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 12 studies Six clinic-based studies targeting at risk and obese children or teens at the onset. Six population-based prevention studies, targeting all children regardless of the presence of obesity at baseline.	
N and characteristics of participants	N = > 2,790 participants	

	Studies included participants of single or mixed genders. Mean age of participants was 3.9 ± 0.07 to 14.2 ± 1.2 years. Pooled estimates of mean age, gender and degree of overweight / obesity not reported.
Duration of follow-up	Intervention lengths varied from 20 minutes to four years. Duration of follow-up varied from four weeks to > four years.
Overall findings	At the end of these studies, intervention groups demonstrated less time engaged in sedentary behaviour and / or modest improvements in weight parameters as compared with control subjects. Interventions with an emphasis on decreasing sedentary behaviour consistently result in positive health behaviour change as measured by self-reported TV / video use and are associated with improvements in weight parameters. Virtually all of the interventions consistently resulted in slowing of the increase in the subjects' BMI relative to similar aged controls. A qualitative overview summarizing the studies according to setting and target population was reported, due to significantly different study populations, interventions, settings and measured outcomes across studies.
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	The systematic review was limited by the quality of the studies available. The heterogeneity of the studies made the anticipated quantitative synthesis impractical. The measurements of sedentary behaviour were primarily self-report questionnaires. While some of these measures had been tested for reliability and validity, many were not appropriate for the age group being studied. However, the consistent directionality of the effect across very heterogeneous studies does suggest that efforts to reduce sedentary behaviour should be employed as means to reduce the prevalence of paediatric obesity. As the sedentary behaviour messages in the interventions are often combined with other health information (e.g. healthy eating and exercise), it is impossible to estimate the magnitude of the weight influences because of sedentary behaviour messages alone.

	While children who are markedly overweight may need the multidisciplinary team to address the issue from all angles, the studies that included contingent rewards for sedentary behaviour make it difficult to tease out whether the decrease in sedentary behaviour could have occurred without tying the sedentary behaviour to physical activity.

Fernandes 2007

Characteristics of the study	
Study Citation	Fernandes M, Atallah AN, Soares BG, Humberto S, Guimaraes S, Matos D, Monteiro L & Richter B 2007, 'Intragastric balloon for obesity', Cochrane Database Syst Rev, no.1, pp.CD004931.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs and quasi-RCTs assessing the effects of intragastric balloons. Studies that reported measurements after a minimum of four weeks follow-up.
Types of participants sought	Participants who were overweight (BMI 25 to 29.9 kg/m^2), level I (BMI 30 to 34.9 kg/m^2), level II (BMI 35 to 39.9 kg/m^2), or level III (BMI > 40 kg/m^2) obese, and super obese patients (BMI > 50 kg/m^2).
Types of intervention	Intragastric balloon (IGB) compared to conventional treatments (diet therapy, physical activity, behaviour therapy, drug therapy); IGB compared to no treatment; IGB compared to intragastric balloon and diet therapy; IGB and diet therapy compared to diet therapy only.

Types of outcomes measured	Primary outcomes included: weight loss; other anthropometrical measures (e.g. BMI, skin-fold thickness, fat free mass, waist size); adverse effects (e.g., technical failure in the procedure, IGB defects). Secondary outcomes included: quality of life ratings; mortality (all-cause, postoperative); revision rates (reversal with the early removal of the IGB); major complications: migration, which may result in oesophageal or gastrointestinal obstruction; minor complications: erosion or ulceration, or both, by permanent contact with the gastric mucous membrane; obesity related co-morbidity; and costs.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	Quasi-randomised trials included
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 9 studies Nine RCTs in 16 publications were included. The duration of the included trials ranged from three to 24 months. The studies compared the following interventions: IGB versus diet; IGB versus no treatment; IGB versus intragastric balloon and diet; IGB and diet versus diet only. Several different measures of weight change were reported: mean or median weight at follow-up; weight loss,	

	percent ideal body weight; percent of initial weight; percent excess weight loss and proportion of “successes”. Many of the studies did not report measures of variability such as CIs or SDs. Co-morbidities were reported in two studies, but quality of life was not reported and there were no data on mortality. Adverse events and additional procedures, or both, were reported by most studies. Some RCTs described the calories ingested before the start of the treatment with the IGB as a base for calculation of the suggested diet.
N and characteristics of participants	N = 395 participants The individual trial sizes ranged from 20 to 90 patients. Participants were between 14 and 64 years of age. Most patients were female. Median or mean preoperative weight of the study sample or subgroup ranged from 71.4 kg to 191.2 kg. Two RCTs described average age only and one trial did not report the age of the patients.
Duration of follow-up	Six out of nine RCTs had a follow-up of less than one year. The longest trial duration was 24 months.
Overall findings	IGB versus diet: three studies compared IGB with a sham procedure; information from the available trials suggested little benefit if any from treatment with an IGB. In one trial, although weight loss occurred more consistently in patients with the IGB, there were no significant differences between any of the three groups at 12 or 24 weeks with respect to weight loss or BMI. The major part of the weight loss occurred during the first 12 week period, irrespective of therapy. Another trial reported a statistically significant weight loss in the groups who use a 1000 kcal/day diet (-6.9 kg ± 1.4) A third study found that weight loss was practically the same in IGB and sham groups in the first three months (IGB 8.5 kg, sham 8.0 kg). Weight loss in the fourth study at two or three months in the conventional therapy group averaged 2.8 kg, and in

	the IGB-treated group mean weight loss was 5.8 kg (P > 0.15). IGB versus no treatment: A RCT with a high risk of bias suggested that IGB can prompt little loss of weight within three months of use, although the rate of weight loss decreased after the first month. The IGB group loss 3.2 kg (SD 0.9) compared with the control group which gained 0.6 kg (SD 0.5). IGB versus intragastric balloon plus diet: One RCT with a high risk of bias described a small positive correlation between the initial weight and the change of weight observed in the IGB group. The similar positive correlation in the IGB plus diet group suggested that this weight loss was due to diet adherence facilitated by the fullness of the balloon. The IGB only group lost 3.2 kg (SD 0.9) and the IGB plus diet group lost 5.1 kg (SD 0.5). IGB plus diet versus diet only: No definite conclusions were drawn due to substantial heterogeneity between trials. Relevant differences between the two therapeutic approaches were not detectable. One study showed a weight loss of 5.1 kg (SD 1.0) in IGB and diet group, versus diet only who demonstrated a weight loss of 6.9 kg (SD 1.4). Results from another study showed that IGB patients lost significantly more weight (15.4 kg) than participants undergoing sham treatment (11.6 kg). A third study found that weight loss was significantly different only during the first and second 2-weeks evaluation periods, and disappeared after four weeks of treatment. There was a significantly greater mean weight loss in the IGB group from a fourth study (7.3 kg (SD 6.1)) compared with the sham/diet only group (3.3 kg (SD 3.9)). Weight loss was not maintained after balloon removal. A fifth study showed cumulative weight loss was 8.6 kg in IGB plus diet, compared with 9.1 kg in sham procedure plus diet group.
Compliance with treatment	Not stated
Adverse events	Major complications reported included:

	Deflation and migration of the balloon: in two trials there was no statistically significant difference between the interventions. These studies used the Garren-Edwards intra-gastric balloon technique. Obstruction of the small intestine: one trial reported data on small bowel obstruction. Three out of 90 participants in the IGB group and none in the control group suffered from this complication. Mallory-Weiss syndrome: one trial evaluated the occurrence of Mallory-Weiss syndrome with 10 out of 90 participants in the IGB group and none in the control group being diagnosed with this condition. Oesophageal laceration: in a single trial only one patient in the IGB group versus none in the control group suffered from oesophageal laceration. Minor complications reported: Gastric ulcers: meta-analysis of six RCTs demonstrated an increased relative risk of 4.91 (95% CI 1.57 to 15.35) for gastric ulcers following IGB treatment. Gastric erosions: meta-analysis of six RCTs revealed an increased relative risk of 9.78 (95% CI 3.87 to 24.69) for gastric erosions following IGB therapy. Abdominal pain: pooling of data from four RCTs illustrated an increased relative risk of 14.00 (95% CI 3.45 to 56.74) for abdominal pain following IGB placement. Vomiting: data from two trials did not indicate a statistically significant difference of pooled relative risks for vomiting.
Notes	Only one third of the analysed RCTs revealed a low risk of bias. No information was available on quality of life, all-cause mortality and morbidity.

Flodgren 2010

Characteristics of the study	
Study Citation	Flodgren G, Deane K, Dickinson HO, Kirk S, Alberti H, Beyer FR, Brown JG, Penney TL, Summerbell CD & Eccles MP 2010, 'Interventions to change the behaviour of health professionals and the organisation of care to promote weight reduction in overweight and obese people', Cochrane Database Syst Rev, no.3, pp.CD000984.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs that compared routine provision of care with interventions that aimed to change either the way health professionals worked to achieve weight loss in overweight or obese people, or interventions aimed to change the organisation of care for them. All trials enrolling adults described as overweight or obese were included. The main reasons for exclusion were: lack of a standard care arm; patients were not recruited in a healthcare setting; not all patients were overweight or obese; no objective outcome data were recorded / available for one or both arms; study was not an RCT; intervention was not led by a healthcare professional; non-adult patients; and intervention simply added a new component of care.
Types of participants sought	Fully qualified health professionals, working with overweight or obese adults. Studies were included if a reduction in weight was specified as an objective of the intervention and outcome weight data were provided for the overweight or obese subpopulations within these patient groups. All patients in an included study had to be overweight or obese, or results from the overweight or obese subpopulation had to be provided separately.
Types of intervention	Interventions aimed at helping health professionals implement an intervention targeting weight reduction in overweight or obese people.

	Interventions were divided into one of the following categories: - Those targeting health professionals included: interventions aimed at improving the effectiveness of health professionals working to reduce the weight of overweight or obese people. Strategies included providing professionals with information or training on appropriate practice. - Interventions targeting the organisation of care included: interventions aimed at changing the organisation of care directed at reducing the weight of overweight or obese people. Interventions were aimed at organisational systems, such as the introduction of multi-disciplinary teams, changes in skill mix, or in the setting of service delivery.	
Types of outcomes measured	Any objective measure of provider performance or patient outcomes. Available cost data. Main outcomes measures were patient's body weight. Secondary outcomes measured included: - BMI, satisfaction with provider practice or healthcare provision, psychological outcomes, morbidity, body fat, effects on risk factors, patient behaviour, number of withdrawals from treatment. - Measures of health practitioners' behaviour, knowledge, attitudes, or satisfaction.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	

Results of study	
N and type of studies	N = 6 studies Six RCTs met the inclusion criteria: four evaluated educational or reminder interventions targeted at GPs and two evaluated organisational interventions.
N and characteristics of participants	N = 1,324 overweight or obese patients + 246 health professionals The six RCTs included five trials with mixed gender and one trial with females only. Age and BMI was not always provided.
Duration of follow-up	Follow up periods varied from six to 24 months from the initiation of intervention.
Overall findings	Trials evaluating educational interventions aimed at GPs - Meta-analysis of three trials suggested that, compared to standard care, such interventions could reduce the average weight of patients after a year (by 1.2 kg, 95% CI -0.4 to 2.8 kg); however, there was moderate unexplained heterogeneity between their results (I^2 = 41%). - One trial found that reminders could change doctors' practice, resulting in a significant reduction in weight among male patients (by 11.2 kg, 95% CI 1.7 to 20.7) but not among female patients (who reduced weight by 1.3 kg, 95% CI -4.1 to 6.7). - One trial found that patients may lose more weight after a year if the care was provided by a dietician (by 5.6 kg, 95% CI 4.8 to 6.4) or by a doctor-dietitian team (by 6 kg, 95% CI 5 to 7), compared with standard care. - One trial found no significant difference between standard care and either mail or phone interventions in reducing patients' weight. Trials evaluating interventions aimed at organisation of care (versus standard organisation of care) - One study comparing outcomes in patients who received an intervention delivered by a doctor and dietitian found that after one year, patients lost 6.7 kg (95% CI, -5.9 to -7.5 kg) more weight than patients in standard care group. Those receiving an intervention from a dietitian lost 5.6 kg (95% CI, -4.8 to -6.4) more weight than patients in the standard care group. For patients in the doctor-dietitian and dietitian-only groups, the cost of each additional kilogram lost over and above the weight change in the control group

	was $7.3 and $9.8, respectively. Patients in both the doctor-dietitian and dietitian-only groups showed significant decreases in mean blood pressure compared to standard care group, with net reductions of 12 mmHg (95% CI, -9 to -15 mmHg) and 7 mmHg (95% CI, -4 to -10 mmHg) respectively, and with a significantly greater decrease in the doctor / dietitian group. - Another study assessed the method of delivery of a counselling intervention to encourage weight loss. Results suggested that although mail interventions were significantly more successful in encouraging patients to start on a weight loss program, phone interventions were more successful in encouraging them to stay on the program and to complete it. However there were no significant differences between the groups in terms of change in weight between baseline and 18 to 24 months. Phone counselling was found to be less cost effective than mail counselling or standard care, with it costing $60 more per kilogram of weight loss.
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	The heterogeneity of interventions, small sample sizes, high drop-out rates among patients, and sometimes low level of implementation make it difficult to draw firm conclusions on how the management of weight loss in obese patients might be improved. Most of the included trials had methodological or reporting weaknesses and were heterogeneous in terms of participants, interventions, outcomes, and settings, so the authors were unable to draw any firm conclusions about the effectiveness of the interventions. The authors reported that there was little evidence about how clinical practice or the organisation of care might be improved to help obese and overweight patients achieve weight loss.

Franz 2007

Characteristics of the study		
Study Citation	Franz MJ, Van Wormer JJ, Crain AL, Boucher JL, Histon T, Caplan W, Bowman JD & Pronk NP 2007, 'Weight-loss outcomes: a systematic review and meta-analysis of weight-loss clinical trials with a minimum 1-year follow-up', J Am Diet Assoc, vol.107, no.10, pp.1755-67.	
Study Design	Systematic review and meta-analysis	
Methods		
Types of studies sought	Randomized clinical trial with ≥ 1 year follow-up; and ≥ 1 intervention arm using at least one of the eight weight-management therapies identified. Studies published between January 1, 1997 and September 1, 2004; in English language.	
Types of participants sought	Overweight or obese adults (aged 18 years or older)	
Types of intervention	Weight-loss interventions, including: diet alone, diet and exercise, exercise alone, meal replacements, very-low-energy diets, weight-loss medications (orlistat and sibutramine), and advice alone.	
Types of outcomes measured	Weight loss at six, 12, 24, 36, and 48 months. Measures of weight loss included absolute weight loss, percentage of weight loss, and BMI changes relative to baseline.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	C	Harms not reported

		Methodological quality not assessed Point estimates not provided Between studies differences not explored
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 80 trials There were 80 RCTs that included 17 with diet and exercise as the primary intervention, seven studies that used meal replacements, 11 studies that used very-low-energy diets, 13 studies used orlistat and seven used sibutramine in intervention arms, and 28 studies had an advice-alone arm. Most investigators excluded dropouts from the final data analysis; thus, weight loss by condition is reported primarily for study completers (although intent-to-treat data were included in the meta-analysis where possible).	
N and characteristics of participants	N = 26,455 subjects Mean age of the participants ranged from 22.8 ± 5 to 68.5 ± 6.6 years. Mean baseline BMI was ≥ 28.9 ± 2.8 kg/m^2. Studies included single or mixed genders.	
Duration of follow-up	Total study duration including treatment and follow-up ranged from 52 to 308 weeks.	
Overall findings	A mean weight loss of 5 to 8.5 kg (5% to 9%) was observed during the first 6 months from interventions involving food and meal-planning strategies - diet alone, diet and exercise and meal replacements. Weight loss stabilized to approximately 4.5 to 7.5 kg at 12 months, and approximately 3 to 4 kg at 24, 36 and 48 months. Weight-loss medications produced results similar to diet and exercise at 6 months, but at 24 months participants	

	maintained a mean weight loss of approximately 2 to 5 kg above diet and exercise interventions. Very-low-energy diets resulted in dramatic weight loss followed by rapid and substantial weight gain. In contrast, advice-only and exercise-alone groups experienced minimal weight loss at any time point.
Compliance with treatment	Not stated. At the one-year follow-up, the average participant attrition rate across studies was 29%. Overall attrition rate was 31% at study end regardless of follow-up length.
Adverse events	Not stated
Notes	Weight-loss interventions utilizing a reduced-energy diet and exercise are associated with moderate weight loss at 6 months. Although there is some regain of weight, weight loss can be maintained. The addition of weight-loss medications somewhat enhances weight-loss maintenance.

Fried 2010

Characteristics of the study	
Study Citation	Fried M, Ribaric G, Buchwald JN, Svacina S, Dolezalova K & Scopinaro N 2010, 'Metabolic surgery for the treatment of type 2 diabetes in patients with BMI <35 kg/m^2: an integrative review of early studies', Obes Surg, vol.20, no.6, pp.776-90.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	English language studies of all study designs published between 1979 and 2009, containing data on treatment of type 2 diabetes mellitus (T2DM) by any form of bariatric / metabolic surgery in human subjects where the mean study BMI was < 35 kg/m^2.

Types of participants sought	Patients with T2DM who also had a mean BMI < 35 kg/m^2 and had undergone bariatric / metabolic surgery.	
Types of intervention	Bariatric / metabolic surgery: BPD, RYGB, LAGB, duodenal-jejunal bypass (DJB), mini-gastric bypass (MGB), ileal interposition with sleeve gastrectomy (II-SG) and ileal interposition with diverted sleeve gastrectomy (IIDSG).	
Types of outcomes measured	BMI, fasting plasma glucose (FPG) (mg/dL), HbA1c (%). Values for total cholesterol, plasma insulin, and homeostasis model assessment (an estimate of steady-state beta cell function and insulin sensitivity as percentages of a normal reference population) were reported with insufficient frequency to be assessed.	
Quality of study	Rating	Comments
Level of evidence	III-2	Highest level of evidence prospective observational studies
Study quality rating*	C	No RCTs included Methodological quality not assessed Individual study differences and heterogeneity not explored
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 16 studies There were 11 prospective observational studies and five retrospective studies from prospectively collected databases. Three of the studies employed restrictive procedures, five were malabsorptive / restrictive, and eight were primarily malabsorptive. Studies assessed BPD (three studies); stomach- and pylorus-preserving BPD (BPD-SPP, one study); RYGB (two	

	studies); LAGB (three studies); DJB (four studies); MGB (one study); II-SG (one study); and IIDSG (two studies).
N and characteristics of participants	N = 343 participants A total of 66% of participants across studies were female. The mean age of participants at baseline was 46.2 years. At baseline, the total review group weighted mean BMI was 29.4 kg/m2; FPG, 198.5 mg/dL; and HbA1c, 8.7%. Most patients were taking a form of daily oral or injectable diabetes medication and / or insulin or a combination thereof. Patients had been diagnosed with T2DM between one and 18 years prior to surgery. 27 participants underwent a form of restrictive procedure; 223 underwent a malabsorptive / restrictive procedure and 93 underwent a primarily malabsorptive procedure.
Duration of follow-up	Follow-up varied from six to 216 months
Overall findings	Across studies BMI decreased by 5.1 kg/m^2 (-5.3 to -4.9) (from a mean of 29.4 to 24.2 kg/m^2). A total of 85.3% patients ceased medications for T2DM. Fasting plasma glucose decreased by 93.3 mg/dL (-61.6 to -114.5). HbA1c decreased by 2.7% (-2.6 to -2.8%). In subgroup comparisons, BMI reduction and T2DM resolution were greatest following malabsorptive / restrictive procedures (-5.7 and -97.1 respectively), and in the preoperatively mildly obese (30.0 to 35.0) versus overweight (25.0 to 25.9) BMI ranges (BMI decrease of 6.8 versus 3.4 kg/m^2; FPG decrease of 103.6 versus 77.2 mg/dL).
Compliance with treatment	Not stated
Adverse events	Operative mortality was 0.29%. In a study in the restrictive procedure category, one patient died 20 months postoperatively from sepsis subsequent to perforation of a dilated upper gastric pouch. The rate of total complications was 4%; one study in the malabsorptive / restrictive procedure category reported a 10.3% of major complications.
Notes	The majority of low-BMI patients experienced T2DM resolution within days or weeks of surgery that was durable

	to individual study end points. Participant weight loss was associated with improved FPG and HbA1c and reduction in the proportion of participants on medication for diabetes. Complications were relatively few and operative mortality was low. A number of low-BMI patients experienced resolution of laboratory and clinical manifestations of T2DM without inappropriate weight loss.

Galani 2007

Characteristics of the study	
Study Citation	Galani C & Schneider H 2007, 'Prevention and treatment of obesity with lifestyle interventions: review and meta-analysis', Int J Public Health, vol.52, no.6, pp.348-59.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs of lifestyle interventions performed in overweight or obese subjects over 18 years of age that had a minimum observation period, including treatment and follow-up, of at least one year. Studies were published between 1995 and 2005.
Types of participants sought	Overweight or obese subjects over 18 years of age with BMI between 25 and 29.9 kg/m^2 who were aiming to prevent the transition from overweight to obesity or those who undertook lifestyle interventions that target obese individuals with a BMI ≥ 30 kg/m^2 to reduce the progression of obesity and associated co-morbidities.
Types of intervention	The study population was classified according to the type of intervention: lifestyle intervention and control group regarded as standard care. The common characteristic of all selected studies is that interventions were carried out in overweight or obese people with or without associated co-morbidities. Additional subgroup analyses were performed in overweight

	subjects with cardiovascular risk factors and overweight or obese subjects with impaired glucose tolerance at risk of developing type 2 diabetes. Lifestyle intervention had to include dietary counselling and physical exercise associated or not with behavioral modification techniques. The goals of lifestyle intervention were to achieve and maintain a weight reduction through consumption of a healthy low-calorie, low-fat diet and to engage in regular physical activities.	
Types of outcomes measured	Outcomes evaluated included: body weight, BMI, waist circumference, SBP and DBP, blood lipids: total cholesterol (TC), low density lipoprotein cholesterol (LDL), and high density lipoprotein cholesterol (HDL), triglyceride (TG), and blood glucose control: two-hour plasma glucose (2h-PG), fasting plasma glucose (FPG), and HbA1c.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 30 studies Thirteen studies were selected in the prevention and seventeen in the treatment of obesity. The included studies were randomized clinical trials of lifestyle interventions in overweight and obese subjects that had a minimum observation period of one year.	
N and characteristics of participants	N = 11,579 participants Participants with overweight: - The studies included a total of 3,566 participants with an average BMI of 28 kg/m^2 and an average body weight of 81 kg.	

<table>
<tr><td></td><td>Participants with obesity: - The studies included 8,013 participants with an average BMI of 34 kg/m^2.
In each participant group the study participants had a mean age of 49 years and were predominantly female.</td></tr>
<tr><td>Duration of follow-up</td><td>The average study duration including follow-up was three years. The range was one to six years.</td></tr>
<tr><td>Overall findings</td><td>Compared with standard care, lifestyle intervention significantly reduced body weight, BMI, waist circumference, blood pressure, blood lipids and blood glucose in people with overweight and obesity. Effects were maintained up to three years.
<table>
<tr><th></th><th>Participants with overweight</th><th>Participants with obesity</th><th>Participants with impaired glucose tolerance</th></tr>
<tr><td>Weight (kg)</td><td>-2.2 (-2.8, -1.6)</td><td>-3.5 (-4.7, -2.3)</td><td>-2.9 (-4.4, -1.5)</td></tr>
<tr><td>BMI</td><td>-1.1 (-1.6, -0.7)</td><td>-1.3 (-1.9, -0.7)</td><td>-1.3 (-1.9, -0.6)</td></tr>
<tr><td>Waist circumference</td><td>-2.1 (-2.6, -1.7)</td><td>NR</td><td>NR</td></tr>
<tr><td>SBP</td><td>-2.1 (-3.3, -0.9)</td><td>-2.8 (-4.4, -1.2)</td><td>-3.5 (-4.8, -2.1)</td></tr>
<tr><td>DBP</td><td>-1.6 (-2.7, -0.5)</td><td>-1.4 (-2.2, -0.6)</td><td>-1.8 (-2.5, -1.2)</td></tr>
<tr><td>Total cholesterol</td><td>-0.3 (-0.4, -0.1)</td><td>-0.1 (-0.2, -0.03)</td><td>-0.1 (-0.3, -0.02)</td></tr>
<tr><td>HDL</td><td>0.01 (-0.22, 0.04)</td><td>0.04 (0.01, 0.08)</td><td>0.02 (0.00, 0.04)</td></tr>
<tr><td>LDL</td><td>-0.2 (-0.3, -0.03)</td><td>NR</td><td>-0.05 (-0.2, 0.1)</td></tr>
<tr><td>Triglycerides</td><td>-0.2 (-0.4, -0.1)</td><td>-0.2 (-0.3, -0.04)</td><td>-0.2 (-0.3, -0.1)</td></tr>
<tr><td>HbA1c</td><td>-0.5 (-1.5, 0.5)</td><td>-0.1 (-0.4, 0.2)</td><td>-0.04 (-0.2, 0.1)</td></tr>
<tr><td>FPG (mmol/L)</td><td>-0.3 (-0.5, -0.1)</td><td>-0.2 (-0.3, 0.02)</td><td>-0.2 (-0.3, -0.1)</td></tr>
</table></td></tr>
</table>

Compliance with treatment	Not stated
Adverse events	Not stated
Notes	The authors conclude that lifestyle interventions are efficacious in the mid- to long-term prevention and treatment of obesity, leading to a significant reduction in body weight and cardiovascular risk factors. Lifestyle interventions may be considered an effective prevention tool that can be applied across different disease areas including obesity, diabetes and CVD with beneficial effects maintained for more than three years.

Garb 2009

Characteristics of the study	
Study Citation	Garb J, Welch G, Zagarins S, Kuhn J & Romanelli J 2009, 'Bariatric surgery for the treatment of morbid obesity: a meta-analysis of weight loss outcomes for laparoscopic adjustable gastric banding and laparoscopic gastric bypass', Obes Surg, vol.19, no.10, pp.1447-55.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	Studies conducted between 2003 and 2007. One-group or two-group prospective or retrospective cohort designs. RCTs, non-RCTs, and consecutive case series. Surgical treatment with LAGB, or laparoscopic gastric bypass (LGB) surgery. Adult populations only (> 18 years old). Consecutive patient series that had had surgical treatment with LAGB or LGB.

	Studies were excluded if they were: non-human studies; non-surgical interventions; studies of open bariatric surgery procedures; case reports; letters and comments; and studies with patient follow-up of less than 1 year.	
Types of participants sought	Adults (> 18 years old). BMI ≥ 35 kg/m^2.	
Types of intervention	Surgical treatment with LAGB or LGB in morbidly obese patients.	
Types of outcomes measured	Weight loss outcome was defined by percent excess weight loss (%EWL).	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	C	Non-RCTs included Harms not appraised and individual study differences not explored
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 28 studies Eighteen included LAGB surgery alone or in combination with LGB, and 13 included LGB alone or in combination with LAGB. Studies included were RCTs, non- RCTs, and consecutive case series. Twenty were retrospective in design (71.4%) and eight were prospective. The setting for the studies was mostly academic hospital (22/28, 78.6%), with the remainder community hospital and private practice (each 3/28, 10.7%).	

N and characteristics of participants	N = 7,383 participants Mean age range (if reported) for LAGB was 37-47 years. Mean age range for LGB was 31.1-50 years.
Duration of follow-up	Mean follow-up was 34 months post-surgery for LAGB studies (range 12 to 60 months) and 28 months for LGB studies (range 12 to 87 months).
Overall findings	Composite estimates showed a significantly greater %EWL for LGB surgery (62.6%) compared with LAGB (49.4%). The superiority of LGB persisted at all three postsurgical time points examined (1, 2 and > 3 years). Results showed significant heterogeneity in effect sizes within surgery type ($p < 0.001$), validating the choice of a random-effects model for the meta-analysis. The composite estimate for %EWL was 49.4% (95% CI 44.9 to 54.0) for LAGB and 62.6 (95% CI 58.6 to 66.6) for LGB. The difference in effect sizes between the two types of surgery was statistically significant ($Q = 30.7$, $df = 1$, $p < 0.001$). Composite %EWL broken down by time since surgery for LAGB showed an improving degree of excess weight loss over time for both LAGB and LGB. Specifically, for LAGB, this was 42.6% at 1 year, 50.3% at 2 years, and 55.2% at > 3 years since surgery. For LGB, this was 61.5% at 1 year, 69.7% at 2 years, and 71.2% at >3 years since surgery. Median attrition rates for LAGB studies and LGB studies at 1-year follow-up were 17.0% (range 0 to 77.7%) for LAGB and 0.0% (0 to 65.9%) for LGB patients. There was a marked loss of bariatric surgery patients to follow-up for both surgery types beyond the 1-year follow-up point. Specifically, the 24-month attrition rate was 49.8% (range 0 to 92.3%) for LAGB and 75.2% (0 to 95.8%) for LGB, and > 3 year follow-up attrition rate was 82.6% (25.9 to 93.3%) for LAGB and 89.0% (49.2 to 90.4%) for LGB.
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	Post-surgical assessments of diet and physical activity were absent from the clinical trials reviewed. Although problems in study quality raised significant concerns regarding the validity of current weight loss

	estimates in this area, there was no evidence of publication bias. The results of this meta-analysis identified a composite %EWL of 49.4% for LAGB and 62.6% for LGB surgery. Problems were identified regarding data quality and patient follow-up rates.

Greenburg 2009

Characteristics of the study	
Study Citation	Greenburg DL, Lettieri CJ & Eliasson AH 2009, 'Effects of surgical weight loss on measures of obstructive sleep apnea: a meta-analysis', Am J Med, vol.122, no.6, pp.535-42.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	Studies in patients of any age with obesity and obstructive sleep apnoea (OSA). Studies had to report both preoperative and postoperative measures of polysomnographically measured parameters of sleep apnoea in order to be considered for inclusion. Acceptable terms for sleep apnoea measures included the apnoea index, apnoea-hypopnea index (AHI), and respiratory-disturbance index. To be acceptable for inclusion, it was necessary that polysomnography be performed in accordance with recommendations of the American Academy of Sleep Medicine, including measures of electroencephalography for sleep staging and measures of airflow.
Types of participants sought	Patients of any age who underwent a clinical assessment and polysomnography before bariatric surgery and at least three months after bariatric surgery to allow sufficient time for weight loss to occur
Types of intervention	Any type of bariatric surgery
Types of outcomes measured	Included studies reported results of polysomnographies performed before and at least three months after bariatric

	surgery. Preoperative and postoperative BMI, changes in BMI, and measures of sleep apnoea were additional outcomes measured in this review.	
Quality of study	Rating	Comments
Level of evidence	III-2	
Study quality rating*	C	Methods not described in detail. Heterogeneity not explored. Quality scoring not reported.
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 12 studies Five studies were performed prospectively and seven performed retrospectively. Most studies were performed in the United States; five studies were from Mexico, Australia, Brazil, and Israel.	
N and characteristics of participants	N = 342 participants With the exception of one article that evaluated adolescents, all other studies included adults only. Participants had an age range of 20 to 65 years and a BMI range of 32 to 73 kg/m^2.	
Duration of follow-up	Follow-up from bariatric surgery to polysomnography ranged from 181 to 1,811 days in the five studies that contained this information.	
Overall findings	The pooled mean BMI was reduced by 17.9 kg/m^2 (95% CI, -16.5 to -19.3) from 55.3 kg/m^2 (95% CI, 53.5 to 57.1) to 37.7 kg/m^2 (95% CI, 36.6 to 38.9).	

	The random-effects pooled baseline apnoea hypopnea index of 54.7 events/hour (95% CI, 49.0 to 60.3) was reduced by 38.2 events/hour (95% CI, -31.9 to -44.4) to a final value of 15.8 events/hour (95% CI, 12.6 to 19.0).
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	Bariatric surgery significantly reduces the apnoea hypopnea index. However, the mean apnoea hypopnea index after surgical weight loss was still consistent with moderate OSA. The authors conclude that the data suggests that patients undergoing bariatric surgery should therefore not expect a cure of OSA after surgical weight loss.

Horvath 2008

Characteristics of the study	
Study Citation	Horvath K, Jeitler K, Siering U, Stich AK, Skipka G, Gratzer TW & Siebenhofer A 2008, 'Long-term effects of weight-reducing interventions in hypertensive patients: systematic review and meta-analysis', Arch Intern Med, vol.168, no.6, pp.571-80.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs published up to and including the year 2007 and in any of the following languages: English, German, Dutch, French, Italian, Portuguese or Spanish. Study duration including follow-up had to be at least 24 weeks. Publications had to assess the association between the weight loss intervention and at least one of the following outcomes: mortality, cardiovascular outcomes, adverse events, and BP. Combinations of different non-pharmacologic interventions for reducing BP without the possibility of analysing the different interventions were excluded. In the case of an additional active care (e.g. antihypertensive medication),

	this co-therapy also had to be a component of the comparison group.	
Types of participants sought	Patients with essential hypertension aged 18 years or older (excluding pregnant women).	
Types of intervention	Dietary, pharmacologic, or surgical interventions for weight loss.	
Types of outcomes measured	Primary outcomes of interest were total mortality, cardiovascular morbidity and adverse events. Secondary outcomes were changes in BP and body weight.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 15 studies (48 articles) Seven studies (38 publications) reported results of dietary interventions. In eight studies (10 publications), pharmacologic interventions (orlistat or sibutramine) were compared with placebo. No studies examining surgical interventions or rimonabant satisfying the inclusion criteria were found.	
N and characteristics of participants	N = 5,374 (total) N = 1,632 (dietary intervention studies) N = 3,132 (pharmacologic intervention studies - orlistat) N = 610 (pharmacologic intervention studies - sibutramine)	

<table>
<tr><td></td><td>The mean age of participants ranged from 45 to 66 years for dietary intervention studies and 46 to 55 years for pharmacologic intervention studies. Gender was not reported.</td></tr>
<tr><td>Duration of follow-up</td><td>Follow-up ranged from six to 36 months for dietary intervention studies and six to 48 months for pharmacologic intervention studies.</td></tr>
<tr><td>Overall findings</td><td>
<table>
<tr><td></td><td>Diet</td><td>Orlistat</td><td>Sibutramine</td></tr>
<tr><td>Weight change (kg)</td><td>-4.1 (-5, -3.3)</td><td>-3.7 (-4.7, -2.8)</td><td>-3.7 (-4.9, -2.6)</td></tr>
<tr><td>SBP (mmHg)</td><td>-6.3 (-9.9, -2.7)</td><td>-2.5 (-4, -0.9)</td><td>NR</td></tr>
<tr><td>DBP (mmHg)</td><td>-3.4 (-5.6, -1.3)</td><td>-1.9 (-3, -0.9)</td><td>3.2 (1.4, 4.9)</td></tr>
</table>
NR = not reported
</td></tr>
<tr><td>Compliance with treatment</td><td>Not stated</td></tr>
<tr><td>Adverse events</td><td>No information on possible adverse effects of the different dietary interventions was reported in any publications of the relevant trials.

Gastrointestinal adverse effects were the adverse events most commonly reported by patients treated with orlistat and there were a significantly higher proportion of patients experiencing musculoskeletal pain.

Patients in the sibutramine groups experienced a higher rate of headaches and reported dry mouth more than patients in the placebo groups. Arthralgia was also more common with sibutramine.</td></tr>
<tr><td>Notes</td><td>In patients with essential hypertension, therapy with dietary interventions to reduce body weight or with orlisat resulted in reductions in BP and body weight. A reduction in body weight of approximately 4 kg was necessary to achieve a reduction of approximately 6 mmHg in SBP with dietary treatment and of approximately 2.5 mmHg with orlistat. Sibutramine treatment elevated DBP in the meta-analysis of included studies.

None of the studies provided data to answer the question whether risk of mortality or other patient-relevant end points can be lowered by weight reduction.</td></tr>
</table>

Huisman 2009

Characteristics of the study	
Study Citation	Huisman SD, De Gucht V, Dusseldorp E & Maes S 2009, 'The effect of weight reduction interventions for persons with type 2 diabetes: a meta-analysis from a self-regulation perspective', Diabetes Educ, vol.35, no.5, pp.818-35.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs published in English between 1990 and 2005. Nonsurgical / nonpharmacological intervention in an outpatient setting or included at least one nonsurgical / nonpharmacological condition. Data specified the weight (loss) and HbA1c of participants before and after treatment, which permitted the calculation of effect sizes. The number of participants in the intervention and control group was more than 10. No exclusion criteria were applied concerning the use of medication in patients.
Types of participants sought	Overweight adults with type 2 diabetes who were self-regulating a nonsurgical / nonpharmacological intervention / condition.
Types of intervention	Non-pharmacological and non-surgical interventions such as diet and exercise.
Types of outcomes measured	The value of a self-regulation approach for weight reduction interventions in patients with type 2 diabetes. Pre-test and post-test weight, BMI, and HbA1c scores. Change scores in weight, BMI, and HbA1c.

Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	C	Search terms not specified Harms from interventions not included No quality assessment of primary studies, between study variability not explored
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 34 studies RCTs of weight reduction in participants with diabetes	
N and characteristics of participants	N = 5,469 patients All participants were overweight or obese and had type 2 diabetes.	
Duration of follow-up	The average length of the intervention was 43.8 weeks (SD = 42.9) with a minimum of 6 weeks and a maximum of 208 weeks. The post-test measurements varied from 12 weeks to 4 years, with an average of 58.5 weeks (SD = 41.7).	
Overall findings	The overall effect sizes for weight loss in the short term (< 6 months) were low (0.18) and even lower in the longer term (> 6 months; (0.06)). The overall effect sizes for HbA1c outcomes were higher (0.35) and remained stable in the longer term (0.34). Interventions that scored high on self-regulation characteristics produced significantly better effects on both weight and HbA1c outcomes. “Goal reformulation” increased the effect on weight outcomes whereas “emotion	

	regulation” increased the effect on HbA1c. Interventions that did not include “planning” had significantly higher effect sizes than interventions that did include “planning”. With respect to the other intervention characteristics, only the “inclusion of a patient’s partner or relative” increased the effect on weight loss.
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	When a study compared two similar interventions to a control group (e.g., two different types of diet), the intervention containing the highest number of self-regulation principles was selected as the experimental group. Self-regulation principles assist lifestyle-associated weight loss and decreases in HbA1c in patients with diabetes.

Imaz 2008

Characteristics of the study	
Study Citation	Imaz I, Martinez-Cervell C, Garcia-Alvarez EE, Sendra-Gutierrez JM & Gonzalez-Enriquez J 2008, 'Safety and effectiveness of the intragastric balloon for obesity. A meta-analysis', Obes Surg, vol.18, no.7, pp.841-6.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	Use of BioEnterics Intragastric Balloon (BIB®) to treat obesity. A minimum of 10 patients per study.

	Treatment period of at least 12 weeks. English, Spanish, Italian, French, and Portuguese articles were included. Articles in other languages that provided data on English abstract were also included. Articles with duplicate data and Congress proceedings were excluded. The quality of the studies was examined with the following five criteria: dropout rate, explicit inclusion criteria, randomization, double blind assessment, and consecutive cases. Studies with a dropout rate lower than 20% were positively qualified.	
Types of participants sought	Patients who had used BIB® to treat obesity. No other details were reported.	
Types of intervention	Use of the BIB® to treat obesity with or without conventional treatment (CT). CT was considered to be a multidisciplinary weight management program that included diet and other interventions such as behavioural modification, psychotherapy, dietary counselling, or physical training.	
Types of outcomes measured	BIB® outcomes measured by kilograms lost, percentage of kilograms lost, BMI lost, excess weight lost, complications during treatment, and causes of early removal.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	C	Non-RCTs included, between study differences not explored
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 16 studies	

	Two of the studies were RCTs and 14 were uncontrolled case series. The two RCTs were well evaluated by the four criteria. The case series were evaluated by three criteria. A total of 64.3% of the case series followed all criteria. The criterion that obtained the worst success rate was “consecutive cases”, 21.4% of articles did not comply it.
N and characteristics of participants	N = ≈3,608 participants Age and gender not stated.
Duration of follow-up	Two of the studies provided information on follow-up one year after the balloons removal. No other information about follow-up was reported.
Overall findings	The estimates for weight lost at balloon removal for BIB® were the following: 14.7 kg, 12.2% of initial weight, 5.7 kg/m^2, and 32.1% of excess weight. However, data were scant after balloon removal. Efficacy at balloon removal was estimated with a meta-analysis of two RCTs (75 patients) that compared balloon versus placebo, indicating the balloon group lost more weight than the placebo group. The pooled estimates of weight loss attributed to BIB® were 6.7 kg lost, 1.5% of initial weight lost, 3.2 kg/m^2 lost, and 17.6% of excess weight lost.
Compliance with treatment	Not stated
Adverse events	Regarding BIB® safety, extracted data from patients treated with that balloon, showed that the majority of complications were mild. Although the early removal rate was significant (4.2%), nearly 43% of early removals were voluntary. Severe complications were infrequent, but they did include the following: 26 obstructions in the digestive tract and four gastric perforations causing two deaths. Non balloon-related complications were reported as follows: four cases of respiratory insufficiency and four cases of gastric perforation related with previous surgery causing two deaths.
Notes	The use of the BIB®, within a multidisciplinary weight management program is a short-term effective treatment to lose weight, but it is not yet possible to verify its capacity to maintain the weight lost over a long period of time.

Janssen 2010

Characteristics of the study	
Study Citation	Janssen I & Leblanc AG 2010, 'Systematic review of the health benefits of physical activity and fitness in school-aged children and youth', Int J Behav Nutr Phys Act, vol.7, pp.40.
Study Design	Systematic review
Methods	
Types of studies sought	Intervention studies (including randomized and quasi experimental designs), case-control and cohort studies (prospective and retrospective) and cross-sectional studies were sought for inclusion. Studies were English language and included participants who were aged between 5 and 17 years. For intervention studies, all cardio-respiratory and / or musculoskeletal based interventions were eligible for inclusion. For the observational studies, there were no limitations placed on the form of physical activity assessment (e.g. questionnaire, activity diary, pedometer, and accelerometer) or fitness assessment (cardio-respiratory or musculoskeletal fitness) methods. Intervention studies were excluded if they included a dietary (e.g. caloric restriction) or other behavioral risk factor component (e.g. smoking cessation) that may have independently affected the health outcomes and subsequently made it impossible to distinguish the independent effect of the physical activity portion of the intervention.
Types of participants sought	School-aged children and youth between 5 to 17 years of age with one or more of the following key indicators of different health outcomes known to be related to physical activity: high blood cholesterol; high blood pressure and markers of the metabolic syndrome as a measure of cardio-metabolic risk; overweight / obesity as a measure of adiposity; low bone density as a measure of skeletal health; depression as a measure of mental health; injuries as a negative health outcome of physical activity. NB: only a subset of participants of included studies had overweight / obesity.

Types of intervention	Exercise / physical activity (not defined)	
Types of outcomes measured	Blood cholesterol, blood pressure, metabolic syndrome, obesity (by any valid objective measure), bone density, depression and injuries.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	B	Quality score not provided and between study differences not explored Non-RCTs included
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 86 (total studies in the systematic review) The systematic review was limited to seven health indicators: high blood cholesterol (nine studies), high blood pressure (11 studies), the metabolic syndrome (18 studies), obesity (56 studies), low bone density (11 studies), depression (six studies), and injuries (four studies). There were 17 RCTs examining changes in obesity measures with exercise / physical activity. The amounts of exercise prescribed typically ranged from 2 to 3.5 hours per week, which averages out to 17 to 30 minutes per day.	
N and characteristics of participants	N = 1,633 participants with overweight / obesity who received exercise interventions (overweight / obesity and exercise subgroup).	
Duration of follow-up	Duration of intervention for the experimental studies with exercise interventions was between 4 weeks and 2 years	

	(including follow-up); the majority were 4 to 6 months in duration.
Overall findings	For the interventions that were based on aerobic exercise, the summary effect size measures were -0.40 (-1.10, 0.31) for % body fat and -0.07 (-0.89, 0.75) for BMI. Effect sizes for blood lipids varied as follows: total cholesterol -0.46 to -0.6, triglycerides -3.3 to 0.3, HDL -0.04 to 0.7 and LDL -0.2 to -1.4. Effect sizes for SBP and DBP were -1.2 and -0.8 respectively. Effect sizes for fasting insulin varied between -1.9 and 0.2. For the resistance exercise intervention, the summary effect size calculation for % body fat was -0.19 (-1.55, 1.18). Effect sizes for SBP and DBP were -0.2 and -0.9 respectively. Effect sizes for fasting insulin varied between -0.1 and -0.2. The effect size of exercise on changes in physical self-worth and global self-worth in children with overweight were 0.89 (-0.42, 2.42) and 0.22 (-1.67, 2.24) respectively.
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	The following recommendations were made by the authors based on the findings of the systematic review: 1) Children and youth 5 to 17 years of age should accumulate an average of at least 60 minutes per day and up to several hours of at least moderate intensity physical activity. Some of the health benefits can be achieved through an average of 30 minutes per day. 2) More vigorous intensity activities should be incorporated or added when possible, including activities that strengthen muscle and bone 3) Aerobic activities should make up the majority of the physical activity. Muscle and bone strengthening activities should be incorporated on at least 3 days of the week. These recommendations were not specific to children and youth with overweight / obesity. The results from experimental studies included in this review suggest that even modest amounts of physical activity can have health benefits in high-risk children and youth, including those with overweight or obesity. Aerobic-based activities were associated with greater improvements in outcome measures that were evaluated.

Jull 2008

Characteristics of the study		
Study Citation	Jull, A., C. Ni Mhurchu, et al. (2008). "Chitosan for overweight or obesity." Cochrane Database Syst Rev (3): CD003892.	
Study Design	Systematic review and meta-analysis	
Methods		
Types of studies sought	RCTs that assessed chitosan for a minimum of four weeks duration. No restriction was imposed on studies with respect to blinding and the type of design such as parallel or crossover. Also, no language restriction was made for selecting studies.	
Types of participants sought	Participants aged 18 years and over defined as overweight / obese by any BMI-based measure at baseline. Pregnant women, children and patients with serious medical conditions were excluded.	
Types of intervention	Clinical trials evaluating chitosan versus placebo, variable doses of chitosan versus placebo, chitosan plus diet versus placebo plus diet, chitosan versus any other pharmacological intervention, and chitosan versus a non-pharmacological intervention.	
Types of outcomes measured	The primary outcome was change in weight (absolute or percentage scales) or change in BMI. Secondary outcomes sought were mortality and morbidity. No study reported these.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	

Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 15 studies Mean trial duration was 8.3 weeks. All studies compared chitosan with placebo.	
N and characteristics of participants	N = 1,219 participants Participant's ages ranged from 18 to 70 years (mean 44 years).	
Duration of follow-up	Not stated	
Overall findings	Chitosan preparations result in a significantly greater weight loss (weighted mean difference -1.7 kg; 95% CI -2.1 to -1.3) compared with placebo.	
Compliance with treatment	Not stated	
Adverse events	Not reported	
Notes	This review suggests that chitosan may be more effective than placebo in the short-term treatment of overweight and obesity. However, conclusions are limited by the poor methodological quality of trials reviewed.	

Kelly 2008

Characteristics of the study		
Study Citation	Kelly SA & Melnyk BM 2008, 'Systematic review of multi-component interventions with overweight middle adolescents: implications for clinical practice and research', Worldviews Evid Based Nurs, vol.5, no.3, pp.113-35.	
Study Design	Systematic review	
Methods		
Types of studies sought	RCTs. English language studies performed between 1980 and 2007. Multi-component intervention that included physical activity, nutrition, and behaviour modification. Studies were excluded from this review if: they were conducted in an in-patient setting, age of participants spanned a range greater than six years, participant age range did not include at least two years in middle adolescence (13 – 17), the mean age of participants was less than 13 years, in junior / middle school if mean age was not included, it was a medication study, or a study with obese adolescents related to a medication side effect.	
Types of participants sought	Middle adolescents (ages 13 – 17). Subjects were overweight or obese.	
Types of intervention	Healthy eating, nutrition, and behaviour modification techniques such as self-monitoring, stimulus control, cue elimination, and attitude restructuring. Physical activity as a component of the intervention.	
Types of outcomes measured	Weight as BMI or BMI percentile, weight, relative weight, percentage overweight, or percentage body fat.	
Quality of study	Rating	Comments
Level of evidence	I	

Study quality rating*	C	No data extraction Point estimates and CIs not reported, quality scoring not provided and heterogeneity not explored
Magnitude of effect rating**	Low	
Relevance of evidence rating***	Low	Poor quality of systematic review limits inferences regarding relevance of evidence
Results of study		
N and type of studies	N = 16 studies All studies were RCTs. The interventions were diverse across the studies, with participants primarily meeting weekly. Additional schedules included meeting two times per week, five times per week, six times per week, intermittent face-to-face sessions with supplementary internet, telephone follow-up or home visits once per month.	
N and characteristics of participants	N = 1,025 participants Participants were aged between 12 and 20 years (mean 14.5 years). Most studies included female participants; six included only girls, seven mostly girls, two mostly boys and one a mixed sample. Participants had to fulfil the following criteria: at least 10% above average weight for height; weight at least 20% above for height, gender, and age; triceps skin fold > 85th percentile for age and sex; at least 10 kg > for weight, gender, and age; BMI above 20% for the median gender and age; > 90th BMI percentile; > 85th BMI percentile, with at least one obese biological parent; greater than 5 lbs overweight; > 120% of weight for height for Chinese reference; 20 – 80% overweight by BMI; 95th BMI percentile per Korean Paediatric Association and low levels of physical activity.	
Duration of follow-up	Follow-up ranged from none to 24 months.	

Overall findings	Where long-term outcomes were measured, most participants returned to pre-intervention weight. Due to a lack of consistency among the studies regarding methods and rigor of the studies, the evidence is not entirely clear on the best multi-component program for addressing overweight in middle adolescents. The success of an intervention was associated with the dose of the intervention received by the adolescent and parental involvement. There were four interventions led by a psychologist, three by a physical education teacher, two by a dietitian and one by a paediatrician. Two interventions were delivered by a dietitian and psychologist and fitness professional working as a team and one intervention was delivered by a psychologist and dietitian working as a team. There were no significant differences in whether the intervention was likely to be successful according to the type of leader of the intervention.
Compliance with treatment	Seven studies reported participants' compliance, but details were not reported in the review.
Adverse events	Not stated
Notes	A major limitation of this review is that outcome measures related to all program components were not extracted and reported. Interpretation of the findings is thus limited because of not understanding how each component of the intervention affected participants' daily lives or the mediating effects of the intervention. However, the authors conclude that a multi-component intervention is successful in improving weight and cardiovascular risk factors, when compared with an unequal attention comparison group.

Li 2008

Characteristics of the study	
Study Citation	Li M, Li S, Baur LA & Huxley RR 2008, 'A systematic review of school-based intervention studies for the prevention or reduction of excess weight among Chinese children and adolescents', Obes Rev, vol.9, no.6, pp.548-59.
Study Design	Systematic review
Methods	
Types of studies sought	Population-based intervention studies for the prevention or control of overweight and obesity in Chinese children and adolescents. English or Chinese language studies published between 1990 and 2006. Studies that reported on the effectiveness of a lifestyle behavioural intervention in population-based samples of children and adolescents in schools or kindergartens in Mainland China. Studies were excluded if they were conducted within a clinical sample or if the study intervention was to treat overweight or obese children with pharmacotherapy.
Types of participants sought	Overweight and / or obese children and adolescents in schools or kindergartens in Mainland China. The target age group was three to 19 years.
Types of intervention	The majority of intervention strategies focused on improving the level of knowledge, physical activity levels and / or diet of overweight children and adolescents.
Types of outcomes measured	Changes in: prevalence of overweight and obesity, weight, skin-fold thickness, BMI z-score, biochemical markers (blood glucose, blood lipid profile, aerobic fitness and blood pressure), and knowledge and behaviour. Some studies used the World Health Organization (WHO) weight-for-height cut-offs, WHO BMI cut-offs, Chinese

	weight-for-height criteria, Chinese BMI cut-offs and Japanese BMI cut-offs. Two studies did not report the definition criteria of overweight and obesity.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	C	Data summary with point estimates and CIs not included Between study differences not explored
Magnitude of effect rating**	Low	No assessment of population characteristics that influence magnitude of effect
Relevance of evidence rating***	Medium	
Results of study		
N and type of studies	N = 22 studies Twenty-two studies were included, of which 17 were conducted among overweight and / or obese children and / or adolescents. 16 RCTs, others controlled clinical trials.	
N and characteristics of participants	N = >6,997 participants Overweight and / or obese children and / or adolescents aged between 3 to 23 years. All attending schools or kindergartens in Mainland China.	
Duration of follow-up	The duration of intervention including follow-up varied from 10 weeks to 3 years, with a mean of 1 year and 3 months.	
Overall findings	Pooled estimates of weight change not calculated.	

	Post-intervention, 18 of the studies showed significant differences (P < 0.05) in body adiposity measured by one of the following: prevalence of overweight and obesity, weight change (BMI change) or skin-fold thickness. Seven studies reported blood pressure outcomes: BP improved in 5 studies and was not improved in 2 studies. Seven studies reported lipids outcomes: lipids improved in 6 studies and were not improved in 1 study Three studies reported blood glucose outcomes: glucose improved in all 3 studies. One study found no effect of the intervention on adiposity, although there was a significant change in blood lipids and glucose. One reported no effect of weight change but an improvement in knowledge. One study reported a significant improvement in fitness but no change in BMI. One study described an improvement in BMI and skin-fold thickness, although no formal statistical test was performed.
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	Because of the heterogeneous nature of both the interventions and the study outcomes, it was not possible to conduct a quantitative meta-analysis of the effectiveness of interventions for obesity prevention. Instead, a qualitative assessment of the effectiveness of studies was conducted. The interventions reported in the studies that focused on health education and / or lifestyle behavioural changes (e.g. eating habits, physical activity) were reported to be effective in knowledge improvement and in the prevention of overweight and obesity. In some studies, improvements in aerobic fitness, blood lipid profile, blood glucose and blood pressure also suggested the effectiveness of the interventions tested. However, the methodological shortcomings inherent in most of the studies included by the review prevent any conclusions being drawn regarding the effectiveness of any of the interventions studied. Moreover, publication bias may be present, and if so, would distort the evidence of the efficacy of the interventions. Most studies reported a beneficial effect of the intervention with one or more of the study outcomes, but all of the studies had serious, or moderate, methodological weaknesses. Descriptions of randomisation or blinding

	procedures, informed consent, student numbers, power calculations or selection processes were not included, thus raising the possibility of selection, recruitment and measurement bias.

McGovern 2008

Characteristics of the study	
Study Citation	McGovern L, Johnson JN, Paulo R, Hettinger A, Singhal V, Kamath C, Erwin PJ & Montori VM 2008, 'Clinical review: treatment of pediatric obesity: a systematic review and meta-analysis of randomized trials', J Clin Endocrinol Metab, vol.93, no.12, pp.4600-5.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	Fully published randomised trials (in any language) with the majority of participants being overweight. Studies assessing the effect of lifestyle and pharmacological interventions on obesity outcomes. Prevention trials were included in the accompanying prevention review.
Types of participants sought	Children and adolescents (aged 2 to18 years) with overweight or obesity. Children and adolescents with insulin resistance and type 2 diabetes. Trials of patients with type 1 diabetes or eating disorders, Prader-Willi patients, and other patients in which obesity was part of a clinical syndrome and followed different natural and clinical histories were excluded.
Types of intervention	Medications used with the objective of reducing obesity measures in overweight children. Lifestyle interventions using any treatment strategy aimed at changing the diet and / or activity level of overweight children. These interventions could target the participant directly or through their family, school, or community.

	The interventions could be delivered by community agents, school personnel, family members, or healthcare personnel. Trials of agents administered with the intent to reduce cardiovascular risk factors in obese children, such as antihypertensive and anti-hyperlipidaemic agents, were excluded.	
Types of outcomes measured	Mass-based outcomes, including BMI, percent overweight, percent fat-free mass, and visceral adiposity measurements, measured at the end of the study period. The authors excluded trials measuring percent weight loss irrespective of height.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	B	Methods description incomplete Heterogeneity not explored in detail
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 76 studies Pharmacological interventions (N = 17), dietary interventions (N = 6), physical activity interventions (N = 20), combined lifestyle interventions (N = 30) Pharmacological treatments This review includes 17 trials of pharmacological interventions. Three trials assessed the effect of sibutramine on adolescents with obesity, three randomised trials used orlistat, and three randomised trials investigated the effect of metformin monotherapy on hyperinsulinemic in non-diabetic obese adolescents. Other trials measured the effect of sympathomimetics (ephedrine and caffeine, dexfenfluoramine), dehydroepiandrosterone, and fibre	

	supplements. Lifestyle intervention: dietary interventions only There were six eligible trials of dietary interventions alone. These trials evaluated different diets against control: reduced-glycaemic-load diet, protein-sparing modified diet, low-carbohydrate diet, high-protein diet and hypocaloric diet. The pooled effect across all these diets was -0.22 (CI = -0.56 to 0.11) with small between-study inconsistency (I^2 = 22.5%). Lifestyle interventions: physical activity interventions only Of the 20 eligible physical activity trials, the 17 trials with complete data yielded inconsistent results (I^2 = 29%). Combination lifestyle interventions (physical activity and dietary modification) The pooled estimate across 23 trials assessing the efficacy of combination of lifestyle interventions with complete data of the 30 eligible trials was consistent with a small to moderate treatment effect.
N and characteristics of participants	N = 1,745 participants (pharmacological) - Participants ranged in age (if reported) from 6 to 26 years. - 45 to 93% (if reported) of the participants were female. N = 259 participants (diet) - Participants ranged in age from 6 to 21 years. - 42 to 74% (if reported) of the participants were female. N ≥ 1,095 participants (physical activity) - Participants ranged in age from 5 to 18 years. - 28 to 68% (if reported) of the participants were female. N ≥ 2,040 participants (combined lifestyle interventions) - Participants ranged in age from 3 to 18 years. - 33 to 100% (if reported) of the participants were female.

Duration of follow-up	The duration and follow-up ranges: - pharmacological interventions 6 to 52 weeks; - dietary interventions 3 to 33 months; - physical activity interventions six weeks to 30 months; - combined lifestyle interventions one month to 5.5 years.
Overall findings	Of 76 eligible trials, 61 had complete data for meta-analysis. Short-term medications were effective, including sibutramine (random-effects pooled estimate of BMI loss of 2.4 kg/m^2 with a 95% CI of 1.8 to -3.1) and orlistat (BMI loss = 0.7 kg/m^2; CI = 0.3 to 1.2). After six months, patients taking sibutramine had higher rates of elevated blood pressure and pulse rate than patients taking placebo. Trials that measured the effect of physical activity on adiposity (i.e. percent body fat and fat-free mass) found a moderate treatment effect (effect size = -0.52; CI = -0.73 to -0.30), whereas trials measuring the effect on BMI found no significant effect (effect size = -0.02; CI = -0.21 to 0.18). Combined lifestyle interventions (24 trials) led to small changes in BMI. The authors did not find a significant interaction between age of participants and the effect of lifestyle interventions with parental involvement, but there was a trend toward a larger treatment effect in children aged eight years or less (-0.70; CI = -1.00 to -0.40).
Compliance with treatment	Not stated
Adverse events	Patients taking orlistat reported more gastrointestinal side effects including abdominal discomfort, pain, and steatorrhoea than patients on placebo.
Notes	Limited evidence supports the short-term efficacy of selected pharmacological monotherapy, increased physical activity, and combined lifestyle interventions.

Moran 2011

Characteristics of the study	
Study Citation	Moran LJ, Hutchison SK, Norman RJ & Teede HJ 2011, 'Lifestyle changes in women with polycystic ovary syndrome', Cochrane Database Syst Rev, no.2, pp.CD007506.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs that compared lifestyle interventions (e.g. diet, exercise, behavioural or combined treatments) with control interventions in improving reproductive, anthropometric (weight and body composition), metabolic and quality of life factors in PCOS were considered for inclusion in the review. Crossover trials were included in the review for completeness but data from the first phase only was to be included in meta- analyses as the interventions under study were anticipated to have lasting effects and the design was not valid in this context. Quasi-randomised trials were not included. Published and unpublished RCTs were sought without language restriction. All study duration lengths over two weeks were included.
Types of participants sought	Females of reproductive age (postmenarchal and premenopausal) with PCOS. Studies using any definition of PCOS or overweight were included in this review, with the trialist's definition of PCOS and overweight described. Exclusion criteria included: conditions with reproductive symptoms similar to PCOS, including congenital adrenal hyperplasia, Cushing's syndrome, hyperprolactinaemia, thyroid disease and androgen-secreting tumours. Participants were not excluded based on DM2, co-morbidities or medication use for clinical or metabolic features of PCOS as long as this medication use was not a primary component of the intervention or control arms. In this scenario, DM2, co-morbidities or medication use were noted and the effects on outcome measures assessed. Participants were not excluded based on ethnicity.
Types of intervention	RCTs comparing a lifestyle intervention to minimal treatment. Lifestyle intervention was defined as a structured dietary, exercise or behavioural intervention (both those designed to induce weight loss through an energy

	deficit or not designed to induce weight loss through an energy deficit) while minimal treatment was defined as either no treatment or standard unstructured minimal dietary, exercise or behavioural advice. A structured program referred to more than one study visit allocated to implementation of the dietary, exercise or behavioural treatment. This aimed to include trials examining: dietary intervention versus minimal treatment; exercise intervention (resistance or aerobic exercise) versus minimal treatment; behavioural management techniques for modifying diet or exercise versus minimal treatment; and a combination of dietary, exercise or behavioural intervention, or a combination, versus minimal treatment.	
Types of outcomes measured	Primary outcomes included reproductive factors such as: fertility outcomes (pregnancy, live birth, and miscarriage), menstrual regularity (an initiation of menses or significant shortening of cycle length where possible) and ovulation (number of ovulatory menstrual cycles where possible). Secondary outcomes included: (1) Reproductive factors such as total testosterone, sex hormone binding globulin (SHBG), estimates of free testosterone and clinical hyperandrogenism (hirsutism assessed clinically by Ferriman-Gallwey score [FG]) (2) Anthropometric factors such as weight, BMI, adiposity distribution (by measures including waist circumference, waist-to-hip ratio [WHR]) (3) Metabolic factors such as oral glucose tolerance test (OGTT), glucose, lipid profile (total cholesterol, high density lipoprotein cholesterol [HDL-C], low density lipoprotein cholesterol [LDL-C], triglycerides), fasting glucose and insulin, surrogate measures of insulin resistance (OGTT insulin)	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	Medium	

Results of study	
N and type of studies	N = 6 studies Three studies compared physical activity to minimal dietary and behavioural advice or no advice. Three studies compared combined dietary, exercise and behavioural interventions to minimal intervention. There were no studies assessing fertility primary outcomes and no data for meta-analysis on ovulation or menstrual regularity. The studies were conducted in the USA, Sweden or Italy. For studies assessing combined lifestyle intervention, the first study used a meal replacement formula diet (Optifast) with meals and multivitamin supplements (energy intake 4200 to 5040 kJ/day), behavioural modification training and individualised energy expenditure goals in a non-supervised environment. The second study used a dietary, exercise and behavioural intervention aiming for a 7 to 10% weight loss through individual and group dietician and exercise physiologist meetings weekly from weeks 0 to 24 and bi-weekly from weeks 25 to 48 and individualised meal (2100 to 4200 kJ/ day energy deficit) and exercise plans (150 minutes/week). The third study used the same methodology of as the second study with weekly group or individual training classes for diet, exercise and behavioural modification skills with overall therapy goals of a weight loss of 5 to 7% and weekly level of exercise of at least 150 minutes/week.
N and characteristics of participants	N = 304 participants
Duration of follow-up	Study duration including follow-up was up to 1 year.
Overall findings	No data were available for analysis on pregnancy outcomes, live births or miscarriage. No studies reported menstrual regularity in accordance with the parameters specified by the authors. Lifestyle interventions compared with control reduced body weight (mean difference [MD] -3.5 kg, 95% CI -4.9 to -2.0), waist circumference (MD -2.0 cm, 95% CI -3.3 to -0.6), WHR (MD -0.04, 95% CI -0.07 to 0.00) and percent weight change (MD -7.0%, 95% CI -10.1 to -3.9); total testosterone (MD -0.27 nmol/L, 95% CI -0.46 to -0.09), hirsutism (MD -1.19, 95% CI -2.35 to -0.03), fasting insulin (MD -2.0 µU/mL, 95% CI -3.3 to -0.8) and OGTT insulin (MD -1.3, 95% CI -1.7 to -0.9). There was no data for quality of life, patient satisfaction or acne.

Compliance with treatment	Intervention compliance varied from < 50% to 89.8%.
Adverse events	Not stated
Notes	Lifestyle intervention reduced excess body weight and improved abdominal obesity. There were no data identified in this review to assess whether lifestyle intervention improved reproductive outcomes including fertility, menstrual regularity or ovulation. It is not known whether the impact of lifestyle interventions on secondary outcomes leads to improvements in primary outcomes.

Navaneethan 2009

Characteristics of the study	
Study Citation	Navaneethan SD, Yehnert H, Moustarah F, Schreiber MJ, Schauer PR & Beddhu S 2009, 'Weight loss interventions in chronic kidney disease: a systematic review and meta-analysis', Clin J Am Soc Nephrol, vol.4, no.10, pp.1565-74.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs and observational studies of weight loss interventions conducted in participants with obesity and renal disease. Only English language publications were considered for inclusion. Studies that used low-protein diets, studies that analysed the role of weight loss in dialysis patients, and studies that assessed the impact of weight loss on albumin excretion in patients with normoalbuminuria were excluded. In studies that enrolled both non-dialysis-dependent patients with CKD and dialysis patients, only data relating to non-dialysis-dependent CKD were included in the analysis. Similarly, in studies that enrolled both patients with

	normoalbuminuria and microalbuminuria, only data pertaining to patients with microalbuminuria were extracted.	
Types of participants sought	Patients aged ≥ 18 years with any class of obesity (class I, II, or III or morbid obesity) and with pre-existing CKD or obesity-related glomerular hyperfiltration (GFR > 125 ml/min).	
Types of intervention	The intervention could be either non-surgical (diet, exercise, psychological interventions and / or pharmacological weight loss interventions) or surgical weight loss interventions.	
Types of outcomes measured	Primary outcome measures in participants with CKD were post-intervention changes in GFR or creatinine clearance (ml/min); and proteinuria (g/24 h). Secondary outcome measures were post-intervention changes in BMI (kg/m^2), SBP and DBP (mmHg), HbA1c (%) and / or fasting blood glucose levels (mg/dl), and lipid profile (total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides (in mg/dl)). The primary outcome measure in patients with glomerular hyperfiltration was the post-intervention change in GFR or creatinine clearance (in ml/min) using measured values (inulin or iothalamate studies, 24-h urinary creatinine clearance). Data from studies that reported estimated GFR were not included in this analysis. Other secondary outcome measures described already in the CKD population were also included.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	B	Non-RCTs included Between study differences not explored
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	

Results of study	
N and type of studies	N = 13 studies Eleven observational and two RCT studies in 14 publications were included in the final review. Six studies assessed the impact of weight loss attained through non-surgical interventions (diet, exercise, and / or pharmacological agents) in patients with pre-existing CKD. In these studies, the baseline kidney disease was due to diabetic nephropathy, hypertensive nephrosclerosis, glomerulonephritis, obesity-related glomerulopathy or undefined proteinuria. The specific non-surgical intervention in each primary study was not described in the systematic review. Seven studies (eight publications) analysed the effects of surgical interventions on GFR in patients with glomerular hyperfiltration.
N and characteristics of participants	N = 528 participants No age or gender information was provided. Pre-intervention BMI ranged from 30.4 ± 5.3 kg/m^2 to 53.6 ± 9.6 kg/m^2 across studies. Co-morbidities included one or more of the following: Diabetes, retinopathy, hypertension, metabolic syndrome, obstructive sleep apnoea and / or coronary artery disease.
Duration of follow-up	Length of follow-up for the non-surgical interventions ranged from 4 weeks to 1 year with a mean follow-up of 7.4 months. Length of follow-up for the surgical interventions ranged from 1 to 2 years.

<table>
<tr><td>Overall findings</td><td>Results for non-surgical interventions were pooled. The pooled changes were as follows:
<table><tr><td></td><td>Non-surgical</td><td>Surgical</td></tr><tr><td>BMI (kg/m^2)</td><td>-3.7 (-6.6, -0.8)</td><td>-16.5 (-19.6, -13.5)</td></tr><tr><td>Proteinuria (g/24hrs)</td><td>-1.3 (-2.1, -0.5)</td><td>NR</td></tr><tr><td>GFR (ml/min)</td><td>4.3 (-3.3, 11.8)</td><td>-25.6 (-36.2, -14.9)</td></tr><tr><td>SBP (mmHg)</td><td>-9.0 (-14.2, -3.7)</td><td>-22.6 (-26.2, -19.1)</td></tr><tr><td>Total cholesterol (mg/dL)</td><td>-16.6 (-31.8, -1.4)</td><td>NR</td></tr><tr><td>Triglycerides (mg/dL)</td><td>-48.0 (-102.8, 6.8)</td><td>NR</td></tr><tr><td>HDL (mg/dL)</td><td>4.8 (-1.6, 11.2)</td><td>NR</td></tr></table>NR = not reported; Insufficient data were available to enable pooled estimates of change in proteinuria or lipids with surgical interventions to be calculated. Insufficient data were available across all studies to enable pooled estimates of glycaemic control to be calculated.</td></tr>
<tr><td>Compliance with treatment</td><td>Not stated</td></tr>
<tr><td>Adverse events</td><td>Not stated</td></tr>
<tr><td>Notes</td><td>The results of this systematic review showed that in patients with CKD, weight loss that was attained through non-surgical interventions was not associated with a significant change in GFR, but was associated with statistically significant improvement in proteinuria. Conversely, weight loss that was attained through bariatric surgery was associated with a normalization of glomerular hyperfiltration (i.e. decrement in GFR to normal range).
After weight reduction that was achieved through either intervention, SBP was reduced.</td></tr>
</table>

Neovius 2008

Characteristics of the study		
Study Citation	Neovius M, Johansson K & Rossner S 2008, 'Head-to-head studies evaluating efficacy of pharmaco-therapy for obesity: a systematic review and meta-analysis', Obes Rev, vol.9, no.5, pp.420-7.	
Study Design	Systematic review and meta-analysis	
Methods		
Types of studies sought	RCTs comparing weight loss drugs in human subjects.	
Types of participants sought	Patients taking weight loss drugs approved in the European Union.	
Types of intervention	Use of the following weight loss drugs: rimonabant, sibutramine and orlistat.	
Types of outcomes measured	The weighted mean difference (WMD) between studies and percentage of weight loss was calculated. When only BMI was reported, the corresponding weight in kg was calculated by assuming a mean height of 1.70 m.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	B	Quality scores not provided Between study differences not explored
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	

Results of study	
N and type of studies	N = 8 studies RCTs directly comparing weight loss drugs approved in the EU. Seven compared sibutramine and orlistat with each other, and three studies compared the individual drug/s with a combination of the two. None of the eight studies included rimonabant. One of these studies investigated weight maintenance after one year of sibutramine treatment in patients randomized at 12 months to either continuation on sibutramine alone, or combination therapy with sibutramine and orlistat. The median study duration was 7 months (range 3 to12) and six studies were 6 months or longer.
N and characteristics of participants	N = 885 patients Patients were taking either sibutramine and / or orlistat for obesity. Four studies investigated women only, while the other four included both genders. Age and BMI of patients were not reported.
Duration of follow-up	Not stated.
Overall findings	The median weight loss in sibutramine and orlistat treated patients were 11.7 kg (range 10.1 to 13.0) and 8.0 kg (range 5.5 to 9.5), respectively. Four of the seven studies directly comparing sibutramine and orlistat mono-therapy showed that sibutramine was significantly more efficacious for weight loss, while the remaining three showed equivalence. Two of the three studies finding equivalence investigated special subgroups, namely type 2 diabetes or hypertensive patients. Three studies also investigated orlistat and sibutramine as combination therapy and two found this combination to be significantly better than orlistat alone (-10.8 vs. -5.5 kg; -13.7 vs. -9.4 kg), but not than sibutramine alone (-10.8 vs. -10.1 kg; -13.7 vs. -11.7 kg. The third study investigating sibutramine+orlistat in combination only compared with sibutramine, had a small sample size (n = 34; 17 per arm), focused on weight maintenance after one year of sibutramine therapy and concluded that it is unlikely that combination therapy has additive effects.

	The WMD in weight loss was 2.2 kg (95% CI 0.5 to 3.9) favouring sibutramine. Only four studies reported attrition, and the pooled risk ratio was 0.6 (0.3 to 1.4) indicating lower dropout for sibutramine.
Compliance with treatment	A proxy measure for safety and compliance was also analysed in a similar way as efficacy, but using pooled risk ratios (RR) as the metameter [(n dropoutagent1 / nagent1)/ (n dropoutagent2 / nagent2)]. Dropout from any cause was used as a composite measure for safety and compliance, as it combines information on efficacy (positively related to compliance) and safety (inversely related to compliance).
Adverse events	Four studies reported total dropout data, but none of these separated dropout data from adverse events. Only one study reported two dropouts out of 50 participants in each arm due to adverse events, but did not specify the total number of dropouts.
Notes	Based on these head-to-head RCT data, sibutramine appears to be significantly more efficacious for achieving weight loss than orlistat in 3 to 12 months' weight loss trials. This is concordant with indirect evidence from previous meta-analyses, where the respective compounds were compared with placebo.

Neve 2010

Characteristics of the study	
Study Citation	Neve M, Morgan PJ, Jones PR & Collins CE 2010, 'Effectiveness of web-based interventions in achieving weight loss and weight loss maintenance in overweight and obese adults: a systematic review with meta-analysis', Obes Rev, vol.11, no.4, pp.306-21.
Study Design	Systematic review and meta-analysis

Methods		
Types of studies sought	RCTs performed from 1995 to April 2008. At least one study arm had to involve a web-based intervention with the primary aim of weight loss or maintenance, and reported weight-related outcomes.	
Types of participants sought	Participants aged ≥ 18 years. BMI ≥ 25 kg/m^2.	
Types of intervention	Web-based interventions whereby participants received information and directly interfaced with the web but they were not required to input information into the website for inclusion. Studies with the aim of achieving positive dietary and physical activity behaviour change with adiposity outcome measures. Web-based programs that included educational and / or behavioural therapy, feedback and counselling.	
Types of outcomes measured	Absolute and / or percentage change in body weight.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	B	Quality scores not provided Between study differences not explored
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	

Results of study	
N and type of studies	N = 18 studies Twenty articles describing 18 different RCTs. Thirteen studies aimed to achieve weight loss, and five focused on weight maintenance. Eleven studies had two intervention arms, six had three arms, and one had four intervention arms. Intervention period ranged from six weeks to two years. Eight interventions were 12 months in duration, eight interventions ranged from six weeks to six months, one was two years and one varied depending on the study arm. Mean length was 31.4 weeks.
N and characteristics of participants	N = 5,700 participants. At least 77% were female. Data for actual BMI and age not stated.
Duration of follow-up	One study followed up participants at three and six months after a 6-week intervention.
Overall findings	Meta-analysis of two studies showed significantly greater weight change in web-based weight loss maintenance interventions compared with controls. Analysis of studies found that web-based weight loss interventions with enhanced behavioural features are more effective at achieving weight loss at post-intervention than web-based programmes with education alone. Eleven studies tracked website usage through log-ins; four studies reported statistically significant differences in number of log-ins between groups, three of which demonstrated higher log-ins in a web-based intervention with behavioural therapy. Five out of seven studies investigating associations between weight loss and number of log-ins, showed a greater number of log-ins associated with increased weight loss. One study found that the initial number of log-ins were significantly lower among those who dropped out by 12 months, compared with those that completed the intervention.

Compliance with treatment	Most studies reported findings as an average number of contacts with a particular feature, which did not allow for comparison between studies, and made it difficult to ascertain compliance with the intervention over time.
Adverse events	Not stated
Notes	Meta-analyses suggest that web-based interventions achieve similar weight loss to control or minimal intervention groups, and web-based interventions with enhanced features achieve greater weight loss than those with education alone.

Nguyen 2011

Characteristics of the study	
Study Citation	Nguyen B, Kornman KP & Baur LA 2011, 'A review of electronic interventions for prevention and treatment of overweight and obesity in young people', Obes Rev, vol.12, no.5, pp.e298-314.
Study Design	Systematic review
Methods	
Types of studies sought	Studies with interactive electronic interventions delivered as either adjunct or sole interventions for the prevention or treatment of obesity and / or obesity-related behaviours in paediatric participants were included. Interventions targeting nutrition, physical activity and / or behavioural therapy without any restriction on the type of study design (RCTs, non-RCTs, longitudinal studies, quasi-experimental studies, pre- or post-studies), setting (school-, community- and / or clinic-based) or provider of the intervention, and which assessed change in either knowledge, mediators, behaviours and / or in physical status as outcomes were included.

Types of participants sought	Children and / or adolescents (up to 18 years of age).	
Types of intervention	Interactive electronic interventions were defined as those requiring participant interaction (e.g. following prompts, entering information, completing online tasks, receiving automated feedback) with the electronic technology and which were delivered via computer-based programs, interactive internet sites, electronic messaging systems, emails, social networking media (e.g. Facebook), e-whiteboards or related media.	
Types of outcomes measured	Knowledge, mediators, behaviours and physical status.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	B	Non-RCTs included
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 24 studies Twenty-four studies relating to 21 separate interventions in which children and / or adolescents interacted with electronic interventions delivered as adjunct or sole interventions for the prevention or treatment of obesity and / or obesity-related behaviours met the inclusion criteria. All included studies were published between 1998 and 2008. Out of the 21 interventions, 11 were described as RCTs, five as non-RCTs and five involved other study designs. The majority (86%) of interventions were conducted in the USA, one was conducted in Germany, one in Belgium and one in Taiwan. Nine studies focused on obesity treatment (one in children and eight in adolescents). Fifteen studies reported adiposity outcomes at both baseline and follow-up with BMI z-scores assessed in	

	eight studies. Interactive electronic interventions delivered as stand-alone or adjunct programs included: CD-ROM (four studies), internet and emails (six studies), internet only (13 studies) and telemedicine (one study) technologies. Seven interventions included some form of parental involvement with five interventions featuring an interactive internet- or CD-ROM-based component for parents. The theoretical basis underlying most interventions related to social cognitive theory or the transtheoretical model.
N and characteristics of participants	N = 5,812 participants Overall, the interventions involved young participants, aged between 6 to 18 years (when stated) with an equal distribution of males and females. Eight out of the 21 interventions were based on ethnically diverse samples, four comprised African-Americans only, four included a majority of Caucasian participants, one involved Taiwanese participants only, and four did not describe participants' ethnicity. BMI was not always reported.
Duration of follow-up	The duration of the interventions varied from two weeks to two years with 14 interventions lasting 16 weeks or less, two delivered over six months, two over one year, one lasting two years and two being of unknown duration.
Overall findings	One treatment intervention for children met the inclusion criteria. This RCT compared a home internet behavioural program with a control website in 30 families. After 6 weeks, there were no significant changes in BMI z-scores. Eight studies focused on obesity treatment in adolescents. Interventions were between 12 weeks and 2 years in duration. All interventions were delivered via the internet with one involving telemedicine support. Six of the eight included parental involvement. Significant positive outcomes were reported in relation to BMI and / or BMI z-score. Compared to controls, adolescents receiving the intervention reduced BMI by 0.43 kg/m^2 and decreased BMI z-score by 0.08 to 0.09 kg/m^2.
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	Overall, many interventions incorporated multiple components and, while most showed positive results, 87% failed to separate the effects of the electronic intervention from other intervention components including

	school-based or community-based education, physical activity sessions and individual counselling. The individual effects of different electronic components (e.g. educational tasks, individualised emails, computer-tailored feedback, online discussion groups) within electronic interventions were also not evaluated. Only six out of 24 studies (two conducted in children, four in adolescents) featured stand-alone electronic interventions. These internet-based interventions demonstrated significant obesity reduction despite indeterminate effects on obesity-related outcomes. Importantly, most interventions did not assess program use and its impact on intervention effectiveness. Research gaps in the existing evidence base include high-quality well-designed long-term trials, particularly those relating to the prevention of obesity; studies incorporating innovative electronic media such as social networking media (e.g. Facebook) and e-whiteboards; studies that can be generalised to other populations; studies targeted towards both young people and their parents; studies that isolate the effects of interactive electronic media interventions; and studies that examine program user engagement, adherence and the relationship between intervention dose and outcomes. While electronic interventions appear a promising approach for the prevention and treatment of obesity in children and adolescents, based on the available evidence it is clear that further high quality research is required to accurately inform the evidence base.

Nield 2007

Characteristics of the study	
Study Citation	Nield L, Moore HJ, Hooper L, Cruickshank JK, Vyas A, Whittaker V & Summerbell CD 2007, 'Dietary advice for treatment of type 2 diabetes mellitus in adults', Cochrane Database Syst Rev, no.3, pp.CD004097.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs of six months or longer.

	Studies in which dietary advice was the main intervention.
Types of participants sought	Adult participants aged ≥ 18 years. Subjects who had been diagnosed with type 2 diabetes. The review excluded: studies performed on participants suffering from impaired glucose tolerance; studies that reported combined results for participants with type 2 diabetes and participants with impaired glucose tolerance or type 1 diabetes but were not able to provide individual patient data; and patients who were acutely ill or pregnant.
Types of intervention	Dietary advice as the main intervention, with an aim of reducing weight and the severity of type 2 diabetes. Dietary advice was taken to mean advice given with the intention of improving dietary habits (i.e. to either produce weight loss or to change diet composition). Dietary advice plus other lifestyle interventions (i.e., exercise, behavioural interventions and alternative therapies to dietary advice), with the aim of reducing weight and complications in people with type 2 diabetes. Studies were excluded if they included medication that was provided differently in the control and intervention groups, or if they evaluated the effects of fish oils (omega-3) or Chinese medical herbs advice or supplementation on type 2 diabetes mellitus.
Types of outcomes measured	Primary outcomes included: weight, and development of micro and macrovascular diabetic complications (including neuropathies, retinopathy, nephropathy and cardiovascular diseases). Secondary outcomes included: quality of life; change in anti-diabetic medication use; overall cardiovascular disease risk assessment (using any of the scales which include at least three risk factors); mortality; glycated haemoglobin (GHb); serum cholesterol and serum triglycerides; maximal exercise capacity (VO2 max); blood pressure; and compliance. Outcome measures were extracted and assessed at baseline, six months, one year, two year and at one year intervals from that point where available.

Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	B	Point estimates not provided No examination of factors influencing magnitude of effect
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 18 RCTs Nine studies focused on the effects of two types of diabetic dietary advice that did not differ in intent to lose weight, three studies focused on looking at dietary advice versus dietary advice plus behavioural approaches, and six studies concentrated on dietary advice versus dietary advice plus exercise. Studies took place in the United States, the United Kingdom, Canada, New Zealand, Australia, Finland and the Netherlands. Dietary approaches assessed in this review were low-fat / high-carbohydrate diets, high-fat / low-carbohydrate diets, low-calorie (1000 kcal per day) and very-low-calorie (500 kcal per day) diets and modified fat diets. Two trials compared the American Diabetes Association exchange diet with a standard reduced fat diet and five studies assessed low-fat diets versus moderate fat or low-carbohydrate diets. Two studies assessed the effect of a VLCD versus a low-calorie diet. Six studies compared dietary advice with dietary advice plus exercise and three other studies assessed dietary advice versus dietary advice plus behavioural approaches. From the six studies that assessed dietary advice versus dietary advice plus exercise, the types of exercise examined in the studies contributing to the review included various forms of aerobic exercise.	

	Three other studies assessed dietary advice versus dietary advice plus behavioural approaches. Generally, the mode of imparting the dietary advice changed in these interventions; either through a touch-screen method or through community resources.
N and characteristics of participants	N = 1,467 participants There were 724 participants in the control groups, and 743 participants in the intervention groups. Trials included both mixed and single genders.
Duration of follow-up	Trial periods were six months or longer. Follow-up ranged from six months to 18 months.
Overall findings	Using exercise as an adjunct to dietary advice, compared with dietary advice alone, appears to improve HbA1c at six and twelve months in people with type 2 diabetes. There were small, yet significant changes in HbA1c in the four studies that contributed data to these analyses. Dietary advice plus exercise was associated with a statistically significant mean (pooled weighted mean difference) decrease in HbA1c of 0.9% (95% CIs [CI], -0.4 to -1.3) at six months and of 1.0% (95% CI, -0.4 to -1.5) at twelve months. There was insufficient evidence to suggest what the effects of the dietary advice would be on weight or diabetic micro- and macrovascular diseases. The studies which examined dietary advice versus dietary advice plus physical activity do suggest benefit for improved glycaemic control from adoption of increasing physical activity levels alongside a reduced energy diet, at six and twelve months in people with type 2 diabetes
Compliance with treatment	More than half of the studies had withdrawals that were not fully described. However, there were seven studies that did not describe the drop-outs and withdrawals to an acceptable degree. Eleven studies reported follow-up data of more than 80% of the baseline sample. A number of studies reported higher drop-out rates; 30% at twelve months, 32% at six months and 44% at six months.
Adverse events	Not stated
Notes	The data included in the trials in this review which assessed dietary advice plus behavioural approaches did not have the data to allow the authors to reach any satisfactory substantial conclusions.

	Despite the frequency and severity of type 2 diabetes, there are comparatively few trials which have studied the impact of dietary advice and interventions. This may be partly due to type 2 diabetes being diagnosed relatively late, by which time islet cell decomposition is reasonably advanced. As a consequence, even impressive degrees of weight loss can result in a rise rather than a fall in HbA1c. This is not an indication that the dietary intervention has failed but that the patient requires an oral anti-diabetic agent.

Nieuwenhuis-Ruifrok 2009

Characteristics of the study	
Study Citation	Nieuwenhuis-Ruifrok AE, Kuchenbecker WK, Hoek A, Middleton P & Norman RJ 2009, 'Insulin sensitizing drugs for weight loss in women of reproductive age who are overweight or obese: systematic review and meta-analysis', Hum Reprod Update, vol.15, no.1, pp.57-68.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs investigating the effect of insulin sensitizing drugs on weight loss, compared with placebo and diet and / or a lifestyle modification program.
Types of participants sought	Women of reproductive age. Overweight (BMI 25 to 29.9 kg/m^2) or obese (BMI ≥ 30 kg/m^2) women.
Types of intervention	Treatment with insulin sensitising drugs: metformin, pioglitazone, rosiglitazone or d-chiro-inositol. Treatment with metformin was assessed in two sub-analyses according to the daily dosage of 1500 or > 1500 mg. One or more of the following: placebo only, or placebo with diet advice or a lifestyle modification program.

Types of outcomes measured	The primary outcome measure was change in BMI. Secondary outcomes were drop-out rates and side effects caused by the drugs. Effect was measured as weighted mean difference (WMD) and 95% CIs.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	Medium	
Results of study		
N and type of studies	N = 14 studies 13 RCTs and one quasi-randomized study. Eleven of trials were double-blind and two single-blind. The duration of the trials varied between 35 days and 6 months.	
N and characteristics of participants	N = 649 participants. The majority of participants had polycystic ovarian syndrome (PCOS).	
Duration of follow-up	Not stated.	
Overall findings	Treatment with metformin showed a statistically significant decrease in BMI compared with placebo (WMD -0.68; 95% CI -1.13 to -0.24) in reproductive aged women who were overweight or obese. High dose metformin contributed to a larger decrease in BMI (WMD -0.98; 95% CI, -1.51 to -0.45).	

	Longer duration (> 8 weeks) metformin contributed to a larger decrease in BMI (WMD -0.97; 95% CI, -1.53 to -0.42). The diet intervention group did not show a significant decrease in BMI.
Compliance with treatment	Owing to the heterogeneous description of side-effects and drop outs in the various studies, the authors could not perform an analysis on percentages of drop outs and side-effects in the above mentioned comparisons.
Adverse events	Metformin treatment produced several gastrointestinal side-effects (nausea, abdominal cramps and diarrhoea).
Notes	A structured lifestyle modification program assists women of reproductive age to achieve weight loss. Treatment with metformin improves the weight loss achieved.

Norris 2005a

Characteristics of the study	
Study Citation	Norris SL, Zhang X, Avenell A, Gregg E, Brown TJ, Schmid CH & Lau J 2005, 'Long-term non-pharmacologic weight loss interventions for adults with prediabetes', Cochrane Database Syst Rev, pp.CD005270.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	Published or unpublished RCTs in any language. Studies that examined weight loss or weight control strategies using one or more dietary, physical activity, or behavioural interventions in adults with prediabetes.

	Studies that included an intervention of any duration, with a follow-up interval of at least 12 months. Weight or BMI at baseline and follow-up, or percent weight lost must have been presented in the study.
Types of participants sought	Participants aged ≥ 18 years. Participants could be of any weight or BMI at baseline. Adults with prediabetes, as defined by an abnormal oral glucose tolerance test (OGTT), impaired fasting glucose (IFG), or a combination of the two.
Types of intervention	Interventions focused on the patient, rather than the provider or health care system. Interventions were dietary, physical activity, or behavioural strategies with weight loss or weight control as one of the primary stated goals. Dietary programs involved providing recommendations and / or material support for achieving a specific dietary regime where the goal was weight loss or weight control. All types of dietary programs were examined in this review, including low-calorie diets (800 to 1500 kcal/day) and VLCDs (< 800 kcal/day). Physical activity programs with the aim to achieve weight loss or weight control by increased physical activity. These included a specific approach to increasing activity levels, including counselling, an exercise prescription, or participation in either a supervised or unsupervised exercise program. Studies were excluded if participants were advised to increase their level of exercise, with no details of the intervention. Behavioural strategies were based on behavioural and learning principles and addressed barriers to diet or physical activity. These strategies included one or more of the following interventions: education, cognitive-behavioural therapy (e.g. stimulus control, reinforcement, goal setting), social support or psychotherapy. A combination of two or more of the interventions discussed above. The authors excluded pharmacologic therapy, surgery, acupuncture, herbal remedies, dietary supplements and hypnosis for the purpose of weight loss. Studies with a range of comparison groups to determine which interventions were more effective than others.
Types of outcomes measured	Primary outcomes: weight, BMI or percentage weight loss from baseline; mortality including diabetes-related, cardiovascular disease and / or total; and quality of life. Secondary outcomes: morbidity; cardiovascular disease events; glycaemic control (glycated haemoglobin

	[GHb], fasting blood sugar); serum lipid concentrations (total cholesterol, triglycerides, low-density lipoprotein [LDL], high-density lipoprotein [HDL]); and blood pressure.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 9 studies All weight loss studies in overweight or obese persons with prediabetes. No study focused exclusively on weight control. All published studies. The nine interventions included were heterogeneous in components, content, and intensity, but the intervention group used at least one dietary, physical activity, or behavioural intervention. The duration of interventions ranged from four weeks to 10 years. Total contacts ranged from four to 78 and one study involved a 28-day in-residence lifestyle intervention. The longest study involved annual contacts over the last five years. Both individual and group sessions were used. A variety of facilitators or educators were involved, but most studies involved a dietician. Seven of the nine studies involved caloric restriction. The physical activity interventions varied from counselling, to encouraging increased activity, to supervised	

	sessions several times a week, to a daily 2.5-hour-per-day aerobic session in an in-residence program. One study had no physical activity intervention. Five studies used behavioural interventions. The comparison group interventions were fairly minimal, consisting of “usual care” or general information and counselling on diet and physical activity.
N and characteristics of participants	N = 5,168 participants Mean age, weight, and BMI at baseline, as well as ethnicity and sex varied considerably among studies. The mean age was 51.2 years. Studies contained an average of 50% women. Mean baseline weight was 82.2 kg (range, 69.7 to 94.2 kg), BMI 28.7 kg/m^2 (range, 25.8 to 34.0 kg/m^2), and HbA1c 5.8% (range, 5.7 to 5.9%).
Duration of follow-up	The duration of interventions ranged from four weeks to 10 years. Follow-up ranged from one to 10 years.
Overall findings	Overall, pooled weight reduction at 12 months was 2.8 kg (95 % CI; 1.0 to 4.7) (3.3% of baseline body weight) and decrease in BMI was 1.3 kg/m^2 (95% CI 0.8 to 1.9). Weight loss at two years was 2.6 kg (95% CI 1.9 to 3.3). At follow-up intervals of up to 10 years, weight reduction was maintained. The incidence of diabetes was significantly lower in the intervention groups versus the controls in three of five studies examining this outcome at three to six years follow-up. Only a few studies examined other outcomes, and the authors believed these were insufficiently representative of all nine studies to justify pooling the effects. Modest improvements were noted in the few studies that examined glycaemic control, blood pressure, or lipid concentrations (P > 0.05). Changes ranged from 0.0% to -0.3% for HbA1c and generally corresponded to changes in weight. SBP and DBP were measured in four studies, and a small decrease was noted in most. Lipids were examined in four studies, and minor improvements were noted.

	No data on quality of life or mortality were found.
Compliance with treatment	Not stated. Mean attrition was 9.6%.
Adverse events	There were no data on adverse events or mortality.
Notes	RCTs of weight loss interventions using dietary, physical activity, or behavioural interventions produced statistically significant between-group weight loss of 2 to 3 kg (3% of initial body weight) at one- and two-year follow-up. Overall, weight loss strategies using dietary, physical activity, or behavioural interventions produced significant improvements in weight among persons with prediabetes and a significant decrease in diabetes incidence.

Norris 2005b

Characteristics of the study	
Study Citation	Norris SL, Zhang X, Avenell A, Gregg E, Brown TJ, Schmid CH & Lau J 2005, 'Long-term non-pharmacologic weight loss interventions for adults with type 2 diabetes', Cochrane Database Syst Rev, no.2, pp.CD004095.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	Published or unpublished RCTs in any language: all types of study designs were included initially; however, an adequate number of RCTs was identified to exclude other study types. Studies examining weight loss or weight control strategies using one or more dietary, physical activity, or behavioural intervention.

	Studies with a follow-up interval of at least 12 months, in order to assess the effect of long-term weight loss on health outcomes such as CVD events. The intervention could be of any duration.
Types of participants sought	Participants were aged ≥ 18 years, and had type 2 diabetes. If the type of diabetes was not specified, studies were included if they involved adults with diabetes, with or without insulin treatment. Studies of mixed type 1 and type 2 populations were included if outcomes were reported separately for persons with type 2 diabetes. Persons labelled with “non-insulin-dependent diabetes” (NIDDM) were assumed to have type 2 diabetes. Participants could be of any weight or BMI. Weight loss or weight maintenance decreases cardiovascular risk in persons with a BMI < 25 kg/m^2 (the lower limit for overweight).
Types of intervention	Interventions focused on the patient, rather than the provider or health care system. Interventions were dietary, physical activity, or behavioural strategies with weight loss or weight control as one of the primary stated goals. Dietary programs involved providing recommendations and / or material support for achieving a specific dietary regime where the goal was weight loss or weight control. All types of dietary programs were examined in this review, including low-calorie diets (800 to 1500 kcal/day) and VLCD s (< 800 kcal/day). Physical activity programs with the aim to achieve weight loss or weight control by increased physical activity. These included a specific approach to increasing activity levels, including counselling, an exercise prescription, or participation in either a supervised or unsupervised exercise program. Studies were excluded if participants were advised to increase their level of exercise, with no details of the intervention. Behavioural strategies were based on behavioural and learning principles and addressed barriers to diet or physical activity. These strategies included one or more of the following interventions: education, cognitive-behavioural therapy (e.g. stimulus control, reinforcement, goal setting), social support or psychotherapy. A combination of two or more of the interventions discussed above.

	The authors excluded pharmacologic therapy, surgery, acupuncture, herbal remedies, dietary supplements and hypnosis for the purpose of weight loss. Studies with a range of comparison groups to determine which interventions were more effective than others.	
Types of outcomes measured	Primary outcomes included: weight, BMI, % weight loss from baseline weight, abdominal fat distribution; mortality; and quality of life. Secondary outcomes included: morbidity; CVD events; glycated haemoglobin (GHb); fasting blood sugar; serum lipids; blood pressure; adverse events; cardiovascular fitness; incidence of hypertension; and biliary tract disease.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 22 studies All studies focused on weight loss interventions, with or without subsequent interventions to maintain weight. All studies addressed interventions in persons with diabetes who were overweight or obese. The interventions included in this review were heterogeneous with respect to their components. There were considerable differences in the care provided to the comparison group. In nine studies this group received usual care, but in six studies the comparison group received a dietary, physical activity, and a behavioural intervention, differing from the intervention group only in the number of calories delivered (VLCD versus LCD), the type of behavioural intervention (specifically self-monitoring blood glucose or spousal	

	involvement in education, or the type of diet). Four studies examined different intensities and methods of delivery of a LCD.
N and characteristics of participants	N = 4,659 participants The number of participants in studies ranged from 20 to 2,205. Mean age was 55 years. Mean duration of diabetes 6.5 years (means not weighted). Mean baseline weight for the comparison groups was 91.8 kg (range 76.4 to 106.8 kg). Mean BMI was 33.2 kg/m^2 (range 23.0 to 38.1 kg/m^2). The only study with a BMI ≤ 25 kg/m^2 involved a weight loss intervention where the goal was a BMI ≤22 kg/m^2. Studies had mixed or single genders.
Duration of follow-up	The interventions lasted ten weeks to five years and follow-up intervals ranged between one and five years.
Overall findings	The pooled weight loss for any intervention in comparison to usual care among 585 subjects was 1.7 kg (95 % CI 0.3 to 3.2), or 3.1% of baseline body weight among 517 subjects. Other main comparisons demonstrated non significant results: Among 126 persons receiving a physical activity and behavioural intervention, those who also received a VLCD lost 3.0 kg (95% CI -0.5 to 6.4), or 1.6% of baseline body weight, more than persons receiving a low-calorie diet. Among 53 persons receiving identical dietary and behavioural interventions, those receiving more intense physical activity interventions lost 3.9 kg (95% CI -1.9 to 9.7), or 3.6% of baseline body weight, more than those receiving a less intense or no physical activity intervention. Comparison groups often achieved significant weight loss (up to 10.0 kg), minimising between-group differences. The pooled effects for six intervention types, including usual care, revealed that all produced significant (p <

	0.05) weight loss, with a VLCD combined with physical activity and behavioural therapy producing the largest effect. Changes in HbA1c generally corresponded to changes in weight and were not significant when between-group differences were examined, although several studies did have a significant decrease in HbA1c. No data were identified on quality of life and mortality.
Compliance with treatment	Not stated, though higher total attrition rates were correlated with increased weight loss (p = 0.028).
Adverse events	No data were identified on mortality, morbidity or adverse events.
Notes	Weight loss strategies using dietary, physical activity, or behavioural interventions produced small between-group improvements in weight. These results were minimised by weight loss in the comparison group, however, and examination of individual study arms revealed that multicomponent interventions including VLCDs or LCDs may hold promise for achieving weight loss in adults with type 2 diabetes.

Norris 2005c

Characteristics of the study	
Study Citation	Norris SL, Zhang X, Avenell A, Gregg E, Schmid CH & Lau J 2005, 'Pharmacotherapy for weight loss in adults with type 2 diabetes mellitus', Cochrane Database Syst Rev, no.1, pp.CD004096.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs where pharmacotherapy was used as the primary strategy for weight loss among adults with type 2 diabetes.

	Published and unpublished literature in any language and with any study design. Studies of any duration and length of follow-up. Follow-up was defined as from the time of randomisation (or for studies without randomisation, from the time of entrance into the study) until the last outcomes measurement. Exclusion criteria included: study populations with binge eating or other eating disorders; drugs withdrawn from market in the U.S.; investigational drugs, defined as those drugs not yet approved for use in the U.S.; herbal supplements that are not regulated by the United States Food and Drug Administration; drugs that may produce weight loss but whose primary purpose is another clinical indication.
Types of participants sought	Adults ≥ 18 years of age with type 2 diabetes. If the type of diabetes was not specified, studies were included if they involved adults with diabetes, with or without insulin treatment. Persons labelled with “NIDDM” were assumed to have type 2 diabetes. Studies that included participants without diabetes if there were outcome data on the subpopulation with diabetes. Patients could be of any weight or BMI at baseline. Participants defined in the study as overweight.
Types of intervention	Any drug therapy delivered for the primary purpose of losing and / or controlling weight was included. Studies that combined pharmacotherapy with other weight loss strategies, including behavioural, educational, lifestyle (diet and exercise), or surgical interventions, were included. Both prescription and over-the-counter medications were included. Drugs that were not approved for weight loss, but which were used for the primary purpose of weight loss were included (i.e. off-label usage of the drug, e.g. fluoxetine). Comparison groups with a different intervention were included regardless of the nature of the comparison intervention. Studies with a range of comparison groups were included, in order to determine which interventions were more effective than others. The comparison group could receive: placebo; no intervention; usual care; or any other weight loss intervention such behavioural strategy, dietary program, physical activity program, or

	surgery. The drugs examined included: (1) Centrally acting appetite suppressants: amphetamine / dextroamphetamine; bupropion; diethylpropion; fluoxetine; mazindol; methamphetamine / benzphetamine; phenmetrazine / phendimetrazine; phentermine; sibutramine; topiramate; and yohimbine. (2) Peripheral effect on appetite: benzocaine. (3) Nutrient partitioning: orlistat / tetrahydrolipstatin; and treacholorocitric acid. (4) Increase thermogenesis: ephedra alkaloids; and caffeine. (5) Combined drug therapy: ephedrine and caffeine. The majority of studies included dietary interventions in addition to the medication or placebo.	
Types of outcomes measured	Primary outcomes measured were: weight and body fat distribution (weight [kg], BMI [kg/m2]); drug-related morbidity (severe necessitating withdrawal or minor); and quality of life. Weight or BMI were to be measured at both baseline and follow-up. Secondary outcomes measured were: glycaemic control (glycated haemoglobin, fasting blood sugar); serum lipids; blood pressure; non drug-related morbidity; and mortality.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	

Results of study	
N and type of studies	N = 22 studies The 22 eligible studies were RCTs, and examined the effects of fluoxetine, orlistat, and sibutramine. Narrative summaries of the results for cimetidine, diethylpropion, mazindol, phenmetrazine, and phentermine were also provided. Most studies used a run-in period lasting 1 to 5 weeks, where a placebo was given and dietary counselling started. The duration of drug treatment was usually the same as the follow-up interval, although in three studies weight change was recorded from the beginning of the run-in period. One study examined weight maintenance after discontinuation of the study drug. There were insufficient data to draw conclusions from the funnel plots. Drug dosages were very consistent among studies, except for one study of sibutramine that used a twice-daily dosage regime. All studies examined continuous therapy. All except one study of fluoxetine involved a dietary intervention for both the treatment and control groups, and the comparison groups all received a placebo. Average contacts ranged from two to 18, an average of 1.1 per month.
N and characteristics of participants	N = 3,379 participants The studies included 296 participants who received fluoxetine, 2,036 orlistat, and 1,047 sibutramine. Age of participants was between 48 and 66 years across studies. More than half of the participants were female. Mean weight of the control group at baseline was 95 kg (SD 18.5 kg) for fluoxetine, 95.9 kg (11.1 kg) for orlistat, and 97 kg (17.3 kg) for sibutramine.

	BMI was presented in only 14 of the studies (range 31 to 37 kg/m^2). Participants generally had poor glycaemic control by current treatment standards. Most studies excluded patients who were taking insulin, although two studies examined insulin-using subjects exclusively.
Duration of follow-up	Follow-up intervals ranged from eight to 52 weeks for fluoxetine, 12 to 57 weeks for orlistat, and 12 to 52 weeks for sibutramine. Generally the duration of drug treatment was the same as the follow-up interval, although in three studies weight change was recorded from the beginning of the run-in period (1 to 5 weeks).
Overall findings	A sufficient number of studies were available for a quantitative synthesis for fluoxetine, orlistat, and sibutramine. Pharmacotherapy produced modest reductions in weight for fluoxetine (5.1 kg (95% CI, -3.3 to -6.9) at 24 to 26 weeks follow up; orlistat 2.0 kg (CI, -1.3 to -2.8) at 12 to 57 weeks follow-up, and sibutramine 5.1 kg (CI, -3.2 to -7.0) at 12 to 52 weeks follow-up. The pooled reduction in HbA1c was 0.5% (95% CI, -0.3 to -0.6) for orlistat (follow-up between 24 and 57 weeks); sibutramine 0.5% (95% CI, +0.2 to -1.3) (follow-up 12 to 52 weeks); fluoxetine 1.0% (95% CI, -0.6 to -1.4) at 24 to 26 weeks. Several studies examined the effects of sibutramine on blood pressure, and a decrease in SBP of 0.8 mmHg (95% CI, 0.02 to 1.65) and in triglycerides (0.3 mmol/L (95% CI, 0.04 to 0.5)).
Compliance with treatment	Attrition during the run-in period ranged from 1.5% to 22% in the studies where it was reported. In three studies participants were randomised only if they had high rates of compliance for visits or pill consumption during the run-in period.
Adverse events	Orlistat, sibutramine and fluoxetine were generally well tolerated, and produced a low incidence of serious adverse events. Gastrointestinal side effects were common with orlistat; tremor, somnolence, sweating and minor gastrointestinal effects with fluoxetine; and palpitations a nonsignificant increase in pulse rate with

	sibutramine. Palpitations led to withdrawal from one study in two of 69 patients taking sibutramine. Rates of rhythm disturbances were similar in the intervention and control groups.
Notes	This meta-analysis provides evidence that fluoxetine, orlistat and sibutramine can achieve modest but statistically significant short-term weight loss when used as a primary weight reduction strategy among adults with type 2 diabetes. However, the long-term effects of these drugs on weight and health outcomes in persons with type 2 diabetes remain uncertain. Across studies, participants were middle aged, were for the most part not using insulin, and were in moderately poor glycaemic control. BMI was infrequently reported, making it difficult to characterise the degree of overweight of participants.

Oude Luttikhuis 2009

Characteristics of the study	
Study Citation	Oude Luttikhuis H, Baur L, Jansen H, Shrewsbury VA, O'Malley C, Stolk RP & Summerbell CD 2009, 'Interventions for treating obesity in children', Cochrane Database Syst Rev, no.1, pp.CD001872.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs of lifestyle (i.e. dietary, physical activity and / or behavioural therapy), drug and surgical interventions for treating obesity in children with or without the support of family members, with a minimum of six months follow up (three months for actual drug therapy). Interventions that specifically dealt with the treatment of eating disorders or type 2 diabetes, or included participants with a secondary or syndromic cause of obesity were excluded. Data were extracted for outcomes at six, nine, 12 and 24 months where possible, and other

	time points where appropriate. This time-frame referred to the intervention itself or to a combination of the intervention with a follow-up phase.
Types of participants sought	Participants in study groups with a mean age < 18 years at the commencement of the intervention were included, recognising that some interventions may target families inclusive of all children and some studies in adolescents include participants aged up to 21 years of age. Pregnant females and the critically ill were excluded, as were children with obesity due to a secondary or syndromic cause (for example Prader-Willi syndrome).
Types of intervention	Strategies: Lifestyle (dietary, physical activity and / or behavioural therapy interventions), drug (orlistat, metformin, sibutramine, rimonabant) and surgical interventions. Drug therapy had to be provided for at least three months. Alternative therapies were not considered in this review. Topics: Diet and nutrition, exercise and physical activity, lifestyle and social support, involving children themselves with or without associated family members. Interventions that dealt with the treatment of eating disorders such as anorexia nervosa and bulimia nervosa were excluded, as were interventions that dealt with the treatment of type 2 diabetes in youth. Settings: Interventions could be community, school or clinic-based. Delivery: There was no restriction on who delivered the interventions. These may have included researchers, primary health physicians, nutrition / diet professionals, teachers, physical activity professionals, health promotion agencies, health departments or specialist doctors.
Types of outcomes measured	To be included, studies had to report one or more of the following primary outcomes, presenting a baseline and a post-intervention measurement. Self-reported measurements of height and weight were not included. The primary outcome measures for this review were measured (not self-reported) height and weight. If conducted by the same, trained operator, these measures are reasonably reliable. To account for sex- and age-related changes over time, the authors chose BMI SD score (BMI-SDs or BMI-z-score) and percentage overweight to compare studies in the results section of this review. Studies were also included if they reported measures of body fatness (in % or kgs) by dual energy X-ray absorptiometry (DXA) or bioelectrical impedance analysis (BIA). Secondary outcomes included:

	(1) Measures of body fat distribution, like abdominal (visceral) or subcutaneous adiposity (measured by DXA or BIA) or waist and hip circumference. (2) Measures of metabolic changes (or markers of future cardiovascular and endocrinological disease), for example, lipid profile, glucose and insulin metabolism, leptin, adipocytokines and other obesity or inflammatory markers. (3) Behaviour change - for example, changes in weekly activity levels or energy intake. (4) Participants views of the intervention. (5) Measures of self-esteem, health status, well being and quality of life. (6) Measures of harm associated with the process or outcomes of the intervention. (7) Cost effectiveness / costs of the intervention.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 64 studies Overall, 54 studies reported on lifestyle interventions, ten on drug interventions (with or without combination with lifestyle intervention) i.e. sibutramine (n = 5), orlistat (n = 3) and metformin (n = 2). None of the surgical intervention studies met the inclusion criteria. No RCTs of bariatric surgery have been reported in adolescents. Neither have there been any published reports of a controlled clinical trial, a controlled before and after study or an interrupted time series study.	

	Thirty of the 54 lifestyle studies took place in the USA and Canada (29 in the USA, one in Canada). Twelve studies were conducted in Europe (three in Germany, two in United Kingdom, one each in Austria, Belgium, Finland, France, Italy, Sweden and Switzerland). Seven studies took place in Australia and Asia (four in Australia, two in China and one in Japan). The other five studies were conducted in South America (one in Brazil) or the Middle-East (all four in Israel). Two studies on sibutramine were conducted in the USA, two in Central America (both in Mexico) and the other one in Europe (the Netherlands). One of the studies with orlistat took place in the USA and one was a multicentre trial in the USA and Canada, the third study took place in Central Eurasia (Turkey). The two metformin trials were conducted in the USA or Australia. Of the lifestyle intervention studies, 12 focused on exercise, physical activity or the reduction of sedentary behaviours, six focused on diet and 36 concentrated on behaviourally orientated treatment programs. A wide range of behavioural approaches have been examined. These include family therapy, cognitive-behavioural treatment, problem-solving approaches and multicomponent behavioural programs which incorporate a variety of behavioural techniques. The specific details of the behavioural programs vary widely between the studies. The target of intervention was the child in nine studies (all but one in adolescents). Two studies did not clearly report their target of intervention but it appeared to be the child. Six studies examined the effects of the level of parent and / or child participation. In one study the target of intervention was the parent. However, in most studies (n = 40) the target of intervention was the family or the child with a parent. In the drug trials the drugs were only administered to the child. Two drug trials reported the family as the target of the lifestyle intervention component.
N and characteristics of participants	N = 5,230 participants The total number of participants in the 64 included studies with outcome data was 5,230, of which 3,806 participated in the lifestyle studies and 1,424 in the drug trials. Ages ranged from three to 21 years. Thirty-four lifestyle studies included children with a mean age < 12 years. All but one drug trial involved adolescents aged 12 to 19 years. One study included children aged nine to 18 years, but the mean age of children was 12.5 years.
Duration of follow-up	The lifestyle interventions ranged in duration from one month to 24 months, with 14 having a duration less than six months. Forty interventions lasted six months or longer, six of which continued for one year. Four interventions lasted at least two years.

Overall findings	Lifestyle interventions focused on physical activity and sedentary behaviour in 12 studies, diet in six studies, and 36 concentrated on behaviourally orientated treatment programs. Three types of drug interventions (metformin, orlistat and sibutramine) were found in 10 studies. No surgical intervention was eligible for inclusion. The studies included varied greatly in intervention design, outcome measurements and methodological quality. Meta-analyses indicated a reduction in overweight at six and 12 months follow up in: (1) lifestyle interventions involving children; and (2) lifestyle interventions in adolescents with or without the addition of orlistat or sibutramine. A range of adverse effects was noted in drug RCTs. Measures of psychological well-being, like global self-worth, self esteem, quality of life and absence of depressive symptoms or internalising behaviour problems were provided in 11 studies. Intervention duration for the aforementioned studies ranged from 3 to 24 months. Braet 2004 recorded positive changes in global, athletic and physical well-being and Epstein 2000a recorded improvement in child problem solving, internalising behaviours and total competence in both study arms at the end of treatment and persisting at follow up. Jelalian 2006 found that adolescents randomised to both treatment conditions demonstrated significant improvements on dimensions of global self-concept, physical appearance, and physical self-worth over time. Depression scores were recorded in five studies. A reduction in depression scores was evident in all studies. However, the decrease over time reported by Daley 2006 was not significant. Munsch 2008 recorded a decrease in both groups, with a significant decrease identified in the children from the behavioural therapy for mother only study arm. This decrease was also noted to be particularly prominent in the early intervention stages. Depressive symptoms were shown to be slightly higher in the control group than that of the soccer group at six months by Weintraub 2008. However this change was not reported as being significant. Hughes 2008, McCallum 2007 and Warschburger 2001 found significant improvements in quality of life by child- and / -or parent-report over time, without differences across groups. None of the studies reported adverse changes in the children's psychological well-being. All studies reported data on cardiovascular variables including absolute values or change in SBP, DBP, and pulse rate. Greater reductions in these variables were generally seen in the placebo group compared with the sibutramine group and these were statistically significant at various time points in some studies: SBP (Berkowitz 2003), DBP (Berkowitz 2006; Van Mil 2007), and pulse rate (Berkowitz 2003; Berkowitz 2006). Echocardiography data were reported in three studies but changes were not statistically or clinically significant (Berkowitz 2006; Godoy-Matos 2005; Van Mil 2007). In one study the increase in ST segment of

	the electrocardiogram in both the sibutramine and placebo group was statistically significant (Garcia-Morales 2006).
Compliance with treatment	Median adherence to metformin was 78% (range 15 to 99%) in one study which was not different from the placebo group. Adherence to orlistat was assessed in two studies and shown to be 73% in one study and > 80% in another. No other compliance information was reported.
Adverse events	In the study by Berkowitz 2006 there were 22 (5.7%) withdrawals due to adverse events in the sibutramine group (2.4% were due to tachycardia and 1.4% due to hypertension) and seven (5.4%) withdrawals in the placebo group (1.5% were due to tachycardia; and none was due to hypertension). In the same study an adverse event was reported by 89% of participants in the sibutramine group and 85% of participants in the placebo group; the proportion of serious adverse events in each group was 2.7% and 0.8% respectively and the incidence of excessive nausea and vomiting in one patient was considered to be the only serious adverse event possibly related to study medication and resulted in premature discontinuation. In the same study, there was one incidence of suicide in both the sibutramine and placebo groups which were considered unlikely to be related to the study drug and 1.4% and 0.8% of participants in both groups respectively were found to have depression (Berkowitz 2006). In the study by Van Mil 2007, symptoms of clinical depression led to the withdrawal of one subject (out of 12) - as was confirmed by both the mother and the participant, these symptoms disappeared thereafter; there were no withdrawals in the placebo group or reports of sibutramine dose reduction for safety concerns. Reporting of harm was noticeably absent in lifestyle studies. Only 18 out of 54 lifestyle studies reported measures of harm such as occurrence or deterioration of disordered eating, depression or anxiety. However, changes in linear height growth over time and reasons for dropouts were commonly reported in lifestyle studies. In contrast, the majority of drug studies reported total adverse events and possible medication-related adverse events. Only one lifestyle study reported withdrawals due to adverse events. In total three participants withdrew from the intervention group and six from the control. Headaches, rash and pain were among the complaints made. However it was specified that all recorded adverse events, both for the intervention and control groups, were unrelated to the intervention. There were no withdrawals due to adverse events in either of the metformin studies; however, medication dose was lowered due to nausea in three participants.

	In all studies, withdrawals due to adverse events were higher in the orlistat intervention compared with the placebo / control intervention. One study reported serious adverse events in 3.1% of those receiving orlistat and 2.7% of those receiving placebo, with only the symptomatic cholelithiasis that led to cholecystectomy in a 15-year-old girl being considered possibly related to orlistat by the investigators. The same primary author reported that at least one adverse event was reported by 97% and 94% of participants in the orlistat and placebo interventions respectively; equivalent data were not reported in the other studies. The most common types of adverse events in all three studies were associated with the gastrointestinal tract (GIT) and were more prevalent in the orlistat intervention compared with the placebo intervention. The most common GIT adverse events were fatty / oily stool or evacuation, oily spotting, increased defecation, cramps and abdominal pain. Changes in blood vitamin A, D, and E levels were reported in two studies and all levels increased or stayed the same, except in one study where vitamin D levels decreased in both the orlistat and placebo interventions. One study also measured estradiol levels, cardiovascular effects, gallbladder structure, renal structure, bone mineral content / density, and other non-GIT adverse events. Girls in the orlistat group had a statistically significant decrease in estradiol compared with a slight increase shown in the placebo intervention. Ten participants in the orlistat intervention and one participant in the placebo intervention developed abnormalities during the study that were detected on electrocardiograms; none of these was believed to be related to the medication based on review by an independent cardiologist. No other adverse cardiovascular effects were found. At the end of the study, six participants in the orlistat intervention (compared with one participant in the placebo intervention) were found to have asymptomatic gallstones not seen at baseline; five of these patients had lost large amounts of weight (8.2 to 29.4 kg) and two were siblings. Another patient had multiple gallstones on ultrasound at day 167 after a 15.8 kg weight loss and had a subsequent cholecystectomy. Ultrasound also identified two additional new renal abnormalities in the orlistat intervention group (mild left hydronephrosis and 6-mm echogenic focus without evidence of renal calculus). There were no differences in bone mineral content / density between the two interventions. Most other non-GIT adverse events were also more prevalent in the orlistat group compared with the placebo group but the difference between groups was less pronounced than for GIT adverse events; the most common adverse events in this category were headache, upper respiratory tract infection, and nasopharyngitis. Three studies reported a safety protocol relating to blood pressure [BP] and pulse rate cut-offs that would be used to initiate withdrawal of participants from the study or a sibutramine dose reduction. In three studies there were withdrawals due to adverse effects / events. One study had two (4.7%) withdrawals in the

	sibutramine group due to adverse effects, one in the first six months (ventricular premature complexes) and another in the second six months (increases in BP and pulse rate); there were no withdrawals in the placebo control group. In the same study 19 participants had a sibutramine dose reduction in the first six months in response to elevations in BP, pulse rate or both. During the full 12 month study, sibutramine was reduced to 10 mg in 16 participants, to 5 mg in seven additional adolescents and discontinued in 10 participants (six because of increased BP and / or pulse rate, two for ecchymoses, one for ventricular premature complexes and one because of rash). In another study there were 22 (5.7%) withdrawals due to adverse events in the sibutramine group (2.4% were due to tachycardia and 1.4% due to hypertension) and seven (5.4%) withdrawals in the placebo group (1.5% were due to tachycardia; and none was due to hypertension). In the same study an adverse event was reported by 89% of participants in the sibutramine group and 85% of participants in the placebo group; the proportion of serious adverse events in each group was 2.7% and 0.8% respectively and the incidence of excessive nausea and vomiting in one patient was considered to be the only serious adverse event possibly related to study medication and resulted in premature discontinuation. In the same study, there was one incidence of suicide in both the sibutramine and placebo groups which were considered unlikely to be related to the study drug and 1.4% and 0.8% of participants in both groups respectively were found to have depression. In an additional study, symptoms of clinical depression led to the withdrawal of one subject (out of 12) - as was confirmed by both the mother and the participant, these symptoms disappeared thereafter; there were no withdrawals in the placebo group or reports of sibutramine dose reduction for safety concerns. In the same study 41 participants in the sibutramine group, compared with 22 in the placebo group reported adverse events but the difference was not statistically significant. Two studies had no withdrawals due to adverse events although four participants in both the sibutramine and placebo groups in one study had an elevated DBP or pulse that disappeared within one week. In one study the increase in ST segment of the electrocardiogram in both the sibutramine and placebo group was statistically significant. Most of the studies also reported the prevalence of non-cardiovascular adverse events. Symptoms that were more prevalent in the sibutramine group compared with the placebo group in two or more studies were dry mouth, dizziness and some form of rash. For other adverse events a higher incidence ($P < 0.05$) was found in the sibutramine group compared with the placebo group for abdominal complaints and constipation.
Notes	This review shows that combined behavioural lifestyle interventions compared to standard care or self-help

	can produce a significant and clinically meaningful reduction in overweight in children and adolescents. In obese adolescents, consideration should be given to the use of either orlistat or sibutramine, as an adjunct to lifestyle interventions, although this approach needs to be carefully weighed up against the potential for adverse effects.

Padwal 2011

Characteristics of the study	
Study Citation	Padwal R, Klarenbach S, Wiebe N, Birch D, Karmali S, Manns B, Hazel M, Sharma AM & Tonelli M 2011, 'Bariatric surgery: a systematic review and network meta-analysis of randomized trials', Obes Rev, vol.12, no.8, pp.602-21.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs examining the efficacy and safety of any bariatric surgery were potentially eligible for inclusion.
Types of participants sought	Eligible trials studied severely obese adults (≥ 16 years) with an accepted indication for bariatric surgery: BMI ≥ 40 kg/m^2 (or BMI ≥35 kg/m^2 with at least one obesity-related comorbidity).
Types of intervention	Eligible trials studied at least one bariatric surgical intervention including: gastric banding, gastroplasty, gastric bypass, jejunoileal bypass, biliopancreatic diversion (BPD) and sleeve gastrectomy (SG). Non-surgical bariatric procedures such as intra-gastric balloons were excluded. Eligible trials compared a bariatric surgical intervention as above with standard care (i.e. diet and exercise) or with another bariatric surgery.
Types of outcomes measured	Eligible trials reported at least one of the following: weight change (primary outcome); all-cause mortality;

	control of comorbidities; hospitalisation; reoperations; gastrointestinal disturbances; and serious surgical sequelae.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 31 studies All studies were RCTs and the median year of publication was 1997. Studies occurred in the following countries: US / Canada (nine), Greece (two), Italy (three), Austria (one), Taiwan (two), Sweden (six), Netherlands (one), Saudi Arabia (one), Denmark (four), Germany (one), and Australia (one). The following surgical interventions / standard care were reviewed: gastroplasty VBG [14 studies], horizontal banded gastroplasty [HBG, one study], horizontal [unbanded] gastroplasty [HG, five studies], gastric bypass (RYGB, 17 studies, jejunoileal bypass [JB, three studies] BPD, [two studies], mini-gastric bypass [two studies]), adjustable gastric banding [AGB, 11 studies], SG [two studies], gastrogastrostomy [one study], and standard care [one used a VLCD, two used diet ± exercise and the last simply referred to 'medical management', which did not appear to include pharmacotherapy]. One banding trial included an intervention group whom underwent omentectomy. In 16 trials, surgery was performed using an open approach, in eight trials the approach was laparoscopic, three trials used a combination, and in four trials the approach was unspecified.	
N and characteristics of participants	N = 2,619 participants The mean age range of trial participants was 30 to 48 years and the proportion of females ranged from 44% to 97%. Mean baseline BMI ranged from 42 to 58 kg/m^2. Few trials reported comorbidities among	

	participants.
Duration of follow-up	The median duration of follow-up was 24 months (range from 6 to 60 months).
Overall findings	As compared with standard care, differences in BMI levels from baseline at year 1 (15 trials; 1103 participants) were as follows: jejunoileal bypass [MD: -11.4 kg/m^2], mini-gastric bypass [-11.3 kg/m^2], BPD [-11.2 kg/m^2], SG [-10.1 kg/m^2], RYGB [-9.0 kg/m^2], horizontal gastroplasty [-5.0 kg/m^2], VBG [-6.4 kg/m^2], and adjustable gastric banding [-2.4 kg/m^2].
Compliance with treatment	Not stated
Adverse events	The authors included evidence from open and laparoscopic comparisons of surgery although they have different adverse effect profiles. One trial compared laparoscopic AGB with open VBG but did not report evidence from outcomes (e.g. wound infection, hernia, vomiting, and luminal stenosis) that may be confounded by these different approaches. Twenty-three trials (N = 2,042) and six trials reported all-cause mortality and resolution and / or improvement in comorbidity, respectively. Bariatric surgery did not significantly reduce mortality risk or the likelihood that comorbidity would resolve. Eleven trials (N = 1218) compared length of hospital stay after surgery. Comparisons of AGB and RYGB, and AGB and VBG found significantly shorter lengths-of-stay in AGB participants (MD: -1.7 days [-2.0; -1.3]; two trials, I^2 = 0% and -3.1 days [-5.0; -1.2]; three trials, I^2 = 0%, respectively). One comparison of mini-gastric bypass vs. RYGB found significantly shorter lengths-of-stay in mini-gastric bypass participants (-1.4 days [-2.4; -0.4]; one trial); other pooled results were non-significant. Four trials (N = 389) reported the incidence of readmission to hospital following surgery. JB led to a significantly elevated risk of readmission compared with RYGB (risk ratio: 2.96 [1.05; 8.39]; one trial); other pooled results were non-significant. Twenty trials (N = 1,769) compared the incidence of reoperations between intervention groups. Compared with RYGB, JB had more late reoperations (RD: 28% [6.5; 50]; one trial), and HG and VBG had more total reoperations (29% [6.7; 50]; three trials, I^2 = 84%, and 17% [5.0; 30]; two trials, I^2 = 0%, respectively). Twelve trials (N = 1018) compared the incidence of repeat surgeries for conversions and reversals between intervention groups. Compared with RYGB, JB and AGB had more late conversions/reversal surgeries (32% [9.9; 53]; one trial, and 8.3% [2.8; 14]; two trials, I^2 = 0%, respectively), and HG and VBG had more total

	conversions / reversals surgeries (38% [27; 50]; two trials, I^2 = 0%, and 29% [1.7; 57]; two trials, I^2 = 85%, respectively). Seven trials (N = 696) compared the incidence of surgical reversals between intervention groups. Compared to RYGB, VBG had significantly more reversals (9.3% [0.9; 18]; one trial). Twenty-two trials (N = 3391) reported incidences of various serious surgical sequelae. AGB groups had significantly lower risk of late stenoses than RYGB groups (RD: -15% [-22; 8.3]; one trial). AGB had significantly lower risk of late hernia than RYGB and VBG (-4.5% [-8.4; -0.5]; two trials, I^2 = 0%, and -16% [-27; -5.4]; one trial). AGB had significantly higher risk of late slippage/dilatation than RYGB and VBG (6.1% [1.3; 11]; two trials, I^2 = 0%, and 20% [12; 28]; two trials, I^2 = 0%). AGB led to significantly lower risk of late staple line break-down than VBG (-25% [-36; -14]; two trials, I^2 = 20%). HG groups had significantly higher risk of luminal stenosis over the course of follow-up than RYGB groups (11% [1.0; 21]; one trial). AGB led to a lower risk of early wound infection than RYGB (-6.3% [-11; -1.4]; one trial). No trials reported the comparative incidence of peri-operative myocardial infarction.
Notes	The authors found that although data from large, adequately powered, long-term RCTs are lacking, bariatric surgery appears substantially more effective than standard care for the treatment of severe obesity in adults. More studies are required to directly compare the clinical benefits of different surgical procedures on clinically relevant outcomes over long follow-up periods — especially for newer procedures types.

Padwal 2003

Characteristics of the study	
Study Citation	Padwal R, Li SK & Lau DC 2003, 'Long-term pharmacotherapy for obesity and overweight', Cochrane Database Syst Rev, no.4, pp.CD004094.
Study Design	Systematic review and meta-analysis
Methods	

Types of studies sought	Randomised double-blind controlled trials of anti-obesity agents were considered for inclusion. Quasi-randomised, open-label, and cross-over trials were not included. Studies had to: (1) enrol overweight or obese patients; (2) include a placebo control group; (3) report an intention-to-treat analysis; and (4) have a minimum follow-up period of one year (from the point of randomisations). No language or publication restrictions were applied. Due to the large number of placebo-controlled studies, the decision was made to focus on placebo-controlled trials only.	
Types of participants sought	Adults (aged ≥ 18) with either: BMI ≥ 30 kg/m^2; BMI ≥ 27 kg/m^2 plus one or more obesity-related co-morbidities.	
Types of intervention	Weight loss and weight maintenance studies evaluating the pharmacologic therapy of obesity including the following medications: sibutramine, phentermine, mazindol, diethylpropion, benzphetamine, phendimetrazine, benzocaine rimonabant and orlistat. Drugs excluded from this review include off-label therapy (e.g. fluoxetine, sertraline, bupropion, topiramate, metformin), those with high addiction potentials that preclude long-term use (amphetamine / dexamphetamine and methamphetamine), investigational / herbal / alternative compounds, and drugs withdrawn from the market due to unacceptable side effect profiles (fenfluramine, dexfenfluramine, phenylpropanolamine).	
Types of outcomes measured	Primary outcomes measured included weight loss, expressed as number of kilograms lost, percentage of baseline weight lost, or both. Secondary outcomes measured included: weight loss expressed as the proportion of patients achieving 5% and 10% weight loss (5% and 10% responders), change in BMI and change in waist circumference; total and cardiovascular mortality; myocardial infarction (fatal and non-fatal); stroke (fatal and non-fatal); medication intolerance (percentage withdrawn from therapy due to adverse events); change in blood pressure; change in lipid profile (total cholesterol, low density lipoprotein (LDL) cholesterol, high density lipoprotein (HDL) cholesterol, triglycerides); change in HbA1c concentration; side effects of therapy.	
Quality of study	Rating	Comments
Level of evidence	I	

Study quality rating*	A	
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 30 studies A total of 30 double-blind, placebo-controlled RCTs, including 16 orlistat, 10 sibutramine and four rimonabant studies were included in the final review. Twenty-seven studies were financially supported by the drug manufacturer. Twenty-seven studies (16 orlistat, seven sibutramine and four rimonabant) were weight loss trials, in which drug therapy was used in conjunction with a weight loss diet for one to four years. One rimonabant and four orlistat weight loss trials also contained a second weight maintenance year. The three remaining sibutramine trials were weight maintenance studies with follow-up periods of one and 1.5 years from the point of randomisations. Of the 16 orlistat trials, nine studies limited enrolment to higher risk populations: four recruited patients with type 2 diabetes on stable doses of oral hypoglycaemic agents or insulin and five enrolled patients with at least one cardiovascular risk factor (e.g. hypertension, dyslipidaemia, type 2 diabetes, or impaired glucose tolerance). Exclusion criteria common to most orlistat studies were obesity of endocrine origin, uncontrolled hypertension, treatment with drugs affecting body weight, pregnant or lactating women, women of childbearing potential not on contraceptives, significant psychiatric or medical illness, previous bariatric surgery, and weight loss of greater than 3 to 4 kg in the three months prior to screening. Most trials included a single-blind, placebo run-in phase, which varied in duration from two to five weeks and many required a compliance rate of 75% or greater during the run-in phase before randomisations into the actual trial. The four orlistat weight maintenance studies represented continuations of weight loss trials in which patients were placed on a weight maintenance diet during their second year. The dose of orlistat used in all trials was 120 mg tds, which is the standard dose recommended for use in clinical practice. Two studies also included 60 mg tds study arms. A standardised, low fat (less than 30% of caloric intake), hypocaloric diet and encouragement to exercise were the main co-interventions. During the second year of weight maintenance, diets differed between trials but, in general, were increased by approximately 200 to 300 kcal/day in those	

	patients still losing weight and remained unaltered in those patients in whom weight remained stable. At the beginning of the weight maintenance phase, patients in the orlistat group were re-randomised to receive placebo, 60 mg tid and 120 mg tid in one study. In a second study, all patients completing year one were re-randomised to orlistat 120 mg tid or placebo. In the final two studies, patients remained in the same groups to which they were assigned during year one (orlistat 60 mg, 120 mg and placebo). Of the 10 sibutramine studies, seven were weight loss trials and three weight maintenance trials with follow-up periods for the randomisations phase ranging between one to 1.5 years. Two studies limited enrolment to hypertensive patients with controlled blood pressure and three to enrolled patients with type 2 diabetes. The dose of sibutramine ranged between 10 to 20 mg, with the most common dose being 15 mg. If results for both 15 and 20 mg arms were reported, the authors used the 15 mg results. Dietary modification with or without advice to exercise were common co-interventions. Four weight loss trials included a single-blind, placebo run-in phase, which varied from two to ten weeks in duration. The weight maintenance studies included initial calorie-restricted induction phases that varied from one to six months. Patients able to lose a pre-defined amount of weight entered the randomisation phase of the study. All studies reported either percent or absolute weight loss. Blood pressure and pulse rate were also commonly reported. No data on cardiovascular morbidity or mortality were found. In addition to reporting overall weight loss, the weight maintenance studies reported the proportion of patients achieving successful weight maintenance, defined as maintenance of 80% to 100% of the weight lost during the induction phase.
N and characteristics of participants	N = 19,889 participants The 16 orlistat trials included 10,631 participants with an average BMI of 36.3 kg/m2, weight of 104 kg, and age of 47 years. Study size ranged from 50 to 3,305 participants, 66% of whom were female and 89% Caucasian. The 10 sibutramine studies included 2,623 participants (range 86 to 485) with an average BMI of 35.1 kg/m2, weight of 97 kg, and age of 45 years, 73% percent of the participants were female and 95% were Caucasian. Most non-Caucasian participants came from two trials, in which 26% of participants were African American.
Duration of follow-up	Duration of follow-up ranged from one to four years.
Overall findings	Compared to placebo, orlistat reduced weight by 2.9 kg (95% CI, -2.5 to -3.2 kg), sibutramine by 4.2 kg (95% CI, -3.6 to -4.7 kg) and rimonabant by 4.7 kg (95% CI 4.1 to 5.3 kg). Patients on active drug therapy were

	significantly more likely to achieve 5% and 10% weight loss thresholds. Placebo-controlled weight losses were consistently lower in patients with diabetes. Orlistat reduced diabetes incidence, improved total cholesterol, LDL-cholesterol, blood pressure, and glycaemic control in patients with diabetes but increased rates of gastrointestinal side effects and slightly lowered HDL levels. Sibutramine improved HDL and triglyceride levels but raised blood pressure and pulse rate. Rimonabant improved HDL-cholesterol, triglyceride and blood pressure levels and glycaemic control in patients with diabetes but increased the risk of mood disorders.
Compliance with treatment	Attrition rates averaged 30% to 40%.
Adverse events	Gastrointestinal (GI) events were the predominant side effect associated with orlistat therapy. The categorisation of outcomes and detail of reporting of GI adverse events varied between trials. Over 80% of orlistat-treated patients experienced at least one GI side effect, with an absolute frequency of 24% (95% CI, 20% to 29%; 14 studies) greater than patients on placebo. The most commonly reported GI events were fatty / oily stool, faecal urgency and oily spotting, each occurring at frequency rates of 15% to 30% in most studies. Approximately 5% of orlistat-treated patients discontinued therapy due to GI side effects, which was 2% (95% CI, 1% to 3%; 12 studies) higher than in patients taking placebo. Faecal incontinence was a reported side effect of orlistat therapy but only three trials reported this complication as a separate endpoint, with an incidence rate of 7%. This was 6% (95% CI 5% to 8%) higher than the frequency of faecal incontinence in patients on placebo. Levels of fat-soluble vitamins (A, D, E) and beta-carotene were reportedly lowered by orlistat therapy, with vitamin D the most frequently affected. However, no study reported the occurrence of clinically significant vitamin deficiency, although patients were routinely advised to take a multivitamin pill daily. Sibutramine was associated with an increase in SBP of 1.7 mmHg (95% CI, 0.1 to 3.3 mmHg; 7 studies), DBP of 2.4 mmHg (95% CI, 1.5 to 3.3 mmHg; 7 studies) and pulse rate by 4.5 beats/min (95% CI 3.5 to 5.6 beats/min; 7 studies) compared with placebo. Insomnia, nausea, dry mouth and constipation were more common in patients on sibutramine therapy, occurring at frequency rates of 7% to 20%. The frequency of serious adverse effects was 6% in rimonabant-treated patients, which was 2% (95% CI, 0% to 3%; 4 studies) higher than those taking placebo. Fourteen percent of patients on rimonabant discontinued

	therapy due to adverse events, which was 6% (95% CI, 5% to 8%; 4 studies) greater than placebo. An increased incidence of psychiatric disorders was observed (depression, anxiety, irritability, aggression), which occurred in 6% of patients receiving rimonabant and was 3% (95% CI, 2% to 5%; 4 studies) more likely in patients receiving rimonabant compared to placebo.
Notes	This meta-analysis of long-term RCTs involving orlistat, sibutramine and rimonabant demonstrated that each drug results in average placebo-subtracted weight reductions of approximately 5 kg or less. No data on the effect of these agents on mortality or cardiovascular morbidity were found. Weight maintenance studies for each agent report similar amounts of weight regain in both active treatment and placebo study arms, such that the original weight differential between groups is maintained. Orlistat was associated with reductions in total cholesterol, LDL-cholesterol, blood pressure, diabetes incidence and with improved glycaemic control but with increased risk of GI side effects and lower HDL-levels. Sibutramine was associated with improved HDL-cholesterol and triglyceride levels but with increased blood pressure and pulse rate. Rimonabant was associated with increased risk of mood disorders. All studies in this review showed a positive treatment effect. The authors did not find any negative or neutral studies. This raises the possibility of publication bias. The vast majority of trials were funded by pharmaceutical companies and this may increase the potential for positive results. The authors were unable to locate unpublished data by contacting primary study authors and drug manufacturers. They generated a funnel plot of orlistat studies to assess for publication or small study bias. This showed a scattering of points near the midpoint and apex of the pyramid and a paucity of points at the bottom. This indicated that the impact of all types of small studies (positive, negative or neutral) may be underestimated in this meta-analysis. However, the limited number of studies included in this review may have limited overall interpretation and accuracy of the funnel plot. The number of sibutramine and rimonabant studies was too small to warrant generation of funnel plots. Statistical heterogeneity was present when quantitative pooling was performed for several outcomes. This was addressed by using a random-effects meta-analysis and by not combining outcomes when the heterogeneity was felt to be clinically significant. As the authors did not have access to individual patient data, they were not able to perform meta-regression analysis to further investigate the cause of the observed heterogeneity. It is likely that differences in patient populations, co-interventions, trial duration and drug dose all were contributing factors. The majority of the patients in this review were middle-aged and Caucasian. Whether results can be

	generalised to patients of different ethnic background and to older people is uncertain. Due to the lack of data, the authors were not able to draw any conclusions regarding the relative efficacy of anti-obesity agents in different ranges of BMI levels and in patients with pre-existing CVD. The role of combination anti-obesity therapy was not reviewed, nor was the role of anti-obesity pharmacotherapy in children and adolescents. Effects on health-related quality of life were not reviewed. The authors found that studies enrolling patients with diabetes reported slightly smaller amounts of weight loss with orlistat and rimonabant therapy, a finding that was not seen with sibutramine therapy. Despite this finding, both orlistat and rimonabant improved glycaemic parameters in patients with diabetes whereas sibutramine did not. The underlying reasons for and the clinical significance of these findings are unclear. One potential contributor to improved glycaemic control with rimonabant therapy is an increase in adiponectin levels. Further data are needed, ideally from head-to-head clinical trials of all three agents, before more definitive conclusions can be made.

Paul-Ebhohimhen 2008

Characteristics of the study	
Study Citation	Paul-Ebhohimhen V & Avenell A 2008, 'Systematic review of the use of financial incentives in treatments for obesity and overweight', Obes Rev, vol.9, no.4, pp.355-67.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs of obesity treatments involving the use of financial incentives as rewards contingent on weight loss or other behaviour change. Minimum follow-up of one year.

	Studies were excluded if it was not possible to extract data on financial incentives.	
Types of participants sought	Adults aged ≥ 18 years. BMI ≥ 28 kg/m^2.	
Types of intervention	The primary type of intervention was financial incentives as rewards for weight loss. Duration of the use of incentives ranged from 8 weeks to 18 months. All intervention groups received behavioural, diet and exercise advice. Monitoring varied and could be provided by the participants themselves, psychologist, or another individual. In one study, reward by a psychologist was compared with reward by a non-psychologist. In two studies, the financial incentives were freely supplied. All other studies used financial incentives were provided from participants' deposited money. Refunds were made for weight loss or compliance with behaviour change or attendance at sessions. Some studies compared refund for weight change with refund for compliance with behaviour change.	
Types of outcomes measured	Change in weight; all weight data were converted to kg where necessary. The effect size of financial incentives was determined by calculating the weighted mean difference (WMD) for weight change and 95% CIs.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	

Results of study	
N and type of studies	N = 9 studies All studies were RCTs of behavioural obesity treatments, mainly financial incentives as rewards for weight loss. All included studies were coordinated by psychologists. Focus was on the use of guaranteed incentive schemes, to avoid confounding from participants' perspective of uncertainty of receiving the incentive.
N and characteristics of participants	N = ~890 participants Participants were mostly women recruited through media advertisements. Mean age ranged from 35.7 to 52.8 years. Mean BMI ranged from 29.3 to 31.8 kg/m2. Studies generally excluded persons with significant medical conditions. There were more female participants in all studies except one all-male study with participants recruited from an already existing trial pool. Ethnicity was given in two studies, where percentage of participants who were white ranged from 71% to ~98%.
Duration of follow-up	The longest reported follow-up period was 30 months.
Overall findings	The use of financial incentives was associated with a WMD weight change at 12 months of -0.4 kg (95% CI -1.6 to 0.8 kg), at 18 months of -0.7 kg (95% CI -2.5 to 1.1 kg) and at 30 months of 1.1 kg (95% CI -1.3 to 3.4 kg), compared with groups where financial incentives were not used in treatment. At 12 months, the use of financial incentives of monetary equivalents < 1.2% of personal disposable income (PDI) was associated with a WMD for weight change of 0.0 kg (95% CI -1.5 to 1.6 kg) compared with groups without use of financial incentives.

	The use of monetary amounts equivalent to 1.2% PDI and above was associated with a WMD change in weight of -1.1 kg (95% CI -3.1 to 0.9 kg) and -0.7 kg (95% CI -2.5 to 1.1 kg), compared with not receiving any financial incentive, at 12 months and 18 months respectively. Assuming use of financial incentives for one year in all studies, comparison of groups receiving financial incentives ≤ 3.1% PDI to groups not receiving any financial incentive gave a WMD change in weight of -0.4 kg (95% CI -1.7 to 0.9 kg), and comparison of groups receiving ≥ 3.1% PDI to groups not receiving any financial incentive gave a WMD change in weight of -0.9 kg (95% CI -2.8 to 1.1 kg). Comparing groups receiving > 1.2% PDI equivalent of money with groups receiving < 1.2% PDI monetary equivalents gave a WMD for weight change of -0.7 kg (95% CI -4.1 to 2.7 kg), which was the same as comparing groups receiving monetary equivalents > 3.1% PDI with groups receiving monetary equivalents < 3.1% PDI (assuming financial incentive use for one year in all groups). At 12 months, treatment with financial incentives for < 16 weeks (the median intervention period) was associated with a WMD weight change of -0.8 kg (95% CI -2.3 to 0.7 kg) compared with treatment without financial incentives. Use of financial incentives for > 16 weeks was associated with a WMD weight change of 0.4 kg (95% CI -1.7 to 2.5 kg) compared with no financial incentive. It is worth noting that the financial incentive was usually discontinued after about 16 to 24 weeks or became less regular in the longer studies.
Compliance with treatment	The attrition rate ranged from 1.1% to 57.9%.
Adverse events	The death of one participant. No further details were available.
Notes	Results from meta-analysis showed no significant effect of use of financial incentives on weight loss or maintenance at 12 months and 18 months. Further sub-analysis by mode of delivery and amount of incentives were suggestive of very weak trends in favour of use of amounts > 1.2% PDI, rewards for behaviour change rather than for weight, rewards based on group performance rather than for individual performance and rewards delivered by non-psychologists rather than delivered by psychologists (not significant).

Paul-Ebhohimhen 2009

Characteristics of the study		
Study Citation	Paul-Ebhohimhen V & Avenell A 2009, 'A systematic review of the effectiveness of group versus individual treatments for adult obesity', Obes Facts, vol.2, no.1, pp.17-24.	
Study Design	Systematic review	
Methods		
Types of studies sought	RCTs comparing the effectiveness of group-based with individual-based modes of treatment delivery in obese adults. Follow-up ≥ 1 year. Groups with obesity-associated eating disorders were excluded.	
Types of participants sought	Adults aged ≥ 18 years. BMI ≥ 28 kg/m2 (except among ethnic groups with obvious justification to allow for a lower cut-off BMI).	
Types of intervention	Weight loss trials with at least one comparison of group-based intervention with individual-based intervention.	
Types of outcomes measured	Change in BMI or weight [weighted mean difference (WMD)].	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	

Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 5 studies Eleven comparison groups from five qualifying RCTs. Studies were excluded if they were < 12 months, participant BMI was < 28 kg/m2, and / or they did not have an adequate comparison group.	
N and characteristics of participants	N = 336 participants One study included only men while in all other studies participants were women. Age range from 20 to 76 years. BMI ranged from 30 to 49 kg/m2. Where mentioned, participants were excluded from the trial if they took medication known to affect weight.	
Duration of follow-up	Randomisation to follow-up assessment was reported as being between 52 and 119 weeks.	
Overall findings	Meta-analysis and sub-analyses on weight change at one year found a statistically significant weight change in group-based over individual treatment with a WMD of -1.4 kg (95% CI -2.7 to 0.1 kg). Sub-analysis comparing group to individual treatment in trials employing the use of financial reward gave a statistically significant effect in favour of group-based intervention with WMD for weight change at one year of -2.8 kg (95% CI -5.4 to -0.2 kg), while comparing group to individual treatment in trials not involving the use of financial rewards showed no significant difference with a WMD for weight change at one year of -1.0 kg (95% CI -2.5 to 0.6 kg). Comparing group to individual treatment in the dietician-led comparison groups gave a non-significant difference with WMD for weight change at one year of -1.6 kg (95% CI -4.2 to 1.1 kg), while comparing group to individual treatment in psychologist-led comparison groups gave a statistically significant difference with a	

	WMD for weight change at one year of -3.1 kg (95% CI -5.5 to -0.6 kg).
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	Group-based interventions were potentially more resource-saving in terms of total health professional hours involved per participant. Findings support the idea that weight loss interventions that provide peer support by modifying the social network are more successful than those that do not. Significantly greater (P = 0.03) weight change at 12 months was found in group-based over individual-based treatment.

Phung 2010

Characteristics of the study	
Study Citation	Phung OJ, Baker WL, Matthews LJ, Lanosa M, Thorne A & Coleman CI 2010, 'Effect of green tea catechins with or without caffeine on anthropometric measures: a systematic review and meta-analysis', Am J Clin Nutr, vol.91, no.1, pp.73-81.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs that evaluated the use of green tea catechins (GTCs) with or without caffeine. Both parallel and crossover trials were eligible for inclusion, but ultimately no eligible crossover trials were identified. No language restrictions were imposed.

Types of participants sought	Not specified	
Types of intervention	Treatment groups received GTCs (dose range: 576 to 714 (median: 588) mg/day) in the GTCs with caffeine compared with caffeine-matched control group trials; 141 to 1207 (median: 474) mg/day in the GTCs with caffeine compared with caffeine-free control group trials; and 282 to 548 (median: 415) mg/day in the caffeine-free trials. GTCs were provided in various dosage forms, such as green tea extract capsules or green tea beverages. Four trials limited additional tea or catechin-rich food consumption other than study materials. Additional caffeine intake was regulated in four studies, with caffeine being restricted to no more than two or three beverages per day, being completely prohibited, or requiring a standardised amount in both intervention and control groups. Two trials required concurrent exercise for both intervention and control groups.	
Types of outcomes measured	At least one of the following endpoints: BMI, body weight, WC or WHR.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	Medium	Concerns regarding hepatotoxicity have not been resolved.
Results of study		
N and type of studies	N = 15 studies All studies were RCTs. Of the 15 trials included, seven trials (N = 600) evaluated GTCs with caffeine compared with a caffeine-matched control, six trials (N = 524) evaluated GTCs with caffeine compared with a caffeine-free control, and two trials (N = 119) evaluated caffeine-free GTCs compared with a caffeine-free control.	

N and characteristics of participants	N = 1,243 participants Trials contained single and mixed genders with an age range of 16 to 70 years. The baseline BMI of the control group ranged from 24.0 to 32.2 kg/m2 and from 24.4 to 32.2 kg/m2 for the intervention group.
Duration of follow-up	Patients were followed for 8 to 24 weeks (median: 12 weeks).
Overall findings	GTCs with caffeine decreased BMI (-0.6; 95% CI, -0.7 to -0.4), body weight (-1.4 kg; 95% CI, -1.7 to -1.1) and WC (-1.9 cm; 95% CI, -2.8 to -1.0) compared with caffeine alone. GTC ingestion with caffeine also significantly decreased body weight (-0.4 kg; 95% CI, -0.7 to -0.2) when compared with a caffeine-free control. Studies that evaluated GTCs without concomitant caffeine administration did not show benefits on any of the assessed anthropometric endpoints.
Compliance with treatment	Not stated
Adverse events	The trials reported that patients did not experience any major adverse events. Case reports of GTC consumption have brought up concerns of hepatotoxicity, and the US Pharmacopoeia Dietary Supplements Information Expert Committee has proposed that all green tea extract products bear a label that suggests consumption together with food because of the possibility of liver problems. Of the five trials that evaluated liver transaminases, one reported elevations in the GTC group; however, transaminase concentrations were elevated at baseline, which suggests potential bias in group allocation.
Notes	The administration of GTCs with caffeine is associated with statistically significant reductions in BMI, body weight, and WC; however, the clinical significance of these reductions is modest. GTCs alone do not positively alter anthropometric measurements.

Picot 2009

Characteristics of the study	
Study Citation	Picot J, Jones J, Colquitt JL, Gospodarevskaya E, Loveman E, Baxter L & Clegg AJ 2009, 'The clinical effectiveness and cost-effectiveness of bariatric (weight loss) surgery for obesity: a systematic review and economic evaluation', Health Technol Assess, vol.13, no.41, pp.1-190, 215-357, iii-iv.
Study Design	Systematic review
Methods	
Types of studies sought	Randomised controlled clinical trials were sought for conducting comparisons between different types of surgery. Randomised controlled clinical trials, controlled clinical trials and prospective cohort studies with a control cohort were sought for comparisons between surgery and non-surgical interventions.
Types of participants sought	Adult patients fulfilling standard BMI criteria for obesity (BMI ≥ 30) and young people who fulfil criteria for obesity for their age, sex and height. As people with a BMI of 30 to 35 do not meet the NICE criteria for bariatric surgery, this subgroup was considered separately to participants with a BMI > 35 in analyses. People with a BMI > 50 (super-obese) were also considered separately.
Types of intervention	Open and laparoscopic bariatric surgical procedures in widespread current use. Surgical procedures that are not in current use were excluded. Surgical procedures in current use in comparison with one another; open surgery compared with laparoscopic surgery for the same procedure; surgical procedures in current use compared with non-surgical interventions, usual care or no treatment. Non-surgical interventions included pharmacological interventions, dietary interventions, exercise and combinations of non-surgical interventions such as diet and exercise.

Types of outcomes measured	Primary outcomes were measures of weight change; quality of life (QoL); perioperative and postoperative mortality and morbidity; change in obesity-related comorbidities and cost-effectiveness.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	B	Non-RCTs included and point estimates not reported
Magnitude of effect rating**	Medium	No point estimates or CIs
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 26 studies Twenty-six studies reported across 52 publications were included in the review. There were three RCTs and three cohort studies (one cohort study had three arms) that compared surgery with nonsurgical interventions and 20 RCTs that compared different surgical procedures, including various types of gastric bypass, vertical banded gastroplasty (VBG), adjustable gastric banding and isolated sleeve gastrectomy, performed with open or laparoscopic surgery. One study was a prospective multicentre cohort study with matched concurrent controls. This study, the SOS study, had multiple publications, 20 of which were included in this review.	
N and characteristics of participants	N = 5,766 participants Studies included participants with BMIs between 30 and 60 kg/m2. A maximum BMI of 50, or 60 was also specified by some studies. The age range and gender breakdown of participants of primary studies was not provided.	
Duration of follow-up	The minimum duration of studies, including follow-up, was 12 months.	

	The duration of most included studies was 12, 24 or 36 months. Six studies had follow-up periods longer than 36 months. The longest follow-up was for 10 years by the SOS study.
Overall findings	Bariatric surgery was a more effective intervention for weight loss than non-surgical options. In one large cohort study weight loss following bariatric surgery was still apparent 10 years after surgery, whereas patients receiving non-surgical treatment had regained the weight they had lost. Some measures of quality of life improved after surgery, but not others. Quality of life characteristics were reported in one RCT and two cohort studies. - The RCT compared changes in the short form health survey (SF-36) domain scores from baseline to two years follow-up for people undergoing LAGB and non-surgical therapy. Although no point estimates were reported, the authors noted improvements in scores on all eight domains for the LAGB group and on three domains (physical function, vitality and mental health) for the nonsurgical therapy group. Statistically significantly greater improvements were reported for five of the eight domains for LAGB compared to the non-surgical group. - Improvements over 10 years in the first cohort study assessed Health Related Quality of Life (HRQoL) using several measures (intervention versus control), including current health perceptions from the General Health Rating Index (1.00 versus 0.42), social interaction from the Sickness Impact Profile (0.25 versus -0.05), overall mood from the Mood Adjective Check List (0.25 versus 0.10), the obesity-related problems scale and the Hospital Anxiety and Depression scale (Depression: -1.4 versus -0.5; Anxiety: -1.4 versus -1.4). All HRQoL measures were improved at 10 years compared with baseline for the surgery group, but for the conventional group some had improved while others had worsened. There was no statistically significant difference in 10-year change for overall mood and anxiety. - A second cohort study applied a range of validated questionnaires which were related to quality of life to participants via telephone interview. The study reported that the Psychosocial Stress and Symptom Questionnaire (PSSQ) was used which incorporated the Hospital Anxiety and Depression Scale (HADS), the Bing Scale Questionnaire (BSQ) and the Psychosocial Assessment Questionnaire (PAssQ). After a mean follow-up of 3.2 years there were no statistically significant differences between groups on mean scores from any of the three questionnaires. After surgery fewer people had metabolic syndrome and there was higher remission of type 2 diabetes than in non-surgical groups. The incidence of comorbidities assessed 10 years after surgery was significantly reduced

	compared with conventional therapy. Gastric bypass (GBP) was more effective for weight loss than VBG and adjustable gastric banding (AGB). Laparoscopic isolated sleeve gastrectomy (LISG) was more effective than AGB in one study. GBP and banded GBP led to similar weight loss and results for GBP versus LISG and VBG versus AGB were equivocal. All comparisons of open versus laparoscopic surgeries found similar weight losses in each group. Comorbidities after surgery improved in all groups, but with no significant differences between different surgical interventions. Adverse event reporting varied; mortality ranged from none to 10%.
Compliance with treatment	Not summarised
Adverse events	Adverse events from non-surgical therapy varied according to the therapy. Major adverse events were reported across a number of studies following surgery, included anastomosis leakage, pneumonia, pulmonary embolism, band slippage and band erosion. The extent of reporting of adverse events varied between studies; few were compared statistically and none were powered to do so. Fourteen RCTs reported no deaths. Where deaths were reported separately for each RCT trial arm, mortality ranged from 2% (1/51 patients receiving Open GBP within the first 30 postoperative days) to 10% (2/20 patients receiving Open GBP, one on the fourth postoperative day, one after 13 months). The largest (SOS) study reported mortality of 0.25% in the surgical cohort (5/2010 patients within 90 days of surgery).
Notes	Baseline characteristics were similar between groups in most of the studies. However, the SOS study involved an interval of nine months between matching of controls and the start of treatment (surgery) that led to significant differences in weight and other possible risk factors. The surgical group were younger than controls, had a higher prevalence of hypertension, and had increased BMI, blood pressure and energy intake at the time of surgery. Bariatric surgery appears to be a clinically effective for moderately to severely obese people compared with non-surgical interventions. However, the burden of morbidity and mortality associated with adverse events is poorly defined.

Pontiroli 2011

Characteristics of the study	
Study Citation	Pontiroli AE & Morabito A 2011, 'Long-term prevention of mortality in morbid obesity through bariatric surgery. a systematic review and meta-analysis of trials performed with gastric banding and gastric bypass', Ann Surg, vol.253, no.3, pp.484-7.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	Controlled clinical trials comparing bariatric surgery versus no-surgery in patients with morbid obesity, irrespective of language of publication. Published data on all-cause mortality, cardiovascular (CV) mortality, and global mortality (sum of all-cause and CV mortality) in patients undergoing gastric banding and gastric bypass were sought.
Types of participants sought	Patients with morbid obesity.
Types of intervention	Bariatric surgery including gastric banding and gastric bypass. The following covariates were included in the meta-regression analysis, including covariates previously shown to be associated with survival in patients; age, sex, presence of diabetes, BMI of each study (weighted means of surgery and control participants), amount of weight lost, year of starting of study (as a proxy for technical improvement in bariatric procedures over time), number of patients enrolled, control group (clinics vs. community patients), duration of follow- up, and efficacy of treatment (compared with controls) in each trial.
Types of outcomes measured	Measures of treatment efficacy were as follows: (1) all-cause (non-CV-related) mortality; (2) CV cause-related mortality; (3) global mortality, that is, sum of the preceding two. Treatment outcomes were expressed as odds ratios (ORs) and pooled odds ratios (PORs), with 95% CIs (CIs) estimated by a fixed-effects model. In an additional analysis, treatment outcomes were expressed by a random-effects model.

Quality of study	Rating	Comments
Level of evidence	III-2	
Study quality rating*	C	No RCTs Quality assessment of primary studies indicated all low quality
Magnitude of effect rating**	High	
Relevance of evidence rating***	Medium	
Results of study		
N and type of studies	N = 8 studies All were CCTs.	
N and characteristics of participants	N = 44,022 participants (14,052 undergoing surgery and 29,970 controls) Across included studies participant ages were 45.1 ± 1.1 years and the BMIs were 47.0 ± 1.1 kg/m2. All studies contained participants of both genders.	
Duration of follow-up	The duration of studies including follow-up ranged from 2.5 to 12 years (7.5 ± 0.7 years).	
Overall findings	Deaths occurred in 3,317 participants (400 in surgery and 2,917 in controls). BMI reduction from surgery ranged from 7 to 17 kg/m2; in controls no BMI change was observed across primary studies. Compared with controls, surgery was associated with a reduced risk of global mortality (OR = 0.55; 95% CI, 0.49 to 0.63), of CV mortality (OR = 0.58; 95% CI, 0.46 to 0.73), and of all-cause mortality (OR = 0.70; 95% CI, 0.59 to 0.84). The reduction of risk was smaller in the larger studies (OR = 0.61 vs. 0.21, 0.63 vs. 0.16, 0.74 vs. 0.35 for global, CV, and all-cause mortality, respectively). The effect of gastric banding and gastric by-pass (3797 vs. 10,255 interventions) was similar for global and all-cause mortality (OR = 0.57 vs. 0.55, and 0.66 vs. 0.70,	

	respectively) but different for CV mortality (OR = 0.71 vs. 0.48). At meta-regression analysis, sex, and age, year of start of study, duration of follow-up, amount of weight lost, and kind of controls were not associated with a different Log OR. Decreased global mortality (Log OR) was not significantly associated with increasing BMI when all studies were considered (coefficient = 0.01, SE = 0.10, t = 0.05, P = 0.96, 95% CI, -0.25 to 0.26. BMI was not significantly associated with all-causes mortality (coefficient = 0.11, SE = 0.12, t = 0.95, P = 0.44, 95% CI, -0.39 to 0.61) and CV mortality (coefficient = 0.21, SE = 0.16, t = 1.35, P = 0.31, 95% CI, -0.46 to 0.88).
Compliance with treatment	Not stated
Adverse events	Death occurred in 3,317 participants (400 in surgery, 2,917 in controls); when the kind of death was specified, 321 CV deaths (118 in surgery, 203 in controls), and 523 all-cause deaths (218 in surgery, 305 in controls) occurred.
Notes	Being non-randomised trials, all studies were of low methodological quality. Results of this meta-analysis suggest that bariatric surgery may reduce the risk of global mortality, all-cause mortality and CV mortality when compared to participants not undergoing surgery. Risk reduction seemed to be lower in large studies than in small studies, and tends to be greater in more obese participants. Both gastric banding and gastric bypass seem to reduce mortality risk with a greater effect of the latter on CV mortality.

Richardson 2008

Characteristics of the study	
Study Citation	Richardson CR, Newton TL, Abraham JJ, Sen A, Jimbo M & Swartz AM 2008, 'A meta-analysis of pedometer-based walking interventions and weight loss', Ann Fam Med, vol.6, no.1, pp.69-77.
Study Design	Systematic review and meta-analysis

Methods		
Types of studies sought	Pedometer-based walking studies without a dietary intervention that reported weight change as an outcome. RCTs and non-RCTs and pre-intervention and post-intervention prospective cohort studies. Studies with five or more adult participants and at least one cohort enrolled in a pedometer-based walking intervention lasting at least four weeks. Studies needed to have pre-intervention and post-intervention mean weights reported or information that could be easily calculated for the intervention group.	
Types of participants sought	Adults who were sedentary at baseline. Overweight or obese subjects.	
Types of intervention	Use of pedometers as motivational tools to increase walking, including step-count goal setting / counselling and continuous self-monitoring.	
Types of outcomes measured	Step count and weight change (kg).	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	C	Non-RCTs included Between study differences not explored Harms not reported
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	

Results of study	
N and type of studies	N = 9 studies Four of the studies were RCTs and five were cohort studies.
N and characteristics of participants	N = 307 participants Sample size ranged from 15 to 106 participants. 73% of the participants were women and 27% were men. Mean baseline BMI ranged from 28.6 ± 2.2 kg/m2 to 35.0 ± 5.1 kg/m2 (study average BMI > 25 kg/m2). Participant age was not reported.
Duration of follow-up	The duration of the interventions ranged from four weeks to one year, with a median duration of 16 weeks.
Overall findings	The pooled estimate of mean weight change from baseline using a fixed-effects model and combining data from all nine cohorts was -1.27 kg (95% CI, -1.85 to -0.70 kg). There was a strong linear association between the duration of intervention and the magnitude of weight change (β = -0.05, P = .003), with interventions of longer duration being associated with greater weight change. On average, participants lost 0.05 kg per week during the interventions. All but one of the cohorts examined had a small decrease in weight at the end of the intervention. The range of weight change for the 9 cohorts was 0.30 to -3.70 kg, with an unadjusted mean weight change across the cohorts of -1.42 kg. In five of the nine cohorts, the weight change was statistically significant comparing post-intervention with pre-intervention weight at the P = 0.05 level.
Compliance with treatment	Not stated
Adverse events	Not stated

Notes	The average participant in a pedometer-based walking program without dietary change can expect to lose a modest amount of weight, in the order of 1 kg. Results from the nine cohort studies examined were remarkably consistent and did not vary by the population targeted or the goal-setting strategies used.

Rucker 2007

Characteristics of the study		
Study Citation	Rucker D, Padwal R, Li SK, Curioni C & Lau DC 2007, 'Long term pharmacotherapy for obesity and overweight: updated meta-analysis', BMJ, vol.335, no.7631, pp.1194-9.	
Study Design	Systematic review and meta-analysis	
Methods		
Types of studies sought	Randomised, double blind, placebo controlled trials, published between December 2002 and December 2006, of approved anti-obesity drugs used to treat overweight or obese adults (aged > 18 years). Trial duration (including follow-up) was at least one year. There were no language restrictions.	
Types of participants sought	Overweight or obese adults (aged > 18 years).	
Types of intervention	Anti-obesity drugs orlistat, sibutramine and rimonabant. Co-interventions included: diet, exercise and counselling.	
Types of outcomes measured	Weight change (kg, % body weight), waist circumference (cm), BMI, blood pressure, lipoproteins, fasting glucose and HbA1c.	
Quality of study	Rating	Comments

Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 30 studies Thirty trials met the inclusion criteria: 16 orlistat, 10 sibutramine and four rimonabant. Exclusion criteria in primary studies included obesity of endocrine origin, uncontrolled hypertension, treatment with other drugs affecting body weight, pregnancy or lactation, psychiatric or relevant medical illness, previous bariatric surgery, and considerable weight loss before screening. Twenty seven studies (16 orlistat, seven sibutramine, and four rimonabant) reported results of weight loss trials in which drug treatment was used in conjunction with a weight loss diet. The three remaining sibutramine trials were weight maintenance studies, in which randomisation was performed after a one to six month induction phase with reduced energy intake. A standardised, low fat, low energy diet and encouragement to exercise were the main co-interventions in most weight loss studies.	
N and characteristics of participants	N = 19,619 participants (n = 10,631 orlistat, n = 2,623 sibutramine and n = 6,365 rimonabant) Patients had similar demographic profiles across trials of all three drugs: about two thirds to three quarters of participants were women, 90% were Caucasian, mean age was 45 to 50 years, mean weight was approximately100 kg and mean BMI was 35 to 36 kg/m2.	
Duration of follow-up	Trial duration including follow-up ranged from one to four years.	
Overall findings		

<table>
<tr><td></td><td>
<table>
<tr><td></td><td>Orlistat</td><td>Sibutramine</td></tr>
<tr><td>Weight (kg)</td><td>-2.9 (-3.2, -2.5)</td><td>-4.2 (-4.7, -3.6)</td></tr>
<tr><td>% change in body weight</td><td>-2.9 (-3.4, -2.5)</td><td>-4.3 (-5.0, -3.7)</td></tr>
<tr><td>Waist circumference (cm)</td><td>-2.1 (-2.9, -1.3)</td><td>-4.0 (-4.7, -3.3)</td></tr>
<tr><td>BMI (kg/m2)</td><td>-1.1 (-1.4, -0.7)</td><td>-1.5 (-1.8, -1.3)</td></tr>
<tr><td>SBP (mmHg)</td><td>-1.5 (-2.2, -0.7)</td><td>1.7 (0.1, 3.3)</td></tr>
<tr><td>DBP (mmHg)</td><td>-1.4 (-2.0, -0.7)</td><td>2.4 (1.5, 3.3)</td></tr>
<tr><td>Cholesterol (mmol/l)</td><td>-0.3 (-0.4, -0.3)</td><td>NR</td></tr>
<tr><td>LDL (mmol/l)</td><td>-0.26 (-0.30, -0.22)</td><td>NR</td></tr>
<tr><td>HDL (mmol/l)</td><td>-0.03 (-0.04, -0.02)</td><td>0.04 (0.01, 0.08)</td></tr>
<tr><td>Triglycerides (mmol/l)</td><td>-0.03, (-0.12, 0.07)</td><td>-0.18 (-0.30, -0.07)</td></tr>
</table>
Compared with placebo, rimonabant reduced weight by 4.7 kg (4.1 kg to 5.3 kg). Further results are not reported here.

Orlistat reduced the incidence of type 2 diabetes in participants with impaired glucose tolerance from 9% to 6.2% (HR 0.63; 95% CI 0,46, 0.86) in one four year trial.
</td></tr>
<tr><td>Compliance with treatment</td><td>Even though studies preselected patients for their ability to adhere to and to tolerate treatment, attrition rates were high, compromising the internal validity of many studies. Attrition averaged 30% for Orlistat; and 40% for Sibutramine and Rimonabant studies.</td></tr>
<tr><td>Adverse events</td><td>Compared with placebo, Sibutramine increased SBP and DBP. Insomnia, nausea, dry mouth and constipation</td></tr>
</table>

	were more common in patients receiving Sibutramine, occurring at frequency of between 7 and 20%. Patients receiving Orlistat were more likely to experience gastrointestinal adverse events and to discontinue because of this. The most commonly reported gastrointestinal events were fatty / oily stool, faecal urgency and oily spotting, each occurring at a frequency of between 15% and 30% across studies. Although concentrations of fat soluble vitamins were reportedly lowered, no study reported clinically relevant vitamin deficiency. Patients receiving Orlistat were routinely advised to take daily multivitamins. An increased incidence of psychiatric disorders (depression, anxiety, irritability, aggression), occurred in 6% of patients receiving Rimonabant. None of the trials reported total mortality, cardiovascular morbidity, and cardiovascular mortality as end points.
Notes	This meta-analysis of one to four year RCTs of Orlistat, Sibutramine and Rimonabant in adults showed that each drug results in average placebo subtracted weight reductions of less than 5 kg. The authors found no data on the effect of these agents on mortality or cardiovascular morbidity. Weight maintenance studies for each drug reported similar amounts of weight regained in active and placebo arms, such that the original weight differential between groups was maintained. They found differing effects on secondary end points and adverse effect profiles.

Sargent 2011

Characteristics of the study	
Study Citation	Sargent GM, Pilotto LS & Baur LA 2011, 'Components of primary care interventions to treat childhood overweight and obesity: a systematic review of effect', Obes Rev, vol.12, no.5, pp.e219-35.
Study Design	Systematic review
Methods	
Types of studies sought	Articles were included if they described an intervention trial that aimed to treat infants, children or adolescents

	with overweight or obesity. Articles describing both RCTs and non-RCTs were eligible for inclusion. Articles were excluded if they described primary prevention interventions or if the majority of participants were over 18 years of age. Articles published in a language other than English, or before 1990 were excluded as were articles where participants had undergone surgery or if obesity was due to pharmacotherapy or a congenital disorder. Those that did not clearly describe the involvement of either a primary care setting or primary healthcare professional were excluded. No restrictions were placed on the outcome measures being reported.	
Types of participants sought	Infants, children or adolescents with overweight or obesity	
Types of intervention	Behaviour change targets for this review were: (1) maintaining a calorie restricted diet; (2) low fat or low sugar diet; (3) achieving a healthier diet (other than 1 or 2); (4) attending physical activity sessions; (5) increasing lifestyle activity; (6) decreasing sedentary behaviour; or (7) incorporating both healthier diet and activity into the daily routine (healthy lifestyle).	
Types of outcomes measured	The 17 studies each evaluated between four and 15 outcome measures, with a combined total of 30 different outcomes. All studies evaluated anthropometric outcomes, nine also measured metabolic outcomes, 10 evaluated behavioural change and eight assessed psychosocial change. Only one study included outcome measures from all four domains. The majority of behaviour change and psychosocial outcomes relied on self-report measures. An objective measure (accelerometry) to verify self-reported changes in sedentary behaviour and physical activity was used in one study.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	B	Non-RCTs included
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	

Results of study	
N and type of studies	N = 17 studies Twenty-two papers describing 17 studies were included. Twelve studies reported at least one significant intervention effect. Comparison of these 12 interventions provided evidence for: training for health professionals before intervention delivery; behaviour change options (including healthy diet, activity and sedentary behaviour); effecting behaviour change via a combination of counselling, education, written resources, support and motivation; and tailoring intensity according to whether behavioural, anthropometric or metabolic changes are the priority. The 17 studies consisted of ten RCTs and seven non-RCTs. Randomisation was implemented at the participant level in nine studies (before and after baseline assessment) and at the physician level in one. Studies were carried out in six different countries: USA (six), Germany (three), Israel (three), Australia (two), Finland (two) and Italy (one). Of the 22 articles, three were published in the 1990s and the remainder in or after 2000. The number of intervention groups and structure of control groups varied considerably between studies, particularly among non-RCTs. Control groups received from zero (no treatment) to 12 contacts. Of the 17 studies included in this review, 11 interventions were principally delivered in primary care. The settings of interventions with significantly effective outcomes were: general or family practice (N = 2), health centre (N = 4), other primary care (N = 3), school (N = 2) and hospital out-patient clinic (after assessment by primary care physician, N = 1). Behaviour change targets most used by effective interventions were: incorporating both healthy diet and activity into the daily routine (N = 5), decreasing sedentary behaviour (N = 4), maintaining a calorie restricted diet (N = 4), attending physical activity sessions (N = 4) and achieving a healthier diet (N = 3). The majority of effective interventions reported employing a combination of: counselling or education (N = 11), provision of written resources (N = 11) and motivation or support (N = 9) in order to affect behaviour change. Each remaining category was associated with at least two successful interventions.
N and characteristics of	N = 3,086 participants

participants	Seven interventions targeted obese children exclusively. Nine interventions targeted overweight and obese children, two of these included children who were normal weight or considered at risk of overweight due to one obese parent. One intervention focused on overweight children and included normal weight children considered at risk due to parental obesity. The age of children targeted for intervention participation ranged from 3 to 17 years old; however, the actual age distribution of children participating in studies was not consistently reported. Five studies did not report the sex distribution of participants and one intervention involved female participants only. The other 11 studies had an average of 49.6% (median 46.5%) male participants. Many interventions targeted a large age range but had insufficient sample size to control for age and sex.
Duration of follow-up	Nine studies reported subsequent follow-up, which took place between six months and four years after initial post-intervention measures.
Overall findings	Statistically significant outcomes, when compared with a control / comparison group at the first post-intervention assessment, were reported in 12 of the 17 included studies. Eight of the 17 studies (47%) reported significant anthropometric changes. Of the nine studies that included metabolic measures, three (30%) reported significant outcomes. Of the 10 studies that included measures of behaviour, six (60%) reported significant changes. Pooled effect sizes of weight loss were not calculated. Across studies where anthropometric change was significant, the following placebo-subtracted changes were observed: - reduction of body weight between 4.0 kg and 7.4 kg - reduction in BMI between 0.8 kg/m2 and 3.3 kg/m2 - reduction in BMI z-score between 0.10 and 0.11
Compliance with treatment	Not stated
Adverse events	No significant psychosocial changes or other adverse effects were recorded.
Notes	This systematic review compiled the literature describing interventions to treat childhood overweight and obesity that have involved primary care. Twelve of the 17 studies reported some statistically significant intervention effect.

	The outcomes of this systematic review provide evidence for the use of specific intervention components in future intervention studies to treat childhood overweight and obesity in primary care. These intervention components are immediately practicable to future intervention studies in primary care.

Seo 2008

Characteristics of the study		
Study Citation	Seo DC & Sa J 2008, 'A meta-analysis of psycho-behavioral obesity interventions among US multiethnic and minority adults', Prev Med, vol.47, no.6, pp.573-82.	
Study Design	Systematic review and meta-analysis	
Methods		
Types of studies sought	Intervention studies with a control group. Studies involving a psycho-behavioural intervention aimed at preventing weight gain or reducing weight. Studies conducted in the US.	
Types of participants sought	Obese or overweight adult men and / or women from a minority group, including being black, African American, American Indian, Mexican American, Hispanic, Latino or Puerto Rican.	
Types of intervention	Psycho-behavioural obesity interventions including physical activity, nutrition, medications, and / or counselling.	
Types of outcomes measured	Body weight, BMI, or percentage of body fat.	
Quality of study	Rating	Comments
Level of evidence	I	

Study quality rating*	C	Heterogeneity analysis not undertaken and between study differences not explored
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 24 studies All 24 studies were controlled intervention studies, representing 23 programs. Nineteen trials were clinically-based and five were community-based. Of the 24 studies, nine were all-minority studies. Five studies used one-component interventions, 13 used two-component interventions, and six used three-component interventions. The five one-component interventions used either physical activity or nutrition interventions. Only one of these five studies used lifestyle interventions or individual approach. Of the 13 studies that used two-component interventions, seven used physical activity and nutrition, six used nutrition and counselling, and 12 out of the 13 studies used lifestyle interventions. Four of the six three-component interventions used physical activity, nutrition and counselling and two used physical activity, nutrition and medication. All of the three-component interventions used lifestyle change techniques.	
N and characteristics of participants	N = 13,326 participants The number of minority adults included in this review was 5,355 participants. Participants were of single or mixed genders, but there were more female only than male only studies. Age ranged from 18-79 years. Baseline body weight (if reported) was ≥ 71.4 kg.	

Duration of follow-up	The median intervention period was 12 months with a minimum of 2.8 months and a maximum of 58 months.
Overall findings	Weight loss ranged from 0.4 kg to 8.6 kg and the mean weight loss was 3.5 kg. The effect size varied from -0.07 to 1.01. The median and mean effect sizes were 0.26 and 0.28, respectively. Among the 24 studies, four showed an effect size near or above 0.50. While one-component (n = 5, d = 0.08, 90% CI = - 0.04, 0.35) and two-component interventions (n = 13, d = 0.22, 90% CI = 0.05, 0.40) showed a low mean effect size, three-component interventions (n = 6, d = 0.52, 90% CI = 0.39, 0.65) showed a moderate effect size. Interventions conducted in individual sessions (n = 15, d = 0.40, 90% CI = 0.24, 0.56) showed a higher mean effect size than group interventions (n = 9, d = 0.08, 90% CI = -0.04, 0.30) although the confidence intervals overlapped. Lifestyle interventions (n = 19, d = 0.35, 90% CI = 0.19, 0.51) showed a higher mean effect size than non-lifestyle interventions (n = 5, d = 0.09, 90% CI = -0.03, 0.35) although the confidence intervals overlapped. Effect size estimates for interventions that used interventionists of the same race / ethnicity as participants, problem solving techniques and family involvement were not statistically different to those from their counterpart programs.
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	Interventions that address all the key areas related to obesity, such as physical activity, eating, and counselling, are more effective than those that address only one or two of them. Use of both individual and group approaches appear to be more effective than use of a group approach alone in reducing body weight among multiethnic and minority adults. Interventions with family involvement might be particularly effective in reducing body weight among minority adults.

Shaw 2006

Characteristics of the study	
Study Citation	Shaw K, Gennat H, O'Rourke P & Del Mar C 2006, 'Exercise for overweight or obesity', Cochrane Database Syst Rev, no.4, pp.CD003817.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs that examined body weight change using one or more physical activity intervention in adults with overweight or obesity at baseline and loss to follow-up of participants of less than 15%.
Types of participants sought	Studies were limited to adult participants (aged over 18 years). Studies included adults with overweight or obesity according to BMI, waist circumference or waist-to-hip ratio (WHR), irrespective of health status.
Types of intervention	The studies included had an exercise prescription. Exercise was defined as any form of physical activity performed on a repeated basis for a defined period of time (exercise training). Exercise prescriptions include specific recommendations for the type, intensity, frequency and duration of any physical activity with a specific objective (e.g. increase fitness, lose weight). Studies stating that they simply recommended increasing physical activity were not included within the analyses unless it was possible to quantify the exercise stimulus by some means. Studies that combined exercise and medication associated with weight loss as an intervention were excluded.
Types of outcomes measured	Primary outcomes measured included: (1) weight or another indicator of body mass (e.g. BMI, waist measurement, WHR); (2) morbidity and mortality; and (3) well-being and quality of life. Secondary outcomes measured included: (1) serum lipids; (2) serum glucose; (3) SBP and DBP; and (4) adverse effects. Studies with a duration including follow-up period of ≥ 3 months were included in this review.

Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	Medium	All included primary studies were short-term duration and follow-up (maximum of 12 months); intervention effects for some but not other weight loss outcomes.
Results of study		
N and type of studies	N = 41 studies A total of 43 studies, reporting the results from 41 trials, met the inclusion criteria and were included in the review. Two studies were duplicate publications of other studies included in the review. Data from these studies were included and were used to maximise available information about the primary studies. All included trials were randomised controlled clinical trials. Eight trials were factorial in design. The remaining 33 were parallel in design. Eighteen trials evaluated multiple exercise interventions within their design and 23 trials evaluated a single exercise intervention. Twenty-one trials evaluated a walking intervention, 10 evaluated cycle ergometry (exercise bicycle), eight evaluated jogging, eight evaluated weights training, five evaluated commercial aerobics, five evaluated treadmill exercise, two evaluated stair stepping, and one evaluated each of dancing, ball games, calisthenics, rowing, and aqua jogging, respectively. No trials evaluated swimming or water aerobics as weight loss interventions. Thirteen trials contained groups that compared exercise with no treatment as a weight loss intervention; eleven trials contained groups that compared exercise to diet as weight loss interventions; sixteen trials contained groups that compared exercise in combination with diet to diet alone as weight loss interventions; eight trials contained groups that compared high with low intensity exercise stimuli as weight loss interventions in people with overweight or obesity. In seven of the eight trials subgroups of participants were also on low fat or LCDs.	

N and characteristics of participants	N = 3,476 participants All trials were conducted in adults. The weighted mean age of participants was 42.4 years for the 32 trials that reported age as a mean value. The remaining nine trials, which reported age as a range, included participants aged between 20 and 75 years. Of the 39 trials that reported gender distribution of participants, 17 included men only, 15 included women only, and 10 included both men and women.
Duration of follow-up	The duration of the included studies ranged from three to 12 months, including follow-up.
Overall findings	Although significant heterogeneity in some of the main effects' analyses limited ability to pool effect sizes across some studies, a number of pooled effect sizes were calculated. When compared with no treatment, exercise resulted in small weight losses across studies. Exercise combined with diet resulted in a greater weight reduction than diet alone (weighted mean difference [WMD] -1.1 kg; 95% CI [CI] -1.5 to -0.6). Increasing exercise intensity increased the magnitude of weight loss (WMD -1.5 kg; 95% CI -2.3 to -0.7). There were significant differences in other outcome measures such as serum lipids, blood pressure and fasting plasma glucose. Exercise as a sole weight loss intervention resulted in significant reductions in DBP (WMD -2 mmHg; 95% CI -4 to -1), triglycerides (WMD -0.2 mmol/L; 95% CI -0.3 to -0.1) and fasting glucose (WMD -0.2 mmol/L; 95% CI -0.3 to -0.1). Higher intensity exercise resulted in greater reduction in fasting serum glucose than lower intensity exercise (WMD -0.3 mmol/L; 95% CI -0.5 to -0.2).
Compliance with treatment	Not stated
Adverse events	No data were identified on mortality, morbidity, adverse events or quality of life among the trials included in this review.
Notes	A limitation of this systematic review was the paucity of long-term trials available for inclusion in the analyses. Most people lose weight initially and then regain it over time. Thus, without longer term trials, the true effect of exercise on body weight is difficult to determine. Also, without long-term trials, the effects of exercise on mortality are difficult

	to determine. The results of this study demonstrated that exercise was associated with improvement in CVD risk factors. However, the effect of exercise on disease endpoints such as myocardial infarction, cerebrovascular accident and type 2 diabetes could not be demonstrated. Without long-term trials it is assumed, but not definite, that exercise will also have positive impacts on these end-points. Also, a large number of studies were excluded from analysis due to the relatively large losses to follow-up. This was done because if studies with large losses to follow-up were included in the analyses, valid conclusions about the relative efficacy of exercise interventions could not be drawn. Although this is a valid justification to exclude studies with large losses to follow-up, the negative effect of doing so is to reduce the power of meta-analyses. Positive effects on CVD risk factors were demonstrated with exercise interventions in overweight and obese adults in this study. Those who participated in exercise interventions alone reduced SBP and DBP, cholesterol, triglycerides and fasting serum glucose. They also increased HDL levels. The changes that were statistically significant compared with no treatment were changes in DBP, triglycerides, HDL and glucose. These changes were independent of significant weight loss. Weight loss does not appear to uniformly improve cardiovascular risk factors, particularly if 5% or less body weight reduction. Both high and low intensity exercise resulted in reduced SBP and serum triglycerides. However, high intensity exercise had a greater positive effect on fasting serum glucose than low intensity exercise, suggesting that exercise intensity affects the magnitude of the health benefit of the exercise undertaken. It has previously been proposed that a threshold of vigorous activity volume exists which has to be reached to affect CVD risk in adults. Results of this study support this hypothesis and suggest that this threshold may also exist in overweight and obese adults.

Shaw 2005

Characteristics of the study	
Study Citation	Shaw K, O'Rourke P, Del Mar C & Kenardy J 2005, 'Psychological interventions for overweight or obesity', Cochrane Database Syst Rev, no.2, pp.CD003818.
Study Design	Systematic review and meta-analysis

Methods	
Types of studies sought	RCTs of a psychological intervention versus a comparison intervention. Studies where one of the outcome measures was weight change. Trials with interventions that lasted longer than three months (including follow-up). Quasi-randomised trials were also considered. Trials with a drop-out rate of greater than 15% were excluded.
Types of participants sought	Studies were limited to participants ≥ 18 years of age. Studies included adults with overweight or obesity (BMI > 25 kg/m^2) at base-line according to any parameter (e.g. BMI, waist measurement, waist-to-hip ratio [WHR]).
Types of intervention	All types of psychological interventions were considered for inclusion. Psychological interventions were included within the analyses if the type of psychological intervention was able to be identified. Individual and group therapies were included. The analysis included the following subcategories: 1) psychological intervention versus no treatment; 2) psychological intervention versus different type of psychological intervention; and 3) psychological intervention plus diet and / or exercise versus control plus diet and / or exercise. Studies combining a pharmacological intervention with a psychological intervention were excluded from analysis.
Types of outcomes measured	Primary outcomes included: weight or another indicator of body mass (e.g. BMI, waist measurement, WHR); morbidity and mortality; well-being and quality of life measures. Secondary outcomes included: cost of implementing the psychological intervention; measured psychological functioning; fasting plasma glucose and HbA1c; plasma triglycerides, high-density lipoprotein (HDL), low-density lipoprotein (LDL) and very-low-density lipoprotein (VLDL); blood pressure; measures of dietary intake and exercise performance; and adverse effects.

	Weight loss or change in an outcome measure of weight was assessed in studies < 12 months and > 12 months duration.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 36 studies Of the 36 trials, 30 were longer than 16 weeks duration. 25 evaluated multiple psychological interventions within their design, and 11 evaluated a single psychological intervention. 30 studies evaluated a behavioural intervention, four evaluated a cognitive behavioural intervention, four evaluated a relaxation intervention, two evaluated a cognitive intervention, one evaluated a psychotherapeutic intervention, and one evaluated a hypnotherapy intervention. Frequency of study sessions ranged from daily to monthly.	
N and characteristics of participants	N = 3,495 participants Trials varied in size from 6 to 1,191 participants. All trials were conducted in adults (> 18 years of age). The weighted mean age of participants was 43.1 years for the 18 trials that reported age as a mean value. The remaining 18 trials, which reported age as a range, included participants aged between 16 and 75 years. Two trials included men only, 14 included women only, and 20 included both men and women. Across these 20	

	trials, 25% of participants were male. All studies were outpatient community studies except for one study which was an inpatient hospital study. Four studies specified weight entry criteria according to BMI (> 27 for three studies and BMI > 30 for one study). Nineteen studies specified weight entry criteria according to percentage overweight according to Metropolitan Life Insurance Tables. The weighted mean % overweight of participants in these studies was 43.3% (range 27 to 75%). Six studies specified weight entry according to pounds / kilograms overweight. The weighted mean kilograms overweight of participants in these studies was 11.6 kg (range 11.4 to 18.8 kg).
Duration of follow-up	The duration of the interventions ranged from four weeks to 12 months (median 12 weeks). Follow-up time post intervention ranged from three months to 36 months. The weighted mean total trial length was 18.6 months (range three to 36 months).
Overall findings	Behaviour therapy was found to result in significantly greater weight reductions than placebo when assessed as a stand-alone weight loss strategy (weighted mean difference [WMD] -2.5 kg; 95% CI, -1.7 to -3.3). Four studies included data comparing behavioural therapy with control for weight loss that were not suitable for meta-analysis. These studies reported weight loss before versus after psychological intervention. Mean weight losses were reported for each study however no variance data were available for these studies. The range of weight change in participants in behavioural interventions was -0.6 kg to -5.5 kg after behavioural intervention, compared with -2.8 kg to +1.8 kg for participants who acted as no treatment controls. When behaviour therapy was combined with a diet / exercise approach and compared with diet / exercise alone, the combined intervention resulted in a greater weight reduction. Studies were heterogeneous however the majority of studies favoured combining behaviour therapy with dietary and exercise interventions to improve weight loss. Increasing the intensity of the behavioural intervention significantly increased the weight reduction (WMD -2.3 kg; 95% CI, -1.4 to - 3.3). Two studies demonstrated a fall in SBP and DBP with weight loss in intervention and control groups, however data were unable to be compared statistically. One study found no significant change in fasting serum glucose or cholesterol between intervention and control

	groups, however fasting serum insulin was improved in the intervention group compared with control group. Cognitive-behaviour therapy (CBT), when combined with a diet / exercise intervention, was found to increase weight loss compared with diet / exercise alone (WMD -4.9 kg; 95% CI, -7.3 to - 2.4). One of these studies found a significant decrease in serum triglycerides in the treatment group compared with the control group ($P < 0.05$). A study comparing CBT with placebo for weight loss, found that participants in the CBT group lost 7 kg by six months (SD 1.96 kg) and 10 kg by 12 months (SD 3.4 kg), compared with participants in the behavioural therapy group who lost 4.5 kg by six months (SD 2.6 kg) and 4.3 kg by 12 months (SD 2.5 kg) ($P < 0.01$). Three studies compared cognitive with behavioural therapies as a weight loss intervention in patients with overweight or obesity. In all three studies, participants in the behavioural therapy group lost more weight than participants in the CBT group. One of these studies found that behavioural therapy participants lost 5.5 kg compared with participants in the CBT group who lost 0.8 kg ($P < 0.01$).
Compliance with treatment	Not stated
Adverse events	No data on mortality, morbidity or quality of life were found.
Notes	People who are overweight or obese benefit from psychological interventions, particularly behavioural and cognitive-behavioural strategies, to enhance weight reduction. They are predominantly useful when combined with dietary and exercise strategies. The bulk of the evidence supports the use of behavioural and cognitive-behavioural strategies.

Siebenhofer 2009

Characteristics of the study		
Study Citation	Siebenhofer A, Horvath K, Jeitler K, Berghold A, Stich AK, Matyas E, Pignitter N & Siering U 2009, 'Long-term effects of weight-reducing drugs in hypertensive patients', Cochrane Database Syst Rev, no.3, pp.CD007654.	
Study Design	Systematic review and meta-analysis	
Methods		
Types of studies sought	RCTs comparing pharmacologic interventions (orlistat, sibutramine, rimonabant) for weight loss with placebo with a follow up of at least 24 weeks were sought.	
Types of participants sought	Men and non-pregnant women > 18 years old with excess body weight and essential hypertension (baseline blood pressure [BP] of > 140 mmHg SBP and / or a DBP of > 90 mmHg or patients on antihypertensive treatment), for whom at least mortality, cardiovascular outcomes, adverse events or BP were reported.	
Types of intervention	Monotherapy with different doses of orlistat, sibutramine and rimonabant, either fixed or titrated as needed.	
Types of outcomes measured	The primary outcomes were total mortality, cardiovascular morbidity and adverse events. Secondary outcomes were the changes in SBP, DBP and body weight.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Medium	

Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 8 studies No relevant study investigating rimonabant was available for inclusion. All four included studies of orlistat vs. placebo had a parallel, double-blind design. Only one did not mention any industrial sponsoring. It was the only study that was performed as a single centre trial. No orlistat study included mortality and cardiovascular morbidity as a pre-defined outcome. All studies reported adverse events. All studies described the mean change in SBP, DBP and the mean change in body weight. All four included sibutramine vs. placebo studies had a parallel, double-blind design and all trials mentioned industrial sponsorship. Two studies were performed as single centre studies and there were two multicentre studies with numbers of study centres not provided. Two studies compared 10 mg sibutramine vs. placebo once daily. In the other two studies the initial dose of sibutramine 5 mg was titrated up to 20 mg once daily within the first eight weeks. No sibutramine study included mortality and cardiovascular morbidity as a pre-defined outcome. All studies reported on adverse events and described the mean change in SBP, DBP and body weight.	
N and characteristics of participants	N = 3,751 participants The included four orlistat studies involved a total of 3,132 hypertensive participants with a mean age of 46 to 55 years, a baseline SBP of 142 to 154 mmHg and a baseline DBP of 85 to 98 mmHg. Mean treatment duration was six to 48 months. In all studies patients received either 120 mg orlistat three times daily or placebo. The four included sibutramine studies involved a total of 619 hypertensive participants with a mean age of 46 to 53 years, a baseline SBP of 129 to 150 mmHg and a baseline DBP of 82 to 94 mmHg. Mean treatment duration was six to 12 months. Participants had a mean BMI of between 28 and 43 kg/m^2.	
Duration of follow-up	Duration of follow-up for all studies ranged from six months to 48 months.	
Overall findings	Patients assigned to weight loss diets, orlistat or sibutramine reduced their body weight more effectively than patients in the usual care / placebo groups. Orlistat resulted in a pooled weight loss of 3.7 kg (95% IC, -4.7 to -2.8).	

	Sibutramine also reduced body weight by a mean of 3.7 kg (95% CI, -4.8 to -2.6). BP reduction in patients treated with orlistat was for SBP: weighted mean difference (WMD): -2.5 mmHg; 95% CI, -4.0 to -0.9 mmHg and for DBP: WMD -1.9 mmHg; 95% CI, -3.0 to -0.9 mmHg. Meta-analysis showed DBP increased under therapy with sibutramine: WMD +3.2 mmHg; 95%CI +1.4 to +4.9 mmHg.
Compliance with treatment	Not stated
Adverse events	Three of the four orlistat studies reported on mortality. There were no deaths reported in two studies. In the third study there were two deaths in the orlistat treated group in the first subgroup analysis (DBP ≥ 90 mmHg) and one in the orlistat group in the second subgroup analysis (SBP ≥ 140 mmHg). Serious side effects that caused withdrawals and necessitated or prolonged hospitalisation were reported as gastrointestinal, musculoskeletal, dermatological, vascular and nervous side effects. Two orlistat studies presented data on cardiovascular morbidity. In the first study, two patients in the orlistat group suffered from a myocardial infarction (MI), two had chest pain and one had an episode of atrial fibrillation. In the placebo group, one had a MI, one had a worsening of atherosclerotic coronary artery disease and two had an episode of chest pain. The second study reported that in patients with resting left ventricular ejection fraction (LVEF) below 50% at baseline, LVEF did not change with placebo (0.6%), but was increased by 4.3% in the orlistat group, ($p < 0.001$). One sibutramine study reported on mortality - there were no deaths in either the treatment or comparison group. None of the four studies presented data on cardiovascular morbidity. In the sibutramine group, 14 patients reported 21 adverse events. In the placebo group, 13 patients experienced 20 adverse events. None of the adverse events were associated with withdrawals from treatment. Most common were constipation, headache, insomnia, joint pain and dry mouth in the sibutramine group.
Notes	Although trials on orlistat and sibutramine in patients with elevated BP demonstrated statistically significant decreases in weight, orlistat reduced BP and sibutramine increased BP. No long-term mortality and morbidity RCT evidence was identified.

Thomas 2006

Characteristics of the study	
Study Citation	Thomas DE, Elliott EJ & Naughton GA 2006, 'Exercise for type 2 diabetes mellitus', Cochrane Database Syst Rev, vol.3, pp.CD002968.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs comparing aerobic, fitness or progressive resistance training exercise with no exercise, in people with type 2 diabetes mellitus. Trials of ≥ eight weeks, in order to evaluate the effect of ongoing exercise training rather than acute single bouts of exercise, particularly on glycated haemoglobin concentrations or body mass. Studies where the same diet was applied to both the intervention group and the control group and hence the exercise in the intervention group was the only difference between the two groups. Exclusion criteria included: single bout exercise interventions; studies where the intervention involved only the recommendation of increased physical activity without further detail; studies where the exercise intervention was not either directly supervised or well-documented; and studies where there was a co-intervention in the experimental group such as a dietary alteration or counselling that was not also applied to the control group.
Types of participants sought	Males and females with type 2 diabetes. People with impaired glucose tolerance (IGT) were not included in the analysis.
Types of intervention	Exercise intervention, defined as a pre-determined program of physical activity. Physical activity can comprise any body movement produced by skeletal muscle, resulting in an increase in energy expenditure. In contrast, exercise prescriptions include specific recommendations for the type, intensity, frequency and duration of physical activity with a specific objective (that is, increase fitness or health).

	Studies that stated they simply recommended increasing physical activity were not included in the analyses unless it was possible to quantify the exercise stimulus. To measure the effect of exercise, studies where the only difference in interventions between groups was exercise were included. Studies involving dietary or medication changes were eligible for inclusion only when the same treatments were applied to both the control and intervention groups. Studies involving three types of intervention were included: exercise versus non-exercise control; exercise plus diet versus diet alone; exercise plus medication versus medication alone.
Types of outcomes measured	Primary outcomes: - glycaemic control measured as percent glycated haemoglobin (HbA1c) (or fasting glucose concentration, glucose tolerance test, postprandial blood glucose); - body mass indices (body mass [kg], BMI [kg/m^2], visceral adipose tissue [cm^2], subcutaneous adipose tissue [cm^2], muscle mass [kg]); - adverse events (hypoglycaemic reactions, exercise induced injuries). Secondary outcomes: - insulin sensitivity (area under the insulin curve, Kitt constant, plasma insulin concentrations); - blood lipids (mmol/L) (total cholesterol, high density lipoprotein-cholesterol [HDL], low-density lipoprotein-cholesterol [LDL], triglycerides); - blood pressure (BP) (mmHg); - quality of life (using validated instruments such as SF-36, Euroquol); - fitness (as measured by maximal exercise capacity [VO2 max]); - diabetic complication rates (diabetic neuropathy, diabetic retinopathy, diabetic nephropathy and diabetic cardiovascular disease); and - mortality.

Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 14 studies All were RCTs. Conducted in Australia, Canada, Denmark, Finland, France, Israel, Japan and New Zealand. The duration of the interventions ranged from eight weeks in four studies and six to 12 months in another.	
N and characteristics of participants	N = 377 participants The number of participants in a single study ranged from 16 to 49 with a pooled total of 361 participants in studies reporting HbA1c. Of these, 198 participants received the exercise intervention. Six studies included more than 16 participants in the intervention group; one of these had 24 participants. The mean age of most groups was between 45 and 65 years. The number of men participating in the studies was greater than women.	
Duration of follow-up	The longest intervention lasted 12 months. Two studies reported 12 month post-intervention follow-up.	
Overall findings	There was no significant difference between groups in whole body mass, probably due to an increase in fat free mass (muscle) with exercise, as reported in one trial (6.3 kg, 95% CI 0.0 to 12.6). There was a reduction in visceral adipose tissue with exercise (-45.5 cm^2, 95% CI -63.8 to -27.3), and	

	subcutaneous adipose tissue also decreased. No study reported adverse effects in the exercise group or diabetic complications. Compared with the control, the exercise intervention significantly improved glycaemic control as indicated by a decrease in HbA1c levels of 0.6% (95% CI, -0.9 to -0.3; P < 0.05). This result is both statistically and clinically significant. The exercise intervention significantly increased insulin response (131 AUC, 95% CI 20 to 242) (one trial), and decreased plasma triglycerides (-0.25 mmol/L, 95% CI -0.48 to -0.02). No significant difference was found between groups in quality of life (one trial), plasma cholesterol or BP. - Body mass (0.0 kg WMD, 95% CI -3.8 to 3.8kg) - Triglycerides (-.25 WMD, 95% CI -0.48 to -0.02)(P < 0.05) - Total cholesterol (-0.1 mmol/l WMD, 95% CI -0.4 to 0.2) - HDL (0.0 mmol/L WMD, 95% CI -0.1 to 0.1) - LDL (0.1 mmol/L WMD, 95% CI -0.3 to 0.5) - SBP (-4.0 mmHg WMD, 95% CI -10.0 to 1.0) - DBP (0.0 mmHg WMD, 95% CI -4.0 to 3.0) - Quality of life: no data reported.
Compliance with treatment	Compliance with exercise ≥ five times per week was required in two studies. One of these studies, which was home-based rather than community based, monitored compliance using hidden counters on the cycle ergometers.
Adverse events	Some reported on the lack of serious adverse effects or exercise induced injuries in the intervention group. One study mentioned that one participant in the control (non-exercise) group had a cerebrovascular accident during the trial period and was withdrawn from the study.
Notes	An exercise intervention resulted in a clinically significantly improvement in glycaemic control compared to controls. The decrease of 0.6% HbA1c was achieved over relatively short periods of time.

Treadwell 2008

Characteristics of the study	
Study Citation	Treadwell JR, Sun F & Schoelles K 2008, 'Systematic review and meta-analysis of bariatric surgery for pediatric obesity', Ann Surg, vol.248, no.5, pp.763-76.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	A systematic review and meta-analysis of published studies of all study types including paediatric patients who have received bariatric surgery. Included studies were required to report outcome data for ≥ 3 patients aged ≤ 21 years at the time of surgery, representing ≥ 50% of paediatric patients enrolled at that centre. The authors only included English language articles with a minimum of 1-year follow-up of weight and BMI. If there were multiple reports from the same surgical centre, the authors avoided double-counting patients by including data and outcomes that were based on the largest number of patients and still meeting the other inclusion criteria.
Types of participants sought	Patients aged ≤ 21 years at the time of their bariatric surgery.
Types of intervention	LAGB, RYGB, VBG, banded bypass (BB), and biliopancreatic diversion (BPD).
Types of outcomes measured	Weight, BMI, quality of life, survival. For quality-of-life outcomes, the study must have measured quality of life before and after surgery using a previously validated instrument. Data on any nonsurgical control groups were included only if the patients receiving nonsurgical treatment were sufficiently similar to surgical patients.

Quality of study	Rating	Comments
Level of evidence	III-2	One was a comparative study with concurrent controls; all other studies were case series.
Study quality rating*	B	Not only RCTs; differences between studies not explained.
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 18 studies Of the 18 unique studies that met the inclusion criteria, eight investigated LAGB, five investigated RYGB; one investigated both RYGB and VBG, two VBG only, one BPD only, and one the BB procedure. Fourteen of 18 studies explicitly stated that, prior to surgery; nonsurgical methods of weight loss had been attempted and were unsuccessful in all patients. Eleven of 18 studies were conducted in the USA; the other seven were conducted in Israel (two studies), Italy (two studies), Australia, Austria, or Saudi Arabia. Six non-USA studies investigated LAGB, and the seventh investigated BPD. Fourteen studies reported data from a single surgical centre, whereas the other four were from two or more surgical centres. One was a comparative study with concurrent controls; all other studies were case series.	
N and characteristics of participants	N = 641 participants. Eight studies of LAGB reported data on 352 patients (mean BMI 45.8 kg/m^2); six studies of RYGB included 131 patients (mean BMI 51.8 kg/m^2); five studies of other surgical procedures included 158 patients (mean BMI 48.8 kg/m^2). Other surgical procedures included 71 participants for VBG, 68 for BPD and 19 for BB. Average patient age was 16.8 years (range 9 to 21 years). For LAGB participants, the mean age ranged from 15.6 to 18 (weighted average 16.7; overall age range 9 to 20). The percentage of females ranged from 50% to 81% (weighted average 70%). The mean baseline BMI ranged from 42.4 to 50.5 (weighted average 46; overall BMI range 31 to 76.6). Of the six RYGB studies, two used a laparoscopic approach, three used an open approach, and one used an open	

	approach for 94% of procedures and a laparoscopic approach for the remaining 6%. The mean age ranged from 15.7 to 17.57 (weighted average 16.8; overall age range 11 to 21). The percentage of females ranged from 57% to 79% (weighted average 66%). The mean baseline BMI ranged from 47 to 56.5 (weighted average 51.8; overall BMI range 38 to 95.5). All other procedures were performed using an open approach; the patients undergoing these procedures were similar to those undergoing LAGB or RYGB.
Duration of follow-up	The mean length of follow-up for all studies was ≤ 11 years.
Overall findings	Meta-analyses of BMI reductions at longest follow-up indicated sustained and clinically significant BMI reductions for both LAGB and RYGB. Over 1 to 3 years patients who received LAGB reduced BMI by between 10.6 and 13.7 kg/m^2 (3.4 BMI units is equivalent to 7% reduction in body weight in this group). Over the follow-up period there was 92% resolution of diabetes (11 of 12 participants), 71% resolution of hypertension (15 of 21 participants), 86% resolution of dyslipidaemia (6 of 7 participants), 100% resolution of asthma (6 of 6 participants) and 38% resolution of musculoskeletal conditions (3 of 8 participants). Over 1 to 6.3 years patients who received RYGB reduced BMI by 17.8 to 22.3 kg/m^2 (4.1 BMI units is equivalent to 7% reduction in body weight in this group). Over follow-up of between 5 months and 2.7 years there was 50% resolution of diabetes (3 of 6 participants), 75% resolution of hypertension (15 of 20 participants), 60% resolution of gastro-oesophageal reflux disease (3 of 5 participants), 36% resolution of musculoskeletal conditions (4 of 11 participants) and 100% resolution of sleep apnoea (16 of 16 participants). There were insufficient data for other surgical procedures to enable reporting against weight change outcomes. BPD was associated with 82% resolution of hypertension (27 of 33 participants) and 100% resolution of dyslipidaemia (11 of 11 participants).
Compliance with treatment	One study included in this review reported that only 13% of paediatric patients continued taking nutritional supplements as instructed. No other included studies examined compliance.
Adverse events	For LAGB, band slippage and micronutrient deficiency were the most frequently reported complications, with sporadic cases of band erosion, port / tube dysfunction, hiatus hernia, wound infection, and pouch dilation. No in-hospital or postoperative death was reported in any LAGB study. Re-operations were performed on 8% of the

	patients (28/352) to correct various complications such as band slippage, gastric dilation, intragastric band migration, psychologic intolerance of band, hiatus hernia, cholecystitis and tubing crack. Overall, band slippage was the most frequently reported specific complication (3%; 12/352). Eight cases of iron deficiency and five cases of mild hair loss were reported; the remaining reported complications had a case number ≤ three. No studies reported data on the impact of surgery on growth or development. For RYGB, complications documented included pulmonary embolism, shock, intestinal obstruction, postoperative bleeding, staple line leak and severe malnutrition. The most frequently reported type of complication involved protein-calorie malnutrition and micronutrient deficiency. Inconsistencies in reporting precluded calculation of an overall re-operation rate after RYGB. No in-hospital death was reported. One patient died nine months after surgery, because of severe Clostridium difficile colitis, severe diarrhoea, an extended period of profound hypovolemia and multiple organ failure. Three additional patients died of causes that were unlikely to be directly related to the bariatric surgeries (in one study one patient died four years after surgery and in another study two patients died two years and six years after surgery). One study reported patients' preoperative and postoperative heights and concluded that there was no evidence of growth retardation after surgery at an average follow-up of six years. However, the authors of the primary study were unable to extract data concerning the expected growth of the adolescents in their study. The results of other procedures showed that no in-hospital deaths were reported, but three follow-up deaths were reported (all after BPD; the causes were protein malnutrition, pulmonary oedema, and acute necrotizing pancreatitis). In the VBG studies, recurrent gastric ulceration (in two patients), enlarged pouches (in two patients) and staple line disruption (in one patient) were reported. The study of BPD reported 11 cases of protein malnutrition. In the BB study, two revisions for gastro-gastric fistula, one cholecystectomy, one recurrent marginal ulcer requiring antacids and three plastic surgeries for excess skin were reported as post-surgery complications. None of the five studies reported any data on the potential impact on physical growth.
Notes	Bariatric surgery in paediatric patients results in sustained and clinically significant weight loss, but also has the potential for serious complications. In a paediatric patient of average age, height and BMI in the included studies, the 5% and 7% goals correspond to BMI reductions of only 2.7 and 3.7 units, respectively. This meta-analysis of BMI reductions showed that postsurgical weight loss far exceeded these targets. The BMI reduction appeared to be larger after RYGB than LAGB, however the RYGB patients had larger pre-surgical BMIs (~52 vs. ~46), and some of the weight loss difference may have been because of the baseline difference.

Tsai 2009

Characteristics of the study	
Study Citation	Tsai AG & Wadden TA 2009, 'Treatment of obesity in primary care practice in the United States: a systematic review', J Gen Intern Med, vol.24, no.9, pp.1073-9.
Study Design	Systematic review
Methods	
Types of studies sought	RCTs. Obesity / weight loss interventions in US adults.
Types of participants sought	US adults with obesity.
Types of intervention	Studies included counselling as a behavioural obesity / weight loss intervention, used alone or in conjunction with pharmacotherapy. Counselling conducted by primary care providers (PCPs) or another provider working in the primary care office (or the trial was implemented in a setting explicitly intended to simulate primary care). The review identified two principal approaches that had been tested for PCPs to manage obesity in their own practices. First, PCPs provide behavioural weight loss counselling, with or without the addition of pharmacotherapy. The second option, referred to as collaborative obesity management, used a team approach in which a non-physician (e.g. a registered dietitian) serves as the primary treatment provider, with the physician in a supporting role.
Types of outcomes measured	Weight change (kg).

Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	B	Between study differences not discussed Point estimates not reported
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 10 studies A total of 10 trials with 24 intervention arms. All were randomised trials. Studies were classified as: PCP counselling alone, PCP counselling + pharmacotherapy, and “collaborative” obesity care. Four trials have assessed the effects of brief physician counselling. Counselling materials were individualised for each patient. Most studies provided low- or moderate-intensity counselling. Only two of the ten studies included a high-intensity intervention (i.e. at least two visits per month for the first three months). Four other trials were moderate intensity (i.e. monthly contact), and the remaining four studies were low intensity. In the active treatment arms of the high-, medium-, and low-intensity studies, the mean number of treatment contacts was 17 (over 7.5 months), 14.8 (over 13.5 months), and 7.2 (over 16 months), respectively.	
N and characteristics of participants	N = 3,679 participants All patients were female, and most were African-American.	

	The average age of patients was 41.7 years. The average BMI was 38.8 kg/m^2.
Duration of follow-up	The duration of the studies including follow-up for all studies was between 1 and 2 years.
Overall findings	Treatment of Obesity by PCP Counselling An intent-to-treat analysis revealed that the PCP counselling group lost an average of 1.4 kg at six months, compared with a gain of 0.3 kg in patients who received usual care (P = 0.01). Changes for the two groups at 18 months were -0.5 vs. +0.1 kg, respectively (P = 0.39). In a similar study, the effect of additional PCP counselling during quarterly visits for patients with type 2 diabetes was evaluated. After one year, patients in the counselling group lost 0.1 kg, compared to a gain of 0.6 kg in the control group (P = 0.23). The odds of achieving a 5% weight loss were higher in the intervention group (p < 0.01). A third study examined the benefits of brief PCP counselling among overweight and obese patients with hyperlipidemia. A total of 45 PCPs were randomised to provide one of three interventions: (1) usual care, (2) physician nutrition counselling, or (3) physician nutrition counselling + office support for intervention delivery. Office support included provision of dietary assessments to patients and counselling materials to PCPs, as well as flagging the results of dietary assessments during PCP visits. After one year, only the patients of physicians in the third arm achieved a statistically significant weight loss (2.3 kg) compared with the control group (weight change of 0.0 kg; p < 0.001). In a similar investigation, resident physicians who were treating obese patients with hypertension were randomised to: (1) nutrition counselling training or (2) usual care. Patients of PCPs that received nutrition counselling training lost 0.9 kg, while patients of PCPs in the control group gained 1.3 kg. The difference between groups was not statistically significant (p > 0.05; exact p value not provided). Treatment of Obesity by PCP Counselling plus Pharmacotherapy Three studies tested the effectiveness of lifestyle counselling plus pharmacotherapy provided by PCPs or as part of interventions that modelled brief office visits for obesity. A 2-year study of orlistat randomised patients to placebo, orlistat 60 mg TID, or orlistat 120 mg TID. All patients received the same brief lifestyle counselling and were assessed by their PCPs ten times during the trial. Weight losses in the three groups after two years were 1.7 kg, 4.5 kg, and 5.0 kg, respectively (P = 0.001 for both orlistat

	groups compared with placebo). A second trial of orlistat simulated brief office visits for obesity. Patients were randomised to: (1) monthly, 15-20 min weight loss counselling visits (with a nurse or registered dietician), (2) orlistat alone (120 mg TID), or (3) the combination of brief counselling visits plus orlistat. At one year, patients in the two groups that received orlistat both lost an average of 1.7 kg, while those in the counselling-alone group gained 1.7 kg ($p < 0.001$ for arms 2 and 3, compared to arm 1). In another medication study, PCPs provided: (1) sibutramine alone (15 mg/day), or (2) sibutramine (15 mg/ day) plus brief lifestyle counselling. Both groups had eight brief visits over one year. Those in the sibutramine + brief counselling group kept food and activity records for the first 18 weeks, at which time they lost significantly more weight than individuals treated by sibutramine alone (7.5 vs.5.0 kg, respectively; $P = 0.05$). Weight losses of the two groups were 7.3 and 4.7 kg at 1 year ($p > 0.1$). Treatment of Obesity by Collaborative Obesity Treatment Three studies evaluated collaborative obesity care, in which registered dieticians or nurses were enlisted to support PCPs' provision of weight loss counselling. Patients studied in one trial were randomly assigned to one of three arms: (1) every-other-week counselling by a registered dietician (RD), (2) every-other-week counselling by a RD, plus meal replacements, or (3) every-other-week visits with a nurse or physician, plus meal replacements. Weight losses at one year in the three groups were 3.4, 7.7, and 3.5 kg, respectively ($P = 0.03$ for group 2, compared with groups 1 and 3), suggesting that meal replacements and RD counselling had an additive effect. One study conducted in three rural primary care practices randomised 101 patients to: (1) educational materials or (2) educational materials, plus a series of eight phone calls from a masters-level counsellor who used motivational interviewing techniques for weight management. PCPs of patients in both groups were given educational materials, and PCPs of patients in the active treatment group were also provided with obesity care recommendations (based on information obtained from phone calls). Weight losses after six months were 1.0 and 4.3 kg, respectively ($P = 0.01$). A similar study randomised patients to an intervention delivered by RDs or to a usual care arm. Patients in both groups received calorie and exercise prescriptions, as well as semi-annual 10-min visits with a RD. Those in the first group also received monthly telephone calls from a RD. Weight losses after six months in the two groups were 1.6 and 0.9 kg, but both interventions were associated with minimal weight losses after two years (0.4 and 0.2 kg,

	respectively; P = 0.5). Only one of two high-intensity studies incorporated collaborative obesity treatment in which a dietician met with patients twice a month and provided meal replacements. Participants lost 7.7 kg, which met the criterion of clinically significant weight loss (i.e. ≥ 5% of initial weight). The other high-intensity trial, which provided twice monthly contact by phone for the first three months, produced a loss of 4.3 kg. Weight loss, however, in this latter study was calculated from a completers analysis (based on 50% of participants) and is likely to overestimate the efficacy of the intervention. Of the remaining eight trials, four were of moderate intensity, and four were of low intensity. Two of the four low-intensity studies produced a clinically significant weight loss by combining lifestyle counselling with either sibutramine or orlistat. None of the four studies in which PCPs provided low- to moderate-intensity behavioural counselling alone resulted in clinically significant weight loss, suggesting that low-intensity PCP counselling alone is insufficient for achieving clinically meaningful weight loss in obese adults. Weight losses in the active treatment arms of high-, medium-, and low-intensity studies ranged from 0.1 to 2.3 kg, 1.7 to 7.5 kg and 0.4 to 7.7 kg, respectively.
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	The evidence from this review does not support the use of low- to moderate-intensity physician counselling for obesity, by itself, to achieve clinically meaningful weight loss. PCP counselling plus pharmacotherapy, or intensive counselling (from a dietitian or nurse) plus meal replacements may help patients achieve this goal.

Turk 2009

Characteristics of the study	
Study Citation	Turk MW, Yang K, Hravnak M, Sereika SM, Ewing LJ & Burke LE 2009, 'Randomized clinical trials of weight loss maintenance: a review', J Cardiovasc Nurs, vol.24, no.1, pp.58-80.
Study Design	Systematic review
Methods	
Types of studies sought	The criteria for inclusion in the review were: (1) a randomised clinical trial of a weight-loss maintenance intervention after an initial weight loss; (2) adult population (18 years of age, 1 trial > 17 years old); and (3) English language. In order to isolate the specific effect on weight-loss maintenance, only trials that used a true experimental design and randomly assigned participants to an intervention for maintenance were included. Thus, weight-loss trials with a maintenance phase that did not randomly assign participants to the maintenance intervention were excluded. Because some early papers were identified as important in the development of knowledge related to weight-loss maintenance, papers from 1984 to 2007 were included. Subsequent articles reporting on the same intervention study were excluded.
Types of participants sought	Participants aged > 17 years with overweight or obesity.
Types of intervention	Interventions included: (1) the internet; (2) VLCD; (3) pharmacotherapy; (4) behavioural strategies; (5) physical activity; and (6) alternative therapies.
Types of outcomes measured	Measures of the principal outcome of interest, weight change (continued loss, maintenance, or regain), were expressed in (1) absolute weight change (kg or lbs) or percentage of weight loss from the completion of the weight-loss period to the completion of the maintenance intervention or (2) from prior to weight-loss treatment to the end of maintenance or follow-up based on the reporting of the article.

Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	C	No pooled estimates of effect or quality scoring of studies No examination of study population characteristics that determine the magnitude of effect of the intervention Heterogeneity not explored
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 42 studies The internet (N = 4 studies), VLCD (N = 19 studies), pharmacotherapy (N = 7 studies), behavioural strategies (N = 10 studies), and physical activity or alternative therapy (N = 2 studies). Most trials required that participants lost ≥ 5% of initial body weight during the weight-loss period before being randomised to the weight-loss maintenance intervention, although one medication trial required only a 2% weight loss. Internet studies: Technological advances have permitted the use of less traditional methods for encouraging weight-loss maintenance. Four randomised trials used the internet as an innovative strategy to assist participants in sustaining their lost weight. In general, these studies compared the use of an internet-based weight-loss maintenance intervention with online chat room sessions to in-person group behavioural therapy sessions after a behavioural weight-loss trial. Very-Low-Calorie Diet (VLCD) studies: Nineteen reviewed studies examined weight-loss maintenance trials after a VLCD and included additional	

	intervention strategies such as medications, meal replacements, macronutrient and other dietary intervention or supplementation, periodic use of the VLCD or pre-packaged foods, and exercise. A VLCD usually provides < 800 kcal/day in a liquid form, is medically supervised to monitor electrolyte balance, includes vitamin and mineral supplementation and has been shown to produce rapid, substantial weight loss. However, sizable weight regain after these diets is also typical, and they may offer no long-term benefit over traditional reduced-calorie diets. The reviewed studies began with a VLCD for varying lengths of time (4 to 16 weeks) using caloric intakes ranging from 220 to 1000 kcal/day, and then participants were randomised to a weight-loss maintenance intervention. VLCD followed by medications in maintenance - In seven trials of weight-loss maintenance after a VLCD, four types of medications were administered- orlistat, sibutramine, acarbose, or sertraline. Three studies examined orlistat, two trials investigated sibutramine, and acarbose and sertraline were evaluated in one study each. VLCD followed by a dietary component in maintenance - Seven trials in the review evaluated the use of a dietary intervention, macronutrients, and other dietary supplements after a VLCD. Treatments used included an ad lib, high-carbohydrate low-fat diet versus a calorie-restricted diet, green tea use, increasing protein intake, adding fibre, and supplementing carbohydrate intake. VLCD followed by physical activity in maintenance - Two randomised trials of weight-loss maintenance explored the role of physical activity after a VLCD. One trial conducted in only women compared a control group (no increase in exercise) to a walking group with a caloric expenditure goal of 1000 kcal/week and a walking group with a goal of expending 2000 kcal/week. The other trial enrolled only male participants and randomised participants to resistance training, or walking, or control. Both studies offered counselling to follow a low-fat diet. Pharmacotherapy studies: Seven trials used medication, either sibutramine or orlistat, with dietary instructions or dietary support in randomised maintenance interventions following a drug therapy weight-loss trial. Two sibutramine studies compared a 15mg/day dose to placebo, and one trial used 10 mg/day, which could be increased to a maximum of 20 mg/day if additional weight gain occurred. The four orlistat studies all used 1-year maintenance interventions. Participants received continuous treatment with orlistat 120 mg/TID for two years. Behaviour Therapy studies: Ten studies used some form of a behavioural therapy in randomised trials for weight-loss maintenance. One group conducted five such studies between 1984 and 2001 in an effort to improve maintenance after behavioural weight-

	loss treatment. Physical Activity and Alternative Therapies studies: Only two studies examined either the effect of a physical activity intervention or an alternative therapy method in randomised trials of weight-loss maintenance. While research has documented the importance of physical activity in weight loss and maintenance, only one trial, not conducted after a VLCD, randomised participants to a weight-loss maintenance intervention that focused on the effect of physical activity in preventing weight regain. This study randomly assigned 67 participants to either an exercise-centred intervention or a weight-centred intervention after a behavioural weight-loss study. The 12-week alternative therapy trial included 10 hours of group meetings and explored the effects of randomly assigning 92 participants to qigong, Tapas Acupressure TechniqueR (TAT), or a support group. Qigong is an ancient Chinese healing discipline that consists of a combination of breathing, mental exercises, and physical movements. TAT merges acupressure with mental focusing to change stored energy patterns in the body. The support group reviewed handouts related to weight-loss maintenance.
N and characteristics of participants	N = 9,740 participants The internet (N = 714), a VLCD, including alternate dietary strategies (N = 2,359), pharmacotherapy (N = 5,139), behavioural strategies (N = 1,364), physical activity (N = 67) and alternative therapies (N = 92). Studies were of both single and mixed genders and ethnicity was often not reported. Baseline age and BMI were not reported in the review.
Duration of follow-up	Duration of intervention and follow-up varied significantly between studies (when reported) with the longest duration being three years weight maintenance after an eight week VLCD.
Overall findings	Internet study findings: Results were mixed. Two studies found no difference in weight-loss maintenance between internet and face-to-face groups. One study found the program via the internet resulted in long-term weight losses similar to in-person programs. In a third study, a comparison of internet treatment with minimal and frequent in-person treatment found that the internet group maintained significantly less weight at the end of the trial than the in-person groups ($p < 0.05$). In the fourth study an internet chat room intervention was found to be less effective in preventing weight

	regain than the in-person, group behavioural treatment (p = 0.02). Very-Low-Calorie Diet (VLCD) study findings: There were four intervention types that were examined – VLCD followed by medications in maintenance, VLCD followed by diet in maintenance, VLCD followed by VLCD in maintenance and VLCD followed by physical activity in maintenance. Medication studies assessed orlistat, sibutramine, acarbose and sertraline. One of three orlistat studies found significant differences with orlistat versus placebo; both sibutramine studies demonstrated sibutramine to be superior to placebo for weight maintenance; no benefit was identified in weight maintenance with acarbose or sertraline. There were seven studies that assessed diet. Dietary types assessed included low fat, low calorie, high protein and high fibre. No clear benefit in one dietary type over another was identified. The results of three studies that included the occasional use of a VLCD during maintenance or provided foods after VLCD-induced weight loss indicated that weight maintenance after 24 months was the same for all groups whether or not a VCLD was included in the maintenance phase. Although neither physical activity study found a difference between groups in weight regain at the completion of the trial, adherence to the exercise prescription was negatively correlated with weight gain ($r = -0.43$, $P < 0.01$), and resistance training reduced the regain of body fat mass in the sample of men. In the trial with women, a higher number of daily steps was significantly associated with weight-loss maintenance, and slightly better maintenance in the 1000 kcal/week group suggests that a moderate exercise prescription was easier to follow. Pharmacotherapy study findings: All three sibutramine studies found the drug to be superior in sustaining weight loss when compared to placebo. No difference was found between groups who received a continuous or periodically interrupted dose. The four orlistat studies all used 1-year maintenance interventions and found the medication to be more efficacious for promoting weight-loss maintenance than placebo. Participants who received continuous treatment with orlistat 120 mg/TID for two years (during weight loss and during weight maintenance) experienced the least amount of regain. Administering higher doses resulted in less regain. Behaviour Therapy study findings: Some studies have found that weight regain is attenuated by forming peer social support groups; by providing ongoing interventionist contact; and by structured behaviour therapy. Problem-solving therapy is significantly better at promoting weight maintenance compared to a no-contact control condition and appears superior to relapse-prevention training in longer-term maintenance. The role of continued participant contact for weight maintenance

	varies across studies. In some but not all studies, increased contact is associated with greater weight maintenance. Treatment individualised to the person's stage of change (Transtheoretical Model of Health Behaviour Change) is not consistently associated with improved weight maintenance. Physical Activity study findings: The weight-centred treatment focused on dealing with participant-introduced barriers to weight-loss maintenance, and the exercised-centred intervention focused on sustaining physical activity, e.g. organised biweekly exercise sessions, incentives for meeting exercise goals, and problem-solving for handling exercise lapses. While both groups regained weight during the trial and 6-month follow-up, the weight-centred group regained less weight, $P < 0.01$ (effect size = 0.31), and ate fewer calories from fat, $P < 0.05$ (effect size = 0.24), suggesting that the exercised-centred intervention might not have included enough emphasis on controlling dietary intake.
Compliance with treatment	Ten reviewed trials had attrition rates of more than 35%
Adverse events	Not stated
Notes	The reviewed studies found that weight-loss maintenance treatment with orlistat or sibutramine and dietary modification, diets that create an energy deficit, behavioural therapies that include problem-solving, peer support and increased participant contact were more likely to be effective in reducing weight regain after weight-loss treatment. Additional studies are needed to confirm and expand upon these findings.

Viner 2010

Characteristics of the study	
Study Citation	Viner RM, Hsia Y, Tomsic T & Wong IC 2010, 'Efficacy and safety of anti-obesity drugs in children and adolescents: systematic review and meta-analysis', Obes Rev, vol.11, no.8, pp.593-602.

Study Design	Systematic review and meta-analysis	
Methods		
Types of studies sought	Double-blind randomised placebo-controlled clinical trials published between January 1996 and July 2008 investigating the effects and safety of anti-obesity drugs (orlistat, sibutramine, rimonabant) for BMI reduction in children and adolescents aged < 20 years with primary obesity were sought. Minimum study duration including follow-up was ≥ 6 months. There was no restriction on language. The authors included any trials which used an established definition of overweight or obesity (BMI ≥ 85th, 95th or 98th centile; BMI > International Obesity Taskforce definitions).	
Types of participants sought	Children and adolescents aged < 20 years with primary obesity.	
Types of intervention	Anti-obesity drugs (orlistat, sibutramine, rimonabant) with diet, exercise and / or a variable element of behavioural modification therapy (BT).	
Types of outcomes measured	BMI reduction. Secondary outcomes included blood lipids, fasting glucose and insulin levels, blood pressure and adverse reactions.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 6 studies	

<table>
<tr><td></td><td>All six trials were RCTs, with four sibutramine and two orlistat trials meeting the inclusion criteria. No trials of rimonabant were identified. All trials included a standardised low-fat low-energy diet and encouragement to exercise, with a variable element of behavioural modification in some trials.</td></tr>
<tr><td>N and characteristics of participants</td><td>N = 1259 participants

Sibutramine trials (n = 686 participants) and orlistat trials (n = 573 participants).

Participants across all trials included in the meta-analysis had similar demographic profiles: the majority were aged 12 to 18 years, mean BMI was between 30 and 40 kg/m^2 and they were predominantly white or Hispanic.</td></tr>
<tr><td>Duration of follow-up</td><td>Study duration including follow-up was ≤ 54 weeks.</td></tr>
<tr><td>Overall findings</td><td>Compared with placebo, sibutramine together with behavioural support reduced BMI by significantly more than orlistat together with behavioural support.
<table>
<tr><td></td><td>Orlistat</td><td>Sibutramine</td></tr>
<tr><td>BMI (kg/m^2)</td><td>-0.8 (-1.2, -0.5)</td><td>-2.2 (-2.8, -1.□)</td></tr>
<tr><td>SBP (mmHg)</td><td>NR</td><td>1.4 (0.1, 2.6)</td></tr>
<tr><td>DBP (mmHg)</td><td>NR</td><td>1.7 (1.0, 2.5)</td></tr>
<tr><td>Cholesterol (mmol/l)</td><td>0.03 (-0.17, 0.23)</td><td>-0.02 (-0.72, 0.69)</td></tr>
<tr><td>LDL (mmol/l)</td><td>-0.05 (-0.11, 0.01)</td><td>-0.18 (-0.62, 0.25)</td></tr>
<tr><td>HDL (mmol/l)</td><td>0.00 (-0.02, 0.03)</td><td>0.09 (0.05, 0.13)</td></tr>
<tr><td>Triglycerides (mmol/l)</td><td>0.00, (-0.17, 0.18)</td><td>-0.31 (-0.39, -0.23)</td></tr>
<tr><td>Glucose (mmol/l)</td><td>0.02 (-4.83, 4.01)</td><td>-0.04 (-0.08, 0.00)</td></tr>
</table></td></tr>
</table>

Compliance with treatment	Not stated
Adverse events	Adverse reactions with sibutramine included significant but small increases in SBP and DBP and heart rate. Sibutramine did not increase the risk of other adverse events except for dry mouth. Orlistat was associated with an approximate 50% increase in minor gastrointestinal adverse events such as oily spotting and an 8 to 17% increase in the absolute incidence of more major gastrointestinal events such as flatus with discharge and faecal incontinence.
Notes	Sibutramine together with behavioural support in obese adolescents produces a clinically meaningful reduction in BMI of 0.6 to 0.8 SD and is well tolerated. In contrast, orlistat together with behavioural support has limited utility as a weight reduction treatment in adolescents, producing a small effect (0.24 to 0.3 SD) with frequent gastrointestinal side effects. Sibutramine provides a clinically meaningful effect size as longitudinal epidemiological data suggest that each additional BMI SD at age 13 years increases the risk of non-fatal cardiovascular events by 11 to 17% and fatal cardiovascular events by 23 to 24%. Sibutramine also increased the absolute percentage of those achieving a 10% BMI loss by approximately 40%. Sensitivity analyses suggested that the addition of BT programs to sibutramine minimally increased mean BMI loss (by approximately 0.2 kg/m^2), and that a longer duration of sibutramine use may increase BMI loss by approximately 0.6 kg/m^2. The effect size for Orlistat was smaller and of borderline clinical significance at 0.24 SD reduction in BMI. The authors found sibutramine to have modest beneficial effects on triglycerides and HDL-cholesterol, similar to findings in adults. However, they found no evidence of beneficial metabolic effects associated with orlistat use, in contrast to meta-analysis in adults which suggests orlistat has small beneficial effects on LDL and total cholesterol. The reasons for this difference are unclear but may relate to the modest BMI loss seen with orlistat in adolescents and the small number of studies.

Whitlock 2010*

Characteristics of the study	
Study Citation	Whitlock EP, O'Connor EA, Williams SB, Beil TL & Lutz KW 2010, 'Effectiveness of weight management interventions in children: a targeted systematic review for the USPSTF', Pediatrics, vol.125, no.2, pp.e396-418.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs or controlled clinical trials (CCTs) of behavioural interventions with minimal intervention or placebo control, with ≥10 subjects per treatment arm. RCTs of pharmacological interventions with placebo pill control, with ≥10 subjects per treatment arm. Behavioural and pharmacologic treatments for overweight and / or obese children. Behavioural, pharmacologic, complimentary / alternative, or health care system interventions, singly or combined, designed to promote weight control / loss or weight maintenance, or an important component of weight loss (e.g. physical activity). Intervention must have been conducted in primary care, feasible for conduct in primary care, or comparable to programs widely available for referral from primary care. Programs that were feasible for implementation in a health care system and, therefore, could be available for referral from primary care. Trials must have provided acceptable adiposity outcome or weight outcome (e.g. baseline and postintervention weight, weight change, net weight change over control group, or a related measure (e.g. BMI, BMI SDS). Studies with outcomes assessment ≥ six months after baseline except for those assessing serious adverse events, where no minimum follow-up was required. Studies conducted in settings rated “high” on Human Development Index (> 0.90).

	Studies published in 1985 or later. All potential harms reported in trials were included. Outcomes were limited to serious adverse events such as death, need for medical or psychiatric treatment, or growth retardation in the trials addressing harms. Trials were excluded in settings not feasible for implementation in primary care or health care systems to which primary care providers (PCPs) could refer, such as schools and inpatient settings. Trials were excluded if the intervention focused on primary prevention, changes in the built environment, mazindol.
Types of participants sought	Participants aged 2 to 18 years. Either: a) entire sample was overweight or obese (85th percentile for age and gender-specific BMI or who meet previously accepted criteria for overweight on the basis of ideal body weight), or b) 50% of the sample were overweight or obese and 80% of the sample had one of the following risk factors for overweight or obesity-related medical problems: children of overweight parents; Hispanic, black, or American Indian / Alaska Native; children with the following medical conditions: diabetes, metabolic syndrome, hypertension, lipid abnormalities, or other cardiovascular-related disorders. The population was primary care or comparable. Excluded trials were those in which the sample was limited to youth: with eating disorders; pregnant / postpartum; overweight / obesity secondary to genetic or medical condition, including PCOS, hypothyroid, Cushing disease, growth hormone deficiency, insulinoma, hypothalamic disorders, Laurence-Moon-Biedl syndrome, Prader-Willi syndrome, weight gain secondary to medications (e.g. antipsychotics), or other idiosyncratic weight-loss issues.
Types of intervention	Behavioural interventions and pharmacologic interventions. Interventions were considered comprehensive if they included: (1) weight-loss or healthy diet counselling, (2) physical activity counselling or physical activity program participation, and (3) behavioural management techniques to help make and sustain changes in diet and physical activity.
Types of outcomes measured	Change in BMI from baseline, change in BMI SD score (SDS) or change in percent overweight. Weight outcomes were categorized as short-term (6 to 12 months since beginning treatment) or maintenance (between one and four years after beginning treatment and at least 12 months after ending active treatment).

Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 20 studies Included 13 studies of behavioural interventions (i.e., (11 RCTs and two CCTs) and 7 trials that combined pharmaceutical treatments (sibutramine or orlistat) with behavioural interventions (two large, multicentre RCTs). The majority of studies were published in 2005 or later.	
N and characteristics of participants	N = 2,552 participants Thirteen behavioural intervention trials contained 1,258 overweight or obese children and adolescents aged 4 to18 years. The seven trials that combined pharmacologic treatments with behavioural interventions contained a total of 1,294 obese adolescents aged 12 to18 years.	
Duration of follow-up	Length of follow-up for the pharmacologic treatments ranged from six to 12 months. Follow-up information for the behavioural interventions was not provided.	
Overall findings	Comprehensive behavioural interventions of medium-to-high intensity in obese children and adolescents (≥ 6 years) were the most effective behavioural approach to improve weight and possible adiposity, with a 1.9 to 3.3 kg/m^2 difference between groups in mean change in BMI after 6 to 12 months. Limited evidence suggests that these improvements can be maintained over the 12 months after the end of	

	treatments and that there are few harms with behavioural interventions. Two medications combined with behavioural interventions resulted in small (0.85 kg/m^2 for orlistat) or moderate (2.6 kg/m^2 for sibutramine) BMI reduction in obese adolescents on active medication. However, no studies followed weight changes after medication use ended. Behaviour therapy - Two of the three trials reporting on fasting insulin found reductions of fasting insulin in the intervention groups relative to the control group. - In contrast, none of the four trials reporting lipid levels found group differences in HDL or triglyceride levels, and only one found reductions in LDL levels. - Neither of the two trials reporting on blood pressure found group differences on DBP and only one reported reductions in SBP. Similarly, none of the three trials reporting on glucose levels found any group differences. Sibutramine - Three of the four trials that reported changes in waist circumference found statistically significant differences favoring the sibutramine groups. In these three trials, the sibutramine groups reduced the waist circumference on average by 7 to 8 cm. In contrast, the placebo groups reduced waist circumference on average by 2 to 3 cm ($p < 0.001$ for all three trials). - Four trials reported the effects on lipid profiles or glycemic parameters at 6 or 12 months followup. Of these, statistically significant differences were only reported in one. This found greater improvements in HDL cholesterol and reductions in triglycerides and serum insulin compared to the placebo group. Differences in LDL cholesterol and fasting serum glucose were not statistically different between groups. Orlistat - There was one included trial. This reported a reduction in waist and hip circumference of -2.67 and -1.52 cm, respectively, for the orlistat group, compared with -0.89 and -0.10 cm the control group. - In a subset of patients evaluated with dual-energy x-ray absorptiometry (DXA), patients in the orlistat group lost significantly more fat mass than patients in the placebo group (-2401 g vs. -380 g; $p = 0.03$). - Levels of LDL, HDL, TG, FPG, and insulin were measured in both Orlistat trials, and no significant differences were found between groups in either trial. - A small reduction in DBP in the orlistat group (-0.51 mmHg), compared to an increase in the placebo

	patients (+1.30 mmHg; p = 0.04) was observed. Change in SBP was similar in both groups and not statistically different.
Compliance with treatment	Not stated
Adverse events	Among the six weight-management trials, none showed differences in height, eating-disorder pathology, or depression. From the two trials in which injuries in exercise programs were examined, one fracture was reported for the intervention groups (n = 114), whereas no children in the control groups reported injuries. All sibutramine trials evaluated the effects on heart rate and SBP and DBP. Three of the five sibutramine trials revealed greater increases in heart rate and SBP and / or DBP in the sibutramine-treated group compared with the control group after six or 12 months of treatment. These differences, however, were small in magnitude. In the 12-month, multicentre sibutramine trial, tachycardia occurred more commonly in the sibutramine-treated group than in the control group (12.5% vs. 6.2%; P = 0.049). The number of withdrawals that resulted from tachycardia, however, was similar between groups. None of the sibutramine trials showed group differences in the overall rates of having any adverse event, any serious adverse event, or discontinuation caused by adverse events. In the large 12-month sibutramine trial, serious adverse events were reported by 2.7% of patients in the sibutramine-treated group and < 1% of those in the control group. Only one of these events (excessive nausea and vomiting) was thought to be related to sibutramine. No adverse effect on growth and maturation was found. Abdominal complaints and constipation were also found to be statistically higher in the sibutramine-treated group in the shorter-term trials. In the trials in which orlistat was tested, rates of serious adverse effects and discontinuation of therapy resulting from adverse effects were low, and similar between groups. In the first trial, only one serious adverse event was thought to be study related: asymptomatic cholelithiasis in a 15-year-old girl who had lost 15.8 kg by the time of the event. In the second trial, one suicide death of a patient who was under a psychiatrist's care occurred in the orlistat-treated group. No deaths occurred in the group on placebo. Gastrointestinal adverse effects were common among patients taking orlistat. In the largest trial, 50% reported fatty or oily stools compared with 8% of those on placebo, and 20% to 30% reported oily spotting, oily evacuation, abdominal pain, faecal urgency, or flatus with discharge compared with 2% to 11% on placebo. Note that 9% of orlistat patients reported faecal incontinence, compared with < 1% of patients on placebo. However, researchers also reported that the gastrointestinal adverse effects were mostly of mild-to-moderate intensity and led to discontinuation of treatment among only 2% of orlistat patients. For both orlistat trials, vitamin A, D, and E levels were measured and levels were not different between groups.

	However, multivitamin supplementation was provided for all participants in the orlistat trials. No between-group differences were reported in quality of life, growth, bone mineral density, or sexual maturation.
Notes	A limitation to this review was the combining of different measures of weight change that had different underlying assumptions and distributions. The authors attempted to minimize the effects of this by analysing BMI change whenever it was available so that the majority of the trials did use a common metric. Results of a qualitative examination of the forest plots indicated no obvious bias in the trials that used measures other than BMI change, and the pattern of results was similar when the review was limited to studies that reported BMI or BMI change.

*This summary table combines references Whitlock 2010a and 2010b

Winzenberg 2007

Characteristics of the study	
Study Citation	Winzenberg T, Shaw K, Fryer J & Jones G 2007, 'Calcium supplements in healthy children do not affect weight gain, height, or body composition', Obesity (Silver Spring), vol.15, no.7, pp.1789-98.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	Placebo-controlled RCTs of calcium supplementation (including by food) compared with placebo, with a treatment period of at least 3 months
Types of participants sought	Participants were children (age < 18 years) without coexistent medical conditions or treatments affecting bone metabolism

Types of intervention	Calcium supplementation compared with placebo.	
Types of outcomes measured	Weight, height, and other body composition measures such as DXA measures of lean mass, fat mass, and percent body fat; skinfold measures; and BMI. There was sufficient data for meta-analysis of four outcomes: weight, height, body fat, and lean mass outcomes.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Low	
Relevance of evidence rating***	Low	
Results of study		
N and type of studies	N = 19 studies Nineteen RCTs were included from 36 references. No study reported differences between treatment and control groups at baseline for potential confounding factors such as age, weight, height, sex, ethnicity, pubertal status, dietary measures, or physical activity, other than a slight difference in carbohydrate intake between calcium (224 ± 14 [standard error] g/day, N = 16) and placebo (190 ± 10 g/day, N = 19) groups in the exercise subgroup of one study.	
N and characteristics of participants	N = 2,859 participants The participants mean ages ranged from 3.9 to 17.3 years and 11 of the studies contained females only.	
Duration of follow-up	The duration of the studies ranged from 0.7 to 7 years.	
Overall findings	There were no statistically significant effects of calcium supplementation on weight (0.1 kg; 95% CI, -0.3 to 0.6),	

	height (0.2 cm; 95% CI, -0.3 to 0.7) or body fat (SMD, +0.04; 95% CI, -0.08 to 0.15).
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	There is no evidence to support the use of calcium supplementation to reduce weight gain or body fat in healthy children.

Witham 2010

Characteristics of the study	
Study Citation	Witham MD & Avenell A 2010, 'Interventions to achieve long-term weight loss in obese older people: a systematic review and meta-analysis', Age Ageing, vol.39, no.2, pp.176-84.
Study Design	Systematic review and meta-analysis
Methods	
Types of studies sought	RCTs of weight loss by lifestyle intervention in older people. Trial length, including follow-up, was a minimum of one year. There were no language restrictions.
Types of participants sought	Studies with participants' mean age ≥60 years and mean BMI ≥ 30 kg/m^2. Participants included patients with coronary artery disease, diabetes mellitus and osteoarthritis.
Types of intervention	Diet and / or physical activity.
Types of outcomes measured	Weight, BMI, total cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, triglycerides, fasting glucose, HbA1c and blood pressure.

	Secondary outcomes were deaths, hospitalisations, morbidity, quality of life, measures of physical function and exercise capacity.	
Quality of study	Rating	Comments
Level of evidence	I	
Study quality rating*	A	
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results of study		
N and type of studies	N = 9 studies Nine eligible RCTs were included. With one exception, the included trials were all carried out in the USA; most studies targeted patients with a specific disease entity (diabetes mellitus, coronary artery disease, osteoarthritis). Studies were a mixture of single-centre and multicentre trials, with some interventions conducted in community or primary care settings and some in secondary care settings. All the trials provided dietary advice, with the exception of one which provided physical activity advice. In two trials, it was not clear whether this was low-fat dietary advice. Two trials did not report giving physical activity advice and three trials provided facilities for undertaking physical activity.	
N and characteristics of participants	N = 1,954 participants Seven studies included both genders and two contained females only. The mean age range for intervention was 57.8 to 69.4 years and control 60.6 to 71.1 years. All studies examined patients who were living in the community rather than in institutional settings. Only two of the studies had a mean baseline BMI of >35 kg/m^2. One trial targeted black and white adults with diabetes living in medically underserved rural communities.	
Duration of follow-up	Eight studies had a study duration including follow-up of between 12 and 30 months; duration and follow-up in the other study was 3.2 years.	

Overall findings	The meta-analysis of seven studies demonstrated a modest but significant weight loss of 3.0 kg (95% CI, -5.1 to -0.9) at one year. Diet and physical activity was associated with greater weight change (-3.8; -6.2, -1.4) than physical activity (-1.4; -2.4, -0.4) or diet (0.1; -1.6, 1.7). The meta-analysis of four studies with total cholesterol data found no significant change: -0.36 mmol/l (95% CI, --0.75, -0.04). There was no significant change in HDL (0.04; -0.04, 0.12), LDL (-0.04; -0.25, 0.18) or triglycerides (0.4; -0.5, 1.4). Quality of life was reported in two studies. Health-related quality of life (HRQoL) improved in one study but not the other. In one study, overall HRQoL improved by 3.6 points in the intervention group but worsened by 0.8 points in the control group at 12 months (reported P = 0.02). In the other, physical health scores improved by 0.8 points in the control group and 3.0 points in the diet group; corresponding values for mental health scores were 0.8 and 1.2 points, respectively. None of these latter changes was reported as reaching statistical significance. Exercise capacity was reported in one study. No significant difference between participants and controls was observed. Blood pressure was assessed in two studies. Blood pressure improved in one study but not the other. In the first study, at 90 days SBP/DBP dropped by 4.0/1.1 mmHg in the intervention group and 0.8/0.8 mmHg in the control group. Antihypertensives could be successfully stopped in 93% of the weight loss group and 87% of the control group by 12 months. In the other study there were not significant differences in SBP or DBP between intervention and control groups at 12 or 24 months.
Compliance with treatment	Not stated
Adverse events	Not reported
Notes	This systematic review showed a modest but significant reduction in weight with weight loss interventions in older, obese people. No clinically significant improvement was seen in cholesterol levels, and data were insufficient to draw conclusions regarding the effect of weight loss interventions on other cardiovascular risk factors, exercise capacity or quality of life.

Randomised controlled trials

Azadbakht 2007

Characteristics of the study	
Study Citation	Azadbakht L, Mirmiran P, Esmaillzadeh A & Azizi F 2007, 'Better dietary adherence and weight maintenance achieved by a long-term moderate-fat diet', Br J Nutr, vol.97, no.2, pp.399-404.
Study Design	Randomised controlled trial (RCT)
Methods	
N (enrolled)	N = 89 participants Moderate-fat diet (N = 45), low-fat diet (N = 44) Study was conducted in Iran.
Inclusion criteria	Overweight and obese men and women. Participants were also subjects of the Tehran Lipid and Glucose Study attending the diet therapy clinic at the Lipid and Glucose Unit of the Endocrine Research Center. Had not participated in weight-reduction programs during the previous six months and had maintained a stable weight (± 1 kg). Participants had not previously participated in dietary studies. Non-smokers, free of chronic disease and readily participated in the monthly visits. Patients were asked to complete personal health and medical history questionnaires that were used as a screening tool.
Exclusion criteria	Taking any medications affecting nutrient metabolism, blood lipids and blood pressure. Taking vitamin and mineral supplements, and antacids containing magnesium or calcium.

Intervention	The intervention was a moderate-fat diet (30% energy) or a low-fat diet (20% energy) for a 14-month randomised trial. All subjects were given general oral and written information about healthy food choices and a diet 2090 kJ (500 kcal) below their energy needs according to their weight, which was offered according to specific individualised programs at baseline and at subsequent visits. The nutritionist who prescribed the diets had to be aware of the group assignment. Laboratory staff were not aware of the group the patients had been assigned. Under- and over-reporters were defined as reported daily energy intakes less than 3350 kJ/d (800 kcal/d) and over 17,570 kJ/d (4200 kcal/d) respectively.	
Comparison	See above	
Outcomes measured	Primary outcome measurements: change in body weight, waist circumference, LDL-cholesterol, HDL-cholesterol, total cholesterol, triacylglycerol (TAG), and systolic and diastolic blood pressure (SBP and DBP). Additional covariate information regarding age, smoking habits, medical history and current use of medication was obtained using validated questionnaires, completed during the screening and every month. Measurements were obtained at baseline, and after seven and 14 months of the dietary program.	
Duration of follow-up	After a three week run-in the duration of the intervention and the follow-up was 14 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	B	Partial blinding (not of outcome assessor or patient)
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	

<table>
<tr><th colspan="2">Results</th></tr>
<tr><td>Participants</td><td>Characteristics of all randomised participants were similar in both groups.

The mean age of the two groups was similar; (45 [SD 5] years in the moderate-fat-diet group and 46 [SD 6] years in the low-fat-diet group). Mean weight was 80 kg (SD 11) in the moderate-fat group and 79 kg (SD 12) in the low-fat group.

The mean values for serum lipid profiles and blood pressure were not different in the two groups at baseline.</td></tr>
<tr><td>Overall findings</td><td>After seven months, the moderate- and low-fat diets had similar effects on cardiovascular risk factors.

The highest reduction in body weight was seen after the first seven months both in the moderate- and low- fat groups. Weight reduction was similar and significant after seven months in both groups; -5.3 kg (SD 1.3) in the moderate-fat group (P < 0.001), and -5.2 kg (SD 1.9) in the low-fat group (P < 0.001). Changes in waist circumference were also similar to those seen in weight.

Changes in cardiovascular risk factors assessed after 14 months of control and low-fat diets (Mean (SD))
<table>
<tr><th>Variable</th><th>Control diet (moderate fat) (n = 45)</th><th>Low-fat diet (n = 44)</th></tr>
<tr><td>Weight (kg)</td><td>-5.0 (2.5)</td><td>-1.2 (1.1)</td></tr>
<tr><td>Waist circumference (cm)</td><td>-5.5 (2.4)</td><td>-2.3 (1.3)</td></tr>
<tr><td>HDL-cholesterol (mg/dl)</td><td>+6.6 (3.2)</td><td>+3.8 (3.6)</td></tr>
<tr><td>LDL-cholesterol (mg/dl)</td><td>-6.9 (4.6)</td><td>-3.9 (5.9)</td></tr>
<tr><td>TAG (mg/dl)</td><td>-10.1 (5.1)</td><td>-2.3 (1.6)</td></tr>
<tr><td>Total cholesterol (mg/dl)</td><td>-10.3 (4.1)</td><td>-5.9 (3.3)</td></tr>
<tr><td>SBP (mmHg)</td><td>-7.4 (2.3)</td><td>-3.3 (1.2)</td></tr>
<tr><td>DBP (mmHg)</td><td>-2.9 (1.2)</td><td>-1.3 (1.1)</td></tr>
</table></td></tr>
</table>

	After 14 months, the moderate-fat diet appeared to be more successful in reducing weight (-5.0 kg [SD 2.5] in the moderate-fat group vs. -1.2 kg [SD 1.1] in the low-fat group; P < 0.0001^), waist circumference (-5.5 cm [SD 2.4] in the moderate-fat group vs. -2.3 cm [SD 1.3] in the low-fat group; P < 0.0001^), and other cardiovascular risk factors (LDL-cholesterol, TAG, total cholesterol and SBP). ^P values for difference between moderate-fat and low-fat group by t test
Compliance with treatment	Diet adherence was checked by food records.
Adverse events	Not stated
Notes	The present results showed that after 14 months' intervention the changes in reduction of weight, waist circumference, LDL-cholesterol, TAG, total cholesterol, and SBP and DBP in the moderate-fat-diet group were significantly greater than for the low-fat diet group. However, after seven months of intervention there were no significant differences between the two groups in decreasing the cardiovascular risks. Better dietary adherence with the moderate-fat diet may be the reason for its successful effects. Therefore, the authors concluded that the moderate-fat diet is more suitable in the long term.

Belalcazar 2010

Characteristics of the study	
Study Citation	Belalcazar LM, Reboussin DM, Haffner SM, Hoogeveen RC, Kriska AM, Schwenke DC, Tracy RP, Pi-Sunyer FX & Ballantyne CM 2010, 'A 1-year lifestyle intervention for weight loss in individuals with type 2 diabetes reduces high C-reactive protein levels and identifies metabolic predictors of change: from the Look AHEAD (Action for Health in Diabetes) study', Diabetes Care, vol.33, no.11, pp.2297-303.
Study Design	RCT
Methods	
N (enrolled)	N = 1,759 participants Intensive lifestyle intervention (ILI) (N = 923), usual care (diabetes support and education [DSE]) (N = 836) Study was conducted in the US.
Inclusion criteria	The authors evaluated a subset of 1,759 participants with type 2 diabetes from the Look AHEAD (Action for Health in Diabetes) study, generally corresponding to the first half of enrolees from 15 of 16 participating clinic sites who had high-sensitivity (hs) C-reactive protein (CRP) determinations and fitness data at baseline and one year. Look AHEAD is an ongoing multicentre clinical trial examining whether a behavioural lifestyle intervention targeting weight loss will reduce cardiovascular events and overall mortality in overweight / obese participants with type 2 diabetes.
Exclusion criteria	Nil stated.
Intervention	ILI aiming for a 7% weight loss from baseline. ILI participants attended frequent group and individual sessions in support of behavioural change to increase moderate-intensity exercise progressively to 175 minutes/week, reduce caloric and saturated fat intake, and change macronutrient composition to improve glycaemic control. All participants continued medical care with their primary providers.

Comparison	DSE participants received three group health information sessions during the year.	
Outcomes measured	Weight (kg), BMI (kg/m^2), waist circumference (cm), fasting glucose (mg/dl), HbA1c (%), LDL cholesterol (mg/dl), triglycerides (mg/dl), HDL cholesterol (mg/dl), fitness (submaximal) (MET), hs-CRP (mg/L) for men, women and overall group.	
Duration of follow-up	1-year lifestyle intervention including follow-up.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	A	
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	Mean age was 57.5 years. Participants were sedentary, with fitness values below the 20th percentile for age. Median hs-CRP was elevated at 4.2 mg/L (interquartile range [IQR] 1.9 to 8.9) and was markedly higher in women (6.3 mg/L [IQR 3.0 to 11.7]) than in men (2.4 mg/L [IQR 1.2 to 4.7]). There were 12% who had CVD and 40% who used statin cholesterol-lowering medications.	

<table>
<tr><td>Overall findings</td><td>ILI decreased weight (8.8%), HbA1c (0.7%), and triglycerides (17%) and increased fitness (19%) and HDL cholesterol (7.5%) (P < 0.0001 versus changes with DSE).
<table>
<tr><td></td><td>ILI (SD)</td><td>DSE (SD)</td></tr>
<tr><td>Weight (kg)</td><td>-9 (7.6)</td><td>-0.8 (5)</td></tr>
<tr><td>BMI (kg/m^2)</td><td>-3.2 (2.6)</td><td>-0.3 (1.8)</td></tr>
<tr><td>Waist (cm)</td><td>-7.4 (7.8)</td><td>-0.9 (6.3)</td></tr>
<tr><td>Fasting glucose (mg/dL)</td><td>-21.7 (44.4)</td><td>-6.7 (46.8)</td></tr>
<tr><td>HbA1c (%)</td><td>-0.7 (1)</td><td>-0.2 (0.9)</td></tr>
<tr><td>LDL (mg/dL)</td><td>-4.3 (26.2)</td><td>-4.8 (28.7)</td></tr>
<tr><td>HDL (mg/dL)</td><td>3.2 (6.9)</td><td>1.4 (6.6)</td></tr>
<tr><td>Triglycerides (mg/dL)</td><td>-32.3 (114.8)</td><td>-12.6 (94.2)</td></tr>
<tr><td>hs-CRP (mg/L)</td><td>-1.24 (-3.4 to -0.1)</td><td>-0.35 (-2.0 to 0.8)</td></tr>
</table>
ILI reduced median hs-CRP by 43.6% from baseline to one year, compared with a 16.7% reduction with DSE (P < 0.001).</td></tr>
<tr><td>Compliance with treatment</td><td>Not stated</td></tr>
<tr><td>Adverse events</td><td>Not stated</td></tr>
<tr><td>Notes</td><td>A 1-year lifestyle intervention for weight loss in obese individuals with diabetes was associated with substantial reductions in hs-CRP.</td></tr>
</table>

Campbell 2008

Characteristics of the study	
Study Citation	Campbell PT, Wener MH, Sorensen B, Wood B, Chen-Levy Z, Potter JD, McTiernan A & Ulrich CM 2008, 'Effect of exercise on in vitro immune function: a 12-month randomized, controlled trial among postmenopausal women', J Appl Physiol, vol.104, no.6, pp.1648-55.
Study Design	RCT
Methods	
N (enrolled)	N = 115 female participants Aerobic exercise intervention (N = 53 participants) and stretching control (N = 62 participants)
Inclusion criteria	Participants were a subset of women recruited for an exercise intervention trial who met additional criteria for this separately funded study of measurement of immunological outcomes. Eligibility criteria were as follows: postmenopausal; aged 50 to 75 years; in good health; non-smoker; sedentary (< 60 minutes/week of moderate- and vigorous-intensity recreational activity and maximal O2 uptake [VO2 max] < 25.0 ml/kg-1/min-1); not taking postmenopausal hormones in the past 6 months; alcohol consumption of fewer than two drinks per day; BMI between 25 and 40 kg/m^2 (or BMI 24.0 to 24.9 if body fat > 33%); no personal history of invasive cancer, diabetes, CVD, or asthma; no current serious allergies; no regular (≥ twice per week) use of aspirin or other non-steroidal anti-inflammatory medications; and no use of corticosteroids or other medications known to affect immune function.
Exclusion criteria	Women were excluded if they volunteered to lose weight, had a previous surgery for weight loss, or were currently attempting, or planning to attempt, weight loss by taking diet pills or entering a structured weight-loss program.
Intervention	This 12 month RCT compared the effect of a moderate-intensity aerobic exercise intervention to a stretching control program on markers of immune function and phenotype, 3 and 12 months after randomisation.

	The exercise intervention progressed to at least 45 minute of moderate-intensity exercise five days/week. During months 1 to 3, participants were required to attend three supervised exercise sessions per week at a study facility (University of Washington or a commercial gym) and to exercise two days/week at home. For months 4 to 12, participants were required to attend at least one session per week at a study facility and to perform the remaining exercise sessions either at home or at the facility. Because women recruited into this study were physically inactive and had low aerobic fitness at baseline, the training program started at 40% of observed maximal heart rate (HR) for 16 minutes per session and increased to 60 to 75% of maximal HR for 45 minutes per session by week 8, where it was maintained for the remainder of the study. Participants wore Polar HR monitors during exercise sessions. Facility sessions consisted of treadmill walking and stationary bicycling. Strength training to fatigue was recommended, but not required, to decrease risk of injury and maintain joint stability. Resistance training consisted of two sets of 10 repetitions of leg extension, leg curls, leg press, chest press and seated dumbbell row. A variety of home exercises were suggested and encouraged, including walking, aerobics and bicycling. Participants were encouraged to wear their HR monitors when exercising at home. Participant adherence was assessed via daily activity logs, on which exercise intervention participants reported the type and duration of exercise they performed and the maximal HR and rating of perceived exertion achieved during the session. Activity logs were reviewed weekly by study staff to monitor compliance and intervene when needed. Women in the parent study were recruited through a combination of mass mailings and media placements.
Comparison	Control participants attended 60-minute stretching and relaxation sessions one day per week for 12 months and were asked not to change exercise habits. Both exercisers and stretchers were asked not to modify their dietary intake for the duration of the study.
Outcomes measured	The markers of immune status that were measured were: natural killer (NK) cytotoxicity; T-lymphocyte proliferation; cell counts and phenotypes of T cells, B cells, and NK cells, measured by flow cytometry; and serum concentrations of immunoglobulins. Body weight, BMI, total body fat and % body fat (analysed by dual-energy x-ray absorptiometry); intra-abdominal and subcutaneous fat (analysed by one-slice computed tomography at L4-5); VO2 max.
Duration of follow-up	Study duration including follow-up was 12 months.

Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	Low	
Relevance of evidence rating***	Medium	
Results		
Participants	There were no significant differences between exercise and control groups at baseline. On average, women were 61 years old, and 88% were non-Hispanic white. BMI was between 25 and 40 kg/m^2.	
Overall findings	The exercise intervention resulted in decreased body weight versus control (exercise: -1.8 kg; control: +0.3 kg; P = 0.002), and decreased percent body fat (exercise: -1.5%; control: +0.02%, P < 0.0001). The main outcomes, natural killer cell cytotoxicity and T-lymphocyte proliferation did not differ between groups at 12 months. Secondary outcome and subgroup (i.e. stratification by baseline categories of BMI, immune status, CRP and age) analyses did not show any clear patterns of association.	
Compliance with treatment	The authors reported excellent retention and high exercise adherence.	
Adverse events	Not stated	
Notes	The authors reported the following study limitations. Firstly, the exercise intervention was only one year in duration and secondly, they evaluated in vitro blood immune function at rest. No effects on in vitro immune function from a year-long aerobic exercise intervention relative to a stretching control group were identified.	

Cheskin 2008

Characteristics of the study	
Study Citation	Cheskin LJ, Mitchell AM, Jhaveri AD, Mitola AH, Davis LM, Lewis RA, Yep MA & Lycan TW 2008, 'Efficacy of meal replacements versus a standard food-based diet for weight loss in type 2 diabetes: a controlled clinical trial', Diabetes Educ, vol.34, no.1, pp.118-27.
Study Design	RCT
Methods	
N (enrolled)	N = 119 participants Portion controlled diet (N = 54), standard diet (control) (N = 58). Study was conducted in US.
Inclusion criteria	Participants were men and women aged 18 to 70 years diagnosed by standard criteria with type 2 diabetes at least three months prior to enrolment, and were overweight or obese, with a BMI of 25 to 40 kg/m^2. If they were currently taking medications to control diabetes, a stable dose for at least three months prior to randomisation was required. Participants had a normal electrocardiogram (ECG) or abnormalities deemed medically acceptable, a regular source of health care, and the permission of their primary care provider to enrol. Women of childbearing potential were required to be using an acceptable method of birth control.
Exclusion criteria	Individuals with uncontrolled health problems (aside from obesity and type 2 diabetes), type 1 diabetes, bulimia, laxative / substance abuse, alcohol intake > 10 drinks per week, or an uncontrolled psychiatric disorder (e.g. major depression, bipolar disorder) were excluded. Depression was assessed using the Beck Depression Inventory; A score > 15 resulted in exclusion. Major eating disorders were screened using the Eating Attitudes Test (EAT). A score > 30 resulted in exclusion. Use of appetite-affecting medications (e.g. certain antidepressants, steroids) unless on a stable dose for > 3 months or weight loss drugs resulted in exclusion, as did lactation, pregnancy, or seeking to become pregnant.

Intervention and comparison	Participants were prescribed either a 25% energy-deficit diet (standard diet [SD]) or an equicaloric, portion-controlled diet using Medifast Plus for Diabetics meal replacements (portion-controlled diet [PCD]). Study staff members and participants could not be blinded to type of diet, but otherwise, participants received identical interventions and staff attention. After an initial 34-week weight loss period, the SD group continued their diet at a maintenance energy level for 52 weeks. PCD participants were re-randomised for their 52-week maintenance phase to either 26 weeks of PCD followed by 26 weeks of SD (PCD1) or vice versa (PCD2). Both groups received diets of similar macronutrient composition: 45% to 50% carbohydrate, 25% to 30% fat, and 15% to 25% protein. The caloric target for each individual was calculated using the Harris-Benedict equation to estimate total daily energy requirements. A 25% of energy calorie deficit was used to construct the weight-loss-phase diet, and a 10% calorie deficit (based on the new body weight after weight loss) was used to construct the weight-maintenance-phase diet. The PCD group received approximately 50% to 60% of their prescribed calories from meal replacements, while the SD group received all their prescribed calories from whole foods using choices from exchange lists. The meal replacements used in this study were low glycaemic index, low sugar, and soy-based products (bars, shakes, soups). Each patient met three times for individual consultations with a dietician or nutritionist to review their meal plans during the study: once at the beginning, once mid-way through the weight loss phase, and once upon beginning the weight maintenance phase. All participants were required to attend group educational sessions based on social cognitive theory. The sessions were every other week during the 34-week weight loss phase and every four weeks during the 52-week maintenance phase. At these group sessions, an educational topic on nutrition, exercise, or diabetes was presented; weight was measured; compliance was assessed; and any unused meal replacements were returned and recorded. Repeat measurements identical to those collected at the screening visit were conducted at week 34 of weight loss and at weeks 26 and 52 of weight maintenance (week 60 and 86 of the study, respectively).
Outcomes measured	Height, weight, waist circumference (WC), hip circumference, blood pressure, and body composition using bioelectrical impedance. > 6 hour fasting blood for a complete metabolic panel, lipid panel, HbA1c, and insulin. Beck and EAT screening tools.
Duration of follow-up	The trial included a 34-week weight loss phase and a 52-week maintenance phase.

Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% non-completion
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	Overweight or obese adults with type 2 diabetes desiring weight loss. Fifty three men and 66 women were enrolled. The PCD group were 79.6% Caucasian, 20.4% African American and had a mean (± standard deviation (SD)) age of 54.6 ± 7.0 years and mean (±SD) BMI of 35.3 ± 3.5 kg/m^2. The SD group were 74% Caucasian, 24.1% African American, 1.7% Asian and had a mean (±SD) age of 55.48 ± 7.2 years and mean (±SD) BMI of 35.7 ± 3.8 kg/m^2.	

<table>
<tr><td>Overall findings</td><td>Using intention-to-treat analyses, weight loss at 34 weeks and weight maintenance at 86 weeks was significantly better on PCD versus SD. Approximately 40% of the PCD participants lost 5% of their initial weight compared with 12% of those on the SD.

At 86 weeks the following were observed:

<table>
<tr><td></td><td>PCD (variance not reported)</td><td>SD (variance not reported)</td></tr>
<tr><td>Weight (kg)</td><td>-5.6</td><td>-4.7</td></tr>
<tr><td>BMI (kg/m^2)</td><td>-1.9</td><td>-1.7</td></tr>
<tr><td>Waist (cm)</td><td>-4.3</td><td>-4.3</td></tr>
<tr><td>HbA1c (%)</td><td>0</td><td>-1.2</td></tr>
<tr><td>Fasting glucose (mmol/L)</td><td>-0.37</td><td>-0.30</td></tr>
<tr><td>SBP (mmHg)</td><td>-7.6</td><td>-14.0</td></tr>
<tr><td>DBP (mmHg)</td><td>-2.7</td><td>-9.7</td></tr>
<tr><td>Total cholesterol (mmol/L)</td><td>-0.2</td><td>0.1</td></tr>
<tr><td>HDL (mmol/L)</td><td>0.2</td><td>0.4</td></tr>
<tr><td>Triglycerides (mmol/L)</td><td>0.02</td><td>-0.15</td></tr>
</table>
</td></tr>
<tr><td>Compliance with treatment</td><td>Self-reported compliance was higher for PCD than SD (64.2% vs. 56.0%).</td></tr>
<tr><td>Adverse events</td><td>The authors reported that there were no important adverse events in either group.</td></tr>
<tr><td>Notes</td><td>A diet using portion-controlled meal replacements yielded greater initial weight loss and less regain after one year of maintenance than a standard, self-selected, food-based diet.</td></tr>
</table>

Christian 2008

Characteristics of the study	
Study Citation	Christian JG, Bessesen DH, Byers TE, Christian KK, Goldstein MG & Bock BC 2008, 'Clinic-based support to help overweight patients with type 2 diabetes increase physical activity and lose weight', Arch Intern Med, vol.168, no.2, pp.141-6.
Study Design	RCT
Methods	
N (enrolled)	N = 310 participants Brief physical counselling (N = 155), health education pamphlets (N = 155) Study was conducted in the US.
Inclusion criteria	Latino / Hispanic in ethnicity with a language preference of either English or Spanish, aged 18 to 75 years, with a diagnosis of type 2 diabetes; a BMI ≥ 25 (kg/m^2); and uninsured, Medicaid eligible, or Medicare beneficiaries.
Exclusion criteria	The authors excluded patients with substance use or abuse, severe arthritis or other medical conditions limiting physical activity, recent myocardial infarction or stroke, or peripheral vascular disease or who had undergone or been scheduled for gastric bypass surgery.
Intervention	In the intervention group, self-management goals for nutrition and physical activity were set using a tailored computer program. Goals were then reviewed at each clinic visit by physicians. Participants assigned to the intervention group completed a computer-based assessment of their motivational readiness to increase physical activity and make dietary changes. On completion of the assessment, the computer expert system generated a 4 to 5-page individualised, tailored report, which provided feedback addressing participant-identified barriers to improving their physical activity and diet. The purposes of this feedback were (1) to enhance participants' motivation to increase physical activity and reduce caloric intake, (2) to identify potential barriers to making lifestyle changes, and (3) to provide tailored counselling suggestions to enhance readiness, decision making, and self-

	efficacy to make lifestyle changes. Prior to the baseline clinic visit, intervention patients read their report and listed two or three dietary and / or physical activity self-management goals they wanted to achieve. In addition, intervention group patients were given a 30-page planning guide that provided supplemental information on diabetes and achieving a healthy lifestyle. The computer expert system also generated a companion report for the patient's physician, which included a brief, bulleted summary of the findings from the patient's assessment (i.e. priority change areas and perceived barriers to change) and provided the physician with patient-specific counselling recommendations. Prior to baseline patient visits, 19 physicians completed a 3-hour training session on how they should use these patient lifestyle change goal sheets to provide brief motivational interviewing counselling to help patients make changes in dietary and physical activity behaviours. During a regularly scheduled study-related visit, intervention patients met with their physician who discussed the patient's tailored lifestyle change goals and provided encouragement in attaining these goals. Neither physicians nor patients could be blinded to the intervention assignment.	
Comparison	Control group patients were given a packet of health education materials at the baseline visit addressing diabetes, diet, and exercise. Thereafter, they completed their regular clinic visit with their usual physician but had no additional prompts or motivational interviewing from their physicians regarding their specific goals for weight or physical activity other than what they might receive during usual care.	
Outcomes measured	Weight loss, expressed as mean weight lost and the fraction of participants in each group achieving a clinically meaningful weight loss defined as a 5% reduction in body weight. Secondary outcomes included the change in physical activity, estimated in metabolic equivalent task minutes (MET-min), change in energy intake, and changes in lipid and HbA1c levels.	
Duration of follow-up	Duration of intervention and follow-up was 12 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	B	Blinding of outcome assessors not mentioned

<table>
<tr><td>Magnitude of effect rating**</td><td>Low</td><td></td></tr>
<tr><td>Relevance of evidence rating***</td><td>High</td><td></td></tr>
<tr><td colspan="3">Results</td></tr>
<tr><td>Participants</td><td colspan="2">Intervention: 35% male, a mean age of 53.0 years (SD 11.25), and a mean BMI of 35.4 kg/m2 (SD 6.62).

Control group: 32% male, a mean age of 53.4 years (SD 10.70), and a mean BMI of 34.8 kg/m2 (SD 7.11).

More than 60% of patient populations were Hispanic / Latino, and approximately 65% of patients at both sites had family incomes at or below 100% of the US poverty level ($20,650 annually for a family of four).</td></tr>
<tr><td>Overall findings</td><td colspan="2">In the intervention group, recommended levels of physical activity increased from 26% at baseline to 53% at 12 months (P < 0.001) compared with controls (30% to 37%; P = 0.27), and 32% of patients in the intervention group lost six or more pounds at 12 months compared with 18.9% of controls (OR = 2.2; P = 0.006).
<table>
<tr><td></td><td>Intervention (SD)</td><td>Control (SD)</td></tr>
<tr><td>Weight (kg)</td><td>-0.2 (10.9)</td><td>1.4 (10.6)</td></tr>
<tr><td>HbA1c (%)</td><td>-0.14 (1.76)</td><td>-0.46 (1.63)</td></tr>
<tr><td>Total cholesterol (mg/dL)*</td><td>-15.8 (44.8)</td><td>-3.9 (45.2)</td></tr>
<tr><td>HDL (mg/dL)</td><td>-0.4 (17.1)</td><td>1.6 (11.6)</td></tr>
<tr><td>Triglycerides (mg/dL)</td><td>-13.6 (97.1)</td><td>-9.5 (95.7)</td></tr>
<tr><td>SBP (mmHg)</td><td>-2.6 (20.4)</td><td>-4.7 (20.8)</td></tr>
<tr><td>DBP (mmHg)</td><td>-2.6 (13.8)</td><td>-2.5 (11.6)</td></tr>
<tr><td colspan="3">* = significant difference between intervention and control groups</td></tr>
</table></td></tr>
</table>

Compliance with treatment	Not stated
Adverse events	Not stated
Notes	An intervention using patient self-management goal setting and brief physician health lifestyle counselling may be useful in producing positive behavioural change in patients with diabetes.

Cooper 2010

Characteristics of the study	
Study Citation	Cooper Z, Doll HA, Hawker DM, Byrne S, Bonner G, Eeley E, O'Connor ME & Fairburn CG 2010, 'Testing a new cognitive behavioural treatment for obesity: A randomized controlled trial with three-year follow-up', Behav Res Ther, vol.48, no.8, pp.706-13.
Study Design	RCT
Methods	
N (enrolled)	N = 150 participants Cognitive behaviour therapy (CBT) (N = 49), Behaviour therapy (BT) (N = 50), and Guided self-help (GSH) (control group) (N = 51) Study was conducted in the United Kingdom.
Inclusion criteria	Potential participants were either referred by their family physician or they direct contacted in response to advertisements placed in physicians' clinics and local hospitals. They were eligible to take part if they met the following criteria: (1) female, (2) aged between 20 and 60 years, (3) BMI between 30.0 and 39.9 kg/m2, (4) available for treatment for 44 weeks, and (5) willing to participate in the study. Those receiving treatment for

	hypertension or hypercholesterolemia were eligible to take part provided their condition had been stable on medication over the previous three months. Participants who reported binge eating were eligible to take part.
Exclusion criteria	The exclusion criteria were: (1) weight loss of 10% or more within the previous six months, (2) major medical or psychiatric illness (including Type I or Type II diabetes), (3) current psychiatric or psychological treatment, and (4) disorders or treatments known to affect eating, weight or metabolic rate, and disorders in which calorie or fat restriction were contraindicated.
Intervention	Cognitive behaviour therapy: The new form of CBT was designed to address certain psychological processes that had been hypothesised to interfere with successful weight maintenance. The goal of the new treatment was not only to produce weight loss but also to help people accept and value more modest changes in weight and appearance. The treatment was also designed to encourage the acquisition and practice of weight maintenance skills as these differ from those required to lose weight. The CBT treatment comprised 24, 50-minute, one-to-one sessions over the 44 week period of treatment with the sessions being weekly for the first seven weeks and every two weeks thereafter. The weight loss phase lasted for the first 24 to 30 weeks (during which participants were helped to restrict their energy intake to about 1500 kcal daily) with the remainder of treatment being devoted to the establishment of weight maintenance skills. Behaviour therapy: BT was based on the Pittsburgh Behavioural Weight Control Manual and the Weight Maintenance Guide. It was designed to represent the optimal behavioural treatment available at the time, adapted for use on an individual basis. The style of the treatment was that of modern behaviour therapy with the treatment being applied flexibly so as to match the individual's needs and progress. It involved the same number of sessions as CBT and the same pattern of appointments. Well-established behavioural methods were used to help participants change their eating habits and activity level, the aim being that they restrict their energy intake to 1200 kcal daily. Between weeks 24 and 30, and again at week 36, the subject of weight maintenance was raised and participants were given the choice of either continuing to pursue further weight loss for the remainder of treatment or deciding to maintain their new lower weight.
Comparison	Guided self-help (control group): This treatment was based on the LEARN Programme for Weight Control. Participants were asked to restrict their

	energy intake to 1200 kcal daily, make healthy food choices, and gradually increase their level of activity. Participants received a limited amount of guidance and support from a therapist. GSH involved two initial face-to-face sessions with a therapist followed by up to 15, 20-minute telephone sessions.	
Outcomes measured	Outcome measures included: mean weight, adjusted weight and percentage weight change for the three treatment conditions at each time point (i.e. six, 12, 24 and 36 months after the 44-week assessment). General psychiatric features were measured using the Brief Symptom Inventory (BSI) a short form of the Symptom Checklist (SCL-90). Quality of life was measured using the Medical Outcomes Study 36 item Short Form Health Survey (SF-36).	
Duration of follow-up	Each participant was followed-up for three years from week 44 (i.e. the end of the CBT and BT conditions).	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	A	
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results		
Participants	At baseline the mean age of the participants was 41.5 years (SD 9.1), and mean BMI was 34.7 kg/m2 (SD 2.9).	
Overall findings	Both of the main treatments resulted in an average weight loss of about 10% of initial weight whereas weight loss was more modest with GSH. At 24 weeks (end of GSH), the mean percentage weight losses were 6.7%, 11.3% and 10.0%, respectively, in the GSH, BT, and CBT conditions. At 1-year follow-up, those who had lost weight at the end of treatment had regained, overall, almost half the weight that they had lost (median regain of weight lost, 43.5% in BT and 58.0% in CBT) and at 3-year follow-up they had regained almost all the weight lost (89.8% regain in BT; 88.6% regain in CBT).	

	Treatment had a beneficial effect on patients' psychiatric symptoms and their quality of life. There was a statistically significant improvement from baseline to the end of treatment in BSI scores across all treatment groups (mean (SD) improvement = 0.30. Adjusting for pre-treatment BSI scores and weight change, those receiving CBT achieved slightly lower scores on the BSI than those receiving BT but the difference was not statistically significant. Across all three groups there were statistically significant improvements in the eight SF-36 domains and the two summary scores (PCS and MCS) from baseline to the end of treatment (mean (SD) improvement PCS 3.96 (9.23); MCS 5.43 (9.21), although generally there were statistically significant deteriorations in scores during follow-up (mean (SD) deterioration PCS 3.20 (10.2); MCS 2.40 (7.53).
Compliance with treatment	Compliance with the assessment protocol was high. There were no differences between the treatment groups in their compliance with the assessment protocol.
Adverse events	None stated
Notes	The great majority of the participants lost weight and then regained it. CBT was successful at achieving change in participants' acceptance of shape. CBT did not result in improved weight maintenance.

Cussler 2008

Characteristics of the study	
Study Citation	Cussler EC, Teixeira PJ, Going SB, Houtkooper LB, Metcalfe LL, Blew RM, Ricketts JR, Lohman J, Stanford VA & Lohman TG 2008, 'Maintenance of weight loss in overweight middle-aged women through the Internet', Obesity (Silver Spring), vol.16, no.5, pp.1052-60.
Study Design	RCT

Methods	
N (enrolled)	N = 135 participants Internet group (N = 66), self-directed group (N = 69) Study was conducted in the US.
Inclusion criteria	Women between 40 and 55 years of age. BMI between 25.0 and 38.0 kg/m2. Non-smoker, and be free from major illnesses. Access to a computer that could run an Internet browser and Java scripts. Participants were recruited through newspaper and TV advertisements from the Tucson, Arizona area. All participants agreed to refrain from participating in any other weight loss program for the duration of the study.
Exclusion criteria	Participants were excluded if they did not meet the inclusion criteria.
Intervention	The Healthy Weight for Life study was a 2-year behavioural weight loss and weight maintenance lifestyle intervention comparing internet intervention with self-directed weight maintenance. The purpose of this study was to compare weight regain in a group of perimenopausal women randomised to a 12-month weight maintenance internet intervention or to self-directed weight maintenance after a 4-month weight loss treatment. Weight loss intervention Participants met weekly with the intervention team in six groups of about 26 participants / group for 150 min/session. Participants were encouraged to produce small but lasting changes in eating and physical activity patterns, leading to a moderate daily energy deficit (-1260-2090 kJ/day [300-500 kcal/day]). A weight loss of ~0.5 kg a week was targeted and individualised goals for energy intake (EI) and expenditure were

	provided to all participants. Weight was monitored weekly. The intervention comprised four components of behavioural change: Physical activity: topics on physical activity / exercise included planning and implementing a structured exercise plan to reach caloric expenditure goals, increasing daily walking and lifestyle physical activity, dealing with safety, weather, and equipment issues, overcoming typical barriers to exercise, and others. Nutrition and healthy eating: nutrition and eating behaviour topics included reducing portion sizes, increasing meal partitioning, reducing dietary fat content, promoting adequate water intake, increasing fibre content, maintaining sufficient calcium intake, preventing binge and emotional eating, planning for special occasions, monitoring hunger and avoiding severe hunger states, the importance of breakfast, choosing low energy density and less processed foods, and increasing meal satiety among many others. Social support: an important aspect of the intervention was to create new social support opportunities for participants based on healthy habits, positive role models, and health-conscious networking. Groups were formed for exercise / activity partners, participation in fitness events, and emotional support discussions. Both groups were given this training to help maintain group support after the 4-month intervention. Mind / body: wellness skills were introduced that focused on total health including physical, emotional, career, intellectual, environmental, and spiritual dimension. Weight loss maintenance intervention: Internet versus self-directed During the weight loss portion of the study, women met weekly in six groups. To maintain group cohesion, and to avoid intergroup contact among the participants assigned to different randomised arms, three weekly groups were randomised to the internet condition and three groups to the self-directed condition at the end of the 4-month weight loss program. Self-directed participants had no further contact with study staff except for testing. They were permitted, however, to continue to meet and practice the principles learned during the 4-month program. The website for the Internet group was a password-protected environment, hosting communication tools, progress monitoring tools (body weight, physical activity, dietary intake, and “mind-body” logs), curriculum materials and up-to-date dietary and physical activity information, and links to other websites of interest. Women were offered two 2-hour classes at the beginning of the internet maintenance period on how to navigate the website and how to enter and track their own data by accessing electronic self-reporting logs.

	There were eight measures of internet use captured with Java scripting. These included four internet logs into which data were entered by participants: weight, physical activity, dietary intake, and “your week”. The number of email communications and articles accessed and the number posted were also tracked. Internet participants were asked to weigh themselves the same day and time each week, track their diet four times per week, and record exercise a minimum of three times per week. Participants were asked to log on and enter their data at least once per week. They were also able to retrieve a report of their weight progress. Communicating via the internet, participants organised and ran support groups and these groups were encouraged to meet online once per week. Study staff answered emails, posted bulletins, and organised occasional chat room sessions on the website to answer questions. Feature articles were posted by either staff or participants to present new dietary and exercise information. Several web-based incentive programs were developed and implemented to stimulate internet use and data entries.	
Comparison	The self-directed women had no contact with study staff.	
Outcomes measured	All women were measured for weight, height and body composition, and diet intake, and were interviewed using the 7-day physical activity questionnaires at baseline, four months, and 16 months. BMI was calculated from these measurements. Leisure-time physical activity was assessed at baseline and at the 4- and 16-month follow-up periods, using the Seven-Day Physical Activity Recall interview. Dietary intake was assessed from nine randomly assigned days of diet records collected at baseline (three days), four months (three days), and 16 months (three days). Each three-week recording period included one weekend day and two non-consecutive weekdays.	
Duration of follow-up	The duration of follow-up was 12 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% loss to follow-up

Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	
Results		
Participants	The average age and weight of women entering the study were 48.0 ± 4.4 years and 84.7 ± 12.3 kg, respectively. Participants had a mean BMI of 31.1 ± 3.8 kg/m2. They reported expending an average of 120 ± 121 kcal/day in at least moderate physical activity and reported consuming 1,933 ± 516 kcal/day.	
Overall findings	Weight loss intervention groups did not show significant differences in change in weight, energy expenditure, or energy intake during the 4-month weight loss intervention. Women who remained in the study and were randomised weighed less (83.7 ± 11.8 kg versus 90.0 ± 14.0 kg, P < 0.05), had lower BMI (30.7 ± 3.6 kg/m2 vs. 33.3 ± 4.1 kg/m2, P < 0.01), had a lower % fat (44.2 ± 5.4% vs. 46.7 ± 4.6%, P < 0.05) and expended more energy in exercise at baseline (128 ± 124 vs 78 ± 99 kcal/day, P < 0.05) compared with women who dropped out before the weight maintenance program. At the end of the 12-month follow-up, the internet and self-directed groups had regained on average 0.4 ± 5.0 kg and 0.6 ± 4.0 kg, respectively (P = 0.5). Both intervention groups had similar significant losses in weight during the weight loss period, maintained significant losses after follow-up, and weighed similar amounts by the end of the maintenance period. There was considerable variation in weight gain during the 12-month weight maintenance period within the Internet group. The mean weight regain was only 0.4 kg, however the range of weight change was -20.9 to 12.2 kg. In within-group analyses, internet diet-log entries were correlated with follow-up weight change (r = -0.29; P < 0.05) and moderately with change in exercise energy expenditure (EEE; r = 0.44; P < 0.01).	
Compliance with treatment	Not stated	
Adverse events	Not stated	

Notes	The group of women randomised to an internet weight maintenance program and those randomised to the self-directed group both successfully maintained weight loss over a 12-month maintenance phase. While significant weight loss was maintained over follow-up by both groups of women, internet use did not surpass self-direction in helping to sustain weight loss. The self-directed group was able to maintain weight as successfully as an internet group, possibly because the self-directed group continued to have within-group contact developed during the weight loss program.

Dale 2008

Characteristics of the study	
Study Citation	Dale KS, Mann JI, McAuley KA, Williams SM & Farmer VL 2008, 'Sustainability of lifestyle changes following an ILI in insulin resistant adults: Follow-up at 2-years', Asia Pac J Clin Nutr, vol.18, no.1, pp.114-20.
Study Design	RCT
Methods	
N (enrolled)	N =79 participants Control group (N =23), modest group (N =31), intensive group (N =25) Study was conducted in New Zealand.
Inclusion criteria	Caucasian men and women who were normoglycaemic insulin resistant (as determined by euglycaemic insulin clamp).
Exclusion criteria	None stated.
Intervention	Insulin resistant adults were randomised to a control group or either a modest or ILI group for 4-months. Thereafter

	the two intervention groups were combined for follow-up analysis and were consequently renamed the 'combined' intervention group. Participants in both the 'modest' and 'intensive' intervention groups received detailed diet and exercise advice from an experienced dietitian and physical activity instructor. The terms 'modest' and 'intensive' relate principally to the extent to which they were asked to change their diet and exercise patterns rather than the intensity of the intervention. Participants in both intervention groups were seen weekly by the researchers for weight measurements and a short dietary and exercise assessment. At the end of the 4-month intervention participants were strongly encouraged to maintain their lifestyle changes.
Comparison	Participants in the control group were advised to continue their usual diet and exercise routine over the 4-month intervention period. No contact was made with the control group until the end of the 4-month study period at which time they received some advice regarding healthy lifestyle changes as it was considered unethical not to do so.
Outcomes measured	Anthropometry, blood pressure, fasting glucose, lipids, insulin levels, aerobic fitness and dietary intake. At each of the three visits, weight, waist circumference, BMI and blood pressure were measured. Fasting blood samples were analysed for cholesterol, triglycerides, glucose and insulin. In addition at the 2-year follow-up visit a 75 g Oral Glucose Tolerance Test (OGTT) was conducted and aerobic fitness was assessed using a sub maximal VO2 treadmill test. Participants were asked to fill-out a 4-day estimated diet record. Participants attended a 90-minute interview which included a standard lifestyle questionnaire, which was developed specifically for the 2-year follow-up visit. The questionnaire contained 80 qualitative and semi-quantitative questions. The questionnaire was developed to assess physical activity and eating behaviour patterns over the previous two weeks, changes in lifestyle habits since the end of the initial 4-month intervention and maintenance of the advised lifestyle habits. Participants also answered questions regarding their level of motivation, control, confidence, and support. Questions regarding goal setting, barriers to maintaining lifestyle changes, contributors to the maintenance of lifestyle change, financial effects and previous weight issues were also included. Finally, the usefulness of the lifestyle programme and perceived additional strategies for future interventions were assessed.
Duration of follow-up	Participants were followed-up at eight, 12 and 24 months.

Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	
Results		
Participants	The control group included 17 females and six males with a mean age of 45 years. The modest group included 19 females and 12 males with a mean age of 48 years. The intensive group included 17 females and eight males with a mean age of 46 years.	
Overall findings	At 4-months the adjusted difference in weight between the modest and control groups was -3.4 kg (95% CI, -5.4 to -1.3) and intensive and control groups was -4.7 kg (-6.9, -2.4) P = 0.0001 respectively. At 2-years there were no significant differences for weight when the initial three groups were compared or when the combined intervention group was compared with the control group. At 2-years, 64% of participants reported that more frequent follow-up would have helped them to maintain healthy lifestyle habits.	

<table>
<tr><td></td><td>Changes in variables at 2 years (variance for changes not provided):
<table>
<tr><td></td><td>Intervention</td><td>Control</td></tr>
<tr><td>Weight (kg)</td><td>-1</td><td>-0.8</td></tr>
<tr><td>Waist (cm)</td><td>-1</td><td>-2</td></tr>
<tr><td>BMI (kg/m^2)</td><td>-0.7</td><td>-0.8</td></tr>
<tr><td>SBP (mmHg)</td><td>-5</td><td>-1</td></tr>
<tr><td>DBP (mmHg)</td><td>1</td><td>2</td></tr>
<tr><td>Total cholesterol (mmol/L)</td><td>-0.4</td><td>0.2</td></tr>
<tr><td>HDL (mmol/L)</td><td>0</td><td>0.1</td></tr>
<tr><td>Triglycerides (mmol/L)</td><td>-0.1</td><td>0.3</td></tr>
<tr><td>Glucose (mmol/L)</td><td>-0.1</td><td>0</td></tr>
</table>
There were no statistically significant differences between intervention and control groups for any variables.</td></tr>
<tr><td>Compliance with treatment</td><td>Not stated</td></tr>
<tr><td>Adverse events</td><td>Not stated</td></tr>
<tr><td>Notes</td><td>Intensive counselling for 4-months with 4-monthly and then yearly monitoring were not enough for maintaining lifestyle changes sufficient to sustain weight loss.</td></tr>
</table>

Daniels 2007

Characteristics of the study	
Study Citation	Daniels SR, Long B, Crow S, Styne D, Sothern M, Vargas-Rodriguez I, Harris L, Walch J, Jasinsky O, Cwik K, Hewkin A & Blakesley V 2007, 'Cardiovascular effects of sibutramine in the treatment of obese adolescents: results of a randomized, double-blind, placebo-controlled study', Pediatrics, vol.120, no.1, pp.e147-57.
Study Design	RCT
Methods	
N (enrolled)	N = 498 participants Sibutramine group (N = 368), placebo group (N = 130) Study conducted in US.
Inclusion criteria	Adolescents aged 12 to 16 years in good general health with a BMI (kg/m^2) not less than a lower limit of ≥ 2 units above the US weighted mean for the 95th percentile based on age and gender and ≤ 44 kg/m^2.
Exclusion criteria	Cardiovascular disease (including arrhythmias), type 1 or type 2 diabetes mellitus, major psychiatric disorders, pregnancy, use of medications promoting weight loss or weight gain or those contraindicated with the use of sibutramine, or cigarette smoking. Participants with SBP > 130 mmHg, DBP > 85 mmHg, or a pulse rate (PR) > 95 beats per minute were excluded, but hypertensive participants stable on therapy were permitted.
Intervention	Sibutramine in conjunction with behavioural therapy (BT). The participants were randomly assigned to BT plus 10 mg of sibutramine or BT plus placebo daily. After an initial screening visit, eligible participants were randomly assigned in a 3:1 ratio to receive either single daily doses of sibutramine 10 mg or placebo. Randomisation was stratified by centre and by low (≤ 37 kg/m^2) and

	high (> 37 kg/m^2) baseline BMI. At month six, all of the participants who had not lost > 10% of their initial BMI were up-titrated in a blinded fashion to15 mg of sibutramine or placebo. Participants were seen weekly until week two, biweekly until week 12, and then monthly until study completion. At each scheduled visit, participants were assessed for receipt of behaviour modification instruction, and medication adherence was evaluated by capsule count.	
Comparison	Placebo plus behaviour therapy.	
Outcomes measured	Change in body weight, BMI, blood pressure.	
Duration of follow-up	The intervention including follow-up was 12-months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	Baseline BMI was 28.1 to 46.3 kg/m^2. Participants came from multiethnic backgrounds including 56.6% white, 21.1% black, and 15.7% Hispanic / Mexican American. Overall, 72% of the enrolled participants completed the study: 76% (281 of 368) of the participants in the sibutramine group and 62% (80 of 130) in the placebo group.	
Overall findings	There was a mean treatment group difference in BMI of 2.6 kg/m^2 (95% CI, 2.0 to 3.1 kg/m2) in favour of sibutramine; participants in the sibutramine group reduced BMI by 2.9 kg/m^2 compared with a reduction of 0.3	

	kg/m^2 in the control group. Small mean decreases in BP and PR were seen in both sibutramine and placebo groups at the end point (SBP: -2.1 vs. -2.1 mmHg; DBP: -0.1 vs. -1.1 mmHg; PR: -0.2 vs. -1.8 beats per minute). In both treatment groups, these reductions in vital signs were greater at the end point when BMI reduction was 5% compared with < 5%.
Compliance with treatment	Mean compliance was sibutramine: 89.1%; placebo: 83.9%.
Adverse events	The incidence of adverse events reported was similar between participants in the sibutramine and placebo treatment groups. Tachycardia was higher in participants receiving sibutramine (13% [46 of 368] compared with placebo (6% [8 of 130]). Overall, adverse events led to 6% (23 of 368) withdrawals in the sibutramine group and 5% (7 of 130) in the placebo group (P = 0.832). There were 1% (5 of 368) of participants in the sibutramine group (and none in the placebo group) discontinued for hypertension.
Notes	Sibutramine treatment effectively promotes weight loss in obese adolescents with concomitant improvements in blood pressure and heart rate. Sibutramine treatment seems to have minimal cardiovascular effects and to be well tolerated in this population.

Dixon 2008

Characteristics of the study	
Study Citation	Dixon JB, O'Brien PE, Playfair J, Chapman L, Schachter LM, Skinner S, Proietto J, Bailey M & Anderson M 2008, 'Adjustable gastric banding and conventional therapy for type 2 diabetes: a randomized controlled trial', JAMA, vol.299, no.3, pp.316-23.
Study Design	RCT

Methods	
N (enrolled)	N = 60 participants Conventional diabetes therapy with a focus on weight loss by lifestyle change (control) (N = 30), laparoscopic adjustable gastric banding (LAGB) with conventional diabetes care (N = 30). Study was conducted in Australia.
Inclusion criteria	Aged between 20 and 60 years, had a BMI of 30 to 40, had been diagnosed with clearly documented type 2 diabetes within the previous two years, had no evidence of renal impairment or diabetic retinopathy, and were able to understand and comply with the study process.
Exclusion criteria	Candidates were excluded if they did not meet the inclusion criteria and had a history of type 1 diabetes, diabetes secondary to a specific disease, previous bariatric surgery, a history of medical problems such as mental impairment, drug or alcohol addiction, recent major vascular event, internal malignancy, or portal hypertension or a contraindication for either study group. Participants were excluded if they did not attend two initial information visits.
Intervention	Lifestyle modification programs were individually structured to reduce energy intake, to reduce intake of fat (< 30%) and saturated fats, and to encourage intake of low glycaemic index and high-fibre foods. Physical activity advice encouraged 10,000 steps per day and 200 minutes per week of structured activity, including moderate-intensity aerobic activity and resistance exercise. Lifestyle was the primary approach to weight loss, but very low-calorie diets (VLCDs) and medications were discussed with all patients and used after consultation with the dietician or general physician if the patient expressed a desire to use additional measures. In addition to all aspects of the conventional-therapy program (described below), the surgical group underwent placement of a LAGB by one of two experienced surgeons within one month of randomisation. Progress was reviewed by the bariatric surgical team every four to six weeks throughout the study, and adjustments to band volume were made using standard clinical criteria.
Comparison	The conventional therapy program delivered best available medical practice for the treatment, education, and follow-up of patients with type 2 diabetes. Patients had open access to a general physician, dietician, nurse, and diabetes educator and had visits with at least one team member every six weeks throughout the two years. Medical therapies, including pharmaceutical agents, were determined by an experienced diabetes specialist on an individual basis.

Outcomes measured	Glycaemic control at two years after randomisation: the proportion of participants achieving remission (exceptional glycaemic control) of type 2 diabetes, defined as fasting plasma glucose levels < 126 mg/dL in addition to HbA1c values < 6.2% without the use of oral hypoglycaemics or insulin. Secondary outcome measures included percentage change in HbA1c levels, weight, blood pressure, waist circumference, and levels of fasting lipids, including total cholesterol, triglycerides, and high-density lipoprotein cholesterol. Changes in medication use, changes in the proportion of participants with the metabolic syndrome as defined by the National Cholesterol Education Program Adult Treatment Panel III criteria, and changes in indirect measures of insulin resistance using the homeostatic model assessment method were assessed.	
Duration of follow-up	The duration of the intervention and follow-up was two years.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	A	
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results		
Participants	The mean BMI of those recruited to the study was 37.1 kg/m^2. There were 13 participants with a baseline BMI < 35 kg/m^2 - six randomised to surgery and seven to the conventional-therapy group. The mean age (SD) of the participants in the surgery group was 46.6 (7.4) years and 47.1 (8.7) years in the conventional therapy group. The percentage of men in the surgery group vs. the conventional therapy group was 50:43. All bands were placed laparoscopically, with a mean procedure time of 54 minutes (SD 10.8; range 40 to 74), and hospital admissions lengths were one day for 23 (80%) patients, two days for five (17%) patients and four days for one (3%) patient.	

<table>
<tr><td></td><td>In the conventional-therapy group participants elected to use a VLCD (N = 11) or sibutramine (N = 7) at some stage during the two years. None elected to use orlistat.</td></tr>
<tr><td>Overall findings</td><td>Of the 60 patients enrolled, 55 (92%) completed the 2-year follow-up.
<table>
<tr><td></td><td>LAGB</td><td>Usual care</td></tr>
<tr><td>Weight (kg)</td><td>-21.1 (10.5)</td><td>-1.5 (5.4)</td></tr>
<tr><td>Waist (cm)</td><td>-17.9 (10.8)</td><td>-4.0 (9.1)</td></tr>
<tr><td>WHR</td><td>-0.06 (0.06)</td><td>-0.01 (0.06)</td></tr>
<tr><td>SBP (mmHg)</td><td>-6.0 (17.9)</td><td>-1.7 (14.2)</td></tr>
<tr><td>DBP (mmHg)</td><td>-0.7 (11.1)</td><td>-0.9 (11.1)</td></tr>
<tr><td>HbA1c (%)</td><td>-1.8 (1.2)</td><td>-0.4 (1.3)</td></tr>
<tr><td>Total cholesterol (mg/dL)</td><td>3.6 (51.6)</td><td>-0.4 (31.4)</td></tr>
<tr><td>Triglycerides (mg/dL)</td><td>-71.7 (92.9)</td><td>-2.1 (120.6)</td></tr>
<tr><td>HDL (mg/dL)</td><td>12.6 (9.8)</td><td>2.6 (6.1)</td></tr>
</table>
Remission of type 2 diabetes was achieved by 22 (73%) in the surgical group and four (13%) in the conventional-therapy group.

Relative risk of remission for the surgical group was 5.5 (95% CI, 2.2 to 14.0). Surgical and conventional-therapy groups lost a mean (SD) of 20.7% (8.6%) and 1.7% (5.2%) of weight, respectively, at two years (P < 0.001).

Remission of type 2 diabetes was related to weight loss (R^2 = 0.46, P < 0.001) and lower baseline HbA1c levels (combined R^2 = 0.52, P < 0.001).</td></tr>
</table>

Compliance with treatment	Not stated
Adverse events	One patient in the surgical group developed a superficial wound infection over the access port site two weeks post-placement, which resolved with intravenous antibiotics. Two patients developed gastric pouch enlargement, both at 10 months after placement, and were treated with non-urgent laparoscopic revisional surgery to remove and replace the band. One patient experienced eating difficulties and persistent regurgitation with no saline in the band and no impedance of flow on contrast study. The band was removed 15 days after placement. Hospital stay for each revisional procedure was less than one day, and there were no complications. Other adverse events reported were postoperative febrile episodes in one patient. No cause was found, and the fever resolved. A minor hypoglycaemic episode occurred in one patient and gastrointestinal tract intolerance to metformin in another. Two patients in the conventional therapy group had minor gastrointestinal tract adverse effects, and one had persistent diarrhoea with metformin. One patient developed vasculitic rash, possibly related to rosiglitazone. All problems resolved when the medications were discontinued. One patient had multiple hypoglycaemic episodes, and another was admitted to hospital with angina and a transient cerebral ischemic episode. Two patients were intolerant of very low-calorie meal replacement.
Notes	Weight loss associated with adjustable gastric banding resulted in diabetes remission in the majority of obese participants diagnosed as having type 2 diabetes and was associated with greater improvements in features of the metabolic syndrome and use of related medications.

Eliasson 2007

Characteristics of the study	
Study Citation	Eliasson B, Gudbjornsdottir S, Cederholm J, Liang Y, Vercruysse F & Smith U 2007, 'Weight loss and metabolic effects of topiramate in overweight and obese type 2 diabetic patients: randomized double-blind placebo-controlled trial', Int J Obes (Lond), vol.31, no.7, pp.1140-7.
Study Design	RCT

Methods	
N (enrolled)	N = 38 participants Placebo-treated (N = 19), topiramate-treated (N = 19) Study was conducted in Sweden.
Inclusion criteria	Non-smoking men aged 35 to 75 years and postmenopausal women aged 45 to 75 years, who had type 2 diabetes (DM2) for at least six months before enrolment, were recruited via newspaper advertisements. Diagnosis of DM2 was established by no history of ketoacidosis, no urine ketone 2+ or more on urine dipstick, and with a maintained endogenous C-peptide production defined as ≥ 0.5 µg/L 15 minutes following 1 mg of glucagon injected intravenously. Glycosylated haemoglobin (HbA1c) was required to be between 6.5% and 10% and BMI was 27 to 50 kg/m^2. Patients should be weight-stable (±4 kg for two months) and their diabetes controlled either by diet alone or by a stable dose of a sulfonylurea (SU) in monotherapy for a minimum of six months.
Exclusion criteria	Not stated
Intervention	Participants in this double-blind placebo-controlled trial were randomised to treatment with topiramate or placebo. The trial included a 6-week screening phase, an 8-weeks double-blind titration phase and a 9-months double-blind maintenance phase. Topiramate was dosed as 192 mg/day (96 mg b.d.). After the maintenance phase, topiramate was tapered over two weeks and participants were followed up a further 4 weeks off-drug, concluded by a final visit. During the double-blind phase, the SU dose remained unchanged in all the topiramate-treated patients. In the placebo-treated group, the dose of glimeperide was reduced in one patient whereas the dose of glibenclamide was increased in two patients. Among the patients participating the full double-blind period, 11 participants were treated with antihypertensive drugs (including four topiramate-treated participants), and one placebo-treated patient used a statin for hyperlipidaemia. The participants were instructed not to start a diet or an exercise programme intended to induce weight loss during the course of the study.
Comparison	Inactive placebo medication
Outcomes measured	Insulin sensitivity (as measured with the euglycemic hyperinsulinemic clamp).

	Secondary outcomes were body weight, HbA1c, fasting plasma glucose (FPG), blood lipid profile and circulating cytokine levels. Meal tests were performed to evaluate postprandial glucose and insulin levels. Three-day diet recalls were carried out to evaluate energy ingestion.	
Duration of follow-up	12 months including follow-up	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	Medium	Small numbers
Results		
Participants	The mean age was 58.6 ± 7.1 years, body weight 98.1 ± 16.1 kg, BMI 33.0 ± 4.5 kg/m^2, and HbA1c 7.3 ± 0.9%.	

<table>
<tr><td>Overall findings</td><td>In topiramate-treated patients, there were significant reductions in HbA1c (-1.1 ± 0.9%), fasting plasma glucose, body weight (-6.6 ± 3.3%), as well as body fat, lean body mass, postprandial glucose and free fatty acid levels but there were no significant changes in insulin sensitivity.
<table><tr><td></td><td>Intervention (SD)</td><td>Control (SD)</td></tr><tr><td>Weight (kg)</td><td>-7.2 (4.3)</td><td>0.01 (2.5)</td></tr><tr><td>BMI (kg/m^2)</td><td>-2.3 (1.3)</td><td>0.05 (0.9)</td></tr><tr><td>Waist (cm)</td><td>-6.5 (5.5)</td><td>-0.6 (4.7)</td></tr><tr><td>WHR</td><td>-0.03 (0.03)</td><td>0.01 (0.07)</td></tr><tr><td>HbA1c</td><td>-1.1 (0.9)</td><td>0.3 (0.8)</td></tr><tr><td>Total cholesterol (mmol/L)</td><td>0.01 (0.4)</td><td>0.1 (0.7)</td></tr><tr><td>Triglycerides (mmol/L)</td><td>-0.11 (1.0)</td><td>-0.1 (0.5)</td></tr><tr><td>HDL (mmol/L)</td><td>0.1 (0.2)</td><td>0.1 (0.1)</td></tr><tr><td>LDL (mmol/L)</td><td>-0.1 (0.4)</td><td>0.1 (0.5)</td></tr></table>The daily average energy intake decreased more in the topiramate group than in the placebo group.</td></tr>
<tr><td>Compliance with treatment</td><td>Not stated.</td></tr>
<tr><td>Adverse events</td><td>The most common central nervous system (CNS)-related adverse events that occurred more frequently in topiramate-treated than in placebo-treated patients were paraesthesia (15 vs. four patients), headache (six vs. four), fatigue (six vs. four), dizziness (three vs. two), anorexia (three vs. zero), depression (two vs. one), difficulty with concentration / attention (two vs. zero), insomnia (two vs. one), and nervousness (two vs. zero). Other</td></tr>
</table>

	common treatment-emergent adverse events that were not CNS-related and were reported more often in the topiramate group were nausea (three vs. one), gastritis (two vs. zero), dry mouth (two vs. zero), tooth caries (two vs. zero) and muscle weakness (two vs. zero). Serious adverse events occurred in three topiramate-treated patients (atrial fibrillation, pulmonary hamartoma and a malignant breast neoplasm). All of these were classified by the investigators as not related to the study treatment. More topiramate-treated patients than placebo-treated patients discontinued owing to an adverse event (eight patients vs. one patient).
Notes	Topiramate treatment of overweight DM2 patients resulted in significant weight reductions and reductions in body fat as well as a marked improvement in the glycaemic control. Frequent side effects were associated with topiramate treatment, limiting its use in obese DM2 patients.

Ford 2010

Characteristics of the study	
Study Citation	Ford AL, Bergh C, Sodersten P, Sabin MA, Hollinghurst S, Hunt LP & Shield JP 2010, 'Treatment of childhood obesity by retraining eating behaviour: randomised controlled trial', BMJ, vol.340, pp.b5388.
Study Design	RCT
Methods	
N (enrolled)	N = 106 participants Mandometer group (N = 54) and standard care group (N = 52) Study was conducted in the United Kingdom.
Inclusion criteria	Eligibility criteria were age 9 to < 18 years at recruitment, BMI > 95th centile, minimal or no learning difficulties, no underlying medical problem such as hypothyroidism, and no medication for insulin resistance. Participants were

	recruited from new patients referred to the obesity clinic.
Exclusion criteria	Exclusion was based on not meeting the inclusion criteria mentioned above.
Intervention	A computerised device, Mandometer, providing real time feedback to participants during meals to slow down speed of eating and reduce total intake was compared with standard lifestyle modification therapy. Those in the Mandometer group saw a research nurse (previously trained in Mandometer technology at the Mandometer Clinic, Stockholm, Sweden), initially once a week for six weeks, every second week for a further six weeks, and once every sixth week thereafter. The research nurse telephoned the patients to offer support and encouragement every second week from week 12 onwards. Dietary advice was provided by a paediatric dietician not involved with the standard clinic, based on the Food Standards Agency “eat-well plate” at www.eatwell.gov.uk. This educational tool can be used to improve diet by encouraging the consumption of starchy foods, fruit and vegetables, moderate amounts of milk, dairy products, fish and lean meat and small amounts of high fat and high sugar foods. Recommended portion sizes for fruit and vegetables are also provided. Participants were given four dietetic consultations over 12 months. A clinician met the participants every four months, emphasising the need to change eating habits and improve physical activity as advocated in the standard clinic.
Comparison	At the first contact with the standard care group about an hour was spent with each family discussing the reasons underlying childhood obesity, its implications, and possible lifestyle measures that might be associated with an improved BMI. The clinic was run by a multidisciplinary team composed of a clinician, a paediatric dietician, and an exercise specialist, all of whom consulted with each family. Emphasis was placed on implementing changes to increase levels of enjoyable physical activity to national recommended levels (60 minutes of exercise a day) alongside a balanced diet, again based on the eat-well plate. Families were encouraged to set their own dietary goals and targets, with practical advice and guidance from the dietician. In encouraging activity the approach was one of facilitation rather than prescription. Motivational interviewing techniques were used to engage participants and families in the decision making process for lifestyle changes, which is consistent with self-determination principles and is more likely to lead to responsibility for long term change. Families were given further clinic appointments at three monthly intervals.
Outcomes measured	The primary outcome measured was the change in BMI SD score (SDS) over 12 months with assessment 18 months after the start of the intervention. Measures included weight, height and waist circumference. BMI was

	adjusted for age and sex to give a BMI SDS with British 1990 growth reference data from the Child Growth Foundation. Secondary outcomes were body fat SDS, metabolic status, quality of life evaluation, change in portion size, and eating speed. Fasting glucose and insulin concentrations, lipid profile, and high sensitivity C reactive protein (HsCRP), blood pressure and insulin resistance were measured, while paediatric quality of life inventory 4.0 was used to measure state of wellbeing and quality of life.	
Duration of follow-up	Duration of the intervention was 12 months with a six month follow-up after the intervention had ended.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	B	Non-blinded
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results		
Participants	The standard care group had a mean (SD) age of 12.5 (2.3) years, a mean BMI (range) of 33.1 (24.5 to 49.7) kg/m^2 and contained 56% females. The Mandometer group had a mean (SD) age of 12.7 (2.2) years, a mean BMI (range) of 34.4 (24.2 to 46.6) kg/m^2 and also contained 56% females.	
Overall findings	Using the last available data on all participants (N = 106), those in the Mandometer group had significantly lower mean BMI SDS at 12 months compared with standard care (baseline adjusted mean difference 0.24; 95% CI, 0.11 to 0.36). Similar results were obtained when analyses included only the 91 who attended per protocol (baseline adjusted mean difference 0.27; 95% CI, 0.14 to 0.41), with the difference maintained at 18 months (adjusted mean difference 0.27; 95% CI, 0.11 to 0.43) (N = 87). The mean meal size in the Mandometer group fell by 45 g (7 to 84	

	g). Mean body fat SDS adjusted for baseline levels was significantly lower at 12 months (0.24, 0.10 to 0.39; P = 0.001). HDL cholesterol concentration improved significantly (mean adjusted difference -0.07; 95% CI, -0.14 to -0.00; P = 0.043) compared with the standard care group. Measures of quality of life improved in both arms during the study, with no significant difference at 12 months (data not provided).
Compliance with treatment	Over the 12 months attendance at the scheduled clinic appointments was 66% in the standard arm (mean clinics attended 2.6 of 4) and 81% the Mandometer arm (mean 2.5 of 3) Participants in the Mandometer group kept 83% of a maximum 15 appointments with the training nurse in the 12 months.
Adverse events	No adverse events were reported.
Notes	Mandometer therapy, focusing on eating speed and meal size, is a useful addition to other weight loss options for treating adolescent obesity.

Foster 2009

Characteristics of the study	
Study Citation	Foster GD, Borradaile KE, Sanders MH, Millman R, Zammit G, Newman AB, Wadden TA, Kelley D, Wing RR, Pi-Sunyer FX, Reboussin D & Kuna ST 2009, 'A randomized study on the effect of weight loss on obstructive sleep apnea among obese patients with type 2 diabetes: the Sleep AHEAD study', Arch Intern Med, vol.169, no.17, pp.1619-26.
Study Design	RCT

Methods	
N (enrolled)	N = 264 participants Study conducted in US.
Inclusion criteria	Participants for this study were enrolled in the Sleep AHEAD (Action for Health in Diabetes) study, an ancillary investigation of the Look AHEAD study, a 16-centre randomised, controlled clinical trial investigating the long-term health impact of an ILI on diabetes. In the Look AHEAD study, a total of 5,145 overweight and obese adults with type 2 diabetes were randomised to ILI or to diabetes support and education (DSE). Primary inclusion criteria for Look AHEAD were patients aged 45 to 75 years with a BMI ≥ 25 (≥ 27 if taking insulin), physician-verified type 2 diabetes, a HbA1c level of < 11%, and a BP of < 160/100 mmHg. In addition to Look AHEAD criteria, an exclusion criterion for the Sleep AHEAD study was previous surgical or current medical treatment for obstructive sleep apnoea (OSA). Patients with previously diagnosed but untreated OSA were eligible to participate. Potential participants were assessed by unattended overnight polysomnograph (PSG). Of the 306 patients assessed by PSG at baseline, 42 did not have OSA, leaving 264 participants for the current study.
Exclusion criteria	Exclusion criterion for the Sleep AHEAD study was previous surgical or current medical treatment for OSA.
Intervention	The ILI participants received a group behavioural weight loss program developed specifically for obese patients with type 2 diabetes. Participants were prescribed portion-controlled diets that included using liquid meal replacements, frozen food entrees, and snack bars for the first four months (with reduced use from months 5 to 12). The prescribed energy intake was 1200 to 1500 kcal/day if the patients weighed < 113.6 kg or 1500 to 1800 kcal/day if the patients weighed ≥ 113.6 kg, with 30% or less calories from fat. The physical activity prescription was 175 min/week of moderate-intensity activity such as brisk walking.
Comparison	The DSE participants attended three group sessions over a 1-year period. These sessions focused on diet, physical activity, and social support as they related to effective diabetes management. The current prospective, randomised study design took advantage of the anticipated between-group differences in weight change over time to assess the effect of weight loss on OSA.

Outcomes measured	OSA as assessed by PSG. Weight, height, waist circumference and neck circumference were assessed within one week of the PSG, which was performed at both baseline and one year where possible.	
Duration of follow-up	This RCT had a one year follow-up.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results		
Participants	Participants all had type 2 diabetes. Mean (SD) age was 61.2 (6.5) years, weight was 102.4 (18.3) kg, BMI was 36.7 (5.7) and the mean apnoea-hypopnea index (AHI) was 23.2 (16.5) events per hour. The participants included a mixture of races / ethnicity: 18.6% were African American; 1.1% American Indian / Native American; 1.9% Asian / Pacific Islander; 3.8% Hispanic; and 1.5% other. The sample was 59.1% female. Of the 264 participants 38.7% had mild OSA (AHI 5.0 to 14.9), 35.2% had moderate OSA (AHI 15.0 to 29.9), and 26.1% had severe OSA (AHI ≥ 30).	
Overall findings	The ILI participants lost more weight at one year than did DSE participants (10.8 kg vs. 0.6 kg; $P < 0.001$). Relative to the DSE group, the ILI intervention was associated with an adjusted (SE) decrease in AHI of 9.7 (2.0) events per hour ($P < 0.001$). At one year, more than three times as many participants in the ILI group than in the DSE group had total remission of their OSA, and the prevalence of severe OSA among ILI participants was half that of the DSE group. Initial AHI and weight loss were the strongest predictors of changes in AHI at one year ($P < 0.01$). Participants with a weight loss of 10 kg or more had the greatest reductions in AHI.	

Compliance with treatment	Not stated
Adverse events	Not stated
Notes	Weight loss produced through an ILI significantly improved OSA among obese participants with type 2 diabetes. The greatest benefit was observed in participants with more severe OSA at baseline and in participants who lost the most weight. The authors conclude that the significant increase in AHI over one year in participants who were weight stable suggests that OSA is a rapidly progressing syndrome that will worsen without treatment in middle-aged obese adults with type 2 diabetes; and that physicians and their patients can expect that weight loss will result in significant and clinically relevant improvements in OSA among obese patients with type 2 diabetes.

Golley 2007

Characteristics of the study	
Study Citation	Golley RK, Magarey AM, Baur LA, Steinbeck KS & Daniels LA 2007, 'Twelve-month effectiveness of a parent-led, family-focused weight-management program for prepubertal children: a randomized, controlled trial', Pediatrics, vol.119, no.3, pp.517-25.
Study Design	RCT
Methods	
N (enrolled)	N = 111 participants Parenting-skills training with intensive lifestyle education (P+DA) (N = 38), parenting-skills training alone (P) (N = 37), and wait-listed for intervention for 12 months (WLC) (control group)(N = 36) Study was conducted in Australia.

Inclusion criteria	Child age 6 to 9 years, and overweight. Caregiver of child must be willing to attend sessions and able to read and understand English.
Exclusion criteria	BMI z-score > 3.5, diagnosed with a syndromal cause of obesity, using medications that influence weight gain or loss, a diagnosis of physical or developmental disability or chronic illness, and a sibling enrolled in the study.
Intervention	P Group Parenting-skills training was used to facilitate and support parents to undertake family lifestyle change. Parents participated in the Positive Parenting Program (Triple P), which is based on child development theory and social learning principles and aims to promote parental competence to manage their child's behaviour. The program consisted of four weekly 2-hour group sessions followed by four weekly, then three monthly 15 to 20 minute individual telephone sessions. Application of the program to eating and activity behaviours was supported by provision of a general healthy-lifestyle pamphlet. P+DA Group Parents in the P+DA arm completed the Triple P program as described for the P group above, and participated in an additional intensive lifestyle support group sessions. These sessions commenced after completion of the four weekly parenting sessions, every two weeks at first, then monthly. These sessions focused on lifestyle knowledge and skills including the following: family-focused healthy eating with specific core food serve recommendations monitoring; label reading; snacks; modifying recipes; being active in a variety of ways; roles and responsibilities around eating; managing appetite; self-esteem; and teasing. While parents attended the lifestyle sessions, children in the P+DA group attended structured, supervised activity sessions developed by physical activity experts. The sessions consisted of fun, non-competitive games designed around aerobic activity and development of fundamental motor skills. Sessions were designed as play rather than exercise and were diversional rather than interventional. The activities required minimal equipment and were deliverable by non-expert staff and easily replicated at home.
Comparison	WLC Group

	The WLC group received the same general healthy-lifestyle pamphlet as the parenting alone group. During the 12-month wait-listed period, the WLC group was contacted by telephone three to four times for five minutes as a retention strategy. Researcher contact with the WLC families was minimised to avoid the potential placebo effect of therapist contact.	
Outcomes measured	Baseline measurements occurred before randomisation. Outcome measures were assessed at program completion (six months) for participants in intervention groups and at 12 months after baseline for all participants. Data collection was performed by the same trained assessor who was blinded to participant group allocation. The primary study outcome was BMI z-score. Height, weight, waist-circumference and blood pressure were measured and BMI was calculated from these measurements. Fasting glucose, total cholesterol, HDL cholesterol, LDL cholesterol and triacylglycerol levels were assessed from blood samples. Parental height and weight were either assessor-measured or self-measured and BMI was calculated. At baseline a questionnaire was completed and included: parent characteristics, family structure, and postcode. Socioeconomic status was also assessed.	
Duration of follow-up	Total duration of follow-up and intervention was 12 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	

Results	
Participants	Families were recruited between July 2002 and August 2003 predominantly via media publicity and school newsletters. 64% of participants were female. The majority of participants were eight years of age or older and obese. 34% of parents were classified as overweight and 44% as obese.
Overall findings	After 12 months, the BMI z-score was reduced by 10% with parenting-skills training plus intensive lifestyle education versus 5% with parenting-skills training alone or wait-listing for intervention. Waist-circumference z-score fell over 12 months in both intervention groups but not in the control group. There was a significant gender effect, with greater reduction in BMI and waist-circumference z-scores in boys compared with girls. Boys in both intervention groups had significantly lower BMI z-scores at 6 and 12 months compared with baseline. 45% of children in the WLC group increased their BMI z-score over 12 months, compared with 19% and 24% in the P+DA and P groups, respectively (P = 0.3). There were no differences in metabolic health outcomes between study groups at baseline or 12 months. DBP was significantly reduced at 6 months but not at 12 months, compared with baseline.
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	A family-focused intervention using parenting-skills training and promoting a healthy family lifestyle may be an effective approach to weight management in prepubertal children but with a clear gender effect. Both parenting-skills training and lifestyle education are potentially important components. This approach addresses family and parental factors influencing children's eating and activity behaviours and achieves a moderate reduction in adiposity after 12 months.

Greenway 2010

Characteristics of the study	
Study Citation	Greenway FL, Fujioka K, Plodkowski RA, Mudaliar S, Guttadauria M, Erickson J, Kim DD & Dunayevich E 2010, 'Effect of naltrexone plus bupropion on weight loss in overweight and obese adults (COR-I): a multicentre, randomised, double-blind, placebo-controlled, phase 3 trial', Lancet, vol.376, no.9741, pp.595-605.
Study Design	RCT
Methods	
N (enrolled)	N = 1,742 participants Naltrexone 32 mg plus bupropion (N = 583); naltrexone 16 mg plus bupropion (N = 578); placebo (N = 581) Study conducted in the US.
Inclusion criteria	Men and women aged 18 to 65 years. Participants with a BMI of 30 to 45 kg/m^2 and uncomplicated obesity or BMI 27 to 45 kg/m^2 with dyslipidaemia or hypertension. Women of childbearing potential and using effective contraception. After commencement of the trial, the protocol was amended to include enrolment of participants taking β blockers, since these agents are common medications in people who are overweight or obese.
Exclusion criteria	Women who were pregnant or lactating. Participants with obesity of known endocrine origin; type 1 or type 2 diabetes; cerebrovascular, cardiovascular, hepatic, or renal disease; previous surgical or device intervention for obesity; or loss or gain of more than 4 kg within three months before randomisation. Additional exclusion criteria included history of seizures or serious psychiatric illness, treatment with bupropion or

	naltrexone in the previous 12 months, and history of drug or alcohol use in the previous 12 months. No additional weight loss drugs besides double-blind study treatment were allowed.
Intervention	Combination treatment with sustained-release naltrexone and bupropion was developed to produce complementary actions in CNS pathways regulating bodyweight. The Contrave Obesity Research I (COR-I) study assessed the effect of such treatment on bodyweight in overweight and obese participants. The study was a randomised, double-blind, placebo-controlled, phase 3 trial undertaken at 34 sites in the USA from October, 2007 to May, 2009. Study centres were a combination of academic and primary care centres. Participants were prescribed mild hypocaloric diet and exercise. Participants were randomly assigned in a 1:1:1 ratio to receive: sustained-release naltrexone 32 mg per day plus sustained-release bupropion 360 mg per day combined in fixed-dose tablets (also known as NB32), sustained-release naltrexone 16 mg per day plus sustained-release bupropion 360 mg per day combined in fixed-dose tablets (also known as NB16), or matching placebo twice a day, given orally for 56 weeks. The trial included a 3-week dose escalation.
Comparison	Matching placebo twice a day, given orally for 56 weeks.
Outcomes measured	Body weight and vital signs were measured at each visit. Fasting glycaemic variables, high-sensitivity C-reactive protein, and lipids were measured at baseline, week 28, and week 56. Questionnaires were administered at baseline and weeks eight, 16, 28, and 56. Questionnaires included the Impact of Weight on Quality of Life-Lite (IWQoL-Lite), Food Craving Inventory (FCI), and Control of Eating Questionnaire (COEQ). The FCI measures cravings for specific food items, which are aggregated into four subscales.
Duration of follow-up	The total duration of intervention and follow-up was 56 weeks.

Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	50% loss to follow-up
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	The placebo group had a mean (SD) age of 43.7 (11.1) years and mean (SD) BMI of 36.2 (4.0) kg/m^2. Participants taking naltrexone 16 mg plus bupropion had a mean (SD) age of 44.4 (11.3) years and mean (SD) BMI of 36.2 (4.3) kg/m^2. Participants taking naltrexone 32 mg plus bupropion had a mean (SD) age of 44.4 (11.1) years and a mean (SD) BMI of 36.1 (4.4) kg/m^2. All groups contained 85% women.	

Overall findings

Secondary endpoints at 56 weeks (change and percentage change from baseline).

	Placebo	Naltrexone 16 mg + bupropion	P value for comparison with placebo	Naltrexone 32 mg + bupropion	P value for comparison with placebo
Waist circumference (cm)	-2.5 (-3.3 to -1.6)	-5.0 (-5.9 to -4.2)	<0.0001*	-6.2 (-7.1 to -5.4)	<0.0001*
Triglycerides (mmol/L)	-3.1% (-6.6 to 0.6)	-8.0% (-11.4 to -4.4)	0.0461*	-12.7% (-15.8 to 9.5)	<0.0001*
HDL cholesterol (mmol/L)	0.8% (-1.0 to 2.5)	7.6% (5.9 to 9.4)	<0.0001*	8.0% (6.3 to 9.7)	<0.0001*
LDL cholesterol (mmol/L)	-0.5% (-2.6 to 1.6)	-1.5% (-3.6 to 0.6)	0.8112	-2.0% (-4.0 to 0.1)	0.4838
SBP (mmHg)	-1.9 (-2.7 to -1.2)	0.3 (-0.5 to 1.1)	<0.0001	-1.0 (-0.9 to 0.7)	0.0008
DBP (mmHg)	-0.9 (-1.4 to -0.3)	0.1 (-0.5 to 0.7)	0.0150	0.0 (-0.5 to 0.6)	0.0217

*Endpoints that were significant according to the prespecified sequential closed testing procedure undertaken to correct for multiple comparisons.

Percentage change values are least squares geometric mean minus one (95% CI).

Mean change in bodyweight was:

-1.3% (SE 0.3) in the placebo group,

-6.1% (0.3) in the naltrexone 32 mg plus bupropion group (P < 0.0001 vs. placebo) and

	-5.0% (0.3) in the naltrexone 16 mg plus bupropion group (P < 0.0001 vs. placebo). Eighty four (16%) participants assigned to placebo had a decrease in bodyweight of 5% or more compared with 226 (48%) assigned to naltrexone 32 mg plus bupropion (P < 0.0001 vs. placebo) and 186 (39%) assigned to naltrexone 16 mg plus bupropion (P < 0.0001 vs. placebo).
Compliance with treatment	Drug compliance was measured at every visit by pill count; a compliance rate of at least 70% was deemed acceptable. Non-compliant participants (< 70% compliance rate) were counselled about the importance of compliance and re-educated on how to take study medication. Participants who were non-compliant for two consecutive months or who did not take the study drug for more than 15 consecutive days were considered for discontinuation from the study.
Adverse events	The most frequent adverse event in participants assigned to combination treatment was nausea (naltrexone 32 mg plus bupropion, 171 participants [29.8%]; naltrexone 16 mg plus bupropion, 155 [27.2%]; placebo, 30 [5.3%]). Headache, constipation, dizziness, vomiting, and dry mouth were also more frequent in the naltrexone plus bupropion groups than in the placebo group. A transient increase of around 1.5 mmHg in mean SBP and DBP was followed by a reduction of around 1 mmHg below baseline in the naltrexone plus bupropion groups. Combination treatment was not associated with increased depression or suicidal events compared with placebo.
Notes	This study had a generally healthy population comprised mainly of middle-aged white women and a completion rate of approximately 50% in all groups. These are common limitations in phase 3 trials in obesity, and women are more likely to seek pharmacotherapy for weight loss than are men. Furthermore, the effect of early withdrawal was assessed and all sensitivity analyses support the results of the primary analysis. Although this 56-week study expands upon shorter phase 2 studies, adults with diabetes or active CVD were excluded, and safety findings might not be generalisable to patients with obesity who have higher cardiovascular risk. Data for adherence to diet and exercise instruction was not obtained, therefore the contribution of these interventions to the study outcome cannot be fully understood. Finally, this study compared naltrexone plus bupropion with placebo; until head-to-head studies are undertaken, the ability to compare this combination with currently available

	pharmacotherapies for obesity is limited. Although lifestyle modification is first-line therapy for obesity, adherence to this intervention is poor. Treatment with sustained-release naltrexone plus bupropion offers a new approach to management of obesity that might improve the ability to control eating behaviour and response to food cravings. The combination of naltrexone plus bupropion could be a useful addition to the current range of medications that facilitate adherence to lifestyle modification and produce clinically meaningful weight loss for treatment of obesity and obesity-related disorders.

Groenveld 2010

Characteristics of the study	
Study Citation	Groeneveld IF, Proper KI, van der Beek AJ & van Mechelen W 2010, 'Sustained body weight reduction by an individual-based lifestyle intervention for workers in the construction industry at risk for cardiovascular disease: results of a randomized controlled trial', Prev Med, vol.51, no.3-4, pp.240-6.
Study Design	RCT
Methods	
N (enrolled)	N = 816 participants Intervention groups (N = 408) (energy balance group [N = 191] and smoking cessation group [N = 70] analysed); control groups (N = 408) (energy balance group [N = 181] and smoking cessation group [N = 75] analysed). Study conducted in The Netherlands.
Inclusion criteria	Male workers in the construction industry aged 18 to 65 years with an elevated risk of CVD were invited to the study, based on the results of their most recent periodical health screening. A worker was considered eligible for the study in case of a higher than moderate 10-year risk of coronary heart disease

	based on the Framingham risk score and having one or more additional risk factors, i.e. BMI ≥ 30; HbA1c ≥ 6.5%; not meeting the physical activity guidelines; heart complaints; psychological complaints; alcohol intake ≥ 35 glasses per week.	
Exclusion criteria	Not specified.	
Intervention	Six months of individual counselling using motivational interviewing (MI) techniques, delivered face to face and by telephone. Participants aimed at improving energy balance-related behaviour or smoking cessation. Over a period of six months, each participant in the intervention group had three 45 to 60 minute face-to-face and four 15 to 30 minute telephone contacts with an occupational physician or occupational nurse. The workers who consented to participate were pre-stratified for work type (blue-collar workers performing the construction work versus white-collar workers involved in administration and supervision), and individually randomised into intervention or control. After the first session, where their CVD risk and current health were discussed, participants chose whether to discuss diet and / or exercise, or to discuss smoking cessation.	
Comparison	Participants in the control group received usual care, consisting of brief oral or written information from the occupational physician about their CVD risk profile.	
Outcomes measured	Body weight (kg), BMI (kg/m^2), SBP and DBP (mmHg), HDL cholesterol (mmol/L), total cholesterol/HDL cholesterol ratio, and HbA1c (%).	
Duration of follow-up	Study duration including follow-up was 12 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	Low	Magnitude of weight loss at 12 months small

<table>
<tr><td>Relevance of evidence rating***</td><td>High</td><td></td></tr>
<tr><td colspan="3">Results</td></tr>
<tr><td>Participants</td><td colspan="2">Mean age was 46.9 years (intervention) and 46.2 years (control); mean BMI was 28.8 (intervention) and 28.2 (control).</td></tr>
<tr><td>Overall findings</td><td colspan="2">The intervention group lost weight and reduced BMI by 12 months; the control group gained weight and increased BMI.
<table>
<tr><td></td><td>Intervention</td><td>Control</td></tr>
<tr><td>Weight (kg)</td><td>-0.9</td><td>0.9</td></tr>
<tr><td>BMI (kg/m^2)</td><td>-0.4</td><td>0.3</td></tr>
<tr><td>SBP (mmHg)</td><td>-4.9</td><td>-3.8</td></tr>
<tr><td>DBP (mmHg)</td><td>-3.7</td><td>-3.2</td></tr>
<tr><td>HDL (mmol/l)</td><td>0.07</td><td>0.05</td></tr>
<tr><td>HbA1c (%)</td><td>0.08</td><td>0.12</td></tr>
</table></td></tr>
<tr><td>Compliance with treatment</td><td colspan="2">Compliance was reported as high by the authors.</td></tr>
<tr><td>Adverse events</td><td colspan="2">No adverse events of the intervention were reported.</td></tr>
<tr><td>Notes</td><td colspan="2">This study shows that an individual-based intervention using motivational interviewing techniques for workers in the construction industry can result in small but sustained beneficial changes in body weight.</td></tr>
</table>

Haapala 2009

Characteristics of the study	
Study Citation	Haapala I, Barengo NC, Biggs S, Surakka L & Manninen P 2009, 'Weight loss by mobile phone: a 1-year effectiveness study', Public Health Nutr, vol.12, no.12, pp.2382-91.
Study Design	RCT
Methods	
N (enrolled)	N = 125 participants Experimental group using a mobile phone-operated weight-loss program (N = 62), and control group with no intervention (N = 63) Study conducted in Finland.
Inclusion criteria	Adult volunteers were recruited via newspaper advertisement and telephone screening. Age range was 25 to 44 years. BMI range = 25 to 36 kg/m^2. Access to a mobile phone and an internet connection. No diagnosed chronic disease or major psychiatric disease. No current, planned or previous pregnancy within six months.
Exclusion criteria	Not stated
Intervention	The present study investigated the effectiveness of a mobile phone-operated weight-loss program, Weight Balance. The program was delivered via text messaging, and instructed a staggered reduction of food intake and daily

	weight reporting with immediate tailored feedback. The program calculated the dieter's daily energy requirement and physical activity coefficients. After receiving information on the dieter's current weight, the program sent a text indicating the percentage dieters had reached for the day's target weight; the extent to which they had reached their daily weight goal; the amount of food to be consumed in proportion to the subjects' normal diet, as a fraction, percentage and as energy; and the days remaining until the target. The program advised dieters to start reducing their food intake by leaving out unnecessary foods high in sugar and / or fat and to cut down on alcohol. It encouraged an increase in daily physical activity and emphasised the need for regular weight reporting. A password-protected website provided a personal webspace for dietary record keeping and tracking one's weight loss in visual form. It also offered links to reliable sources of information on healthy nutrition and physical activity. Dieters were allowed to set their target weight as either a short- or long-term goal and to adjust it as needed at every 3 month visit. After the user reached the set target weight, they could still use the program for weight loss maintenance. No specific instruction on diet or exercise was given to either group.	
Comparison	The control group was invited for the baseline and the 12-month visits to the study centre.	
Outcomes measured	Main outcome variables were: changes in body weight and waist circumference. Weight, height and waist circumference measurements were performed at each follow-up. Dietary habits were assessed at baseline, six and 12 months with questions related to the self-reported frequency of consuming eight energy-dense foods.	
Duration of follow-up	The total duration of intervention and follow-up was 12 months.	
Quality of study	Rating	Comments
Level of evidence	II	

Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	The experimental group had a mean (SD) age of 38.1 (4.7) years and a mean (SD) BMI of 30.6 (2.7) kg/m^2. The control group had a mean age of 38.0 (4.7) years and a mean BMI of 30.4 (2.8) kg/m^2. There were 79% and 76% females in the experimental and control groups, respectively.	
Overall findings	By 12 months the experimental group had lost significantly more weight than the control (4.5 ± 5.0 v. 1.1 ± 5.8 kg). Experimental group had a greater reduction in waist circumference compared with the control group (6.3 ± 5.3 v. 2.4 ± 5.4 cm). Most of the weight loss in the experimental group took place during the first three months (4.5 ± 3.1 kg) while the cumulative reduction was highest at 6 months (5.2 ± 4.4 kg). By 12 months, the experimental group had lost 4.5 ± 5.0 kg while the weight loss among the controls was non-significant (1.1 ± 5.8 kg). In the experimental group, subjects who withdrew from the study lost less weight by 3 months than those who continued in the study (1.0 ± 3.4 vs 5.3 ± 3.5%). Physical activity increased on average in both groups, from 2 to 3 times per month to once per week ($P < 0.05$).	
Compliance with treatment	Overall frequency of use of the program faded from eight times per week to 3 to 4 times per week by 12 months.	
Adverse events	Not stated	
Notes	Early weight loss, self-efficacy, contact frequency, attitudes towards the medium, changes in work and family life and changes made in dietary habits were the strongest predictors of weight loss.	

Hemmingsson 2009

Characteristics of the study	
Study Citation	Hemmingsson E, Udden J, Neovius M, Ekelund U & Rossner S 2009, 'Increased physical activity in abdominally obese women through support for changed commuting habits: a randomized clinical trial', Int J Obes (Lond), vol.33, no.6, pp.645-52.
Study Design	RCT
Methods	
N (enrolled)	N = 120 participants Intervention (N = 60), control (N = 60) Study was conducted in Sweden.
Inclusion criteria	Healthy female volunteers with abdominal obesity (waist circumference 88 to 120 cm). Aged 30 to 60 years at inclusion. No physician-identified contraindication for physical activity. Participants were required to work away from home at least three days per week (self-reported), and to be able to participate in active commuting to work on most working days.
Exclusion criteria	ECG abnormality, subjectively assessed lack of motivation, physician suspected depression, severe arthritis, Baker's cyst, severe asthma, gynaecological problems and not a resident in the Stockholm area.
Intervention	This intervention focused on commuting in a physically active (cycling and walking) manner. The intervention group was a moderate-intensity program with physician meetings, physical activity prescriptions, group counselling and bicycles.

	The intervention program consisted of all aspects of standard care combined with a more intensive behavioural counselling package which included: Three individual 30 minute sessions with a physician experienced in behaviour change theory and practice at baseline, six and 12 months, including detailed physical activity prescriptions ('PaP, Physical activity on Prescription'). The prescriptions focused on increased cycling and walking, mainly between work and home. The physician meetings aimed at changing physical activity behaviour. For example enhancing motivation for physically active commuting, especially bicycling, routine building, overcoming barriers, strengthening self-efficacy, relapse prevention and preventing injuries. Two x 2-hour group counselling sessions during the cycling season (at months 2 and 14).	
Comparison	The control group was a low-intensity group support program with a pedometer-driven walking intervention with two x 2-hour group counselling sessions at baseline and six months. There were 10 women in each group.	
Outcomes measured	The primary outcome variable was cycling (km/day); measured with a trip meter in the intervention group and self-reported in the control group. Walking was measured with a pedometer in the control and intervention group. Waist circumference, height and weight anthropometrical data at baseline and at follow-up after six and 18 months. BMI was calculated from this information.	
Duration of follow-up	Intervention and follow-up were for a total of 18 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	

Results	
Participants	At baseline, mean (SD) age was 48.2 years (7.4), waist circumference 103.8cm (7.8), walking 8471 steps per day (2646), bicycling 0 km per day.
Overall findings	The intervention group was more likely to achieve treatment success for cycling than controls: 38.7 vs. 8.9% (odds ratio [OR] = 7.8 [95% CI = 4.0 to 15.0, P < 0.001]). There was no difference between the two groups for compliance with the walking recommendation: 45.7 vs. 39.3% (OR = 1.2 [95% CI = 0.7 to 2.0, P = 0.50]). The intervention group was more likely to comply with at least one of the treatment goals (either cycling ≥ 2 km/day or walking 10,000 steps/day than the control group: 60.8 vs 41.8% (OR = 2.2 (95% CI: 1.3 to 3.8, P = 0.003)). Commuting by car and public transport were reduced by 34% (P < 0.01) and 37% (P < 0.001), respectively, with no differences between groups. Both groups attained similar waist circumference reductions (-2.1 and -2.6 cm, P = 0.72) after six months, which were maintained at 18 months, whereas body weight did not change.
Compliance with treatment	Not stated. Attrition at 18 months was 10% for the intervention group and 25% in the control group (P = 0.03).
Adverse events	Not stated
Notes	The results suggest that physical activity can be increased in abdominally obese, middle-aged women through behavioural support for changed commuting habits.

Hughes 2008

Characteristics of the study	
Study Citation	Hughes AR, Stewart L, Chapple J, McColl JH, Donaldson MD, Kelnar CJ, Zabihollah M, Ahmed F & Reilly JJ 2008, 'Randomized, controlled trial of a best-practice individualized behavioral program for treatment of childhood overweight: Scottish Childhood Overweight Treatment Trial (SCOTT)', Pediatrics, vol.121, no.3, pp.e539-46.
Study Design	RCT
Methods	
N (enrolled)	N = 134 participants Behavioural program (intervention) (N = 69), standard care (control) (N = 65) Study was conducted in Scotland.
Inclusion criteria	Eligibility criteria were overweight children (BMI ≥ 98th centile relative to United Kingdom 1990 reference data) who were aged 5 to 11 years and attending a standard elementary school and had at least one parent who perceived the child's weight as a problem and was willing to make lifestyle changes. This study was conducted at the Royal Hospitals for Sick Children in Glasgow and Edinburgh, Scotland. Overweight children were recruited from dietetic waiting lists and were referred from hospital doctors, family physicians, school nurses, community dieticians, and community paediatricians in Glasgow and Edinburgh.
Exclusion criteria	The authors excluded children who had an underlying medical cause for their overweight or serious comorbidity that required urgent treatment or who had received treatment for overweight in the past year.
Intervention	The intervention used family-centred counselling and behavioural strategies to modify diet, physical activity, and sedentary behaviour. This was a practical, best-practice behavioural program delivered by experienced paediatric dieticians who were trained in behaviour change counselling on a 1-to-1 basis (i.e. one dietician saw one family). The program

	consisted of eight appointments (seven outpatient visits and one home visit) during 26 weeks with a total patient contact time of ~5 hours. The program used a family-centred approach whereby the child (and family) took control of his or her own lifestyle changes. The authors used various behavioural change techniques, guided by models of behaviour change, to enhance the child's motivation for making lifestyle changes: exploring motivation to make changes, exploring pros and cons of change, identifying barriers to change, problem-solving barriers, goal-setting, rewards, self-monitoring, social support, and preventing relapse. Although these behavioural techniques were developed for adults, they are increasingly being used to elicit lifestyle changes in children; however, the dieticians had to modify their explanation of these strategies to the children, particularly with younger children. The strategies were directed at the children; although parents and the dietician helped the child (especially younger children) understand and engage with the behavioural techniques. Children were encouraged to alter their diet by using a modified traffic-light approach (reduce intake of foods high in fat and sugar [red], increase intake of fruit and vegetables [green]) increase their physical activity, and restrict their sedentary behaviour (television viewing and playing computer / video games) to no more than two hours per day or the equivalent of 14 hours per week as is widely recommended. Because the intervention focused on behaviour change rather than weight change, children were weighed only three times during the 6-month program. Weight maintenance was the aim of both treatment conditions.
Comparison	Children who were randomly assigned to the control group received typical dietetic care offered to overweight individuals by hospital and community dietetic services in Scotland. This involved 3 to 4 outpatient appointments delivered by paediatric dieticians during 6- to 10 months with a total patient contact time of ~1.5 hours. Standard care did not reflect best practice, because it was very low intensity, concentrated on dietary change with minimal focus on physical activity or sedentary behaviour, and involved a didactic "medical model" rather than a behavioural, client-centred approach. In addition, advice on weight management was mainly directed toward the parents rather than the child.
Outcomes measured	Primary outcome was BMI z-score. Waist circumference was expressed relative to United Kingdom reference data as a z-score to provide an index of fat distribution. The authors measured habitual physical activity and sedentary behaviour objectively for seven days during all waking hours. Weight, fat distribution, quality of life (QoL), and height z-score, along with those measures mentioned above, were recorded at baseline and at six and 12 months.
Duration of follow-up	Duration of intervention and follow-up was 12 months.

Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	
Results		
Participants	The mean (SD) age of the control group was 8.5 (1.9) years compared with 9.1 (1.7) years for the intervention group. The BMI z-score, median (IQR) was 3.3 (2.8 to 3.6) for the control group and 3.2 (2.7 to 3.6) for the intervention group. Overall there were 59 boys and 75 girls included in the study.	

<table>
<tr><td>Overall findings</td><td>The intervention had no significant effect relative to standard care on BMI z-score from baseline to six months and 12 months. BMI z-score decreased significantly in both groups from baseline to six and 12 months. For those who complied with treatment, there was a significantly smaller weight increase in those in the intervention group compared with control subjects from baseline to six months. There were significant between-group differences in favour of the intervention for changes in total physical activity, percentage of time spent in sedentary behaviour, and light-intensity physical activity.<table><tr><td></td><td>Intervention</td><td>Control</td></tr><tr><td>BMI z-score</td><td>-0.07 (-0.32 to 0.04)</td><td>-0.19 (-0.31 to 0.02)</td></tr><tr><td>Waist z-score</td><td>-0.20 (-0.50 to -0.03)</td><td>-0.20 (-0.40 to 0.05)</td></tr><tr><td>Child self-report physical health</td><td>3.1 (-6.2 to 15.6)</td><td>8.0 (3.1 to 18.8)</td></tr><tr><td>Child self-report psychosocial health</td><td>3.3 (-5.8 to 10.8)</td><td>5.0 (0 to 10.0)</td></tr><tr><td>Parent proxy physical health</td><td>3.1 (-4.7 to 15.0)</td><td>6.2 (-6.2 to 14.1)</td></tr><tr><td>Parent proxy psychosocial health</td><td>5.0 (-1.7 to 9.2)</td><td>3.3 (-3.3 to 11.0)</td></tr></table></td></tr>
<tr><td>Compliance with treatment</td><td>Compliance with wearing the accelerometer was very poor at 12 months. However the authors reported compliance to both intervention and standard care treatments was good and retention rates at follow-up assessments were high.

Of the 69 participants assigned to the intervention, 44 (63.8%) complied well with treatment, defined as attendance at ≥ 75% of scheduled appointments. Of the 65 participants assigned to the control condition, 46 (70.8%) attended ≥ 75% of scheduled appointments.</td></tr>
<tr><td>Adverse events</td><td>There was widespread concern, particularly from parents, that treating overweight children may increase the risk for adverse effects; however, research in this area is limited. The authors found that their best-practice program, which was family-centered and intensive, did not adversely affect the child’s growth or QoL.</td></tr>
</table>

Notes	The generalisable, best-practice individualised behavioural intervention that was tested in this study had modest benefits on objectively measured physical activity and sedentary behaviour. Furthermore, the intervention had a positive effect on weight for those who complied with the program. Both treatments had a small but significant effect on BMI z-score over the 12 months. The modest magnitude of the benefits observed perhaps argues for a longer term and even more intense approach to treatment of paediatric overweight, although such treatments may not be realistic for many health care systems.

Ilanne-Parikka 2008

Characteristics of the study	
Study Citation	Ilanne-Parikka P, Eriksson JG, Lindstrom J, Peltonen M, Aunola S, Hamalainen H, Keinanen-Kiukaanniemi S, Laakso M, Valle TT, Lahtela J, Uusitupa M & Tuomilehto J 2008, 'Effect of lifestyle intervention on the occurrence of metabolic syndrome and its components in the Finnish Diabetes Prevention Study', Diabetes Care, vol.31, no.4, pp.805-7.
Study Design	RCT
Methods	
N (enrolled)	N = 522 participants Individualised lifestyle intervention group (IG) (N = 265), standard care control group (CG) (N = 257) The Finnish Diabetes Prevention Study (DPS) study was conducted in Finland.
Inclusion criteria	(1) aged 40 to 64 years at screening; (2) BMI > 25 kg/m^2 at screening; and (3) the mean value of two 75 g oral glucose tolerance tests (OGTT) in the impaired glucose tolerance (IGT) range based on WHO 1985 criteria.
Exclusion criteria	Exclusion criteria included recent (within six months) CVD event.

Intervention	Middle-aged, overweight people with IGT were randomised into intensive intervention (including physical activity, weight reduction and dietary counselling), or control ‘‘mini-intervention’’ group. The participants randomised to ILI were given individualised counselling by the study nutritionists to achieve the lifestyle goals. They were also advised to increase their level of physical activity, and voluntary physical activity sessions were offered. The lifestyle goals were: (1) weight reduction of ≥ 5%; (2) < 30% of the daily energy intake from fat; (3) < 10% of the daily energy intake from saturated fat; (4) fibre intake ≥ 15 grams per 1000 kcal; and (5) moderately intense physical activity ≥ 30 minutes per day.	
Comparison	The control participants were given general health behaviour information at randomisation.	
Outcomes measured	Weight, waist circumference, blood pressure, HDL cholesterol, triglycerides, fasting glucose. An oral glucose tolerance test was performed at baseline and at each annual visit.	
Duration of follow-up	Mean follow-up of 3.9 years.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	Randomisation and blinding not described
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results		
Participants	Participants had a mean age of 55 ± 7 years and mean BMI of 31.2 ± 4.6 kg/m^2. There were 172 men and 350 women with IGT included in the trial.	
Overall findings	The prevalence of metabolic syndrome decreased from 74% to 58% in the intervention group and from 74% to 68%	

	in the control group. The prevalence of metabolic syndrome was lower in the intervention group compared with the control group at the end of the study (OR 0.62; 95% CI, 0.40 to 0.95). Abdominal obesity prevalence decreased from 80% at baseline to 68% at study end in the intervention group and from 72% to 72% in the control group. Lifestyle intervention reduced abdominal obesity in the intervention group compared with the control group by the end of the study (OR 0.48; 95% CI 0.28 to 0.81).
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	Compared with the standard care offered to the control group, the ILI in the DPS reduced the occurrence of abdominal obesity and the overall prevalence of metabolic syndrome.

Jacob 2009

Characteristics of the study	
Study Citation	Jacob S, Rabbia M, Meier MK & Hauptman J 2009, 'Orlistat 120 mg improves glycaemic control in type 2 diabetic patients with or without concurrent weight loss', Diabetes Obes Metab, vol.11, no.4, pp.361-71.
Study Design	RCT
Methods	
N (enrolled)	N = 2,250 participants Orlistat 120 mg tds (N = 1,279), placebo (N = 1,271). Study was conducted in the US, Canada, Germany, Spain, South Africa and Thailand.

Inclusion criteria	Retrospective analysis of pooled data from seven multicentre, double-blind, placebo-controlled studies involved overweight or obese patients (men or women) with type 2 diabetes (aged 18 to 70 years) treated with metformin, sulphonylureas (SU) or insulin. Patients were required to have a BMI of 27 to 43 kg/m^2, HbA1c of 6.5 to < 13%, and stable weight for three months.	
Exclusion criteria	Exclusion criteria included: women who were pregnant, lactating, or of childbearing potential and not taking adequate contraceptive measures; presence of bulimia or laxative abuse; type 1 diabetes, previous bariatric surgery; uncontrolled hypertension; psychiatric disorders; a medical history or presence of cancer; renal, hepatic, gastrointestinal, cardiac or endocrine disorders; proliferative retinopathy, significant peripheral vascular disease or neuropathy.	
Intervention	Patients were randomised to treatment for six or 12 months with orlistat 120 mg or placebo three times daily in addition to their usual anti-diabetic medication. A mildly reduced-calorie diet (500-600 kcal/day deficit) was also prescribed. The diet contained approximately 30% of calories as fat, 50% as carbohydrate, 20% as protein, and a maximum of 300 mg cholesterol/day. At baseline and at regular intervals throughout the study, patients received dietary counselling and were encouraged to participate in moderate physical activity.	
Comparison	Lifestyle intervention and placebo medication	
Outcomes measured	The key efficacy variables were weight loss and change in glycaemic control as assessed by HbA1c and fasting plasma glucose (FPG) levels.	
Duration of follow-up	Study duration including follow-up was a maximum of 12 months	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	

Results	
Participants	The placebo group had a mean age of 54.5 ± 0.3 years and a mean BMI of 34.6 ± 0.1 kg/m^2 and contained 44% men. The orlistat group had a mean age of 54.4 ± 0.3 years and a mean BMI of 34.8 ± 0.1 kg/m2 and contained 43% men.
Overall findings	Orlistat120mg–treated patients had significantly greater decreases in bodyweight (-3.77 kg) than placebo-treated patients [-1.42 kg; least squares mean (LSM) difference from placebo: -2.35 kg. Compared with the placebo group, more than twice as many orlistat 120 mg–treated patients lost > 5% of baseline body weight (34.8 vs.14.1%), or lost > 10% of baseline body weight (9.7 vs. 3.7%). Reduction in waist circumference from baseline was significantly greater (-2.2 cm) with orlistat 120 mg than with placebo ($p < 0.05$). Patients treated with orlistat 120 mg had significantly greater mean decreases in FPG compared with placebo-treated patients (-1.39 mmol/L vs. -0.47 mmol/L; $P < 0.0001$). Orlistat 120 mg provided significantly larger mean decreases in HbA1c compared with placebo (-0.74% vs. -0.31%; $P < 0.0001$). For patients with minimal weight loss (1% of baseline body weight), orlistat 120 mg still provided a significantly greater decrease in the least squares mean value for both FPG (-0.83 mmol/L vs. ±0.02 mmol/L; $P = 0.0052$) and HbA1c (-0.29% vs. ±0.14%; $P = 0.0008$). Using linear regression analysis, improvement in glycaemic control (FPG and HbA1c) with orlistat 120 mg was less strongly correlated with weight loss than for placebo.
Compliance with treatment	Not stated
Adverse events	A similar proportion of orlistat-treated (8%) and placebo-treated patients (6%) discontinued treatment because of an adverse event.
Notes	In addition to its beneficial effect on body weight in patients with type 2 diabetes, orlistat 120 mg appears to improve glycaemic control more than would be predicted by weight loss alone.

James 2010

Characteristics of the study	
Study Citation	James WP, Caterson ID, Coutinho W, Finer N, Van Gaal LF, Maggioni AP, Torp-Pedersen C, Sharma AM, Shepherd GM, Rode RA & Renz CL 2010, 'Effect of sibutramine on cardiovascular outcomes in overweight and obese participants', N Engl J Med, vol.363, no.10, pp.905-17.
Study Design	RCT
Methods	
N (enrolled)	N = 10,744 participants Study conducted in 29 centres in 16 countries.
Inclusion criteria	Men and women, 55 years of age or older, with a BMI of at least 27 and no more than 45; participants were also eligible if they had a BMI of at least 25 and less than 27 and a waist circumference of at least 102 cm in the case of men or 88 cm in the case of women. Participants were required to have a history of CVD (defined as coronary artery disease, stroke, or peripheral arterial occlusive disease), type 2 diabetes mellitus with at least one other cardiovascular risk factor (hypertension, dyslipidaemia, current smoking, or diabetic nephropathy) or both. Participants who were enrolled in the study were categorised as belonging to one of three pre-specified cardiovascular-risk groups: diabetes only (DM-only group), CVD only (CV-only group) or both (CV-DM group).
Exclusion criteria	Exclusion criteria were symptoms of heart failure greater than New York Heart Association functional class II, blood pressure (BP) higher than 160/100 mmHg, a pulse rate (PR) of more than 100 beats per minute, scheduled cardiac surgery or coronary angioplasty, or a weight loss of more than 3 kg within the previous three months.
Intervention	All the participants received sibutramine in addition to participating in a weight-management program during a 6-

	week, single-blind, lead-in period. After the lead-in period 9,804 participants underwent random assignment in a double-blind fashion to sibutramine (4,906 participants) or placebo (4,898 participants).	
Comparison	Placebo plus weight management program	
Outcomes measured	The primary outcome was the time from randomisation to the first occurrence of a primary outcome event. The primary outcome events were non-fatal myocardial infarction, non-fatal stroke, resuscitation after cardiac arrest and cardiovascular death. Secondary outcomes were death due to any cause; first myocardial infarction; first stroke; cardiovascular death; first occurrence of composite outcome (that included nonfatal myocardial infarction, nonfatal stroke, resuscitated cardiac arrest, cardiovascular death and any of the following revascularisation procedures: PTCA, CABG, coronary artery stent placement, cardiac transplant, peripheral vascular bypass or angioplasty and carotid endarterectomy); and first occurrence of either haemodialysis or renal transplantation.	
Duration of follow-up	The mean duration of study treatment after randomisation was 3.4 years with the study follow-up extended to a maximum of six years.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% did not complete
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	The mean age of the participants was 63.2 years (range, 51 to 88). In the intervention versus control group body weight was 96.3 kg versus 96.2 kg; mean BMI in males was 33.7	

	versus 33.6 kg/m^2; mean BMI in females was 35.4 versus 35.7 kg/m^2; waist circumference in males was 114.4 in both groups; waist circumference in females was 109.1 versus 109.5. In the intervention versus control group mean SBP was 138.2 in both groups; mean DBP was 77.9 versus 77.8 mmHg; HbA1c was 7.5 in both groups; total cholesterol was 195 mg/dl in both groups.
Overall findings	Mean weight loss during the lead-in period was 2.6 kg; after randomisation, the participants in the sibutramine group achieved and maintained further weight reduction (mean 1.7 kg at 12 months). The mean BP decreased in both groups, with greater reductions in the placebo group than in the sibutramine group (mean difference 1.2/1.4 mmHg). The risk of a primary outcome event was 11.4% in the sibutramine group as compared with 10.0% in the placebo group (hazard ratio (HR) 1.16; 95% CI 1.03 to 1.31). The rates of non-fatal myocardial infarction and non-fatal stroke were 4.1% and 2.6% in the sibutramine group and 3.2% and 1.9% in the placebo group, respectively (HR for non-fatal myocardial infarction 1.28; 95% CI 1.04 to 1.57; P = 0.02; HR for non-fatal stroke 1.36; 95% CI 1.04 to 1.77; P = 0.03). The rates of cardiovascular death and death from any cause were not increased.
Compliance with treatment	Not stated
Adverse events	Adverse events were reported if they were serious or contributed to discontinuation of the study drug. Serious adverse events and adverse events leading to permanent discontinuation of the study drug were evaluated regardless of whether they were adjudicated as cardiovascular outcome events. Adverse events resulting in discontinuation of the study drug occurred in 13.6% of the participants in the sibutramine group and 12.4% of the participants in the placebo group. The most common adverse event in both groups was myocardial infarction. Serious adverse events were reported in 42.1% of the participants in the sibutramine group and 40.5% in the placebo group. Adverse events with an incidence of at least 0.5% or with a significant between-group difference were those reported by investigators and do not necessarily reflect adjudicated primary outcome events. A review of serious adverse events showed that there were significantly more reports of myocardial ischemia and ischemic stroke in participants taking sibutramine than in participants taking placebo and significantly more reports of second-degree atrioventricular block and acute pancreatitis in participants taking placebo than in participants

	taking sibutramine. Adverse events leading to discontinuation of the study drug included: myocardial infarction; atrial fibrillation; constipation; acute myocardial infarction; sudden death; tachycardia; abdominal pain upper; cardiac failure acute; and left ventricular failure. Serious adverse events included: coronary artery disease; angina (unstable and pectoris); atrial fibrillation; osteoarthritis; acute myocardial infarction; myocardial infarction; coronary artery stenosis; cardiac failure; diabetes mellitus inadequate control; myocardial ischemia; cardiac failure (congestive); peripheral artery occlusive disease; pneumonia; cerebrovascular accident; ischaemic stroke; benign prostatic hyperplasia; transient ischemic attack; carotid artery stenosis; diabetes mellitus; cataract; cholelithiasis; prostate cancer; acute coronary syndrome; death; ventricular tachycardia; cardiac arrest; erysipelas; atrial flutter; sudden death; hypertension; urinary tract infection; varicose veins; osteomyelitis; duodenal ulcer haemorrhage; pancreatitis (acute); atrioventricular block (second degree); tendon rupture; arrhythmia; and hip fracture.
Notes	Among participants who were receiving long-term treatment with sibutramine, those with pre-existing cardiovascular conditions had an increased risk of non-fatal myocardial infarction and non-fatal stroke but not of cardiovascular death or death from any cause.

Jenkinson 2009

Characteristics of the study	
Study Citation	Jenkinson CM, Doherty M, Avery AJ, Read A, Taylor MA, Sach TH, Silcocks P & Muir KR 2009, 'Effects of dietary intervention and quadriceps strengthening exercises on pain and function in overweight people with knee pain: randomised controlled trial', BMJ, vol.339, pp.b3170.
Study Design	RCT
Methods	
N (enrolled)	N = 389 participants

	Diet + exercise (N = 109), diet only (N = 122), exercise only (N = 82) and leaflet only (N = 76). Study conducted in UK.
Inclusion criteria	All men and women aged 45 and over with a BMI of ≥ 28.0 kg/m^2 and knee pain who were registered at one of five general practices in Nottingham were eligible for inclusion. In addition, a small number of people were recruited after publicity in local media. To ascertain eligible people in the community, each general practice sent a postal questionnaire to all registered patients aged 45 and older. There was no upper age limit. People with knee pain were defined as those who reported having knee pain on most days of the past month. The authors did not include those with recent onset acute pain related to obvious trauma.
Exclusion criteria	Exclusion criteria were rheumatoid arthritis, cardiac pacemaker, intra-articular injection of steroid into either knee within past three months, lower limb amputation, total knee replacement, unable to complete recruitment questionnaire, unable to undertake either intervention, unwilling to take part. Terminally ill patients or those with psychiatric illness, dementia, or other incapacitating disease deemed by their general practitioner to make them unsuitable for participation were excluded by their general practitioner.
Intervention	Participants were randomised to one of four groups: dietary intervention plus quadriceps strengthening exercises; dietary intervention alone; quadriceps strengthening exercises alone; and advice leaflet only (control group). The dietary intervention consisted of individualised dietary advice that would help to create a deficit of 2.5 MJ (600 kcal) a day, in line with healthy eating recommendations (reducing fat and sugar intake, eating more fruit and vegetables, and reducing portion size) and achieve a weight loss of 0.5 to 1.0 kg a week. The exercise program comprised a series of simple exercises in five sections, primarily designed to strengthen the quadriceps muscle. Although participants received initial instruction in performing the exercises, exercises were subsequently undertaken at home, unsupervised, and with minimal contact with the research visitor and therefore were predominantly self-managed. Participants in the dietary groups were visited at home once a month for the first six months and then every other month for the duration of the 24 months of follow-up. Those in the exercise only or control groups were visited every four months throughout the 24 months but received a support telephone call in between their visits.

Comparison	Advice leaflet only (control group).	
Outcomes measured	The primary outcome was a “response” defined as a reduction in pain score from baseline of ≥ 30% at 24 months with knee pain severity scored with the pain subscale of the Western Ontario and McMaster Universities (WOMAC) osteoarthritis index. The authors compared mean knee pain scores at six, 12, and 24 months between treatment arms as a secondary outcome. Additional secondary outcome measures, analysed at 24 months only, comprised mean change in WOMAC stiffness subscale, WOMAC physical function subscale, hospital anxiety and depression rating scale, and mean change in the bodily pain and physical function domains of the SF-36.	
Duration of follow-up	Duration of follow-up was 24 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% did not complete study
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	Medium	
Results		
Participants	The baseline characteristics of participants were similar between the groups (mean age 61, median BMI 33.6 kg/m^2, 66% women). Most participants (351, 90%) had knee radiography within the first few weeks, 47% of which showed signs of osteoarthritis (Kellgren-Lawrence scale > 2). According to the Nottingham logically derived line drawing atlas, 57 (16%) had isolated tibiofemoral osteoarthritis, 35 (10%) had isolated patellofemoral osteoarthritis, and 14 (4%) had both.	
Overall findings	Two hundred and eighty nine (74%) participants completed the trial. There was a significant reduction in knee pain in the knee exercise groups compared with those in the non-exercise	

	groups at 24 months (percentage risk difference 11.61, 95% CI 1.81% to 21.41%). The absolute effect size (0.25) was moderate. The number needed to treat to benefit from a 30% improvement in knee pain at 24 months was nine (five to 55). In those randomised to knee exercise improvement in function was evident at 24 months (mean difference -3.64, -6.01 to -1.27). The mean difference in weight loss at 24 months in the dietary intervention group compared with no dietary intervention was 2.95 kg (1.44 to 4.46); for exercise versus no exercise the difference was 0.43 kg (-0.82 to 1.68). This difference in weight loss was not associated with improvement in knee pain or function but was associated with a reduction in depression (absolute effect size 0.19).
Compliance with treatment	The authors were not able to measure direct compliance with the dietary intervention but all participants were weighed at each visit. Compliance with exercise was graded as high or low according to how well the exercise diaries had been completed. They were categorised by a single observer who made a global judgment of all exercise diaries with some adjustment for pattern of regularity. In the diet + exercise group and the exercise only group, 49 (45%) and 37 (45%), respectively, complied highly with the exercise program for 24 months. Those with high compliance were more likely to have a baseline WOMAC pain score above the top third (> 9.0) and were more likely to be women. Compared with before starting the trial, self-reported use of analgesics (for knee pain) and dose during the trial were both significantly lower in the exercise group than in the non-exercise group. Significantly fewer people in the exercise group reported having had knee pain on most days of the past month of the trial. There were no significant differences in the distribution of responses to these questions when the authors compared the dietary group with the non-dietary group (results not shown). A participant's willingness to change their lifestyle or their diet, categorised from responses in the ascertainment questionnaire (and thus before the start of the trial), was not associated with exercise compliance, pain improvement of > 30%, or with loss of > 5% of initial body weight.
Adverse events	Not stated
Notes	In overweight and obese adults aged 45 and over, a simple home based knee strengthening exercise program reduced knee pain, improved the function of the knee, and reduced knee stiffness over a two year period. These effects were not apparent in people allocated to a dietary intervention alone, even though weight loss was achieved.

Johnston 2010

Characteristics of the study	
Study Citation	Johnston CA, Tyler C, Fullerton G, McFarlin BK, Poston WS, Haddock CK, Reeves RS & Foreyt JP 2010, 'Effects of a school-based weight maintenance program for Mexican-American children: results at 2 years', Obesity (Silver Spring), vol.18, no.3, pp.542-7.
Study Design	RCT
Methods	
N (enrolled)	N = 60 participants Instructor-led intervention (ILI) (N = 40), self-help (SH) program (N = 20) Study was conducted in the US.
Inclusion criteria	This study evaluated 24-month outcomes of a RCT involving an intensive lifestyle-based weight maintenance program targeting overweight Mexican-American children at a charter school in Houston, Texas. Children of any weight classification (e.g. normal, overweight) were eligible to participate and were not differentiated during the intervention.
Exclusion criteria	Not stated
Intervention	Students were recruited in two waves / school years (2004-2005 and 2005-2006). Individuals in each wave or cohort of participants were randomised to either the SH or ILI. No incentives were provided for participation in the study; however, children whose parents consented for them to give blood received $25 at the 6-month data collection and $50 at the 12-month data collection. Both the SH and ILI conditions focused on increasing healthy eating and physical activity using behavioural strategies to individualise the plans for the specific needs of the participants. Those randomised to the ILI

	condition participated in an instructor / trainer-led intervention for 24 weeks of daily (Monday through Friday) sessions. The ILI classes were held during the last period of the school day while self-help and non-participating children attended study hall in separate rooms to reduce the likelihood of contamination. All children at the school received a snack during this period, though the study staff provided ILI children with peanuts / peanut butter and a fruit or vegetable to enhance satiety and to provide an opportunity for fruit / vegetable consumption. Researchers did not control for the caloric content or nutritional value of the snack provided by the school to the SH students. The researchers also worked to educate the school on how to provide an environment to support healthy eating and physical activity habits that would benefit all students.	
Comparison	Children in the SH condition used a 12-week parent-guided manual intended to promote child weight loss and long-term maintenance of changes.	
Outcomes measured	Participants' heights and weights were collected at baseline, one and two years. BMI was calculated using measured height and weight and was standardised (zBMI) using age and gender normative data from the Centers for Disease Control and Prevention. Tricep skinfold thickness was used as a proxy for percent body fat at baseline and 1-year follow-up. At baseline and 1-year follow-up, venous blood samples were collected in the morning following an overnight (> 8 hour) fast. Blood samples were analysed for total cholesterol, triglycerides, HDL cholesterol, and calculated LDL cholesterol. Blood pressure (BP) was measured after five minutes rest, while heart rate was monitored and recorded continuously during each physical activity session.	
Duration of follow-up	Total study duration including follow-up was two years.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	Details of randomisation not provided Blinding not mentioned

Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	Children were between the ages of 10 and 14 (mean [SD] age = 12.3 [0.7]) years and in the 6th or 7th grade. All children self-identified as Mexican American. All participants included in analyses were overweight or obese (i.e. BMI > 85th or > 95th percentile for age and gender, respectively) according to Centers for Disease Control and Prevention guidelines. The ILI condition consisted of 11 overweight and 10 obese boys and 10 overweight and nine obese girls. The SH condition consisted of six overweight and six obese boys and two overweight and six obese girls. No differences were found between conditions with respect to baseline demographic or anthropometric variables. In addition, there were no significant differences between completers and non-completers on baseline demographic variables.	

<table>
<tr><td>Overall findings</td><td>ILI participants showed significantly greater decreases in zBMI at one and two years (F = 26.8, P < 0.001, F = 4.1, P < 0.05, respectively) compared to SH controls. ILI participants showed greater improvements in body composition, as measured by tricep skinfold (F = 9.75, P < 0.01). Children in the ILI condition experienced benefits with respect to total cholesterol (F = 7.19, P < 0.05) and triglycerides (F = 4.35, P < 0.05) compared to children in the SH condition.
<table>
<tr><td></td><td>Diet</td><td>Activity</td><td>Diet + Activity</td></tr>
<tr><td>BMI (kg/m^2)</td><td>-0.5 (-1.1 to 0.1)</td><td>0.4 (-0.1 to 1.0)</td><td>-0.2 (-0.7 to 0.3)</td></tr>
<tr><td>BMI-z</td><td>-0.4 (-0.5 to -0.3)</td><td>-0.2 (-0.3 to -0.1)</td><td>-0.3 (-0.4 to -0.2)</td></tr>
<tr><td>Waist (cm)</td><td>-1.1 (-2.9 to 0.7)</td><td>2.3 (0.6 to 4.0)</td><td>1.0 (-0.5 to 2.5)</td></tr>
<tr><td>SBP (mmHg)</td><td>0.9 (-2.4 to 4.2)</td><td>-2.9 (-6.4 to 0.5)</td><td>4.4 (1.6 to 7.2)</td></tr>
<tr><td>DBP (mmHg)</td><td>1.4 (-1.0 to 3.7)</td><td>-0.9 (-3.3 to 1.5)</td><td>1.7 (-0.3 to 3.6)</td></tr>
<tr><td>Total cholesterol (mmol/L)</td><td>-0.03 (-0.26 to 0.2)</td><td>0.18 (-0.05 to 0.41)</td><td>0.17 (-0.03 to 0.38)</td></tr>
<tr><td>HDL (mmol/L)</td><td>-0.01 (-0.08 to 0.07)</td><td>-0.02 (-0.1 to 0.07)</td><td>0.06 (-0.01 to 0.13)</td></tr>
<tr><td>LDL (mmol/L)</td><td>0.04 (-0.19 to 0.28)</td><td>0.20 (-0.04 to 0.43)</td><td>0.26 (0.04 to 0.48)</td></tr>
<tr><td>Triglycerides (mmol/L)</td><td>-0.02 (-0.27 to 0.22)</td><td>0.28 (0.02 to 0.54)</td><td>0.00 (-0.22 to 0.22)</td></tr>
</table></td></tr>
<tr><td>Compliance with treatment</td><td>Not stated</td></tr>
<tr><td>Adverse events</td><td>Not stated</td></tr>
<tr><td>Notes</td><td>The school-based intervention resulted in improved weight and some metabolic outcomes in overweight Mexican-American children, and zBMI was maintained over two years.</td></tr>
</table>

Kalarchian 2009

Characteristics of the study	
Study Citation	Kalarchian MA, Levine MD, Arslanian SA, Ewing LJ, Houck PR, Cheng Y, Ringham RM, Sheets CA & Marcus MD 2009, 'Family-based treatment of severe pediatric obesity: randomized, controlled trial', Pediatrics, vol.124, no.4, pp.1060-8.
Study Design	RCT
Methods	
N (enrolled)	N = 192 participants Intervention (N = 97), usual care (N = 95). Study was conducted in the US.
Inclusion criteria	Child age between 8.0 and 12.0 years; Child BMI of ≥ 97th percentile; and Adult willing to participate in the program with the child.
Exclusion criteria	Mental retardation, pervasive developmental disorder, or psychosis; Psychiatric symptoms requiring alternative treatment; Genetic obesity syndrome; Current obesity treatment; Inability to engage in prescribed daily activity; Medical conditions contraindicating usual care; and Use of medication known to affect body weight (stable doses of stimulant or antidepressant medication were allowed).

Intervention	The intervention consisted of 20 group meetings during months 0 to 6. Adult and child groups met separately and were presented with complementary material. Immediately before or after group meetings, the adult and child were weighed and together met with a lifestyle coach to review self-monitoring records and to set weekly goals. Six booster sessions (three group sessions and three telephone calls) were provided between month 6 and month 12. There was no contact between the 12-month and 18-month assessments. Participants were provided with a modified version of the Stoplight Eating Plan and were given a daily energy range on the basis of body weight. Families were taught behavioural strategies to increase physical activity and to decrease sedentary behaviours, with a goal of limiting those behaviours to < 15 hours/week. Behaviour modification techniques included self-monitoring, environmental changes, stepwise goal-setting, stimulus control, and positive reinforcement for meeting prescribed goals. The authors also included instruction in setting realistic expectations, promoting body image, minimising emotional eating, and coping with teasing. Participating adults were instructed to set goals for and to model healthy changes in eating and physical activity. Overweight adults were encouraged, but not required, to lose weight.
Comparison	Adults and children in the usual care condition were offered two nutrition consultation sessions to develop an individual nutrition plan based on the Stoplight Eating Plan. There was no additional contact between assessments. Usual care participants were offered the intervention after completion of the 18-month assessment.
Outcomes measured	Assessments were conducted at baseline, six months, 12 months, and 18 months. The primary outcome was percent overweight (percent over the median BMI for age and gender). Changes in blood pressure, body composition, waist circumference, and HRQoL were also evaluated. Factors associated with changes in child percent overweight, particularly session attendance, were also examined.
Duration of follow-up	The duration of intervention and follow-up was for18 months.

Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	Child participants had a mean ± SD age of 10.2 ± 1.2 years, with an average BMI percentile of 99.18 (SD 0.72).	
Overall findings	Intervention was associated with a 7.6% decrease in child percent overweight at six months, compared with a 0.7% decrease with usual care, but differences were not significant at 12 or 18 months. Children who attended 75% of intervention sessions maintained decreases in percent overweight through 18 months. Lower baseline percent overweight, better attendance, higher income, and greater parent BMI reduction were associated with significantly greater reductions in child percent overweight at six months among intervention participants.	
Compliance with treatment	Not stated	
Adverse events	Not stated	
Notes	Intervention was associated with significant decreases in child percent overweight, relative to usual care, at six months. Intervention was associated with significant short-term reductions in obesity and improvements in medical parameters and conferred longer-term weight change benefits for children who attended 75% of sessions.	

Kalavainen 2007

Characteristics of the study	
Study Citation	Kalavainen MP, Korppi MO & Nuutinen OM 2007, 'Clinical efficacy of group-based treatment for childhood obesity compared with routinely given individual counseling', Int J Obes (Lond), vol.31, no.10, pp.1500-8.
Study Design	RCT
Methods	
N (enrolled)	N = 70 participants Routine counselling (N = 35), family-based group treatment (N = 35) Study was conducted in Finland.
Inclusion criteria	Obese children, 7 to 9 years old Weight for height from 120 to 200%.
Exclusion criteria	Disease or a medication causing obesity, obvious movement disturbance, major mental problems in either children or parents, or a family member participating in an alternative weight management program.
Intervention	The approach of the family-centred group program was based on the principles of behavioural and solution-oriented therapy. The program focused on promoting a healthy lifestyle and well-being of obese children instead of weight management. Group treatment included the same components (e.g. promoting healthy diet, increasing physical activity and decreasing sedentary life-style with the help of behavioural therapy). The recommended meal pattern and quality of the diet were in line with recommendations given for Finnish families. The parents were targeted as the main agents of change, and they were responsible for inducing changes at home. Most lifestyle changes were intended for the entire family.

	The group program consisted of 15 sessions of 90 minutes in duration held separately for parents and children, except one joint session of making healthy snacks. The first 10 sessions were held weekly, and the next five sessions were held every two weeks for three months. There were five groups, each consisting of seven children and their parents. Homework was provided to both parents and children to give a chance to practice between sessions. Parents were provided with treatment manuals and children with workbooks. Material was modified from national Magnificent Kids and Magnificent Teens materials, and a cognitive behaviour therapy workbook, supplemented with additional self-developed material. The children were measured only at one group session, but the importance of regular weighing at home was emphasised. The children's program was adjusted to children's cognitive developmental level and thus consisted of functional activities. Most sessions included non-competitive physical activities aimed to develop children's motor skills and to motivate them to increase recreational physical activity. The children's program included special themes, like treasure hunting and material printing, to encourage the children to continued participation and to make the atmosphere more favourable on learning.
Comparison	Routine program was modified from current counselling practice for obese children in school health care in Finland. The program consisted of booklets for families and two individual appointments for each child by school nurses. The booklets contained information about weight management, eating habits and physical activities, and were sent to families at the beginning of the program. The appointments were intended only for the children, but parents were allowed to participate if they were willing. The appointments of 30 minutes in duration were held at the end of the fall and spring terms. The themes of the appointments were self-knowledge and physical activity, and the children fulfilled workbooks partly with school nurses and partly at home with parents. In addition, the weights and heights of the children were measured at both appointments. The booklets for parents and the workbooks for children were based on the national 'Magnificent Kids' material and on a cognitive behaviour therapy workbook.
Outcomes measured	Children's weights and heights were measured at baseline, after the 6-month intervention and after the 6-month follow-up. Primary outcome measure: change of weight for height based on Finnish growth charts Secondary outcome measures: changes in BMI and BMI SD scores (BMI-SDS).
Duration of follow-up	Duration included a 6-month intervention and a 6-month follow-up.

Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	B	Non-standardised follow-up procedure
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	The mean age of the children was 8.1 years (range 6.6 to 9.7). Mean weight for height was 142% (115 to 182).	
Overall findings	Children attending the group treatment lost more weight for height (6.8%) than children receiving routine counselling (1.8%) (P = 0.001). The difference was significant when the data were analysed in four groups by the cut-off limits of 0, -5 and -10% for the change in weight for height. The respective decreases in BMI were 0.8 vs. 0.0 (P = 0.003) and in BMI-SDS 0.3 vs. 0.2 (P = 0.022). The results remained similar in adjusted analyses. After six months follow-up: change in weight for height, % (SD) [95% CI] for the routine program +1.8 (7.8) [-0.9 to 4.5], and group program -3.4 (7.7) [-6.0 to -0.7], P-value: 0.008; change in BMI kg/m^2 (SD) [95% CI] for the routine program + 0.8 (1.3) [0.4 to 1.3], and group program +0.1 (1.2) [-0.3 to 0.5], P-value: 0.016; change in BMI-SDS (SD) [95% CI] for the routine group -0.1 (0.3) [-0.2 to 0.0], and group program -0.2 (0.3) [-0.3 to -0.1], P-value: 0.081.	
Compliance with treatment	Not stated	
Adverse events	Not stated	
Notes	The main result of the present study was that the group treatment, which stressed a health-promoting lifestyle and	

	consisted of 15 group sessions during six months, was more effective than the current practice, individually given counselling consisting of two appointments, in the treatment of obesity in children. Family-based group treatment that stresses a health-promoting lifestyle and is given separately for parents and children, offers an effective mode of therapy to treat obese school-aged children.

Keranen 2009

Characteristics of the study	
Study Citation	Keranen AM, Savolainen MJ, Reponen AH, Kujari ML, Lindeman SM, Bloigu RS & Laitinen JH 2009, 'The effect of eating behavior on weight loss and maintenance during a lifestyle intervention', Prev Med, vol.49, no.1, pp.32-8.
Study Design	RCT
Methods	
N (enrolled)	N = 82 participants Intensive counselling intervention (N = 35), short-term counselling control (N = 47) Study was conducted in Finland.
Inclusion criteria	The inclusion criteria included: aged 18 to 65 years; and BMI > 27 kg/m^2.
Exclusion criteria	Participation in another weight loss program, abnormal laboratory values, had a clinically significant illness with contraindication for weight loss or physical activity.
Intervention	The intensive counselling of the intervention group lasted 20 weeks. It included both individual and group counselling; altogether ten visits every second week. Counselling was conducted by a clinical nutritionist.

	The goal of dietary counselling was to improve eating frequency, increase portion sizes of healthy foods and to reduce those of unhealthy foods, favour a low fat diet high in unsaturated fats and low in saturated fats, increase the intake of foods rich in fibre and calcium, and decrease the consumption of sweets, alcohol and snack products. The goal of the eating behaviour counselling was to recognize and improve personal eating behaviour. Homework was given to the participants and they were encouraged to take the responsibility of the changes by themselves.	
Comparison	The short-term counselling of the control group included two visits at a two-week interval and included only individual dietary counselling given by a nurse who was specialised in obesity. The content of the dietary counselling was similar to intensive counselling at two first visits but no repeated counselling was included. Because of the study measurements the control group had two additional visits at the same time as counselling visits six and 10 for the intervention group.	
Outcomes measured	Body weight was measured at every visit. Blood pressure and waist circumference were measured at counselling visits six and 10. Height was measured so that BMI could be calculated. Eating behaviour was repeatedly assessed by the Three Factor Eating Questionnaire-18 and Binge Eating Scale.	
Duration of follow-up	The study lasted 18 months from the beginning of the intervention to the end of the follow-up.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	

Results	
Participants	The total number of participants included 23 males and 59 females. BMI was between 28 to 52 kg/m^2 (mean 35 ± 5 kg/m^2). Mean age was 49 ± 9 years.
Overall findings	Eating behaviour improved in both groups. Effect of counselling on weight was -5.0 ± 5.7 kg compared with -2.4 ± 2.5 kg in the control group ($P < 0.05$ between the groups) during the first six months. At 18 months the weight loss results were -2.6 ± 6 kg and -0.7 ± 3.5 kg, respectively. Success in weight loss maintenance is associated with improved eating behaviour ($P < 0.05$), cognitive restraint, and a reduction in binge eating scale (BES), emotional and uncontrolled eating (UE). In contrast, failure in weight loss is associated with high scores of uncontrolled eating and binge eating symptoms at the baseline ($P < 0.05$).
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	Both intensive and short-term interventions improved eating behaviour and weight loss and there was no difference between the two modes of intervention. The association between the improvement of eating behaviour and the success of weight loss suggests a causal relationship. The authors propose that weight loss programs should aim to increase skills to improve cognitive restraint in order to obtain weight loss maintenance. To prevent failure in weight loss it would be beneficial to evaluate the level of UE and BES at the beginning of the counselling.

Knowler 2009

Characteristics of the study	
Study Citation	Knowler WC, Fowler SE, Hamman RF, Christophi CA, Hoffman HJ, Brenneman AT, Brown-Friday JO, Goldberg R, Venditti E & Nathan DM 2009, '10-year follow-up of diabetes incidence and weight loss in the Diabetes Prevention Program Outcomes Study', Lancet, vol.374, no.9702, pp.1677-86.
Study Design	RCT
Methods	
N (enrolled)	N = 2,766 participants Intensive lifestyle study (ILS) group (N = 910), metformin group (N = 924), placebo group (N = 932) Study conducted in US.
Inclusion criteria	Adults with excess body weight and pre-diabetes who participated in the Diabetes Prevention Program (DPP). Age at least 25 years, BMI 24 or higher (or 22 or higher in Asians), plasma glucose concentration in the fasting state of 5.3 to 6.9 mmol/L and 7.8 to 11 mmol/L 2 hours post-prandially.
Exclusion criteria	Not stated
Intervention	Standard lifestyle recommendations plus metformin (850 mg bd), standard lifestyle recommendations plus placebo (bd) or intensive lifestyle modification. Lifestyle sessions were offered every three months, with provision of educational materials to reinforce weight loss and physical activity goals. DPP lifestyle participants were also offered two group classes each comprising four sessions every year to reinvigorate their self-management behaviours for weight loss. Those previously assigned to the metformin group continued to receive metformin 850 mg twice daily. Outcome assessment examinations continued on the same yearly and six monthly schedule as in the DPP.

Comparison	Lifestyle intervention plus placebo.	
Outcomes measured	The primary outcome, as in the DPP, was development of diabetes according to American Diabetes Association criteria—fasting plasma glucose 7.0 mmol/L or higher measured every six months, or 2-h plasma glucose 11.1 mmol/L or higher after a 75 g oral glucose load, measured yearly. Weight loss, blood pressure, plasma lipids, and medication history were assessed.	
Duration of follow-up	The Diabetes Prevention Program (DPP) was for 2.8 years. Median follow-up from randomisation in the DPP to the most recent assessment in the DPPOS was 10.0 years (IQR 0 to 10.5). Eighty-eight percent enrolled for a median additional follow-up of 5.7 years (interquartile range [IQR] 5.5 to 5.8).	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	B	
Magnitude of effect rating**	Low	
Relevance of evidence rating***	Medium	
Results		
Participants	Sixty eight percent of participants were women, 45% were from ethnic and racial minority groups, and 20% were aged 60 years or older.	
Overall findings	During the 10.0-year (IQR 9.0 to 10.5) follow-up since randomisation to DPP, the original lifestyle group lost, then partly regained weight. Mean weight loss associated with lifestyle was approximately 2 kg overall. The modest weight loss with metformin was maintained and was approximately 2.5 kg overall. Placebo was less than 1 kg mean weight loss overall. Diabetes incidence rates during the DPP were 4.8 cases per 100 person-years (95% CI, 4.1 to 5.7) in the ILI group,	

	7.8 (95% CI, 6.8 to 8.8) in the metformin group, and 11.0 (95% CI, 9.8 to 12.3) in the placebo group. Diabetes incidence rates in this follow-up study were similar between treatment groups: 5.9 per 100 person-years (95% CI, 5.1 to 6.8) for lifestyle, 4.9 (95% CI, 4.2 to 5.7) for metformin, and 5.6 (95% CI, 4.8 to 6.5) for placebo. Diabetes incidence in the 10 years since DPP randomisation was reduced by 34% (95% CI, -24 to -42) in the lifestyle group and 18% (95% CI, -7 to -28) in the metformin group compared with placebo.
Compliance with treatment	For participants in the lifestyle group, decreased intensity of treatment during the bridge and DPPOS might have resulted in lowered adherence at a time when weight regain was taking place.
Adverse events	Not stated
Notes	During follow-up after DPP, diabetes incidence in the former placebo and metformin groups fell to equal those in the former lifestyle group, but the cumulative incidence of diabetes remained lowest in the lifestyle group. Prevention or delay of diabetes with lifestyle intervention or metformin can persist for at least 10 years.

Littman 2007

Characteristics of the study	
Study Citation	Littman AJ, Vitiello MV, Foster-Schubert K, Ulrich CM, Tworoger SS, Potter JD, Weigle DS & McTiernan A 2007, 'Sleep, ghrelin, leptin and changes in body weight during a 1-year moderate-intensity physical activity intervention', Int J Obes (Lond), vol.31, no.3, pp.466-75.
Study Design	RCT
Methods	
N (enrolled)	N = 173 participants Facility- and home-based moderate-intensity physical activity intervention (N = 87), stretching control group (N =

	86) Study was conducted in the US.
Inclusion criteria	Post-menopausal women aged 50 to 75 years. Sedentary at baseline, characterised as less than 60 minutes/week of moderate or vigorous intensity physical activity and maximal oxygen consumptions (VO2 max) of less than 25.0 ml kg-1 min-1. Women were required to have a BMI > 25.0 kg/m^2 (or a BMI between 24.0 and 25.0 kg/m^2 if percent body fat as measured by bioelectrical impedance was > 33.0%).
Exclusion criteria	Tobacco use, a clinical diagnosis of diabetes or a fasting blood glucose level of 140 mg/day or more, a history of any potentially cachectic state such as malignancy (except non-melanoma skin cancer) within 10 years or liver or kidney disease.
Intervention	The exercise intervention goals were to perform a minimum of 45 minutes of moderate-intensity aerobic exercise, five days per week for 12 months. During the first three months of the intervention, exercisers completed three supervised sessions per week at one of the training facilities, and exercised on their own two additional days per week. In months four through 12, exercisers performed one to three supervised exercise sessions, and exercised on their own for a total of five days per week. The training program started at 40% of maximal heart rate for 16 minute/session and gradually increased to 60-75% of maximal heart rate for 45 minutes/session by week eight. Women maintained this level of exertion and duration for the remainder of the study. Walking and use of a stationary bicycle were the most commonly performed activities. Exercisers and stretchers were strictly instructed to maintain their usual diet.
Comparison	Women randomised to the control group attended a 45-minute stretching session once per week for a year, and were asked not to change other exercise habits during the study.
Outcomes measured	Fasting plasma ghrelin, leptin, height, and weight were measured and self-reported sleep was assessed at baseline

	and 12 months. Participants completed questionnaires before randomisation ('baseline') and at three and 12 months after randomisation. The questionnaires inquired about their medical histories, demographic information, usual food intake, sleep patterns, job status and depression using the short version of the Center for Epidemiologic Studies Depression Scale.	
Duration of follow-up	The duration of the intervention and follow-up was 12 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	B	Randomisation not described, <15% loss to follow-up
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	Participants had a mean age of 61 years. Baseline demographic and body weight measures in the exercise and stretching groups were similar with a mean (SD) BMI for the exercise group of 30.4 (4.1) kg/m^2 and 30.5 (3.7) kg/m^2 for the stretching (control) group.	
Overall findings	There were no consistent cross-sectional patterns between self-reported sleep measures and ghrelin or leptin at baseline. The weight loss differences between exercisers and stretchers were greater for those who slept less at follow-up than at baseline, compared with those whose sleep duration did not change (-3.2 kg, 95% CI -5.8 to -0.5). Improvements in sleep quality were associated with significantly greater differences between exercisers and stretchers for ghrelin increases (improved vs. same sleep quality: +115 pg/ml, 95% CI +25 to +206) and leptin decreases (improved vs. worsened sleep quality: -5.7 ng/ml, 95% CI -9.5 to -1.5).	

	Overall, stretchers did not gain or lose weight during the trial (+0.1 kg, 95% CI -0.6 to +0.8), whereas exercisers lost 1.3 kg (95% CI -2.1 to -0.6), resulting in a 1.4 kg difference between the intervention groups (95% CI -2.5 to -0.4).
Compliance with treatment	Adherence to the exercise regimen was assessed using daily exercise logs and measurements of cardiopulmonary fitness at baseline and 12 months.
Adverse events	Not stated
Notes	There was limited evidence that changes in sleep duration or quality modified exercise-induced changes in weight, ghrelin or leptin. Moreover, the observed differences were not in the directions hypothesised.

Madsen 2008

Characteristics of the study	
Study Citation	Madsen EL, Rissanen A, Bruun JM, Skogstrand K, Tonstad S, Hougaard DM & Richelsen B 2008, 'Weight loss larger than 10% is needed for general improvement of levels of circulating adiponectin and markers of inflammation in obese participants: a 3-year weight loss study', Eur J Endocrinol, vol.158, no.2, pp.179-87.
Study Design	RCT
Methods	
N (enrolled)	N = 93 participants Orlistat group (N = 49), placebo group (N = 44). Scandinavian multicentre study.
Inclusion criteria	Participants were a subgroup that had completed all visits of the Scandinavian multicentre study of obese participants with the metabolic syndrome (SMOMS) trial.

	Inclusion criteria were: aged between 18 and 65 years; a BMI of ≥ 30 to ≤ 45 kg/m^2; and a waist circumference ≥ 102 (male) or ≥ 92 cm (female). Participants also need to have at least one of the following risk factors: impaired fasting glucose (≥ 6.1 mmol/L); manifest type 2 diabetes (only diet treated); or dyslipidaemia (high density lipoprotein [HDL] cholesterol ≤ 0.9 [male] or ≤ 1.1 mmol/L [female] and / or serum triglycerides ≥ 2.0 to < 10 mmol/L). Participants received an 8-week very-low-energy diet (800 kcal/day). Participants had to lose at least 5% of their body weight in this phase in order to be randomised into the treatment phase of the study (orlistat versus placebo).	
Exclusion criteria	Exclusion criteria were drug-treated diabetes mellitus, severe dyslipidaemia (serum triglycerides ≥ 10 mmol/L), use of lipid-lowering agents, uncontrolled hypertension, or significant gastrointestinal problems.	
Intervention	All participants completed an initial eight weeks of VLED (600-800 kcal/day; Modifast or Nutrilett supplement). Those participants who were able to lose at least 5% of their initial body weight were randomly assigned to either orlistat (120 mg three times daily) or matching placebo capsules for a further three years. Both treatment groups were supplemented with the same dietary and exercise counselling. Participants saw a dietitian 10 times and were advised to follow a diet with a reduced fat content. The participants were also encouraged to increase their level of physical activity.	
Comparison	Control participants received placebo capsules together with lifestyle counselling.	
Outcomes measured	Body weight, waist and hip circumference were measured by standardised techniques. Plasma samples from all time points were analysed together for fibrinogen, lipids, glucose, and insulin using standardised assays. Adiponectin and hs-CRP were analysed together in serum.	
Duration of follow-up	Duration of intervention including follow-up was three years after randomisation.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	Randomisation stated but not described

		Blinding not mentioned > 15% loss to follow-up
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	All participants were obese with a mean weight of 108.9 ± 15.8 kg, mean BMI of 37 kg/m^2 and had elevated total cholesterol (6.0 ± 1.2 mmol/L), glucose (6.6 ± 1.6 mmol/L), insulin (15.2 ± 8.1 IU/L) and SBP and DBP (150/96 mmHg). Mean age was 45.8 ± 8.2 years, and the proportion of males, was 54.4%. The two treatment groups did not differ significantly concerning age or proportion of males, anthropometrical variables or lipids nor concerning blood pressure (148/94 vs. 151/97 mmHg) or HOMA-IR (4.2 ± 3.1 vs. 5.1 ± 3.7).	
Overall findings	Weight loss after VLED treatment was 14.3 ± 4.5 kg and after three years was 7.7 ± 8.7 kg. The following changes in metabolic parameters were observed over the 3 years (there were no statistically significant differences between the intervention and control group for the following except for weight): - Weight: -7.8% (-5.8 to -9.7%) - Total cholesterol: -7.5% (-2.9 to -11.8%) - HDL cholesterol: 1.6% (6.1 to -2.7%) - Triglycerides: -12% (-1.3 to -21.5%) - HbA1c: -13.1% (-11.3 to -14.9%) Orlistat-treated participants regained 3.9 kg less than placebo-treated from the end of the VLED to three years (P = 0.01). No differences were detected between the two groups regarding changes in adiponectin, hs-CRP, or fibrinogen. Serum adiponectin increased by 22% (P < 0.05) after the VLED but returned to baseline after 3 years. Both short- and long-term weight losses needed to be in excess of 10% (~12 kg) in order to increase adiponectin levels significantly. Weight loss was associated with a significant decrease in hs-CRP. Fibrinogen decreased by 12% (P < 0.05) after three years.	

Compliance with treatment	Energy intake and compliance to the diet were formally assessed at baseline and three times from after the VLED to three years. Average daily intake of total calories as well as fat energy content and cholesterol was significantly reduced from baseline to three years ($P < 0.05$).
Adverse events	Not stated
Notes	The authors found a dose-effect relationship between the degree of weight loss and the improvement in plasma levels of adiponectin and hs-CRP. A net weight loss larger than 10% of the initial body weight seemed necessary for long-term combined improvement of adiponectin, hs-CRP and fibrinogen levels. Orlistat did not confer any additional benefit to lifestyle intervention on body weight, lipids and HbA1c.

Manini 2010

Characteristics of the study	
Study Citation	Manini TM, Newman AB, Fielding R, Blair SN, Perri MG, Anton SD, Goodpaster BC, Katula JA, Rejeski WJ, Kritchevsky SB, Hsu FC & Pahor M 2010, 'Effects of exercise on mobility in obese and nonobese older adults', Obesity (Silver Spring), vol.18, no.6, pp.1168-75.
Study Design	RCT
Methods	
N (enrolled)	N = 424 participants Study conducted in US.
Inclusion criteria	Age between 70 and 89 years; Sedentary (defined as spending < 20 min per week in regular structured physical activity [PA]);

	Short Physical Performance Battery (SPPB) score ≤ 9; Able to walk 400 m within 15 min. Excess body weight was not an inclusion criterion however 42% of participants had obesity (mean BMI 35.7 (SD 5.0)) and over 50% of non-obese participants were overweight (mean BMI 26.1 (SD 2.6)).
Exclusion criteria	Not reported
Intervention	A 1-year moderate intensity PA program that included walking, strength, and balance exercise, although the primary mode was walking. Participants performed walking, strength, flexibility, and balance training. The goal for all participants was to walk for 150 minutes at a moderate intensity on five or more days of the week, which was approached in three phases. In the adoption phase (weeks 1-8), three supervised centre-based PA sessions per week were conducted. These sessions were 40 to 60 minutes in length and used to initiate the walking program and to introduce participants to the strength, stretching and balance portions of the program in a safe and effective manner. The strength exercises included standing chair squats, toe stands, leg curl, knee extensions, and side hip raises with ankle weights. The balance exercises involved a series of dual and signal leg standing movements. Participants were instructed to walk at a ratings of perceived exertion (RPE) intensity of 13 (“SOMEWHAT HARD”, range 12-14) and perform strength training at an intensity of 15-16. In the transition phase (weeks 9-24), the number of centre-based sessions was reduced to two times per week and home-based walking/strengthening/flexibility activities were increased. In the maintenance phase (week 25 to the end), participants were encouraged to perform home-based PA a minimum of five days per week and one weekly centre-based session was offered. The maintenance phase was continued until the final closeout assessment visits.
Comparison	The successful ageing (SA) control was designed to provide health education. Study participants attended weekly group presentations for the first 26 weeks and then monthly until the end of the trial. Presentations were given on health topics that were relevant to older adults such as nutrition, medication use, foot care, and preventive medicine. All SA participants received basic information about PA participation and each class was concluded with upper extremity stretching. Regular telephone contact was made to encourage participation.
Outcomes measured	Physical function outcomes: the speed at which participants completed a 400-m walk test (participants were asked to walk 10 laps of a 20-m course at their usual pace. Participants were allowed to stop and rest if necessary, but

	without sitting). The authors also assessed physical function using the SPPB. This test was based on timed measures of standing balance, walking speed, and ability to rise from a chair. Body weight (kg), waist circumference. Measures of adherence to lifestyle changes.	
Duration of follow-up	Participants were followed for an average of 1.2 years.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	Randomisation stated but not described
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Overall findings	Study participants with obesity reduced their waist circumference by an average of 2 cm but did not change body weight. Controls did not lose weight or waist circumference over the course of the study. 400 metre gait speed was higher in non-obese compared with participants with obesity. In non-obese participants, gait speed improved between baseline and 12 months; and the adjusted difference in gait speed between the physical activity and control groups was 0.05 m/s. In participants with obesity, gait speed decreased between baseline and 12 months; and the difference in gait speed between the physical activity and control groups was < 0.01 m/s. The Short Physical Performance Battery (SPPB) scores improved in non-obese participants and in participants with obesity over the 12 months, by 19% and 14% respectively. Participants in the control groups did not improve their SPPB scores.	

Compliance with treatment	Adherence to the PA intervention was assessed through attendance records taken at each phase of the intervention. Overall, the number of sessions attended by non-obese participants and participants with obesity was 71.4% and 67.0% respectively. Attendance in the adoption phase was higher for participants with obesity, a median of 86.9% versus 79.2% in non-obese individuals. Both groups had similar attendance rates during the transition phase, but participants with obesity experienced a decrease in attendance during the maintenance phase, 12% lower than non-obese individuals during this part of the study. Non-obese individuals maintained their physical activity levels over the 12 months of the study; participants with obesity experienced a decline in physical activity participation between six and 12 months.
Adverse events	Not stated
Notes	The major findings of this study were that moderate intensity physical activity was: (i) successfully implemented in low to moderate functioning obese and non-obese older adults; (ii) obese individuals were less able to sustain the intervention when supervision was reduced;(iii) as demonstrated by the RPE, obese individuals were exerting themselves to an adequate level to induce physiological benefits;(iv) obese subjects did not improve their speed while walking long-distances; and (v) obesity blunted the positive effects of PA on SPPB scores. The results highlight that increased PA without weight loss in obese older adults can promote improvements in short-duration mobility tasks of daily life as measured with the SPPB. However, these benefits do not appear to transfer to long-distance mobility tasks such as walking 400 m.

Martin 2008

Characteristics of the study	
Study Citation	Martin PD, Dutton GR, Rhode PC, Horswell RL, Ryan DH & Brantley PJ 2008, 'Weight loss maintenance following a primary care intervention for low-income minority women', Obesity (Silver Spring), vol.16, no.11, pp.2462-7.
Study Design	RCT
Methods	
N (enrolled)	N = 144 participants Tailored weight loss intervention (N = 68), standard care comparison group (N = 69) Study was conducted in the US.
Inclusion criteria	African-American women were recruited from the office of their primary care physician and enrolled in the study. To participate in the study, women had to be: between the ages of 18 and 65 years, overweight or obese (BMI ≥ 25 kg/m^2), classified as low income (< $16,000 annual income), attendees of the primary care clinic for at least one year, and free of serious or uncontrolled medical conditions. Women with well-controlled chronic diseases such as hypertension, diabetes, or hyperlipidaemia were included.
Exclusion criteria	Use of weight-altering medications, pregnancy, severe psychiatric illness, alcohol intake > 14 drinks per week, or serious physical illness.

Intervention	Eight primary care physicians from the family practice clinics were randomly assigned to provide either a tailored weight loss intervention or standard care. This resulted in two physicians delivering tailored interventions at each clinic and two physicians delivering standard care at each clinic. Participants were assigned to receive one of the two interventions based on the random assignment of their physician. Recruitment continued until each physician had a maximum of 20 patients. All physicians received two hours of instruction on general obesity treatment, as outlined by the National Heart, Lung, and Blood Institute's clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. The four physicians providing tailored interventions received an additional five hours of training, which addressed the assessment of stage of change, motivational interviewing, and techniques for the behavioural treatment of obesity. Training also included instruction on appropriate dietary recommendations, such as ways to reduce dietary fat intake, appropriate fruit and vegetable intake, how to read food labels, and how to modify recipes. Tailored interventions were derived from information provided by participants during the initial assessment. Participants in the tailored intervention group received five physician-counselled office visits on a monthly basis. Topics of the monthly meetings included: introductory information on weight loss (month 1), ways to decrease dietary fat (month 2), ways to increase physical activity (month 3), dealing with barriers to weight loss (month 4), and healthy alternatives when eating out and shopping (month 5). Participants also received one maintenance session at month 6, which addressed ways to stay motivated during weight loss efforts. Each visit lasted ~15 minutes, resulting in a total of ~90 minutes of physician-patient contact. Physicians received protocols for each monthly visit, and participants received both oral recommendations from their physician as well as handouts summarizing the focus of each visit. Tailored intervention participants received messages consistent with standard weight loss protocols, including gradual increases in physical activity with a goal of 150 minutes per week, decreased consumption of energy-dense

	foods, and increased consumption of fruits and vegetables. Both dietary and physical activity recommendations were personalised for participants based on their activity and food preferences, physical and environmental limitations, normal eating patterns, and caloric intake requirements needed to achieve weight loss. Participants received culturally specific menus and recipe books as well.	
Comparison	Standard care participants received no special instructions regarding weight loss and were seen by a physician as required for regular medical care.	
Outcomes measured	The baseline assessment provided information used for tailoring the monthly interventions and included the Block Food Frequency Questionnaire, the Food Preference Questionnaire, and a measure of physical activity.	
Duration of follow-up	Total duration of study including intervention and follow-up was 18 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	
Results		
Participants	The mean baseline weight of participants was 101.95 ± 19.37 kg. Mean baseline BMI of participants was 38.85 ± 7.63 kg/m^2.	
Overall findings	The weight loss of intervention participants (-1.52 ± 3.72 kg) was significantly greater than that of standard care participants (0.61 ± 3.37 kg) at month 9 (P = 0.01). However, there was no difference between the groups at the	

	12-month or 18-month follow-ups. Participants receiving a tailored weight loss intervention from their physician were able to maintain their modest weight loss up to 3-6 months following treatment. However, women demonstrated weight regain at the 18-month follow-up assessment.
Compliance with treatment	All participants received a reimbursement of $35 per visit for completing the baseline, post-treatment, and three follow-up assessments. Tailored intervention participants also received reimbursement of $10 for each monthly treatment visit. Physicians received reimbursement for all office visits associated with the project, including tailored intervention and usual care visits, consistent with state Medicaid reimbursement practices. The attrition rates at the 6-month, 9-month, 12-month, and 18-month follow-up assessments were 27, 29, 35, and 37% respectively.
Adverse events	Not stated
Notes	A brief, physician-delivered weight loss intervention can be initially effective in achieving modest weight loss among African-American women. However, this tailored intervention did not result in significant weight loss maintenance 12-18 months later, as the intervention group demonstrated gradual weight regain over this extended follow-up interval.

McCallum 2007

Characteristics of the study	
Study Citation	McCallum Z, Wake M, Gerner B, Baur LA, Gibbons K, Gold L, Gunn J, Harris C, Naughton G, Riess C, Sanci L, Sheehan J, Ukoumunne OC & Waters E 2007, 'Outcome data from the LEAP (Live, Eat and Play) trial: a randomized controlled trial of a primary care intervention for childhood overweight/mild obesity', Int J Obes (Lond), vol.31, no.4, pp.630-6.
Study Design	RCT
Methods	
N (enrolled)	N = 163 participants Intervention (N = 82), control (N = 81) Study was conducted in Australia.
Inclusion criteria	All children aged 5 years 0 months to 9 years 11 months attending participating general practices for any reason during April to December 2002 were eligible to be invited to participate in the BMI survey, in which practice staff measured each child's height and weight and invited the parent to provide contact details if they were interested in participating in a new intervention research study. All children classified as overweight or mildly obese (BMI z-score < 3.0) in a BMI survey, who were not receiving ongoing weight management in a secondary or tertiary care program and whose parents had provided contact details, were eligible to take part in the Live, Eat and Play (LEAP) RCT.
Exclusion criteria	Before randomisation participants were excluded from the RCT for any chromosomal, endocrine or medical condition / disability / medication which, in the judgement of the investigators, could have an impact on their weight or growth.
Intervention	The intervention included four standard GP consultations over 12 weeks, targeting change in nutrition, physical

	activity and sedentary behaviour, supported by purpose-designed family materials. BMI was transformed to standardised z-scores based on sex and exact age, using the LMS method and the 1990 UK Growth Reference, which enabled exclusion of 'very obese' children (BMI z-score ≥ 3.0) for whom a brief secondary prevention approach was considered inappropriate.	
Comparison	Control families were notified of their status via letter and were not identified to the GPs at any time. General practice records of children in the control group were subsequently audited to assess the extent of possible contamination (that is, attendances for discussion of weight).	
Outcomes measured	Primary: BMI at nine and 15 months post-randomisation. Secondary: Parent-reported child nutrition, physical activity and health status; child-reported health status, body satisfaction and appearance / self-worth.	
Duration of follow-up	Intervention and follow-up lasted for 15 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	A	
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	
Results		
Participants	Baseline characteristics of the children were comparable between the trial arms with the exception that higher socio-economic groups were better represented in the intervention arm. Overall the participants had a mean (SD) age of 7.4 (1.6) years, 52% were female, 72% had overweight and 28% had obesity.	

<table>
<tr>
<td>Overall findings</td>
<td>
Attrition was 10%. The adjusted mean difference (intervention-control) in BMI was -0.2 kg/m^2 (95% CI: -0.6 to 0.1; P = 0.25) at nine months and -0.0 kg/m^2 (95% CI: -0.5 to 0.5; P = 1.00) at 15 months.

There was a relative improvement in nutrition scores in the intervention arm at both nine and 15 months. There was weak evidence of an increase in daily physical activity in the intervention arm. Health status and body image were similar in the trial arms.

There was little evidence of harm or benefit with respect to parent and child-reported child health status and child-reported body satisfaction and appearance / self-worth.

Peds QL Parent Proxy at baseline and follow-up were as follows (other QoL results at baseline and follow-up not reported):
<table>
<tr><td></td><td>Baseline</td><td>15 months</td></tr>
<tr><td>Intervention</td><td>75.2 (13.7)</td><td>78.1 (13.2)</td></tr>
<tr><td>Control</td><td>78.8 (12.8)</td><td>78.8 (12.9)</td></tr>
</table>

Between group differences from baseline to follow-up were reported and are as follows:
<table>
<tr><td></td><td>Between group difference (intervention – control) at 15 months</td></tr>
<tr><td>BMI</td><td>0.5 (-0.4 to 1.3)</td></tr>
<tr><td>PedsQL Parent Proxy</td><td>-0.7 (-5.1 to 3.7)</td></tr>
<tr><td>PedsQL Child Self-Report</td><td>2.2 (-1.9 to 6.4)</td></tr>
<tr><td>Body satisfaction</td><td>0.2 (-0.2 to 0.5)</td></tr>
<tr><td>Physical appearance and global self-worth</td><td>-0.0 (-0.2 to 0.1)</td></tr>
</table>
</td>
</tr>
</table>

Compliance with treatment	Not stated
Adverse events	Not stated
Notes	The strengths of the study include its randomised design, the strong uptake by families and GP practices spanning the range of socio-economic status, follow-up for more than a year and the high retention rate. However, as the study GPs were a select volunteer group the authors could not generalise the high attendance and retention rates to all GPs. LEAP provides encouragement that a primary care-based, secondary prevention approach to overweight in the middle childhood years is feasible and acceptable. However, it did not meet its primary aim of a reduction in BMI increment relative to the control arm. Several ideas can be advanced to explain this. First, the intervention may be ineffective. The 'dose' of intervention may have been too small with either more sessions required or over a more extended period of time; the relatively unstructured 'solution-focused' approach may have allowed families to set lifestyle change goals that would by their nature be insufficient to have any great impact on BMI increment. Second, despite the high attendance rate by intervention families, the authors were not able to objectively monitor whether the GPs actually delivered the program as planned or acquired the necessary skills in brief behavioural change strategies, despite positive and detailed self-report feedback from the GPs and families on topics discussed in consultations. Third, contamination could have masked an effective intervention, although this seems highly unlikely (based on the findings of the audit of case notes, exit parent questionnaires and the rate of rise in BMI in both groups). This intervention did not result in a sustained BMI reduction, despite the improvement in parent-reported nutrition. Brief individualised solution-focused approaches may not be an effective approach to childhood overweight. Alternatively, this intervention may not have been intensive enough or the GP training may have been insufficient; however, increasing either would have significant cost and resource implications at a population level.

McConnon 2007

Characteristics of the study	
Study Citation	McConnon A, Kirk SF, Cockroft JE, Harvey EL, Greenwood DC, Thomas JD, Ransley JK & Bojke L 2007, 'The Internet for weight control in an obese sample: results of a randomised controlled trial', BMC Health Serv Res, vol.7, pp.206.
Study Design	RCT
Methods	
N (enrolled)	N = 221 participants Internet group (N = 111), usual care group (N = 110) Study was conducted in the UK.
Inclusion criteria	Potential participants were screened by telephone for eligibility, which included: individuals with a BMI of ≥ 30, aged 18 to 65 years, able to access the internet at least once per week and able to read and write in English.
Exclusion criteria	Not stated
Intervention	The trial aimed to compare the additional effect of the website against usual care available. The intervention website was developed to reflect current guidelines and clinical evidence regarding a lifestyle approach to treating obesity, including dietary advice, physical activity advice and behaviour therapy. The website provided advice, tools and information to support behaviour change in terms of dietary and physical activity patterns. It was designed to enable patients to manage their own care and to vary the frequency of use according to their own needs.

	The website also offered personalised advice and motivational statements to participants, which involved targeting the information provided to an individual, based on their responses to a series of online questions regarding eating and activity habits and current weight status. Motivational statements were generated based on participants self-report of progress about reaching their personal behaviour change goals. Automatic generic emails were generated if participants did not visit the website regularly to encourage them to visit more often. Participants randomised into the internet group were given a demonstration of the website and its services, along with a username and password to access the website and were asked to log on to the website at least once a week over the trial period.	
Comparison	Participants randomised to the usual care group were advised to continue with their usual approach to weight loss and were given a small amount of printed information at baseline, reflecting the type of information available within primary care.	
Outcomes measured	Measures of weight and height. Questionnaires were used to collect dietary, lifestyle, physical activity and quality of life data. Data were collected at baseline, six months and 12 months.	
Duration of follow-up	Participants were followed-up six months and 12 months after randomisation.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	Low	
Relevance of evidence rating***	Medium	

Results	
Participants	The sample was predominantly white (95%), female (77%), with a mean (SD) age of 45.8 (10.6) years, a mean (SD) weight of 98.4 kg (17.4) with a median (IQR) BMI of 34.4 (31.9-38.7) kg/m^2.
Overall findings	Data were collected on 54 (49%) participants in the internet group and 77 (70%) participants in the usual care group at 12 months. Based on analysis conducted on all available data, the internet group lost 1.3 kg, compared with 1.9 kg weight loss in the usual care group at 12 months (difference = 0.6 kg; 95% CI: -1.4 to 2.5, P = 0.56). Changes in BMI between the two groups at 12 months was a mean difference of 0.3 kg/m^2 (CI = -0.5 to 1), ranging from -5.9 to 3.8 kg/m^2 for the Internet group and -8.1 to 3.5 kg/m^2 for the usual care group at 12 months. The differences in change in secondary outcome measures (i.e. physical activity, dietary habits) between the two groups at six or 12 months was not significant.
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	The trial failed to demonstrate any additional benefits from the internet-based tool in terms of weight loss or secondary outcome measures, compared with usual care. Limited use of the internet in general in this population may have reduced the ability of this website to produce a significant weight loss.

Morey 2009

Characteristics of the study	
Study Citation	Morey MC, Snyder DC, Sloane R, Cohen HJ, Peterson B, Hartman TJ, Miller P, Mitchell DC & Demark-Wahnefried W 2009, 'Effects of home-based diet and exercise on functional outcomes among older, overweight long-term cancer survivors: RENEW: a randomized controlled trial', JAMA, vol.301, no.18, pp.1883-91.
Study Design	RCT
Methods	
N (enrolled)	N = 641 participants Intervention group (N = 319); delayed intervention (control) group (N = 322). Study conducted in US.
Inclusion criteria	Overweight (BMI ≥ 25 kg/m^2 and < 40 kg/m^2), long-term (≥ 5 years) survivors (aged 65 to 91 years) of colorectal, breast, and prostate cancer, with no evidence of progressive disease or second cancers.
Exclusion criteria	Individuals were deemed ineligible if they were: (1) institutionalised; (2) had a BMI < 25 or > than 40; (3) had a severe hearing or speaking impairment; (4) were non-English speaking or writing; (5) had contraindications to unsupervised exercise (angina, myocardial infarction ≤ 6 months, congestive heart failure, chronic obstructive pulmonary disease, plan to have a hip or knee replacement, walker or wheelchair use, recent stroke with hemiparesis); or (6) were already performing more than 150 minutes of moderate to vigorous exercise per week (i.e. already meeting recommended physical activity guidelines).
Intervention	Individuals were recruited for the Reach out to Enhance Wellness (RENEW) trial from July 1, 2005 through May 17, 2007. The RENEW intervention consisted of a personally tailored workbook and series of quarterly newsletters, along with a program of telephone counselling and automated prompts (i.e. 15 sessions and eight prompts over the 12-month period), promoting exercise, improved diet quality, and modest weight loss. The intervention was theoretically based using the social cognitive theory and transtheoretical models.

Comparison	The control group was wait-listed for 12 months.	
Outcomes measured	Change in self-reported physical function on the Short-Form 36 (SF36) physical function subscale (score range, 0-100; a high score indicates better functioning) from baseline to 12 months was the primary end point. Secondary outcomes included changes in function on the basic and advanced lower extremity function subscales of the Late Life Function and Disability Index (score range, 0-100), BMI, and overall health-related quality of life.	
Duration of follow-up	Duration of intervention including follow-up was 12 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% did not complete follow-up
Magnitude of effect rating**	Low	
Relevance of evidence rating***	Low	
Results		
Participants	Participant baseline characteristics were similar in both intervention and control groups. Characteristics for the intervention group included mean (SD): age of 73.0 (5.0) years; and BMI of 29.1 (3.3) kg/m^2. The mean (SD) of comorbidities was 2.0 (1.3), 46% of the group were male and 89% white. Characteristics for the control group included mean (SD): age of 73.1 (5.1) years; and BMI of 29.2 (3.6) kg/m^2. The mean (SD) of comorbidities was 2.0 (1.2), 45% of the group were male and 88% white.	
Overall findings	Weight loss was greater in the intervention than the control group (2.1 kg [95% CI, -1.7 to -2.4 kg] versus 0.9 kg [95% CI, -0.5 to -1.3 kg]). At 12 months the mean changes in basic lower extremity function were 0.34 (95% CI, -0.84 to 1.52) in the	

	intervention group compared with -1.89 (95% CI, -0.70 to -3.09) in the control group (P = 0.005). The mean changes in SF36 between intervention and control groups were as follows: physical function -2.2 versus -4.8; general health 0.8 versus -1.9; pain -0.8 versus -3.2; vitality -0.5 versus -2.4; social functioning -1.3 versus -5.1; mental health 0.5 versus -2.0; physical role -2.4 versus -4.7 and emotional role -0.7 versus -0.6.
Compliance with treatment	Not stated
Adverse events	Changes in health status were identified at each telephone contact (survey or counselling) or by self-report. A total of 201 events were reported, reviewed, and classified, with the majority coded as not serious. A total of 106 of the 201 events were classified as cardiac, musculoskeletal, or digestive concerns possibly attributable to the diet and exercise intervention. Of these, 32 involved hospitalization. There were five events that were considered directly attributable to the study. One participant experienced increased blood pressure with exercise (physician clearance was obtained for continued participation in the study). The four other participants experienced (1) hip pain with exercise, (2) pulled hamstring while walking, (3) fall during hiking, or (4) calf pain and stiffness while using exercise bands. After analysis of these events, there were no differences between the intervention and control groups in the total number of events, or in events in any subcategory.
Notes	Among older, long-term survivors of colorectal, breast, and prostate cancer, a diet and exercise intervention reduced the rate of self-reported functional decline compared with no intervention. This study has some limitations to consider, which may affect generalisability: - all of the outcomes are based on self-report, and it is possible that some of the behavioural outcomes are subject to overestimation or underestimation of desired behaviours. - according to the authors the intervention was most likely delivered to highly motivated individuals. - Recruitment for this study was extremely difficult as long-term cancer survivors present a particular challenge to recruitment because: (1) their follow-up with oncologists (who usually serve as points of entry to oncology-based trials) is frequently discontinued; and (2) they may have died.

Nissen 2008

Characteristics of the study	
Study Citation	Nissen SE, Nicholls SJ, Wolski K, Rodes-Cabau J, Cannon CP, Deanfield JE, Despres JP, Kastelein JJ, Steinhubl SR, Kapadia S, Yasin M, Ruzyllo W, Gaudin C, Job B, Hu B, Bhatt DL, Lincoff AM & Tuzcu EM 2008, 'Effect of rimonabant on progression of atherosclerosis in patients with abdominal obesity and coronary artery disease: the STRADIVARIUS randomized controlled trial', JAMA, vol.299, no.13, pp.1547-60.
Study Design	RCT
Methods	
N (enrolled)	N = 839 participants Rimonabant (N = 422), placebo (N = 417) Study was conducted in 112 centers in North America, Europe, and Australia.
Inclusion criteria	Patients required coronary angiography for a clinical indication, which most often consisted of ischemic chest pain or an abnormal finding on a functional study. The angiogram needed to demonstrate at least one coronary obstruction with greater than 20% angiographic luminal diameter narrowing. Patients were ≥ 18 years of age. Patients had a waist circumference > 88 cm (34.6 inches) for women or 102 cm (40.2 inches) for men. Either met pre-specified criteria for the presence of the metabolic syndrome or were current smokers.
Exclusion criteria	Previous weight loss surgery, uncontrolled diabetes, or a urine test result positive for tetra-hydrocannabinol. Concomitant administration of other weight loss agents such as orlistat or sibutramine at baseline and during the trial was prohibited. To assess the safety of rimonabant in a broad population, the study intentionally did not exclude patients with a

	prior history of psychiatric disorders.	
Intervention	Following successful intravascular ultrasound (IVUS) examination of the coronary arteries, all patients were scheduled for a randomisation visit occurring within two weeks after baseline IVUS. During this visit, they were randomly assigned to receive either rimonabant 20 mg daily, or a matching placebo, for 18 to 20 months. At the time of randomisation, patients were referred to a dietician for instruction on a moderate reduced-calorie diet and, if appropriate, were counselled on smoking cessation. Investigators were instructed to institute appropriate risk factor modification according to local guidelines. The patients returned for scheduled clinic visits at baseline and at three, six, 12, and 18 months following randomisation.	
Comparison	Matching placebo.	
Outcomes measured	The primary efficacy parameter was change in percent atheroma volume (PAV); Secondary efficacy parameter was change in normalised total atheroma volume (TAV).	
Duration of follow-up	The total duration of intervention and follow-up was 18 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% discontinued study
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	On average, patients were < 60 years of age; approximately two-thirds were men.	

	Patients were abdominally obese, with a mean waist circumference of approximately 117 cm (46 in) and a mean BMI of 35 kg/m^2.
Overall findings	In the rimonabant vs. placebo groups, PAV (95% CI) increased 0.25% (-0.04% to 0.54%) vs. 0.51% (0.22% to 0.80%) (P = 0.22), respectively, and TAV decreased 2.2 mm^3 (-4.09 to -0.24) vs. an increase of 0.88 mm^3 (-1.03 to 2.79) (P = 0.03). In the rimonabant vs. placebo groups, imputing results based on baseline characteristics for patients not completing the trial, PAV increased 0.25% (-0.04% to 0.55%) vs. 0.57% (0.29% to 0.84%) (P = 0.13), and TAV decreased 1.95 mm^3 (-3.8 to -0.10) vs. an increase of 1.19 mm^3 (-0.73 to 3.12) (P = 0.02). Rimonabant-treated patients had a larger reduction in body weight (4.3 kg [-5.1 to -3.5] vs. 0.5 kg [-1.3 to 0.3]) and greater decrease in waist circumference (4.5 cm [-5.4 to -3.7] vs. 1.0 cm [-1.9 to -0.2]) than the placebo group (P < 0.001 for both comparisons). In the rimonabant vs. placebo groups, HDL cholesterol levels increased 5.8 mg/dL (4.9 to 6.8) (22.4%) vs. 1.8 mg/dL (0.9 to 2.7) (6.9%) (P < 0.001), and median triglyceride levels decreased 24.8 mg/dL (-35.4 to -17.3) (20.5%) vs. 8.9 mg/dL (-14.2 to -1.8) (6.2%) (P < 0.001). Rimonabant-treated patients had greater decreases in high-sensitivity C-reactive protein (hs-CRP) (1.3 mg/dL [-1.7 to -1.2] [50.3%] vs. 0.9 mg/dL [-1.4 to -0.5] [30.9%]) in placebo patients, and less increase in HbA1c levels (0.11% [0.02% to 0.20%] vs. 0.40% [0.31% to 0.49%]) compared with placebo patients (P < 0.001 for both comparisons). Psychiatric adverse effects were more common in the rimonabant group (43.4% vs. 28.4%, P < 0.001). LDL-cholesterol levels and blood pressure changes did not differ significantly between treatment groups.
Compliance with treatment	Not stated
Adverse events	The most common treatment-emergent adverse events included psychiatric disorders, which occurred in 118 placebo-treated patients (28.4%) and 183 rimonabant-treated patients (43.4%) (P < 0.001). These adverse events consisted primarily of an increase in anxiety and depression. Severe psychiatric adverse effects, defined as major depression, suicidal ideation, or attempted or successful suicide occurred with similar frequency in the placebo- and rimonabant-treated patients (3.8% vs. 4.7%, respectively; P = 0.52).

	A single patient in the placebo group attempted suicide and a single patient in the rimonabant group successfully completed suicide. Gastrointestinal tract disorders also showed an imbalance between the two groups, occurring in 74 placebo-treated patients (17.8%) and 142 rimonabant-treated patients (33.6%) ($P < 0.001$). Adverse events were more likely to lead to drug discontinuation in the rimonabant-treated patients compared with placebo-treated patients (74 [17.5%] vs. 31 [7.5%], $P < 0.001$). The composite outcome of cardiovascular death, nonfatal myocardial infarction, nonfatal stroke, or hospitalization for unstable angina, revascularization or transient ischemic attack occurred in 46 placebo-treated patients (11%) and 44 rimonabant-treated patients (10.4%). The individual components of this end point did not show any consistent pattern suggesting differences between placebo and rimonabant.
Notes	After 18 months of treatment, the study failed to show an effect for rimonabant on disease progression for the primary end point (PAV) but showed a favourable effect on the secondary end point (TAV). Despite these limitations, the authors believe that the STRADIVARIUS trial supports the following conclusions. Treatment with the CB1 antagonist rimonabant for 18 months reduced body weight and waist circumference and improved lipid profiles, glycaemic measures, and hs-CRP levels, but did not significantly reduce atherosclerosis for the primary efficacy parameter, change in PAV. However, rimonabant treatment did show a statistically significant favourable effect for a secondary IVUS end point and an additional exploratory end point. Accordingly, this agent may favourably influence the progression of atherosclerosis. Significant psychiatric and gastrointestinal tract adverse effects were observed but were usually mild or moderate in severity. The authors believe that this approach to treatment of abdominal obesity, inhibition of CB1 receptors with rimonabant, continues to hold promise in the treatment of patients with coronary disease and should be explored in further clinical trials.

O’Brien 2010

Characteristics of the study	
Study Citation	O'Brien PE, Sawyer SM, Laurie C, Brown WA, Skinner S, Veit F, Paul E, Burton PR, McGrice M, Anderson M & Dixon JB 2010, 'Laparoscopic adjustable gastric banding in severely obese adolescents: a randomized trial', JAMA, vol.303, no.6, pp.519-26.
Study Design	RCT
Methods	
N (enrolled)	N = 50 participants Lifestyle group (N = 25) and Gastric Banding group (N = 25) Study was conducted in Australia.
Inclusion criteria	Participants were recruited from the community through newspaper advertisements. Eligibility criteria included age between 14 and 18 years; BMI > 35 kg/m^2; identifiable medical complications such as hypertension, metabolic syndrome, asthma, back pain; physical limitations such as an inability to play a sport, difficulties with activities of daily living; or psychosocial difficulties such as isolation or low self-esteem, subject to bullying that stems from obesity and evidence of attempts to lose weight by lifestyle means for more than three years. Participants and their parents were informed of the two study groups and consented to randomisation to either treatment program.
Exclusion criteria	Three applicants were excluded with intellectual disability and one with Prader Willi syndrome.
Intervention	Participants in the gastric banding group had the procedure performed within a month of randomisation. The LAP-BAND Adjustable Gastric Banding system was used in all cases. Detailed instructions on the requirements for correct eating and exercise after gastric banding were provided by discussion as well as in written form before the procedure. Eating rules centred on having three or fewer small (approximately 125 ml), protein-containing meals per day, eaten slowly and chewed well. Each participant was encouraged to undertake at least 30 minutes of formal exercise per day and to maintain a high level of activity through the day. Clinical reviews were conducted approximately every six weeks for two

	years by experienced medical staff. Adjustments to the volume of fluid in the band were conducted in the office, without use of X-ray imaging, based on weight loss, sense of satiety, and eating pattern and symptoms. Consultations and adjustments of the gastric banding were carried out at a community clinic dedicated to obesity management or at a specialist hospital clinic. Gastric banding procedures were conducted in a private hospital.	
Comparison	The lifestyle program centred on reduced energy intake (individualised diet plans ranging between 800 and 2,000 kcal/d, depending on age and weight status), increased activity (target of > 10,000 steps per day on pedometer) with a structured exercise schedule of at least 30 minutes a day and behavioural modification. Compliance was monitored intermittently with food diaries and step counts. Consultation occurred approximately every six weeks throughout the 24-month study period by an adolescent physician and a dietician or exercise consultant, the study nurse coordinator, and a sports medicine physician. The participant's family was included in activities and education where appropriate. Exercise and activity recommendations included decrease of sedentary activities with a limit of 2-hour computer or television screen time, increase of formal exercise including bicycle riding, walking, and swimming plus informal individual and group activities. Group outings to fun parks, bike rides, hiking trips, walking, jogging, kickboxing, indoor bowling, and outdoor reunions were scheduled. A personal trainer was provided to each participant for a 6-week period. Parents were invited to participate in a specific educational program that included sports motivational talks, nutritional education, and discussions of the psychological aspects of adolescence.	
Outcomes measured	Weight loss. Secondary outcomes included change in metabolic syndrome, BP, quality of life and adverse events. Laboratory analyses included fasting blood glucose, serum insulin, C-peptide, HbA1c and lipids.	
Duration of follow-up	Duration of follow-up was two years.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	B	> 15% loss to follow-up
Magnitude of effect rating**	High	

<table>
<tr><td>Relevance of evidence rating***</td><td>High</td><td></td></tr>
<tr><td colspan="3">Results</td></tr>
<tr><td>Participants</td><td colspan="2">There were no statistically significant differences in demographics, anthropometric, clinical, or biochemical values except for higher SBP and HOMA β-cell value in the lifestyle group. The participants were at a mean of 99⅓ BMI percentile (range, 97.9 to 99.9) according to growth charts. Extreme obesity (> 99th percentile) was present in all but four participants. The participants showed physiological maturity with secondary sexual characteristics in all and most had completed bone growth. Boys made up 36% of the LAGB group and 28% of the Lifestyle group.</td></tr>
<tr><td>Overall findings</td><td colspan="2">Twenty-four of 25 patients in the gastric banding group and 18 of 25 in lifestyle group completed the study. Twenty-one (84%) in the gastric banding and three (12%) in the lifestyle groups lost more than 50% of excess weight, corrected for age. Overall, the mean changes in the gastric banding group were a weight loss of 34.6 kg (95% CI, -30.2 to -39.0), representing an excess weight loss of 78.8% (95% CI, -66.6% to -91.0%), 12.7 BMI units (95% CI, 11.3 to 14.2), and a BMI z-score change from 2.39 (95% CI, 2.05 to 2.73) to 1.32 (95% CI, 0.98 to 1.66). The mean losses in the lifestyle group were 3.0 kg (95% CI, -2.1 to -8.1), representing excess weight loss of 13.2% (95% CI, --2.6% to -21.0%), 1.3 BMI units (95% CI, 0.4 to 2.9), and a BMI z-score change from 2.41 (95% CI, 2.21 to 2.66) to 2.26 (95% CI, 1.91 to 2.43).

The gastric banding group experienced improved quality of life with no perioperative adverse events.

Cardiometabolic outcomes were as follows:
<table>
<tr><td></td><td>Gastric banding (SD)</td><td>Lifestyle (SD)</td></tr>
<tr><td>SBP (mmHg)</td><td>-12.5 (12.4)</td><td>-20.3 (21.7)</td></tr>
<tr><td>DBP (mmHg)</td><td>-6.0 (9.4)</td><td>-6.9 (12.5)</td></tr>
<tr><td>Triglycerides (mg/dL)</td><td>-52 (38)</td><td>-32 (83)</td></tr>
<tr><td>HDL (mg/dL)</td><td>9.3 (14.7)</td><td>3.9 (6.0)</td></tr>
</table>
</td></tr>
</table>

Compliance with treatment	In the lifestyle group compliance was monitored intermittently with food diaries and step counts. No further information regarding compliance was reported.
Adverse events	Twelve participants (48%) experienced a total of 13 adverse events in the gastric banding group, eight of which required a revisional procedure among seven patients (28%) during the 2-year period. Six proximal pouch dilatations caused symptoms of heartburn, reflux, or vomiting, and two needle-stick injuries to tubing. Revision consisted of removal and replacement of the band or replacement of the access port. These procedures occurred without complication, and the length of stay was less than 24 hours. This subgroup had a mean (SD) weight loss of 83.3% (9.9%) of excess weight loss at two years, which did not differ from the 77.7 % (37%) excess weight loss among the rest of the members of the gastric banding group. One patient developed acute cholecystitis treated by cholecystectomy. Another patient, who had depression and trichotillomania at study entry, required hospital admission for depression at eight months of follow-up, subsequent to parental divorce. There were two pregnancies. One ended at six weeks from spontaneous abortion, while the other delivered a healthy infant after completion of the study. There was one loss to follow-up. In the lifestyle group adolescents visited the adolescent physician, study dietician, study nurse practitioner, or other physicians a mean 15.5 (range, 7 to 31) times. There was also a mean of five telephone consultations per patient and each participant had six sessions with a personal trainer. Eighteen adverse events occurred in 11 participants (44%). Seven patients withdrew from the study. Six had gained weight at the time of withdrawal. One patient had eight hospital admissions for headache, depression, and tonsillitis. After multiple psychiatric assessments and three lumbar punctures, the diagnoses of bipolar disorder and benign intracranial hypertension were made just prior to completion of the study. One patient required cholecystectomy for cholelithiasis.
Notes	Among obese adolescent participants, use of gastric banding compared with lifestyle intervention resulted in a greater percentage achieving a loss of 50% of excess weight, corrected for age. There were associated benefits to health and quality of life.

Okely 2010

Characteristics of the study	
Study Citation	Okely AD, Collins CE, Morgan PJ, Jones RA, Warren JM, Cliff DP, Burrows TL, Colyvas K, Steele JR & Baur LA 2010, 'Multi-site randomized controlled trial of a child-centered physical activity program, a parent-centered dietary-modification program, or both in overweight children: the HIKCUPS study', J Pediatr, vol.157, no.3, pp.388-94, 394 e1.
Study Design	RCT
Methods	
N (enrolled)	N = 165 participants Parent-centered dietary program (N = 63), child-centered physical activity program (N = 73), combination (N = 70) Study was conducted in Australia.
Inclusion criteria	Eligibility criteria included the child being overweight or obese (referred to hereafter as ‘‘overweight’’) according to International Obesity Task Force cut points, aged 5.5 to 9.9 years, pre-pubertal (Tanner Stage I) and generally healthy. Participants were recruited from the local communities, primarily through print media and advertisements placed in school newsletters.
Exclusion criteria	Exclusion criteria included: extreme obesity (BMI z-score > 4); known syndromal obesity; a chronic illness; following a therapeutic diet; and taking medications associated with weight gain or long-term steroids.
Intervention	All groups received 10 weekly face-to-face sessions followed by three monthly relapse-prevention phone calls. Analysis was by intention-to-treat. The Hunter and Illawarra Kids Challenge Using Parent Support (HIKCUPS) study involved three intervention arms: a Dietary-Modification Program (Diet), a Physical Activity Skill Development Program (Activity), and a combination

	of the Dietary-Modification and Physical Activity Skill Development Programs (Diet + Activity). Each intervention was designed to be inexpensive and sustainable in a community setting and was conducted on a separate, pre-designated afternoon of the week. Each had three major components: (1) a weekly 2-hour face-to-face session for 10 weeks; (2) homework activities, designed to be completed in between each face-to-face session; and (3) a 3-month relapse prevention program where short- to medium-term goals set by parents were reviewed over the phone following a standard study procedure, by a trained facilitator once a month for three months.	
Comparison	Described above.	
Outcomes measured	Outcome measures were assessed at baseline and at six and 12 months by trained assessors who were blinded to group assignment. Primary outcome was BMI z-score at 12-month follow-up.	
Duration of follow-up	Duration of intervention and follow-up was 12 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% did not complete study
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	Baseline participant mean (SD) age ranged from 8.1 (1.2) to 8.3 (1.0) years and mean (SD) BMI ranged from 24.4 (3.7) to 25.2 (4.1) kg/m^2. The percentage of males in the three different groups ranged from 38-45%.	
Overall findings	BMI z-scores were reduced at 12-months in all groups, with the Diet (mean [95% CI]) (-0.39 [-0.51 to 0.27]) and Diet + Activity (-0.32, [-0.36, -0.23]) groups showing a greater reduction than the Activity group (-0.17 [-0.28, -0.06]) (P = 0.02).	

Compliance with treatment	Not stated
Adverse events	There were no adverse events reported in any of the groups throughout the intervention or during the follow-up phase.
Notes	Relative body weight decreased at six months and was sustained at 12 months through treatment with a child-centred physical activity program, a parent-centred dietary program, or both. The greatest effect was achieved when a parent-centred dietary component was included.

Parikh 2010

Characteristics of the study	
Study Citation	Parikh P, Simon EP, Fei K, Looker H, Goytia C & Horowitz CR 2010, 'Results of a pilot diabetes prevention intervention in East Harlem, New York City: Project HEED', Am J Public Health, vol.100 Suppl 1, pp.S232-9.
Study Design	RCT
Methods	
N (enrolled)	N = 99 participants Intervention (N = 50), delayed intervention (control) (N = 49) Study was conducted in the US.
Inclusion criteria	Recruitment occurred in two phases. In phase 1, the authors screened individuals for eligibility: aged 18 years or older, resided in East Harlem, spoke English or Spanish, were overweight, were not currently pregnant, did not have diabetes, did not use glucose-altering medications, and were able to participate in a group session. In phase 2, participants with abnormal glucose were identified with point-of-care testing of blood glucose, followed

	up with glucose tolerance testing if results were equivocal.	
Exclusion criteria	Participants with normal glucose levels were informed that they were ineligible for the study and given information on weight loss. Participants were also excluded if they did not meet the above inclusion criteria.	
Intervention	Intervention participants attended lifestyle workshop at community sites. Participants received brief verbal and written information about pre-diabetes and results of all their screening tests, with a copy to take home that they could also share with their clinicians.	
Comparison	Waiting list control.	
Outcomes measured	Weight, blood pressure, and health behaviours were measured at baseline and three, six, and 12 months. Venous blood was used to measure haemoglobin A1c (HbA1c) and serum cholesterol levels.	
Duration of follow-up	Total duration of intervention and follow-up was 12 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% did not complete study
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	Participants had a mean age of 48 years (range = 25 to 84 years), and were predominantly female (85%). Many participants reported hypertension (31%), hyperlipidaemia (25%), food insufficiency (25%), depressive	

	symptoms (49%), and a family history of diabetes (43%). All participants were overweight, with 56% obese and 6% morbidly obese. Their mean HbA1c level was 5.6.
Overall findings	The intervention group lost significantly more weight than the control group and maintained weight loss at 12 months (7.2 versus 2.4 pounds; P < 0.01). The majority of weight loss was in the first six months. One fourth of participants progressed to diabetes.
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	The qualitative findings revealed that control participants benefited from just knowing they had pre-diabetes, because they lost a mean 2 pounds at one year, by contrast with the average adult, who gains 1 pound annually.

Pi-Sunyer 2007

Characteristics of the study	
Study Citation	Pi-Sunyer X, Blackburn G, Brancati FL, Bray GA, Bright R, Clark JM, Curtis JM, Espeland MA, Foreyt JP, Graves K, Haffner SM, Harrison B, Hill JO, Horton ES, Jakicic J, Jeffery RW, Johnson KC, Kahn S, Kelley DE, Kitabchi AE, Knowler WC, Lewis CE, Maschak-Carey BJ, Montgomery B, Nathan DM, Patricio J, Peters A, Redmon JB, Reeves RS, Ryan DH, Safford M, Van Dorsten B, Wadden TA, Wagenknecht L, Wesche-Thobaben J, Wing RR & Yanovski SZ 2007, 'Reduction in weight and cardiovascular disease risk factors in individuals with type 2 diabetes: one-year results of the look AHEAD trial', Diabetes Care, vol.30, no.6, pp.1374-83.
Study Design	RCT

Methods	
N (enrolled)	N = 5,145 participants Participants were randomised to an ILI (N = 2,570) or DSE intervention (N = 2,575) Study conducted in US.
Inclusion criteria	Participants were 45 to 74 years of age (which was changed to 55 to 74 years during the 2nd year of recruitment to increase the anticipated cardiovascular event rate), had a BMI > 25 kg/m^2 (> 27 kg/m^2 if currently taking insulin), HbA1c < 11%, SBP < 160, DBP < 100 mmHg, and triglycerides < 600 mg/dl. Before randomisation, all study participants were required to complete a 2-week run-in period that included successful self-monitoring of diet and physical activity, and they were provided an initial session of diabetes education with particular emphasis on aspects of diabetes care related to the trial such as management of hypoglycaemia and foot care. The session stressed the importance of eating a healthy diet and being physically active for both weight loss and improvement of glycaemic control. All individuals who smoked were encouraged to quit and were provided self-help materials and / or referral to local programs as appropriate
Exclusion criteria	The most common reasons for ineligibility were related to age, lack of diabetes or the likelihood that the diabetes was type 1, elevated blood pressure, or incomplete behavioural run-ins.
Intervention	An ILI involving group and individual meetings to achieve and maintain weight loss through decreased caloric intake and increased physical activity. The weight loss intervention prescribed in the 1st year combined diet modification and increased physical activity and was designed to induce a minimum weight loss of 7% of initial body weight during the 1st year. Individual participants were encouraged to lose > 10% of their initial body weight, with the expectation that aiming high would ensure that a greater number of participants would achieve the minimum 7% weight loss. During months 1 to 6, participants were seen weekly with three group meetings and one individual session per month. During months 7 to 12, group sessions were provided every other week and the monthly individual session was continued. Sessions were led by intervention teams that included registered dieticians, behavioural psychologists, and exercise specialists.

	Caloric restriction was the primary method of achieving weight loss. The macronutrient composition of the diet was structured to enhance glycaemic control and to improve CVD risk factors. It included a maximum of 30% of total calories from fat (with a maximum of 10% of total calories from saturated fat) and a minimum of 15% of total calories from protein. Participants were prescribed portion-controlled diets, which included the use of liquid meal replacements (provided free of charge) and frozen food entrées, as well as structured meal plans (comprised of conventional foods) for those who declined the meal replacements. Monthly reviews took place at an individual session to reassess progress. The physical activity program prescribed in the ILI relied heavily on home-based exercise with gradual progression toward a goal of 175 minutes of moderate-intensity physical activity per week. Although walking was encouraged, participants were allowed to choose other types of moderate-intensity physical activity, and programs were tailored based on the results of a baseline physical fitness test and safety concerns.
Comparison	Participants assigned to DSE attended the initial pre-randomisation diabetes education session and were invited to three additional group sessions during the 1st year. A standard protocol was used for conducting these sessions, which provided information and opportunities for discussing topics related to diet, physical activity, and social support. However, the DSE group was not weighed at these sessions and received no counselling in behavioural strategies for changing diet and activity.
Outcomes measured	All participants were scheduled to attend baseline and 1-year assessments, at which time measures of weight, height and BP were taken, fitness and serum levels (as described below) were assessed and prescription medicines and a history of CVD was recorded. At 1 year, a submaximal exercise test was performed and terminated when the participant first achieved or exceeded 80% of age-predicted maximal heart rate. If the participant was taking a β-blocker at baseline or 1-year assessment, the submaximal test was terminated at the point when the participant first reported achieving or exceeding 16 on the 15-category RPE scale. For participants not taking a β-blocker, change in cardiorespiratory fitness was computed as the difference in estimated METS between points during the baseline and 1-year tests when > 80% of age-predicted maximal heart rate was attained. For participants taking β-blockers at either base-line or one year, change in cardiorespiratory fitness was computed as the difference in estimated METS between points during the baseline and 1-year tests when RPE > 16 was attained. Serum measures included HbA1c, fasting serum glucose, total serum cholesterol and triglycerides, LDL cholesterol, HDL cholesterol, albumin and creatinine concentrations.

	Glycaemic control was defined as HbA1c < 7.0%, blood pressure control as SBP < 130 and DBP < 80 mmHg, and lipid control as LDL cholesterol < 100 mg/dl.	
Duration of follow-up	These data describe 1-year changes in CVD risk factors.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	Blinding not mentioned Standardisation of assessment not mentioned
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results		
Participants	Individuals with type 2 diabetes, aged 45 to 74 years, with BMI > 25 kg/m^2 (> 27 kg/m^2 if taking insulin). Overall, 14.0% reported a history of CVD, 94.0% met the definition for the metabolic syndrome, 15.3% were taking insulin, 87.5% were using diabetes medicines (including insulin), 75.3% were using antihypertensive medicines, and 51.0% were using lipid-lowering medicines. A BMI of ≥ 30.0 kg/m^2 was present in 85.1% of participants.	
Overall findings	Participants assigned to ILI lost an average 8.6% of their initial weight vs. 0.7% in DSE group (P < 0.001). Mean fitness increased in ILI by 20.9 vs. 5.8% in DSE (P < 0.001). A greater proportion of ILI participants had reductions in diabetes, hypertension, and lipid-lowering medicines. Mean HbA1c dropped from 7.3 to 6.6% in ILI vs. from 7.3 to 7.2% in DSE. SBP and DBP, triglycerides, HDL cholesterol, and urine albumin-to-creatinine ratio improved significantly more in ILI than DSE participants (all P < 0.01).	

		ILI (SD)	DSE (SD)
	% body weight	-8.6 (6.9)	-0.7 (4.8)
	Use of diabetes medicines (%)	-7.8 (0.6)	2.2 (0.5)
	HbA1c	-0.64 (0.02)	-0.14 (0.02)
	SBP	-6.8 (0.4)	-2.8 (0.3)
	DBP	-3.0 (0.2)	-1.8 (0.2)
	LDL (mg/dl)	-5.2 (0.6)	-5.7 (0.6)
	HDL (mg/dl)	3.4 (0.2)	1.4 (0.1)
	Triglycerides (mg/dl)	-30.3 (2.0)	-14.6 (1.8)
Compliance with treatment	Not stated		
Adverse events	Not stated		
Notes	At one year, ILI resulted in clinically significant weight loss in people with type 2 diabetes. This was associated with improved diabetes control and CVD risk factors and reduced medicine use in ILI versus DSE.		

Plachta-Danielzik 2007

Characteristics of the study	
Study Citation	Plachta-Danielzik S, Pust S, Asbeck I, Czerwinski-Mast M, Langnase K, Fischer C, Bosy-Westphal A, Kriwy P & Muller MJ 2007, 'Four-year follow-up of school-based intervention on overweight children: the KOPS study', Obesity (Silver Spring), vol.15, no.12, pp.3159-69.
Study Design	RCT
Methods	
N (enrolled)	N = 1,764 participants Non-intervention group (N = 1,419), intervention group (N = 345) Study was conducted in Germany.
Inclusion criteria	To evaluate the 4-year outcome of a school-based health promotion on weight status as part of the Kiel Obesity Prevention Study (KOPS), the authors enrolled 4997 six-year-old children during the school entry examinations, between 1996 and 2001. There were no eligibility criteria except willingness to participate. A total of 1764 of the children (35%) could be restudied at 10 years of age within a cluster-sampled quasi- RCT.
Exclusion criteria	None stated
Intervention	The intervention program was based on the assumption that attitudes of behaviour and other factors (e.g. familiar risk, low socio-economic status) are predictive for weight changes. Messages (eat fruit and vegetable every day, reduce intake of high-fat foods, keep active at least one hour/day, and decrease television consumption to < 1 hour/day) were given to children, parents, and teachers. All first graders of intervention schools were addressed by six nutrition units performed during two to three weeks

	within the second term of the first school year. Parents were informed on the occasion of a parental school meeting. Messages were conveyed as nutrition fairy tales, interactive games, and by preparing a healthy breakfast. After each unit, running games were offered for 20 minutes on the schoolyard. Teachers were trained within a half a day structured nutrition education program. Costs of the intervention were calculated to be $26.20/child.	
Comparison	The school-based intervention was performed between 1996 and 2001 in two to four “intervention schools” per year. The schools were randomly assigned to the intervention (I) and non-intervention (NI) groups. Randomisation was done every year therefore, 14 of 32 schools in Kiel served as “intervention schools” where 780 first graders were addressed. In the following years, former “intervention schools” served as “non-intervention schools.” After 4 years, 345 children (I; 44.2%) were restudied. The data of these children were compared with children from NI schools (NI; N =1419).	
Outcomes measured	Prevalence, incidence, and remission of overweight were main outcome measures. Secondary outcome parameters (nutrition, activity, media time) were analysed in a subgroup of children. Anthropometric (height, weight, skinfolds, waist circumference [WC]) and bio-electric impedance analysis measurements were performed. A validated questionnaire addressed diet, physical activity and inactivity, self-reported weight and height of parents, and parental education and nationality.	
Duration of follow-up	Duration of follow-up was four years.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% did not complete study

Magnitude of effect rating**	Low	
Relevance of evidence rating***	Medium	
Results		
Participants	The mean weight of children was 35.7 kg (31.7 to 42.0) and 36.1 kg (31.7 to 41.2) for non-intervention and intervention groups, respectively. The mean BMI of children was 17.2 kg/m^2 (15.8 to 19.6) and 17.5 kg/m^2 (16.0 to 19.1) for non-intervention and intervention groups, respectively.	
Overall findings	The 4-year change in BMI was 11.6%, with increases in prevalence of overweight and obesity from 5.2% to 11.1% and 3.9% to 5.1%, respectively. Cumulative 4-year incidence of overweight and obesity was 9.2% and3.1%, respectively. Intervention had no effect on mean BMI. The effect on prevalence was significant in children from families with high socio-economic status (odds ratio [OR], 0.35; 95% CI, 0.14 to 0.91, p = 0.03) and marginally significant in children of normal-weight mothers (OR, 0.57; 95% CI, 0.33 to 1.00, p = 0.05). Cumulative 4-year incidence of overweight was lower only in intervention children from families with high SES (OR, 0.26; 95% CI, 0.07 to 0.87, p = 0.03). Remission of overweight was most pronounced in children of normal-weight mothers (OR, 5.43; 95% CI, 1.28 to 23.01, p = 0.02). A marginally significant effect on remission of overweight was seen in all children (adjusted OR, 2.52; 95% CI, 0.88 to 7.16, p = 0.08) and in girls (adjusted OR, 4.52; 95% CI, 0.86 to 23.65, p = 0.07), whereas no effect was seen in boys. Prevalence of underweight was unchanged. The intervention had minor but favourable effects on lifestyle. The 4-year cumulative incidence of: remission of overweight (I, 41.7; NI, 27.0; adjusted OR, 2.52; 95% CI, 0.88 to 7.16; P = 0.084); remission of obesity (I, 30.8; NI, 38.2, adjusted OR, 1.71, 95% CI, 0.42 to 6.91; P = 0.449)	
Compliance with treatment	Not stated	

Adverse events	Not stated
Notes	A school-based health promotion has sustainable effects on remission and incidence of overweight; it was most pronounced in children of normal-weight mothers and children from families with high socio-economic status. There was no effect on obesity.

Potteiger 2008

Characteristics of the study	
Study Citation	Potteiger JA, Kirk EP, Jacobsen DJ & Donnelly JE 2008, 'Changes in resting metabolic rate and substrate oxidation after 16 months of exercise training in overweight adults', Int J Sport Nutr Exerc Metab, vol.18, no.1, pp.79-95.
Study Design	RCT
Methods	
N (enrolled)	N = 74 participants Non-exercise control group (CON) (N = 33: 18 women, 15 men), exercise group (EX) (N = 41: 25 women, 16 men) Study was conducted in the US.
Inclusion criteria	The participants in this experiment were part of the Midwest Exercise Trial, which examined the effects of 16 months of exercise on body weight and body composition. The participants were 17 to 35 years old, BMI was 25.0 to 34.9 kg/m^2.
Exclusion criteria	History of chronic disease, elevated blood pressure (> 140/90), elevated lipids (cholesterol > 6.72 mmol/L, triglycerides > 5.65 mmol/L), or elevated fasting glucose (> 7.8 mmol/L). Participants were excluded if they were

	smokers, took medications that would affect physical performance or metabolism, or lacked the ability to perform the laboratory tests or participate in moderate-intensity exercise.
Intervention	Each participant's initial exercise prescription was calculated from the graded exercise test (GXT) at baseline. Exercise duration progressed from 20 minutes at baseline to 45 minutes at six months, and exercise intensity progressed from 60% of the heart-rate reserve at baseline to 75% at six months. This exercise duration and intensity were maintained for the remainder of the study. This level of exercise corresponded to 55-70% of VO2max. The targeted minimum energy expenditure of exercise was ~400 calories per session (~2000 kcal/week). This goal was gradually achieved during the first six months of training, and then participants performed moderate-intensity exercise for 45 minutes per day, five days per week for the duration of the study. Exercise consisted primarily of walking on motor-driven treadmills; however, alternative activities such as stationary biking and walking on stationary elliptical trainers were allowed for 20% of the total exercise sessions. All exercise was performed under direct supervision of research personnel. Exercise intensity was verified during each exercise session by use of a Polar heart-rate monitor. To document the level of energy expenditure achieved during the exercise sessions, energy expenditure was measured during at least two exercise sessions by indirect calorimetry at 4-month intervals. A maximal GXT was completed at baseline and four, nine and 12 months to allow for adjustments of the exercise prescription as changes in VO2max occurred.
Comparison	Participants in the control group participated in the same testing as the exercise group, with the exception of the additional GXTs performed at four and 12 months. The participants were instructed to maintain their usual physical activity and dietary intake patterns throughout the study.
Outcomes measured	Body mass and composition, maximal oxygen consumption (VO2max), resting metabolic rate (RMR), and resting substrate oxidation were assessed at baseline and after nine and 16 months of training.
Duration of follow-up	Total duration of intervention and follow-up was 16 months.

Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	
Magnitude of effect rating**	Medium	> 15% non-completion
Relevance of evidence rating***	High	
Results		
Participants	Participants age (mean ± SD) for women ranged from 21 ± 4 to 24 ± 5 years and for men 22 ± 4 to 24 ± 4 years. BMI (mean ± SD) for women ranged from 28.7 ± 3.2 to 29.3 ± 2.3 kg/m^2 and for men 29.0 ± 3.0 to 29.7 ± 2.9 kg/m^2.	
Overall findings	EX men had significant decreases from baseline to nine months in body mass (94.6 ± 12.4 to 89.2 ± 9.5 kg) and percent fat (28.3 ± 4.6 to 24.5 ± 3.9), with no further reduction at 16 months The EX men had significantly lower body mass, body-fat percentage and fat mass at 16 months than the CON men (88.8 kg ± 9.5 vs 93.6 kg ± 11.6; 24.6% ± 5.1 vs 25.9% ± 6.2; and 21.9 ± 5.5 kg vs 24.8 ± 8.1 kg, respectively). The EX men had significant decreases in both waist and hip circumferences at 9 months (110.8 cm ± 6.8 vs 106.5 cm ± 5.8 and 94.4 kg ± 7.3 vs 89.7 cm ± 5.5, respectively) with no further change, whereas the CON men had no significant changes. CON women had significant increases in body mass (80.2 ± 8.1 to 83.2 ± 9.2 kg) from baseline to 16 months. A significant increase of 2.1 ± 4.8 kg of fat mass was observed for the CON women. The CON women had a significant increase in both waist and hip circumference (108.3 cm ± 6.2 vs 111.0 cm ± 6.8 and 85.7 cm ± 5.3 vs 87.8 cm ± 6.6, respectively). At 16 months, the EX women had significantly lower body weight and fat mass than CON (77.6 kg ± 12.8 vs 82.8 kg ± 9.2, respectively).	

	VO2max increased significantly from baseline to nine months in the EX men (3.67 ± 0.62 to 4.34 ± 0.58 L/min) and EX women (2.53 ± 0.32 to 3.03 ± 0.42 L/min). The 16 month VO2max value was significantly different for EX men compared with CON men (4.34 l/min ± 0.58 vs 4.03 l/min ± 0.55, respectively). The 16 month VO2max value was significantly higher for EX women compared with CON women (3.03 l/min ± 0.42 vs 2.71 l/min ± 0.24, respectively). RMR increased from baseline to nine months in EX women (1583 ± 221 to 1692 ± 230 kcal/day) and EX men (1995 ± 184 to 2025 ± 209 kcal/d). There were no significant differences within genders for either EX or CON in fat or carbohydrate oxidation. Fat oxidation was significantly higher for women than for men at nine months in both CON and EX groups.
Compliance with treatment	Reasons for termination generally included lack of time, unwillingness to take meals in the university cafeteria, and conflict with work. In addition, participants were released from the study if adherence fell below 85% of the scheduled exercise sessions. Adherence to the exercise protocol was 90.3% ± 2% and 89.6% ± 2% of the total sessions completed for men and women, respectively.
Adverse events	Not stated
Notes	Regular moderate-intensity exercise in healthy, previously sedentary, overweight adult men and women increases RMR but does not alter resting fat or carbohydrate oxidation.

Proietto 2010

Characteristics of the study	
Study Citation	Proietto J, Rissanen A, Harp JB, Erondu N, Yu Q, Suryawanshi S, Jones ME, Johnson-Levonas AO, Heymsfield SB, Kaufman KD & Amatruda JM 2010, 'A clinical trial assessing the safety and efficacy of the CB1R inverse agonist taranabant in obese and overweight patients: low-dose study', Int J Obes (Lond), vol.34, no.8, pp.1243-54.
Study Design	RCT
Methods	
N (enrolled)	N = 1,041 participants Patients were randomised to placebo (N = 209) or taranabant: 0.5 mg (N = 207); 1 mg (N = 208); or 2 mg given orally once daily (N = 417). Patients recruited worldwide from 72 different locations.
Inclusion criteria	Men and women ≥ 18 years old with a BMI between 30 and 43 kg/m^2 or with a BMI ≥ 27 kg/m^2 and < 30 kg/m^2 if they had the obesity-related comorbidities of hypertension, dyslipidaemia or sleep apnoea. Patients must have maintained a stable body weight (±3 kg) for at least three months before entry.
Exclusion criteria	A history or presence of a major psychiatric disorder including but not limited to schizophrenia, other psychotic disorders, major depression, bipolar disorder, generalised anxiety disorder, personality disorder and eating disorder (for example, anorexia nervosa or bulimia). However, patients with a history of mild depression, who were asymptomatic at the time of screening / randomisation, including those who were on a single medication for the treatment of their depression, were allowed to participate. Patients assessed as being at risk of suicide were excluded.

	Other exclusion criteria included hypertension (SBP / DBP > 160 / > 100 mmHg), diabetes mellitus; and any other clinically significant disorder including cardiovascular, pulmonary, hepatic, renal, gastrointestinal, neurological, malignancy < 5 years, or endocrine diseases with the exception of patients with stably treated hypothyroidism as determined by a normal TSH. Patients with a history of seizures or at high risk of developing seizures were also excluded. Patients were excluded if they had undergone surgical treatment for obesity within the past five years. Patients on potent or moderate inhibitors of CYP3A4 (taranabant is metabolised by CYP3A4) or systemic corticosteroids were excluded. Patients who smoked cigarettes or used products containing nicotine within six months before study initiation, or planned to over the course of the study were excluded.
Intervention	To evaluate the weight loss efficacy, safety and tolerability of taranabant, a CB1R inverse agonist, in obese and overweight patients, participants were randomised 1:1:2:1 to once-daily treatment with taranabant 0.5, 1, or 2 mg or placebo for 52 weeks. Clinic visits occurred at 4-week intervals during the treatment period and intervening patient telephone contacts were made by study site staff to enhance patient retention. Initial dietary assessment and counselling were provided by a registered dietitian at the start of the placebo run-in period. The recommended diet was 25% lower in kcal than weight maintenance requirements and contained 55-60% carbohydrate, 10-20% protein, and not more than 30% fat, with a minimum daily caloric intake of 1200 kcal. Dietary counselling and review of daily food intake and physical activity records were also performed at each visit throughout the study. All patients were encouraged to increase their level of physical activity based on their current activity and health status. Patients who were at least 75% compliant (as defined by capsule count) and who did not gain weight over the diet / activity run-in period, and who met all entry criteria, were randomised into the study. Medication compliance was assessed by capsule count at each subsequent visit.
Comparison	Placebo medication and lifestyle intervention
Outcomes measured	The primary efficacy endpoints were absolute change in body weight from baseline (last measurement before start of double-blind study drug) and the proportion of patients who lost at least 5% or 10% of their baseline body weight at week 52.

	Secondary endpoints were change from baseline in waist circumference (WC), % body fat measured by dual energy x-ray absorptiometry, fasting plasma glucose, insulin, insulin sensitivity, fasting lipid profile (triglyceride, total cholesterol, high-density lipoprotein cholesterol [HDL-C], non-HDL-C, low-density lipoprotein cholesterol [LDL-C]), blood pressure, adiponectin and high sensitivity C-reactive protein. The Patient Health Survey (SF36/Acute v2) and Impact of Weight on Quality of Life (IWQoL) were used to evaluate the effect of treatment on quality of life. The key efficacy measurements included body weight (BW), WC, lipid endpoints and glycaemic endpoints.	
Duration of follow-up	The study included a 2-week single-blind placebo run-in period with dietary / activity counselling, a 52-week treatment period, and a 4-week post-treatment follow-up period.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	B	> 15% loss to follow-up but last observation carried forward analysis
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	At baseline mean age across groups was between 48.7 and 50.1 years; 91.3% to 95.7% were White; BMI was between 34.4 and 34.9 kg/m^2; WC was between 109.5 and 110.3 cm; SBP was between 120.3 and 121.2 mmHg; DBP was between 77.2 and 78.2 mmHg.	
Overall findings	The proportions of patients who lost at least 5% and 10% of their baseline BW at week 52 were significantly higher for all taranabant doses vs. placebo (P < 0.001 for all doses). Results in bold indicate statistically significant changes from baseline:	

<table>
<tr><td></td><td>
<table>
<tr><td></td><td>Placebo</td><td>Tar 0.5mg</td><td>Tar 1mg</td><td>Tar 2mg</td></tr>
<tr><td>Weight (kg)</td><td>-1.4</td><td>-5.0</td><td>-5.2</td><td>-6.4</td></tr>
<tr><td>WC (cm)</td><td>-3.0</td><td>-5.6</td><td>-5.7</td><td>-6.9</td></tr>
<tr><td>SBP (mmHg)</td><td>0.7</td><td>0.1</td><td>-0.5</td><td>0.7</td></tr>
<tr><td>DBP (mmHg)</td><td>-0.04</td><td>-0.6</td><td>-0.5</td><td>-0.4</td></tr>
<tr><td>TG (%)</td><td>0</td><td>-3.9</td><td>-3.3</td><td>-5.4</td></tr>
<tr><td>HDL (%)</td><td>9.2</td><td>10.6</td><td>11.2</td><td>11.7</td></tr>
<tr><td>TC (%)</td><td>7.0</td><td>4.0</td><td>4.4</td><td>4.2</td></tr>
<tr><td>Hs-CRP (%)</td><td>0</td><td>-24.4</td><td>-25.0</td><td>-27.6</td></tr>
<tr><td>FPG (mg/dL)</td><td>-1.1</td><td>-1.9</td><td>-0.2</td><td>-2.0</td></tr>
</table>
</td></tr>
<tr><td>Compliance with treatment</td><td>Of the 1,041 patients randomised, 1,040 received at least one dose of study medication and 693 (66.7%) completed the study.

A total of 347 (33.3%) patients discontinued the study drug before completion of the trial; of these, 122 (35.2%) agreed to continue in the study off study drug. Of these latter 122 patients, 99 (81.1%) completed the study off study drug and six (4.9%) resumed study drug before week 52. Of those six patients, two subsequently discontinued before completion of the trial and four completed the trial.

The overall mean study drug compliance rate of 90.9% was comparable across treatment groups.</td></tr>
<tr><td>Adverse events</td><td>Relative to placebo, discontinuations due to total and drug-related clinical adverse experiences were higher in the taranabant groups with greater differences from placebo in the 1- and 2-mg</td></tr>
</table>

	groups. Treatment with taranabant 1 and 2 mg was associated with a significantly higher incidence of psychiatric-related adverse experiences (Psychiatric Disorder SOC plus irritability SOC) compared with placebo. Treatment with taranabant at all doses was associated with a statistically significant higher incidence of irritability compared with placebo. Taranabant 2 mg was associated with a statistically higher incidence of aggression and anger; however, numerically higher incidences of these adverse experiences were also reported in the 0.5 and 1-mg groups, compared with the placebo group. Taranabant 2 mg was also associated with a statistically higher incidence of diarrhoea, nausea, dizziness and flushing compared with placebo. There was one adverse experience of suicidal ideation in each of the taranabant groups and none in the placebo group. The frequencies of adjudicated suicidality were similar across the treatment groups.
Notes	All three doses of taranabant-induced clinically meaningful and statistically significant weight loss. Incidences of adverse experiences in organ systems known to express CB1R were higher in taranabant groups.

Provencher 2009

Characteristics of the study	
Study Citation	Provencher V, Begin C, Tremblay A, Mongeau L, Corneau L, Dodin S, Boivin S & Lemieux S 2009, 'Health-At-Every-Size and eating behaviors: 1-year follow-up results of a size acceptance intervention', J Am Diet Assoc, vol.109, no.11, pp.1854-61.
Study Design	RCT
Methods	
N (enrolled)	N = 144 participants

	Health-At-Every-Size (HAES) group (N = 48), social support (SS) group (N = 48), control group (N = 48) Study was conducted in Canada.
Inclusion criteria	Women with overweight or obesity (BMI between 25 and 35 kg/m^2), A stable body weight for at least two months (± 2.5 kg). All women were characterised by a preoccupation about their weight and eating: showing over concern with shape and weight, exhibiting restriction over food choices for at least two years, and having been previously unsuccessful in losing weight over the past two years.
Exclusion criteria	Women who were currently dieting to lose weight, taking oral contraceptives, pregnant or lactating, presenting metabolic or important psychological disorders, and under treatment for coronary heart disease, diabetes, dyslipidaemia, depression or endocrine disorders.
Intervention	A total 144 premenopausal women volunteered to participate in the research project and to be randomized into one of the three groups. The HAES intervention was conducted into small groups of 12 women during 14 weekly sessions (13 x 3-hour evening sessions and one intensive 1-day session lasting six hours). The interveners were active leaders, providing specific information and structured activities to participants. Led by a registered dietician and a clinical psychologist, the intervention was targeting general well-being and positive ways of having a healthful and satisfying lifestyle. The main goal was to enhance awareness and knowledge about biological, psychological, and sociocultural aspects of body weight. A complete workbook was given to each participant, so that she could be guided by the health professional through self-reflection and observations, group discussions, practical exercises, and lectures. Different topics were discussed during sessions (e.g. enjoyment of physical activity and healthful nutrition, recognition of internal cues of hunger and satiety, identification of external influences on

	eating behaviours and food intake, and acceptation of their own and others' body image). The SS intervention was conducted in small groups of 12 women during 14 weekly sessions (14 x 2-hour evening sessions). Topics from HAES groups were repeated in the SS groups. Health professionals were not active leaders in the SS intervention, rather facilitators of the group discussion and they never tried to influence the content and direction of the discussion. To control for potential bias related to providers, the same registered dietician and clinical psychologist involved in the HAES groups were also in charge of the SS groups. The main goal of the SS intervention was to reproduce the structural social support provided by the group itself, as it can be observed in a group setting. Women from the SS group did not receive any verbal nor printed information from the interveners.	
Comparison	The control group was a waiting-list control condition in which women were instructed to follow their usual lifestyle habits for the duration of the study. Over the study period, these women did not receive any form of contact from the research team, with the exception of post-treatment testing sessions, as performed in the HAES and SS groups. After the final testing session (16 months), women were invited to participate in the HAES intervention.	
Outcomes measured	Eating behaviours, appetite ratings, anthropometric and metabolic variables (BMI, waist and hip circumferences, blood lipid levels and blood pressure) and engagement in moderate to intense physical activity (energy cost ≥ 1.2 kcal X kg-1 X 15 minutes-1 [≥ 4.8 metabolic equivalents]).	
Duration of follow-up	Total duration of intervention and follow-up was 16 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% non-completion

Magnitude of effect rating**	Low	
Relevance of evidence rating***	Medium	
Results		
Participants	Women had a mean age of 42.3 ± 5.6 years.	
Overall findings	No energy restriction was identified in the HAES group. There were 63.4% of the HAES group who maintained a lower weight at 16 months when compared to baseline (mean BMI 30.1 ± 0.4 at baseline vs 29.5 ± 0.5 at 16 months; 2% difference from the initial weight) while lower weights at 16 months than at baseline were noted in 57.6% of women in the SS group and 43.7% of women in the control group (mean BMI 30.6 ± 0.4 at baseline vs 30.3 ± 0.5 at 16 months in the SS group; 1.0% difference in initial weight, and mean BMI 30.5 ± 0.4 at baseline vs 30.5 ± 0.5 at 16 months in the control group; 0.0% of differences in the initial weight).	
Compliance with treatment	Not stated	
Adverse events	Not stated	
Notes	Significant associations were observed between eating behaviour changes and body weight changes only in the HAES group.	

Reis 2010

Characteristics of the study	
Study Citation	Reis LO, Favaro WJ, Barreiro GC, de Oliveira LC, Chaim EA, Fregonesi A & Ferreira U 2010, 'Erectile dysfunction and hormonal imbalance in morbidly obese male is reversed after gastric bypass surgery: a prospective randomized controlled trial', Int J Androl, vol.33, no.5, pp.736-44.
Study Design	RCT
Methods	
N (enrolled)	N = 20 participants Intervention group (N = 10); Control group (N = 10). Study conducted in Brazil.
Inclusion criteria	Morbidly obese men undergoing evaluation and follow-up for gastric bypass at University of Campinas with a BMI > 40.
Exclusion criteria	Co-morbidities requiring regular drug usage (statin, antihypertensive, oral anti-diabetic), endocrine disease (except mild hypogonadism) or recent hormonal manipulation (thyroid / other hormonal reposition / lock in the last three months), testicular impairment, previous history of alcohol or tobacco abuse and phosphodiesterase type-5 inhibitor usage.
Intervention	The intervention included a weight loss plan with nutritional education for a low energy diet and intensive behaviour modification for daily physical activity guided by a multidisciplinary team of nutritionist, physical educator, psychologist and subsequent surgery (RYGB). The goals of intervention prior to surgery were: a reduction in intake of saturated fatty acid to less than 15% of energy consumed; an increase in intake of monounsaturated fatty acid to 15% or more of energy consumed; an

	increase in fibre intake to at least 20 g per 1000 kcal; and moderate exercise for at least 30 minutes/day for at least five days/week. Behavioural and psychological counselling was also offered. The dietary advice was tailored to each subject on the basis of 3-day food records. Each subject in the intervention group had weekly sessions with a nutritionist during the first year of the study and monthly thereafter.	
Comparison	The control group received general oral and written information about healthy food choices and general guidance on increasing their level of physical activity at baseline and at subsequent visits, but no specific individualised program was offered to them. Controls did not receive surgery.	
Outcomes measured	International Index of Erectile Function (IIEF)-5 questionnaire, serum oestradiol, prolactin (PRL), luteinizing (LH) and follicle-stimulating (FSH) hormones, free and total testosterone (FT and TT).	
Duration of follow-up	Duration of intervention including follow-up was 24 months	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	A	
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results		
Participants	The mean age of the patients at baseline was 39.3 years (±11.3); 36.7 years (±11.5) for the intervention group and 42.2 years (±11.0) for the control group. The mean weight and BMI were 168.6 (±28.2) and 55.7 (±7.8) (intervention) and 160.4 (±20.1) and 54.0 (±6.1) (control).	
Overall findings	Mean reduction in BMI in intervention versus control was 55.7 to 31.0 (intervention) and 54.0 to 52.3 (control).	

	Mean reduction in body weight was 169 to 95 kg (intervention) versus 160 to 155 kg (controls). IIEF5, total testosterone and free testosterone increased significantly in the intervention group (19.7 to 23.0; 3.4 to 7.0; and 10.0 to 12.7 respectively) but not in the control group (17.2 to 17.3; 3.4 to 2.9; and 14.4 to 8.4 respectively).
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	This study shows that gastric bypass-induced weight loss improves sex hormone profile and erectile function in morbidly obese men compared with non-surgical weight loss.

Ryan 2010

Characteristics of the study	
Study Citation	Ryan DH, Johnson WD, Myers VH, Prather TL, McGlone MM, Rood J, Brantley PJ, Bray GA, Gupta AK, Broussard AP, Barootes BG, Elkins BL, Gaudin DE, Savory RL, Brock RD, Datz G, Pothakamuri SR, McKnight GT, Sternlof K & Sjostrom LV 2010, 'Nonsurgical weight loss for extreme obesity in primary care settings: results of the Louisiana Obese Subjects Study', Arch Intern Med, vol.170, no.2, pp.146-54.
Study Design	RCT
Methods	
N (enrolled)	N = 390 participants Intensive medical intervention (IMI) (N = 200) and usual care condition (UCC) (N = 190) Study was conducted in the US.

Inclusion criteria	Participants aged 20 to 60 years who were also enrolled in programs of the Louisiana State Employees Group Benefits Office. Women were required to be non-pregnant and agree to avoid pregnancy during the study through use of approved contraception methods. Haematocrit level, white blood cell count and platelet count, and thyrotropin level within reference range and uric acid level lower than 9.0 mg/dL. A Duke Activity Status Index score of 25 or higher.
Exclusion criteria	Exclusions included: history of major depression, suicidal behaviour or eating disorder, hospitalisation for mental disorder or substance abuse in the previous year, active cancer, cardiovascular or cerebrovascular disease event in the past year, heart failure, and current use of weight loss medications. Participants with SBP 160 mmHg or higher or DBP 100 mmHg or higher averaged over the first two visits were excluded, unless they were treated and rescreened.
Intervention	The Louisiana Obese Subjects Study (LOSS) tested whether, with brief training, primary care practices (PCPs) could effectively implement weight loss for individuals with a BMI of 40 to 60 kg/m^2. The LOSS, a 2-year randomised, controlled, “pragmatic clinical trial” trained seven PCPs and one research clinic in obesity management. The IMI group recommendations included a 900-kcal liquid diet for ≤12 weeks, group behavioural counselling, structured diet, and choice of pharmacotherapy (sibutramine hydrochloride, orlistat, or diethylpropion hydrochloride) during months 3 to 7, and continued use of medications and maintenance strategies for months 8 to 24.
Comparison	The UCC group had instruction in an internet weight management program.
Outcomes measured	Primary outcome measure was year-2 percentage change from baseline weight. Weight was measured twice at every assessment. At every contact, weight was measured to

	monitor therapy but it was recorded only in the database for assessment visits. Height was measured at baseline. Blood pressure was obtained at every contact. Fasting blood samples for complete blood count and chemistry profile were obtained at baseline, year 1 and year 2. Serum electrolytes were measured every two weeks during phase 1.	
Duration of follow-up	Total duration of intervention and follow-up was 24 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% non-completion
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results		
Participants	Mean age of participants was 47 years. Participants were predominantly white (75%) and female (83%). There were 21% with known type 2 diabetes mellitus, 5.4% who were taking insulin, and 42% with fasting blood glucose levels of 100 mg/dL or higher at study start. There were no group differences in race, sex, age, BMI, and metabolic characteristics at baseline.	
Overall findings	Metabolic Health Outcomes for Completers in the Intensive Medical Interventions (IMI) group and Usual Care Condition (UCC) group at year 2.	

	IMI Group (n =10)	UCC Group (n =86)	P value
Weight loss (%)	-9.7 (1.3)	-0.4 (0.7)	<0.001
Weight loss, mean (SE), kg	-12.7 (1.7)	-0.5 (0.9)	<0.001
SBP, mean (SE), mmHg	-14.7 (2.4)	-8.6 (2.6)	0.09
DBP, mean (SE), mmHg	-4.4 (1.8)	-3.2 (1.5)	0.60
LDL-cholesterol (%)	1.8 (2.4)	0.7 (2.4)	0.73
HDL-cholesterol (%)	7.9 (1.8)	1.5 (1.8)	0.01
Triglycerides (%)	-9.2 (3.5)	-4.8 (4.3)	0.42

P values represent comparison between IMI and UCC groups for year 2.

Among 390 randomised participants, 31% in the IMI group achieved a 5% or more weight loss and 7% achieved a 20% weight loss or more, compared with 9% and 1% of those in the UCC group at 2 years.

A total of 101 IMI completers lost -9.7% ± 1.3% (-12.7 ± 1.7 kg), whereas 89 UCC completers lost -0.4% ± 0.7% (-0.5 ± 0.9 kg); (P < 0.001 for all group differences).

The mean HDL-cholesterol level increased at year 1 by 2.5 ± 0.8 mg/dL in the IMI completers group compared with -1.0 ± 0.9 mg/dL in the UCC group (P = 0.003). At year 2, those changes were 3.1 ± 0.9 mg/dL and -0.2 ± 0.8 mg/dL (P = 0.1). The percentage change in HDL-cholesterol was significant at both years.

There was a decrease in serum triglyceride level in the IMI group of -13.2% ± 4.1% at year 1 compared with increases of -1.6% ± 4.1% and 11.8% in the UCC group (P = 0.002), however the year 2 results for the IMI group were not significant compared with the results for the UCC group.

There were no significant group differences in mean values for blood pressure or LDL-cholesterol

	level at either time point.
Compliance with treatment	Not stated. Retention rates were 51% for the IMI group and 45% for the UCC group (P = 0.30).
Adverse events	There were no problems with electrolyte imbalance during the liquid diet. There were 20 serious adverse events reported in the IMI group and eight for the UCC group, but none was related to treatment. There was one death from a myocardial infarction in a 48-year-old male patient who had a history of hypertension, bipolar disorder, and asthma, who had lost 22.9 kg but was not taking sibutramine or other weight loss medication.
Notes	Primary care practices can initiate effective medical management for extreme obesity; future efforts must target improving retention and weight loss maintenance.

Savoye 2007

Characteristics of the study	
Study Citation	Savoye M, Shaw M, Dziura J, Tamborlane WV, Rose P, Guandalini C, Goldberg-Gell R, Burgert TS, Cali AM, Weiss R & Caprio S 2007, 'Effects of a weight management program on body composition and metabolic parameters in overweight children: a randomized controlled trial', JAMA, vol.297, no.24, pp.2697-704.
Study Design	RCT
Methods	
N (enrolled)	N = 209 participants Control group (N = 69), weight management group (N = 105), second randomisation within the weight

	management group (N = 35) Study was conducted in the US.
Inclusion criteria	Overweight children (BMI > 95th percentile for age and sex), ages eight to 16 years of mixed ethnic groups with English-speaking ability were recruited. Participants had to show an interest in the weight management program and have a caregiver (e.g. father, mother, or grandparent) who was willing to participate in the educational component of the program.
Exclusion criteria	Participants were excluded if they had diabetes, a psychiatric disorder (e.g. schizophrenia, severe autism or mental retardation, or psychosis), or other serious medical condition that would preclude participation in the program. Participants taking medications that potentially cause significant weight gain (e.g. risperidone, olanzapine, clozopine) were also excluded, as well as participants using medications for weight loss or involved in a coexisting weight management program.
Intervention	Participants randomised to the weight management group attended the program twice a week for six months and then every other week for an additional six months. During the first six months, the program consisted of exercise twice (50 minutes each) and nutrition / behaviour modification once (40 minutes each) per week. Participants and caregivers attended all classes, including nutrition-related topics, together, but behaviour modification classes for participants and caregivers were held separately. Participants were weighed every one to two weeks during the first six months and every two weeks for the last six months. Caregivers were also encouraged to be weighed. The behaviour modification component of the weight management program was facilitated by the registered dietitian or social worker. Topics were provided from the Smart Moves Work-book, a curriculum developed for over-weight children and used in our pilot study. Techniques included self-awareness, goal setting, stimulus control, coping skills training (CST), cognitive behaviour strategies, and contingency management. Behaviour modification classes for caregivers included topics that reflected the challenges parents verbalised. Coping skills training was the primary technique used as it has been used for the treatment of other chronic conditions, including diabetes. These classes emphasised the importance of the parents' role in modelling healthy behaviour change. A pilot study using CST with overweight parents of children in our weight management program showed positive outcome trends for parents when comparing those with and without CST.

	The exercise component of the weight management program was facilitated by exercise physiologists. Each class consisted of a warm-up, high-intensity aerobic exercise, and a cool-down. The main objective of the high-intensity exercise was to sustain 65% to 80% of the age-adjusted maximal heart rate for the duration of the exercise. To ensure this, a heart rate monitor was worn by all participants and Borg's Perceived Exertion Scale was used to monitor exertion. Participants were also encouraged to exercise three additional days at home per week and to decrease sedentary behaviours. The minimum activity that each participant completed was 100 minutes per week (two 50-minute sessions) for the first six months and 100 minutes twice per month for the last six months. Motivational tools were used to encourage regular attendance. The nutrition education component of the weight management program used a non-diet approach that emphasised low-fat, nutrient-dense foods of moderate portion sizes. The registered dieticians used the Smart Moves Workbook, which provided consistent structure for all class topics.	
Comparison	The control group received traditional clinical weight management counselling every six months. Participants randomised to the control group were guaranteed participation in the weight management program after completion of the 12-month randomised study period.	
Outcomes measured	Weight, BMI, body fat, homeostasis model assessment of insulin resistance (HOMA-IR) and blood pressure. Blood samples were obtained after a 10-hour overnight fast for measurement of plasma glucose, insulin, total cholesterol, HDL cholesterol, LDL cholesterol, and triglyceride levels.	
Duration of follow-up	Duration of intervention and follow-up was one year.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% non-completion
Magnitude of effect rating**	Medium	

<table>
<tr><td>Relevance of evidence rating***</td><td>High</td><td></td></tr>
<tr><td colspan="3">Results</td></tr>
<tr><td>Participants</td><td colspan="2">Participants in the weight management group had a mean (SD) age of 11.9 (2.5) years and a mean (SD) baseline BMI of 35.8 (7.6) kg/m^2 with 56.2% of the group being female. Participants in the control group had a mean (SD) age of 12.4 (2.3) years and a mean (SD) baseline BMI of 36.2 (6.2) kg/m2 with 68.1% of the group being female.</td></tr>
<tr><td>Overall findings</td><td colspan="2">Intervention vs. control changes were:
<table>
<tr><td></td><td>Intervention</td><td>Control</td></tr>
<tr><td>Weight (kg)</td><td>0.3 kg (-1.4 to 2.0)</td><td>7.7 kg (5.3 to 10.0)</td></tr>
<tr><td>BMI (kg/m^2)</td><td>-1.7 (-2.3 to -1.1)</td><td>1.6 (0.8 to 2.3)</td></tr>
<tr><td>Body fat (%)</td><td>-4.0 (-5.2 to -2.8)</td><td>2.0 (0.5 to 3.5)</td></tr>
<tr><td>SBP</td><td>-2.0 (-4.4 to 0.3)</td><td>-0.4 (-3.7 to 2.9)</td></tr>
<tr><td>DBP</td><td>1.4 (-0.8 to 3.6)</td><td>2.8 (-0.4 to 6.0)</td></tr>
<tr><td>Total cholesterol (mg/dl)</td><td>-9.2 (-14.8 to -3.5)</td><td>3.7 (-3.9 to 11.3)</td></tr>
<tr><td>HDL (mg/dl)</td><td>3.2 (1.3 to 5.2)</td><td>1.4 (-1.4 to 4.2)</td></tr>
<tr><td>LDL (mg/dl)</td><td>-2.4 (-6.9 to 2.2)</td><td>1.5 (-4.8 to 7.9)</td></tr>
<tr><td>Triglycerides (mg/dl)</td><td>-21.3 (-28.4 to -13.6)</td><td>-8.1 (-20.9 to 7.4)</td></tr>
<tr><td>Fasting glucose (mg/dl)</td><td>-3.4 (-5.2 to -1.8)</td><td>-1.8 (-4.3 to 0.8)</td></tr>
</table></td></tr>
</table>

Compliance with treatment	Not stated
Adverse events	Not stated
Notes	The intervention had beneficial effects on body composition and metabolic parameters in overweight children that were sustained up to 12 months.

Schmitz 2007

Characteristics of the study	
Study Citation	Schmitz KH, Hannan PJ, Stovitz SD, Bryan CJ, Warren M & Jensen MD 2007, 'Strength training and adiposity in premenopausal women: strong, healthy, and empowered study', Am J Clin Nutr, vol.86, no.3, pp.566-72.
Study Design	RCT
Methods	
N (enrolled)	N = 164 participants Treatment group (N = 82), control group (N = 82) Study was conducted in the US.
Inclusion criteria	Women aged 25 to 44 years inclusive, BMI of 25 to 35 kg/m^2 inclusive with stable body weight (< 10% change during the past year), Premenopausal status, Sedentary or only modestly physical active (three weekly sessions of moderate aerobic physical activity), and Non-smoker.

Exclusion criteria	Participation in a weight-loss program, physician-diagnosed menstrual irregularities or significant gynaecologic conditions, any positive response on the Physical Activity Readiness Questionnaire, history of strength training in the past six months, medical conditions or medications that could limit participation in the exercise program or affect study measurements, currently or recently pregnant, currently or recently lactating, uncontrolled hypertension, history of cancer within the past five years, or plans to be out of town for > 3 consecutive weeks during the study. The most common reason for ineligibility was body size outside the eligible range.
Intervention	Treatment group participants were provided with a 2-year membership to the Minneapolis Young Women's Christian Association fitness centres. The intervention started with 16 weeks of twice-weekly sessions supervised by certified fitness professionals (ratio of participants to trainers 6:1). During this supervised intervention, participants were taught stretches, warming up, cooling down, and abdominal and low back—strengthening exercises. The first circuit of strength-training exercises used isotonic variable resistance machines. Free-weight exercises were introduced over time. All weight-training circuits included 8-10 exercises to work the quadriceps, hamstring, gluteal, pectoral, erector spinae, latissimus dorsi, rhomboid, deltoid, biceps, and triceps muscles. By the end of the first month, the 1-hour sessions included three sets of 8-10 repetitions for each exercise. The weight lifted was progressively increased during year 1. During year 2, participants reduced the circuits to two sets per exercise and maintained the highest weight lifted for each exercise, resulting in a session length of 45 minutes. The behavioural aspects of the strength-training intervention were guided by social cognitive theory. Throughout the 2-year intervention, the fitness trainers made weekly reminder calls to participants who had not completed two sessions. Two hours of free childcare per session were provided. After the first 16 weeks, trainers led booster sessions every 12 weeks, during which new exercises were introduced. Otherwise, participants exercised unsupervised. The fitness trainers were available by phone or email and at the gym. Other intervention components included semi-annual social gatherings, a study website, and a monthly newsletter. Participants were asked to maintain whatever amount of aerobic activity they had been doing before study entry throughout the study period. Regardless of group assignment, participants were asked not to make any changes in their diets that might result in weight or fat gain or loss. Seasonal variations in their diets were expected and allowed. This message was communicated during recruitment, included in the consent document, and reiterated during measurement visits and

	strength-training sessions.	
Comparison	Women randomly assigned to the standard care comparison group were mailed American Heart Association brochures that recommended 30 minutes of moderate intensity activity on most days of the week, consistent with current public health recommendations. The advice in those brochures focused mostly on starting a walking program. The comparison group participants were not included in any of the social support components of the intervention or provided any exercise guidance beyond the two brochures.	
Outcomes measured	Assessments at baseline, one, and two years included; intra-abdominal fat by computed tomography scan and body fat and fat-free mass by dual-energy x-ray absorptiometry.	
Duration of follow-up	Total duration of intervention and follow-up was two years.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% non-completion
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	
Results		
Participants	Mean age ± SD of participants in the treatment group was 36 ± 5 years and 36 ± 6 years in the control group. The mean ± SD BMI of both groups was 29.4 ± 0.4 kg/m^2.	
Overall findings	During the two years, percentage body fat changes were -3.68 ± 0.99% for the treatment group and -0.14 ± 1.04% for the control group (P = 0.01). Significantly larger decreases in percentage body fat and attenuation of intrabdominal fat increases were noted during two years, with net treatment effects (changes in treatment group added to change in standard care group)	

	of -3.5% and -14.3%, respectively.
Compliance with treatment	Average adherence was 76% in year 1 and 61% in year 2, for an overall mean of 71% during the full two years. Adherence was lower in year 2 compared with year 1 (P < 0.0001).
Adverse events	Not stated
Notes	The results suggest that strength training is an efficacious intervention for preventing percentage body fat increases and attenuating intra-abdominal fat increases in overweight and obese premenopausal women. This is relevant to public health efforts for obesity prevention because most weight gain can be assumed to be fat, including abdominal fat.

Shea 2010

Characteristics of the study	
Study Citation	Shea MK, Houston DK, Nicklas BJ, Messier SP, Davis CC, Miller ME, Harris TB, Kitzman DW, Kennedy K & Kritchevsky SB 2010, 'The effect of randomization to weight loss on total mortality in older overweight and obese adults: the ADAPT Study', J Gerontol A Biol Sci Med Sci, vol.65, no.5, pp.519-25.
Study Design	RCT
Methods	
N (enrolled)	N = 318 participants Diet only intervention (N = 82), diet + exercise intervention (N = 77), exercise only intervention (N = 81) and control intervention (N = 78). Study was conducted in the US.

Inclusion criteria	Overweight and obese (mean BMI 34 kg/m^2) men and women aged 60 years and older with knee osteoarthritis (OA).	
Exclusion criteria	Study exclusion criteria included known CVD, severe hypertension, chronic obstructive pulmonary disease, and comorbidities that could limit mobility and participation in regular exercise.	
Intervention	The dietary weight loss intervention was divided into three phases for a period of 18 months: intensive (months 1-4, to increase awareness if the need for behaviour modification to change eating habits), transition (months 5-6, to set new goals in order to prevent relapse or to lose weight in participants who had not achieved weight loss goals), and maintenance (months 7-18, to maintain weight loss or provide additional support in participants who had difficulty losing weight). The goal of the dietary weight loss intervention was to lose 5% of baseline body weight for a period of 18 months. The exercise intervention consisted of three days/week of an aerobic exercise phase (15 minutes of walking within 50-75% of heart rate reserve), resistance training (15 minutes, included two sets of 12 reps of lower body strength training), a second aerobic phase (15 minutes), and a cool-down (15 minutes) for a period of 18 months. Participants in the dietary weight loss + exercise group followed both programs.	
Comparison	The healthy lifestyle control group attended three monthly health education programs on OA, obesity, and exercise for the first three months followed by monthly phone contact for months 4-6 and then bimonthly phone contact for months 7-18.	
Outcomes measured	Body weight, BMI, mortality.	
Duration of follow-up	The duration of the intervention was for 18 months, while there was an average of 8.0 years of follow-up.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	B	Randomisation stated but not described Blinding not mentioned

Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	Overall, the mean age was 69 ± 6 years, BMI was 34 ± 5 kg/m^2, 72% were female.	
Overall findings	Diet / exercise and diet only results were pooled and termed 'weight loss' group. Exercise only and control results were pooled and termed 'non-weight loss' group. The diet / exercise and diet group lost an average of 4.8 (SD 7.5) kg at 18 months compared with the exercise and control groups, which lost 1.4 (SD 5.1) kg at 18 months. There were 15 deaths in the diet / exercise and diet groups compared with 30 deaths in the exercise and control groups. The hazard ratio associated with intentional weight loss was 0.5 (95% CI, 0.3 to 1.0). Among older participants (aged > 67.1 years) those randomised to diet / exercise or diet had a lower mortality rate compared with those randomised to exercise or control (HR 0.4; 95% CI, 0.2 to 1.0). The total mortality rate of those who lost > 5% of their body weight was not different to those who lost < 5% of their body weight (HR 1.5; 95% CI, 0.4 to 5.5).	
Compliance with treatment	Not stated	
Adverse events	Not stated	
Notes	This analysis of a randomised controlled weight loss intervention study demonstrates that modest intentional weight loss in overweight older adults may reduce mortality risk over the long-term. Furthermore, the results suggest that the ability to determine intentionality of weight loss in observational studies may not be fully adequate to test the hypothesis about weight loss and mortality. Thus, recommendations based on observational studies should be made with caution.	

Silva 2010

Characteristics of the study	
Study Citation	Silva MN, Vieira PN, Coutinho SR, Minderico CS, Matos MG, Sardinha LB & Teixeira PJ 2010, 'Using self-determination theory to promote physical activity and weight control: a randomized controlled trial in women', J Behav Med, vol.33, no.2, pp.110-22.
Study Design	RCT
Methods	
N (enrolled)	N = 239 participants Autonomous forms of exercise regulation and intrinsic motivation (intervention) (N = 123), general health education program (control) (N = 116) Study was conducted in Portugal.
Inclusion criteria	The study was a university-based behavioural weight loss program, which recruited women: between 25 and 50 years old, premenopausal, not pregnant, with a BMI between 25 and 40 kg/m^2, who were willing to attend weekly meetings (during one year) and be tested regularly (during three years), who were free from major illnesses and not taking (or having taken in the previous year) medication known to interfere with body weight regulation, and who were willing to not participate in any other formal or informal weight loss program during the first year of the study (intervention group only).
Exclusion criteria	See above
Intervention	Participants entered the study in three annual cohorts and each cohort was split into two randomly-assigned groups. The 30 intervention sessions, designed to follow self-determination theory (SDT) basic tenets, covering physical activity (PA), eating / nutrition, body image, and other cognitive and behavioural contents, occurred weekly or bi-

	monthly and lasted about 120 minutes each. To create an autonomy-supportive environment, the intervention team attempted to promote in each participant a sense of ownership over their behaviour such that it would stem from an internal perceived locus of causality. This involved: • building sustainable knowledge that supported informed choices, by using neutral language during interpersonal communication; • encouraging choice and self- initiation; the use of prescriptions, pressure, demands, and extrinsic rewards were minimal if not absent; • providing participants with a menu of options and a variety of avenues for behaviour change; • supporting the presentation of tasks and choices with a clear rational to adopt a specific behaviour by presenting clear contingencies between behaviour and outcome; • encouraging participants to build and explore congruence between their values and goals, and their lifestyles and • giving informational positive feedback, acknowledging that the feeling of competence grows from feedback inherent to the task. Regarding structure, the intervention implementation was generally developed in ‘‘modules’’ which were introduced sequentially but with substantial overlap. The initial emphasis of the program focused on triggering weight loss, which was achieved primarily by reducing energy intake. Accordingly, Modules I (increasing knowledge) and II (triggering weight loss, improving diet) were focused on understanding energy balance and principles of gaining / losing weight, nutrition education, and establishing eating patterns more likely to help weight loss. Module III (adopting and increasing PA) was introduced by about week 10 and aimed at establishing a more active lifestyle. First the authors addressed issues related to safety and skills, setting and managing PA goals, monitoring PA, and dealing with barriers to practice, in order to promote feelings of competence. Furthermore, their approach was to provide options and let people make their own decisions, encouraging participants to find the activities they enjoyed the most and were thus most likely to retain for the future. Dance classes and an activity challenge program were also developed to prompt fun, enjoyment, reaching new goals, and experimenting new activities. Module IV (addressing barriers, promoting self-regulation, developing autonomy) focused on identifying and addressing problem areas and difficulties related to the psychological (attitudinal, motivational) and behavioural changes expected to occur during the program. Critical areas addressed were emotional eating, exercise intrinsic

	motivation, and adequate goals for weight loss. In Module V (improving body image), participants' concerns about their body shape were systematically addressed, with the goal of promoting greater self-acceptance and establishing more realistic goals for one's weight / body. The main emphasis of Module VI (preparing weight maintenance) was on helping patients acquire the strategies and skills needed for long-term weight control, such as regular monitoring of weight, adoption of flexible guide-lines regarding eating instead of rigid dietary rules, and especially establishing a more physically active lifestyle both through formal and informal exercise.	
Comparison	Experimental groups received an equivalent amount of face-to-face contact with treatment providers (29 sessions in the control group, 30 sessions in the intervention group). The 29 sessions in the control group were delivered grouped into ''thematic courses'' such as healthy / preventive nutrition, stress management, self-care, and effective communication skills. The interpersonal climate promoted in this condition was similar to that commonly observed in standard health care settings: choices, rationale, and explanations were limited; specific behavioural goals were not set; minimal feedback was provided.	
Outcomes measured	Laboratory-measured body weight and body composition, assessed at baseline, four and 12 months (end of the intervention program), self-reported physical activity (assessed at baseline, and 12 months), and general (assessed at baseline and 12 months) and exercise (assessed at four and 12 months) SDT-relevant psychological variables. All weight-related measurements were performed in the morning, after fasting for three hours. BMI was calculated using height and weight measurements.	
Duration of follow-up	The trial consisted of a 1-year behavior change intervention and a 2-year follow-up period with no intervention.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	B	> 15% non-completion in controls, No blinding

Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	Women with a mean age of 37.6 ± 7.1 years. Participants had a mean BMI of 31.5 ± 4.1 kg/m^2.	
Overall findings	At 12 months, the intervention group showed increased weight loss (-7.29%) and higher levels of physical activity / exercise (+138 ± 26 minutes/day of moderate plus vigorous exercise; +2,049 ± 571 steps/day), compared to controls (P < 0.001). The intervention group lost 5.6 ± 4.1 kg of fat mass (vs -1.5 ± 4.3 kg in the control group, P < 0.001 for between-group difference) and showed -1.1 ± 1.8 kg of change in lean mass (vs -0.2 ± 1.6 kg, P < 0.001). Percent body fat changed by -6.9 ± 7.9% in the intervention group (vs -2.5 ± 7.5%, P < 0.001). BMI also differed significantly (P < 0.001) between the two groups: -2.3 ± 1.9 kg/m^2 for intervention and 0.7 ± 1.9 kg/m^2 for controls.	
Compliance with treatment	Adherence to the weekly or bi-weekly scheduled intervention sessions (mean 87.2 ± 12.9%, median 90.5%) was also considered.	
Adverse events	Not stated	
Notes	Results suggest that interventions grounded in SDT can be successfully implemented in the context of weight management, enhancing the internalisation of more autonomous forms of behavioural regulation, and facilitating exercise adherence, while producing clinically-significant weight reduction, when compared to a control condition.	

Smith 2010

Characteristics of the study	
Study Citation	Smith SR, Weissman NJ, Anderson CM, Sanchez M, Chuang E, Stubbe S, Bays H & Shanahan WR 2010, 'Multicenter, placebo-controlled trial of lorcaserin for weight management', N Engl J Med, vol.363, no.3, pp.245-56.
Study Design	RCT
Methods	
N (enrolled)	N = 3,182 participants Lorcaserin drug intervention (N = 1,595) and placebo (control) (N = 1,587) Study conducted in the US.
Inclusion criteria	Participants 18 to 65 years of age. BMI 30 to 45 kg/m^2 or 27 to 45 kg/m^2 with at least one coexisting condition (hypertension, dyslipidaemia, CVD, impaired glucose tolerance or sleep apnoea).
Exclusion criteria	Moderate or more severe mitral regurgitation or mild or more severe aortic regurgitation (i.e. valvulopathy), diabetes mellitus, SBP exceeding 140 mmHg or DBP exceeding 90 mmHg, depression or other major psychiatric disease within two years before randomisation that necessitated treatment with prescription medication, and pregnancy or lactation.
Intervention	This study was conducted at 98 academic and private trial sites. For year 1, on study day 1, patients were randomly assigned, in a 1:1 ratio, to receive lorcaserin (at a dose of 10 mg) or placebo twice daily. All patients who remained in the trial at the end of year 1 were eligible to continue in the study for a second year. For year 2, patients who had been receiving placebo continued to receive it, whereas patients who had been receiving lorcaserin were again randomly assigned, in a 2:1 ratio, either to continue to receive lorcaserin or to begin

	to receive placebo. All participants received behavioural support.	
Comparison	Described above.	
Outcomes measured	The pre-specified co-primary end points for year 1 were the proportion of patients with a reduction in baseline body weight of ≥ 5% at the end of year 1, the change in weight between baseline and the end of year 1, and the proportion of patients with a reduction in the baseline body weight of ≥ 10% at the end of year 1. The primary end point for year 2 was the proportion of patients who had had a reduction in the baseline body weight of ≥ 5% at the end of year 1 and who maintained this reduction during year 2. Key secondary end points included: changes from the baseline values for lipids (total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides), glycaemic variables (fasting glucose, fasting insulin, HbA1c and the homeostasis model assessment of insulin resistance), physical measures (waist circumference, BMI, SBP and DBP), inflammatory markers of cardiovascular risk (high-sensitivity C-reactive protein and fibrinogen). Serial echocardiography was used to identify patients in whom valvulopathy developed.	
Duration of follow-up	Duration of intervention and follow-up was two years.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% non-completion
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	

<table>
<tr><th colspan="2">Results</th></tr>
<tr><td>Participants</td><td>The two groups had similar baseline characteristics;
- 82.9% of the intervention group and 84.0% of the control group was female,
- 67.9% of the intervention group and 66.0% of the control group were white.
- mean ± SD age of the intervention group was 43.8 ± 0.3 years and 44.4 ± 0.3 years for the control group.
- mean ± SD BMI for the intervention group was 36.2 ± 0.1 kg/m^2 and 36.2 ± 0.1 kg/m^2 for the control group.</td></tr>
<tr><td>Overall findings</td><td>Changes in efficacy and safety end points between baseline and year 1:
<table>
<tr><td>End point</td><td colspan="3">Intention-to-treat Analysis with LOCF Imputation</td><td colspan="3">Repeated-Measures Analysis</td></tr>
<tr><td></td><td>Lorcaserin
(N =1538)</td><td>Placebo
(N =1499)</td><td>P value</td><td>Lorcaserin
(N =1538)</td><td>Placebo
(N =1499)</td><td>P value</td></tr>
<tr><td>Coprimary end points</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Weight change (kg)</td><td>-5.8±0.2</td><td>-2.2±0.1</td><td><0.001</td><td>-7.2±0.1</td><td>-2.9±0.1</td><td><0.001</td></tr>
<tr><td>Key secondary end points</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Waist circumference (cm)</td><td>-6.8±0.2</td><td>-3.9±0.2</td><td><0.001</td><td>-8.1±0.2</td><td>-4.3±0.2</td><td><0.001</td></tr>
<tr><td>BMI (kg/m^2)</td><td>-2.09± 0.06</td><td>-0.78± 0.05</td><td><0.001</td><td>-2.61± 0.04</td><td>-1.01± 0.04</td><td><0.001</td></tr>
<tr><td>SBP (mmHg)</td><td>-1.4±0.3</td><td>-0.8±0.3</td><td>0.04</td><td>-1.5±0.3</td><td>-0.7±0.4</td><td>0.10</td></tr>
<tr><td>DBP (mmHg)</td><td>-1.1±0.2</td><td>-0.6±0.2</td><td>0.01</td><td>-1.3±0.3</td><td>-0.6±0.3</td><td>0.055</td></tr>
<tr><td>Total cholesterol (%)</td><td>-0.90± 0.33</td><td>0.57± 0.34</td><td>0.001</td><td>-1.37± 0.39</td><td>0.57± 0.43</td><td>0.001</td></tr>
</table></td></tr>
</table>

LDL-cholesterol (%)	2.87±0.56	4.03±0.58	0.049	4.10± 0.64	5.90±0.70	0.04
HDL-cholesterol (%)	0.05±0.33	-0.21±0.34	0.72	-0.93± 0.40	-1.90± 0.43	0.08
Triglycerides (%)	-6.15± 1.03	-0.14± 0.99	<0.001	-9.58± 1.15	-1.82± 1.26	<0.001
Coprimary end points in per-protocol population						
Weight change (kg)	-8.1±0.3	-3.3±0.3	<0.001			

Plus-minus values are means ± SE.

At one year, 55.4% of patients (883 of 1595) receiving lorcaserin and 45.1% of patients (716 of 1587) receiving placebo remained in the trial; 1553 patients continued into year 2.

At one year, 47.5% of patients in the lorcaserin group and 20.3% in the placebo group had lost 5% or more of their body weight ($P < 0.001$), corresponding to an average loss of 5.8 ± 0.2 kg with lorcaserin and 2.2 ± 0.1 kg with placebo during year 1 ($P < 0.001$).

Among the patients who received lorcaserin during year 1 and who had lost 5% or more of their baseline weight at one year, the loss was maintained in more patients who continued to receive lorcaserin during year 2 (67.9%) than in patients who received placebo during year 2 (50.3%, $P < 0.001$).

Lorcaserin was associated with significant decreases in waist circumference and BMI during year 1 as compared with placebo.

Total cholesterol, LDL cholesterol and triglyceride levels at year 1 were significantly lower in the lorcaserin group than in the placebo group but had increased by year 2 in both groups. In patients who received lorcaserin during year 1 and placebo during year 2, levels of total cholesterol, LDL cholesterol and triglycerides tended to increase to the levels seen in the placebo group by year 2.

Among 2472 patients evaluated at one year and 1127 evaluated at two years, the rate of cardiac valvulopathy was not increased with the use of lorcaserin.

Compliance with treatment	Not stated. The rate of discontinuation at one year was nearly 50%.
Adverse events	Upper respiratory infections, headache, dizziness, nasopharyngitis, and nausea were the most common adverse events in the lorcaserin group. Differences in the frequency of headache and dizziness between the lorcaserin group and the placebo group were less evident in year 2 than in year 1 and were not explained by different rates of discontinuation between the two groups owing to these adverse events. The incidence of depression, depressive symptoms, or depressed mood was 2.5% in the lorcaserin group and 2.2% in the placebo group during year 1; during year 2, the rates were 3.0% with lorcaserin given in both years, 2.0% with placebo given in both years, and 2.8% with placebo given in year 2 after lorcaserin had been given in year 1. The incidence of suicidal thoughts, according to one item on the Beck Depression Inventory II questionnaire, was 1.3% in each group. The rates of serious adverse events were similar among the three year-2 study groups. One patient in the placebo group died from injuries sustained in a motor vehicle accident; no other deaths occurred. At year 1, valvulopathy had developed in 2.3% of patients in the placebo group and 2.7% of patients in the lorcaserin group (P = 0.70) (relative risk with lorcaserin, 1.1; 95% CI, 0.69 to 1.85). At year 2, the rate of valvulopathy was 2.7% in the placebo group and 2.6% among patients who received lorcaserin during year 1 and year 2. Changes in valvular insufficiency scores for the mitral and aortic valves did not differ significantly among the study groups during the trial. No severe mitral or aortic insufficiency was reported; one patient in the placebo group reported moderate aortic regurgitation. Intra-reader consistency, evaluated with the use of blinded, standardised echocardiograms, was 79% for the mitral valve and 76% for the aortic valve. Inter-reader consistency, estimated by comparing each reader's interpretation against the mode, was 71% for the mitral valve and 73% for the aortic valve. These results are similar to those for echocardiographic studies involving a smaller number of readers. The study groups did not differ significantly in the change in mean pulmonary-artery SBP, as estimated by means of Doppler f low, between baseline and one year or between year 1 and year 2.
Notes	Lorcaserin used in conjunction with behavioural modification was associated with significant weight loss and improved maintenance of weight loss, compared with placebo. Lorcaserin was also associated with improved values for biomarkers that may be predictors of future cardiovascular events, including lipid levels, insulin resistance, levels of inflammatory markers, and blood pressure.

Stahre 2007

Characteristics of the study	
Study Citation	Stahre L, Tarnell B, Hakanson CE & Hallstrom T 2007, 'A randomized controlled trial of two weight-reducing short-term group treatment programs for obesity with an 18-month follow-up', Int J Behav Med, vol.14, no.1, pp.48-55.
Study Design	RCT
Methods	
N (enrolled)	N = 54 participants Cognitive treatment group (N = 16), and weight-reducing program with moderate-intensity physical activity and behavioral techniques (control treatment group) (N = 26) Study was conducted in Sweden.
Inclusion criteria	A total of 97 obese women (i.e. BMI ≥ 30 kg/m^2) were initially recruited into a health program within the occupational health services. All participants received oral and written information about dieting, exercise and the health outcomes of weight reduction. Two years later those who were still employed (N = 94) and still had a BMI of 30 kg/m^2 or higher were asked to participate in a RCT involving two weight-reducing programs. Of the 94 eligible women, 54 voluntarily agreed to participate.
Exclusion criteria	No exclusion criteria were imposed.
Intervention	Each program consisted of 20 hours divided into 10 lessons, with each lesson given once a week (i.e. the programs extended over a 10-week period). The purpose of the cognitive program was to inform the participants about probable causes of their dysfunctional eating behaviour, as well as provide them with information that could be useful in changing and controlling such eating behaviour. Special attention was given to deficiencies in self-control, low self-esteem, and experiences of

	stress. Participants were assigned homework at the end of each intervention session. The intervention was done by a social worker with special competence in cognitive therapy (CT). The embedded nutrition program was a traditional weight-reduction program with 1200 to 1300 kcal/day. The program included elements from cognitive psychotherapy and psychoeducation. Each lesson was structured and arranged into four blocks: A, B, C, and D. Block A used a special questionnaire manual, which consisted of questions about situations that, in different ways, influenced the participants' eating behaviour during the week. These questions, administered to the participants in the beginning of each lesson, had a central role in the treatment of weight problems. Block B lesson concerned group discussion and participant analysis of the previous lesson's homework. Block C lesson contained its own theme that supplied information from the field of cognitive psychology by first providing facts and then by encouraging discussions among the participants. Each theme consisted of both theory and concrete examples that illustrated the theory. The various themes were cumulative in the sense that each lesson furnished new information to the earlier themes. The content of all the themes was related to eating behaviour. The lesson themes included the following, among others: how assumptions develop and how basic rules of life can be formed that have meaning regarding the way one conducts oneself in private life, in work, and especially in eating behaviour; self-image, self-confidence, and eating behaviour; associations between thinking, feelings, and eating behaviour (the cognitive triangle); functional and dysfunctional thought patterns; control and helplessness; positive and negative stress; the importance of being able to draw one's own boundaries and its significance for eating behaviour. Block D's homework aim was that patients should examine and apply the content of each lecture's theme in relation to their daily life activities regarding their eating behaviour.
Comparison	The control program aimed to achieve behavioural changes in the realm of dieting, stress management, and physical training. The program was performed by the municipality's occupational doctor, occupational nurse, occupational physiotherapist and external people representing diverse areas of expertise. The program consisted of lectures, group discussions, and practical demonstrations so that the participants received both theoretical information and a practical understanding of issues.

	Lesson themes included the following: women's health and lifestyle; how weight reduction can be attained; information on dieting; principles of dieting; practical exercises and information about food; applied knowledge about food; practical training; computers as an aid in eating well and achieving nutritional goals; applied training; the importance of being cognizant of one's body; relaxation techniques and how to deal with stress; the importance of physical training; strength training; instruction and practical exercises.	
Outcomes measured	Weight change at 18 months post-treatment was predefined as the primary outcome variable. All participants were weighed immediately after the termination of the 10-week treatment programs and again at six, 12, and 18 months after the end of treatment. All participants responded to 20 questions or statements about cognition, eating, and obesity, with 10 questions in each program covering central aspects of the knowledge each program sought to convey.	
Duration of follow-up	Both treatment programs lasted for 10 weeks (two hours/week), and thereafter the participants were weighed periodically over an 18-month follow-up period.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% non-completion
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	The mean age for those that began the two programs was 48.5 years, and the mean BMI was 36.6 kg/m^2. Mean weight at baseline for those who participated in the 18-month follow-up was 95.1 ± 11.5 kg in the cognitive group and 91.5 ± 34.1 in the control group.	

Overall findings	Eighteen months after the end of therapy, the mean weight loss was 5.5 kg (SD = 5.5) in the cognitive group, whereas the control group evidenced a weight loss of 0.6 kg (SD = 5.5). The weight change differences between the two groups were highly significant at all follow-up weighings (P < 0.001). The mean weight loss immediately after therapy was 8.6 ± 2.9 in the cognitive group and 0.7 ± 1.2 in the control group.
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	The cognitive group scored much higher than did the control group on knowledge relevant to cognitive treatment of obesity (P < 0.001) but somewhat lower on knowledge of nutrition and physical activity.

Svendsen 2009

Characteristics of the study	
Study Citation	Svendsen M, Helgeland M & Tonstad S 2009, 'The long-term influence of orlistat on dietary intake in obese subjects with components of metabolic syndrome', J Hum Nutr Diet, vol.22, no.1, pp.55-63.
Study Design	RCT
Methods	
N (enrolled)	N = 44 participants Orlistat (N = 23), placebo (N = 21). Study was conducted in Norway.

Inclusion criteria	Participants comprised men and women, aged 18 to 63 years with a BMI > 30 kg/m^2 and metabolic syndrome. Study was the Scandinavian Multicenter study of Obese subjects with the metabolic syndrome (SMOMS). Participants were eligible for the trial if they met the following criteria for metabolic syndrome: abdominal obesity (waist circumference > 92 cm for females and > 102 cm for males) and at least one or more metabolic risk factors, including an impaired fasting glucose (> 6.1 mmol/L and < 7.1 mmol/L) or diet treated type 2 diabetes and / or dyslipidaemia (HDL-cholesterol < 1.1 mmol/L for females and 0.9 mmol/L for males) and / or triglycerides > 2.0 mmol/L.
Exclusion criteria	Participants were excluded if they had clinically relevant conditions that might affect the outcome of the trial.
Intervention	After the screening visit, all participants initiated a VLED (3.4 MJ [800 kcal] /day) for eight weeks. Immediately following the VLED, participants were randomised to orlistat 120 mg three times/day or to matching placebo three times/day for three years. Participants were scheduled to attend 24 clinical visits during the first 18 months and every third month during the next 18 months for a total of 30 visits. At every visit, the participants met with a registered dietitian. For the first 18 months, the dietary behaviour program consisted of scheduled group sessions for four to six participants. Individual sessions were offered only when participants were unable to attend the scheduled visits. For the last 18 months of the study, only individual sessions were offered. Each of the individual and group sessions lasted for approximately 30 minutes. During the dietary and behavioural treatment program, the participants were instructed to follow a diet consisting of < 30% of energy from fat and to decrease the intake of saturated fat to < 10% of energy at the same time as allowing for a small amount of unsaturated fat from fatty fish and plant sources. The participants were to increase the intake of fibre from vegetables, legumes, fruits and whole meal bread, to choose low fat dairy products and lean meat or chicken instead of minced meat and sausages, and to reduce the intake of cakes / biscuits, ice cream, chocolate, sugar containing beverages and alcohol to achieve an energy deficit of 2.5 MJ (600 kcal) /day giving the possibility for further weight reduction when the participants were highly motivated. Subsequently, the participants increased the energy intake. In the group sessions, exhibitions were used to illustrate the amount of fat in foods. Participants were taught to read food labels, make a plan for mealtimes and plan menus. Participants were instructed to use a plate model for hot

	meals and advised to fill one-half of the plate with vegetables, one-fourth with potatoes, rice or pasta and one-fourth with meat, chicken, fish and / or legumes. The plate model was especially recommended at occasions such as eating with friends, at parties and at restaurants. The participants were given exercises to assess eating behaviour and to plan specific strategies to avoid. The behavioural program otherwise included features such as goal setting, stimulus control and cognitive restructuring.	
Comparison	Lifestyle intervention and placebo	
Outcomes measured	Participant's weight, height, blood pressure, waist circumference and hip circumference. Fasting blood samples were collected for serum total cholesterol, HDL cholesterol, triglycerides and glucose at baseline.	
Duration of follow-up	1 year.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	B	Blinding not done Randomisation not described
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	The participants had a mean BMI of 37.5 ± 4.3 kg/m^2, with the mean age of the orlistat group being 49.1 (8.2) years and the placebo group 46.6 (10.9) years. The male/female participant ratio for the orlistat group was 11/12 and 10/11 in the placebo group.	
Overall findings	Overall weight reduction was 7.2 kg (SD 8.1) in the orlistat group and 3.9 kg (SD 7.4) in the placebo group. At one year, dietary intake did not differ between the orlistat and placebo group. Energy percent (E%) fat was	

	reduced and E% carbohydrate was increased within both groups.
Compliance with treatment	The tablet counting showed that one subject in the placebo group and one subject in the orlistat group reported less than 60% compliance with the study drug.
Adverse events	Sixteen participants (16/21) in the placebo group and 20 (20/23) in the orlistat group (P = 0.4) reported adverse events possibly or probably related to the drug once or more during the trial. Both groups reported abdominal pain, increased defecation, decreased defecation, soft stool, liquid stool, faecal urgency and flatulence. Participants in the placebo group were the only ones that reported nausea and faecal incontinency, whereas participants in the orlistat group were the only ones that reported frequent stool, vomiting, fatty evacuation and oily spotting.
Notes	Participants taking orlistat experienced greater weight losses but did not have a lower fat intake compared to placebo.

Svetkey 2008

Characteristics of the study	
Study Citation	Svetkey LP, Stevens VJ, Brantley PJ, Appel LJ, Hollis JF, Loria CM, Vollmer WM, Gullion CM, Funk K, Smith P, Samuel-Hodge C, Myers V, Lien LF, Laferriere D, Kennedy B, Jerome GJ, Heinith F, Harsha DW, Evans P, Erlinger TP, Dalcin AT, Coughlin J, Charleston J, Champagne CM, Bauck A, Ard JD & Aicher K 2008, 'Comparison of strategies for sustaining weight loss: the weight loss maintenance randomized controlled trial', JAMA, vol.299, no.10, pp.1139-48.
Study Design	RCT
Methods	
N (enrolled)	N = 1,032 participants

	Self-directed (N = 342), Internet (interactive) technology (N = 348), Personal contact (N = 342) Study was conducted in the US.
Inclusion criteria	Participants were enrolled in two phases of the clinical trial: phase 1 was a 6-month non-randomised initial weight loss intervention for all participants; phase 2 was a randomised 30-month trial comparing two weight-maintenance strategies (personal contact and interactive technology) vs. a self-directed control condition. To be included into phase 1 of the study, participants were required to have a BMI of between 25 and 45 kg/m^2; to be taking medication for hypertension, dyslipidaemia, or both; to have no active CVD (those with a positive Rose angina questionnaire or a CVD event no less than 12 months before study entry and a negative stress test result could join the study with permission from their physician); access to a telephone and to the internet; and to keep a food diary for 5 days during the screening. Inclusion criteria for phase 2 was overweight or obese adults with hypertension, dyslipidaemia, or both who had lost at least 4 kg during a 6-month weight loss program (phase 1).
Exclusion criteria	Major exclusion criteria for phase 1 were medication-treated diabetes mellitus, a recent cardiovascular event or other medical or psychiatric conditions that would preclude full participation in the study, weight loss of more than 9 kg in the last three months, recent use of weight loss medications, or prior weight loss surgery.
Intervention	After the phase 1 weight-loss program, participants were randomised to one of the following groups for 30 months: monthly personal contact, unlimited access to an interactive technology-based intervention, or self-directed control. Initial Weight Loss Intervention The phase 1 intervention was a group-based behavioural intervention. A trained interventionist led 20 weekly group sessions over approximately six months. Intervention goals were for participants to reach 180 minutes per week of moderate physical activity (typically walking); reduce caloric intake; adopt the Dietary Approaches to Stop Hypertension dietary pattern, which has been shown to reduce CVD risk factors; and lose approximately 1 to 2 lb per week. Participants were taught to keep food and physical activity self-monitoring records and to calculate caloric intake. Maintenance Interventions Participants included in the study's second phase were randomly assigned to three groups: a self-directed

	comparison condition in which participants received minimal intervention, an interactive technology-based intervention in which participants were encouraged to regularly log on to an interactive website; and a personal-contact intervention in which participants had monthly individual contact with an interventionist. The goals of the interactive technology-based and personal-contact interventions were maintenance of the phase 1 weight loss or loss of additional weight if desired, continued adherence to the recommended dietary pattern, and increasing moderate physical activity to at least 225 minutes per week. Both personal-contact and interactive technology-based interventions reinforced the key theoretical constructs (motivation, support, problem solving, and relapse prevention) that had been incorporated in phase 1. In addition, both active interventions incorporated features found to be associated with maintenance of behaviour change in previous studies, such as continual intervention contacts, self- monitoring, accountability, prolonged continuous contact, and motivational interviewing. The counselling strategies and dietary and physical activity recommendations were the same in the personal-contact and interactive technology-based groups. Both maintenance interventions were designed to be easily disseminated and practical to implement. The interactive technology-based intervention included unlimited access to a website designed to support weight loss maintenance. Interactive features allowed participants to set personal goals and action plans for the next week and to graph personal data over time. Modules addressed problem solving and motivation, and a bulletin board facilitated social support but did not provide in-person counselling. When participants logged on, they were required to enter their current weight and were encouraged to use the website for self-monitoring of physical activity and caloric intake. Participants were encouraged to log on at least once a week. If they missed a self-scheduled contact, they were sent an email reminder that was repeated after another week of no contact. If there was no response to two email prompts, participants received two weekly automated telephone calls. If there was no subsequent log-on, study staff contacted the participant and encouraged him/her to return to the website. The personal-contact intervention consisted of a case management approach with monthly person-to-person guidance and support. Participants had telephone contact with an interventionist for 5-15 minutes each month, except for every 4th month when they had a 45- to 60-minute individual face-to- face contact. This frequency of contact was based on previous trials and on disease management programs and is consistent with recommendations of the Medicare Medical Nutrition Therapy Amendment Act of 2001. The personal-contact intervention did not involve internet contacts. Each personal-contact session began with a self-reported weight (or measured weight at face-to-face contacts) and

	a review of progress since the last contact, including number of days on which a food diary was kept, frequency of weighing, average number of minutes of exercise, and progress on additional goals and action plans. Each contact provided support from the interventionist, accountability for commitments made at the previous contact, and opportunities to discuss the individual's barriers to weight loss maintenance and plans to overcome those barriers.	
Comparison	At randomisation, participants in the self-directed group received printed lifestyle guidelines with diet and physical activity recommendations, and they met briefly with a study interventionist again after the 12-month data collection visit.	
Outcomes measured	The primary outcomes measured were changes in weight from randomisation which required weight and height measures. Dietary intake and physical activity were measured at entry, randomisation, and the 12- and 30-month follow-up visits. Diet was assessed by the Block food frequency questionnaire. Physical activity was measured by accelerometry. Participants were asked to wear a calibrated, triaxial accelerometer for at least 10 hours per day for at least four days, including 1 weekend day. Accelerometry results that comprised at least one week day and one weekend day were used to estimate total weekly minutes of moderate to vigorous physical activity (MVPA). Total MVPA reflects both leisure time exercise and daily activity patterns (such as climbing stairs) and thus provides a measure of total MVPA-related energy expenditure.	
Duration of follow-up	Duration of follow-up was for 30 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% of participants did not enter phase 2. Blinding not specified
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	

Results	
Participants	Participants included 38% African Americans, 63% women and they had a mean age of 55.6 years (range, 28 to 83 years). Mean entry weight was 96.7 kg.
Overall findings	During the initial 6-month program, mean weight loss was 8.5 kg (range 4.0 to 30.3 kg). After randomisation into phase 2, weight regain occurred. Participants in the personal-contact group regained less weight (4.0 kg) than those in the self-directed group (5.5 kg; mean difference at 30 months, -1.5 kg; 95% CI, -2.4 to -0.6). At 30 months, weight regain did not differ between the interactive technology-based (5.2 kg) and self-directed groups (5.5 kg; mean difference -0.3 kg; 95% CI, -1.2 to 0.6 kg; P = 0.51); however, weight regain was lower in the interactive technology-based than in the self-directed group at 18 months (mean difference, -1.1 kg; 95% CI, -1.9 to -0.4 kg; P = 0.003) and at 24 months (mean difference, -0.9 kg; 95% CI, -1.7 to -0.02 kg; P = 0.04).
Compliance with treatment	Rates of compliance are described as being high. No details are given.
Adverse events	Not stated
Notes	The majority of individuals who successfully completed an initial 6-month behavioural weight loss program maintained weight below their entry level after 30 additional months. Monthly brief personal-contact sessions provided modest benefit in sustaining weight loss, whereas an internet-based intervention provided early but transient benefit.

Teixeira 2010

Characteristics of the study	
Study Citation	Teixeira PJ, Silva MN, Coutinho SR, Palmeira AL, Mata J, Vieira PN, Carraca EV, Santos TC & Sardinha LB 2010, 'Mediators of weight loss and weight loss maintenance in middle-aged women', Obesity (Silver Spring), vol.18, no.4, pp.725-35.
Study Design	RCT
Methods	
N (enrolled)	N = 225 participants Intervention group (N = 106) and control group (N = 88) Study was conducted in Portugal.
Inclusion criteria	Participants had to be female, between 25 to 50 years old, BMI between 25 and 40 kg/m^2, willing to attend weekly meetings (during one year), free from major illnesses and not taking medications known to interfere with body weight regulation.
Exclusion criteria	Commencement of medication susceptible to affect weight, have a serious chronic disease diagnosis or severe illness / injury, pregnancy, and menopause.
Intervention	The study was a RCT consisting of a 1-year behaviour change intervention and a 1-year follow-up period with no intervention. Participants entered the study in three annual cohorts; each cohort was split into two randomly assigned groups, intervention and control. The intervention group attended 30 group sessions over the first year. Primary targets of the intervention included increasing physical activity and energy expenditure, adopting a diet

	consistent with a moderate energy deficit, and ultimately establishing exercise and eating patterns that would support weight maintenance. Cognitive and behavioural aspects such as identifying personal resistances, overcoming lapses, establishing adequate goals, and implementing self-monitoring were emphasised. Intervention sessions covered topics such as emotional and external eating, its detection and prevention, as well as improving body acceptance and body image. The program's principles and style of intervention were based on Self-Determination Theory with a special focus on increasing competence and internal regulation toward exercise and weight control. Guiding principles of the intervention included providing participants with adequate structure and a range of options to choose from, supporting their autonomous decisions during the program, and encouraging participants to explore their own motivations for treatment and define their personal treatment goals, while limiting external contingencies and controls (e.g. outcomes-based rewards or praise, external monitoring of behaviours and body weight).	
Comparison	The control group received a general health education curriculum based on several educational courses on various topics (e.g. preventive nutrition, stress management, self-care, and effective communication skills).	
Outcomes measured	Key exercise, eating behaviour, and body image variables were assessed before and after the program, and tested as mediators of weight loss. Weight and height were measured and BMI was calculated from these measurements. Cognitive restraint, disinhibition, and perceived hunger were assessed with the 51-item Eating Inventory, also known as the Three-Factor Eating Questionnaire (TFEQ). Self-efficacy for exercise was assessed with the Self-Efficacy for Exercise Behaviours scale measuring beliefs that a person can "stick with" the exercise program under varying circumstances. Body image is a multidimensional construct and was assessed with the Body Shape Questionnaire, the Body Image Assessment questionnaire, and with two scales from the Physical Self-Perception Profile questionnaire.	
Duration of follow-up	Two years including follow-up.	
Quality of study	Rating	Comments
Level of evidence	II	

Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	Participants were: 37.6 ± 7.0 years old, overweight, or mildly obese (BMI: 31.3 ± 4.1 kg/m^2).	
Overall findings	Weight change was -7.3 ± 5.9% (12-month) and -5.5 ± 5.0% (24-month) in the intervention group and -1.7 ± 5.0% and -2.2 ± 7.5% in controls. Despite considerable individual variability, average weight loss and the percentage of participants losing more weight than the accepted success criteria of 5 and 10% of initial weight was higher in the intervention group ($P < 0.001$ for all comparisons). Change in most psychosocial variables was associated with 12-month weight change, but only flexible cognitive restraint ($P < 0.01$), disinhibition ($P < 0.05$), exercise self-efficacy ($P < 0.001$), exercise intrinsic motivation ($P < 0.01$), and body dissatisfaction ($P < 0.05$) predicted 24-month weight change. Lower emotional eating, increased flexible cognitive restraint, and fewer exercise barriers mediated 12-month weight loss ($R^2 = 0.31$, $P < 0.001$; effect ratio: 0.37), but only flexible restraint and exercise self-efficacy mediated 24-month weight loss ($R^2 = 0.17$, $P < 0.001$; effect ratio: 0.89).	
Compliance with treatment	Not stated	
Adverse events	Not stated	
Notes	Results show that lowering emotional eating and adopting a flexible dietary restraint pattern are factors that influence sustained weight loss. For long-term success, interventions must also be effective in promoting exercise intrinsic motivation and self-efficacy.	

Ter Bogt 2009

Characteristics of the study	
Study Citation	ter Bogt NC, Bemelmans WJ, Beltman FW, Broer J, Smit AJ & van der Meer K 2009, 'Preventing weight gain: one-year results of a randomized lifestyle intervention', Am J Prev Med, vol.37, no.4, pp.270-7.
Study Design	RCT
Methods	
N (enrolled)	N = 457 participants Nurse practitioner (NP) (N = 225) and general practitioner usual care (GP-UC) group (N = 232). Study conducted in the Netherlands.
Inclusion criteria	Patients 40 to 70 years of age. Participants with a BMI between 25 and 40 kg/m^2. Participants had either hypertension or dyslipidaemia or both. Hypertension was defined as mean SBP 140 mmHg and DBP 90 mmHg or current use of blood pressure-lowering medication, and dyslipidaemia was defined as a total serum cholesterol > 5.5 mmol/L or low HDL (men: < 0.9; women: < 1.1 mmol/L) or a ratio of total/HDL cholesterol > 6 or current use of cholesterol-lowering medication.
Exclusion criteria	Exclusion criteria were diabetes, hypothyroidism, pregnancy, liver or kidney disease, current treatment for malignancy, shortened life expectancy, mental illness, and addiction to alcohol or drugs.
Intervention	In the intervention group, four individual visits to a NP and one feedback session by telephone were scheduled for lifestyle counselling with guidance of the NP using a standardised computerised software program. The lifestyle intervention consisted of four individual visits and one feedback session by telephone in the first

	year. During these contact sessions, the NP was guided by the standardised computerised software program that contained instructions on lifestyle counselling defined by international guidelines and allowed data entry of the measurements.	
Comparison	The control group received usual care from their general practitioner (GP). The participants in the control group were offered one visit (approximately 10 minutes) with their GP to discuss results from the screening and thereafter received usual GP care. According to national guidelines, this is low-intensity or absent care (regarding focus on lifestyle) for a large majority.	
Outcomes measured	Body weight, height, waist circumference and blood pressure. The presence of cardiovascular risk factors, medication use, and family history of disease and overweight or obesity were documented. Blood samples were collected after an overnight fast to analyse fasting serum lipids and glucose. A questionnaire, which was part of the software program for the lifestyle intervention, was completed via the internet or on paper. It contained questions on general characteristics (e.g. education level, gender) and on several issues related to body weight (e.g. history of dieting). The Short Questionnaire to Assess Health-Enhancing Physical Activity was used to determine physical activity. Metabolic syndrome was defined according to criteria from the National Cholesterol Education Program's Adult Treatment Panel III, and Systematic Coronary Risk Evaluation (SCORE) scores to estimate 10-year risk of fatal CVD.	
Duration of follow-up	Total duration of intervention and follow-up was 12 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	B	Blinding not mentioned
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	

<table>
<tr><th colspan="2">Results</th></tr>
<tr><td>Participants</td><td>Participants were overweight or obese patients (BMI = 25 to 40 kg/m^2). Mean age was 56 years.

52% of participants were women. Participants had either hypertension or dyslipidaemia, or both.

There were no differences in the two study groups at baseline except for higher percentages having sufficient physical activity and a history of > 3 previous attempts to lose weight in the past five years in the GP-UC group compared with those in the NP group.

When stratified for gender, women in the GP-UC group were older (aged 57 vs. 55 years); had hypertension more often (66% vs. 54%); and were sufficiently physically active more often (75% vs. 58%) (P < 0.05 for all).

In men there were no significant differences in baseline values between the NP and the GP-UC group.</td></tr>
<tr><td>Overall findings</td><td>Changes in main outcome variables at 1 year follow-up across treatment groups.

<table>
<tr><th></th><th>Successful weight losers (n =79)</th><th>Weight losers (n =125)</th><th>Stabilisers (n =89)</th><th>Weight gainers (n =123)</th><th>P values</th></tr>
<tr><td>Body weight (kg)</td><td>-8.1 (3.9)</td><td>-2.4 (1.0)*</td><td>0.1 (0.4)*</td><td>3.3 (2.3)*</td><td><0.001</td></tr>
<tr><td>Body weight (% change)</td><td>-8.9 (3.7)</td><td>-2.7 (1.1)*</td><td>0.1 (0.5)*</td><td>3.8 (2.4)*</td><td><0.001</td></tr>
<tr><td>Waist circumference (cm)</td><td>-7.9 (7.1)</td><td>-2.4 (5.3)*</td><td>-0.6 (4.3)*</td><td>1.9 (5.5)*</td><td><0.001</td></tr>
<tr><td>Total cholesterol (mmol/L)</td><td>-0.41 (0.9)</td><td>-0.02 (0.6)*</td><td>0.00 (0.7)*</td><td>0.12 (0.7)*</td><td><0.001</td></tr>
<tr><td>HDL cholesterol (mmol/L)</td><td>-0.05 (0.2)</td><td>-0.07 (0.2)</td><td>-0.09 (0.2)</td><td>-0.11 (0.2)</td><td>0.06</td></tr>
<tr><td>LDL cholesterol (mmol/L)</td><td>-0.26 (0.8)</td><td>0.11 (0.5)*</td><td>0.10 (0.6)*</td><td>-0.20 (0.6)*</td><td><0.001</td></tr>
<tr><td>SBP (mmHg)</td><td>-11.1 (20.2)</td><td>-8.5 (15.0)</td><td>-1.7 (13.0)*</td><td>-0.6 (16.9)*</td><td><0.001</td></tr>
<tr><td>DBP (mmHg)</td><td>-3.6 (10.1)</td><td>-2.1 (8.4)</td><td>0.2 (9.2)</td><td>1.1 (9.3)*</td><td><0.001</td></tr>
</table>
</td></tr>
</table>

	Data are mean ± SD * p<0.01 ANOVA with post hoc Bonferroni test with successful weight losers as the reference category Changes are calculated as the value at 1-year follow up assessment minus the value at baseline. There were more weight losers and stabilisers in the NP group than in the GP-UC group (77% vs. 65%; P < 0.05). Mean weight change was -1.9% (SD 4.9) in the NP group and -0.9% (SD 4.9) in the GP-UC group (P < 0.05). In men, mean weight losses were 2.3% for the NP group and 0.1% for the GP-UC group (P < 0.05). Significant reductions occurred also in waist circumference (-2.4 cm (SD 7.1) in the NP group and by 1.2 cm (SD 5.9). No significant differences occurred for changes in blood pressure, blood lipids, and fasting glucose. In women, mean weight losses were in both groups 1.6%. In the NP group, obese people lost more weight (-3.0%) than the non-obese (-1.3%; P < 0.05).
Compliance with treatment	Not stated
Adverse events	Not stated
Notes	Standardised computer-guided counselling by NPs may be an effective strategy to support weight-gain prevention and weight loss in primary care, in the current trial, particularly among men.

Tuomilehto 2009

Characteristics of the study	
Study Citation	Tuomilehto HP, Seppa JM, Partinen MM, Peltonen M, Gylling H, Tuomilehto JO, Vanninen EJ, Kokkarinen J, Sahlman JK, Martikainen T, Soini EJ, Randell J, Tukiainen H & Uusitupa M 2009, 'Lifestyle intervention with weight reduction: first-line treatment in mild obstructive sleep apnea', Am J Respir Crit Care Med, vol.179, no.4, pp.320-7.
Study Design	RCT
Methods	
N (enrolled)	N = 81 participants Control group: N = 41 and intervention group: N = 40 Study conducted in Finland.
Inclusion criteria	The inclusion criteria were as follows: (1) age 18 to 65 years; (2) BMI 28 to 40 kg/m^2; and (3) apnoea-hypopnea index (AHI), 5 to 15 events/hour.
Exclusion criteria	The authors excluded patients undergoing active treatment of obstructive sleep apnoea (OSA) of any kind, as well as pregnant women and those with chronic kidney, thyroid, or liver disease.
Intervention	This study was a randomised, clinical one year follow-up trial with two groups in patients with mild OSA. The patients in the intervention group received a 1-year lifestyle intervention including an initial weight reduction program with a 12-week VLCD. For the control group, a single general dietary and exercise counselling session was implemented. Study subjects were asked to keep a 3-day food diary at baseline to estimate their nutrient intake. After screening, the intervention group participants were provided with a group-based VLCD of 600-800 kcal/day. These included Nutrilett, Modifast, Nutrifast or Naturdiet for 12 weeks. At the beginning of the intervention, previous attempts to

	lose weight were discussed and an individual goal for weight loss was set. During the VLCD period, follow-up visits were arranged every second week and the sessions were supervised by the nutritionist. Compliance with the program and supervision for any possible adverse events were monitored by individual interviews at each visit by the nutritionist. The weight was measured at every visit and the patients were asked about the lifestyle changes he or she had made. The nutritionist provided face-to-face counselling individually tailored to each patient in the intervention group and also in the group sessions. Each session lasted 60-90 minutes. In addition to VLCD products, the patients were allowed to have calorie-free drinks and vegetables in accordance with the outpatient clinic's weight reduction program. The clinical nutritionist provided dietary and lifestyle counselling at each visit, with the emphasis placed on diet, exercise, and modification of lifestyle in general, specifically focusing on eating behaviour. After the VLCD program, the patients were advised to reduce fat to no more than 30% of total energy by increasing their intake of fruits, vegetables, poultry, fish, and lean meat, and by limiting dairy fats, fatty meat, sweets, pastries, and desserts. The subjects were recommended to increase their overall level of daily physical activity, and endurance exercise (such as walking, skiing, jogging, or swimming) was also recommended. After the VLCD, a physiotherapist supervised two of the group meetings, which focused on circuit-type resistance exercise to improve functional capacity. However, none of the patients had ongoing weight loss procedures, were enrolled into formal exercise programs, or were provided with personal trainers. The lifestyle intervention lasted for one year, and consisted of 14 visits with the study nutritionist. During the intervention period, the rate of participation in these sessions varied from 70 to 80%. The subjects in the control group were given general oral and written information about diet and exercise at baseline, at the 3-month visit, and at the 1-year visit by the study nurse and physician, but no specific individualised programs were offered to them. No individual or specific instructions were given regarding sleeping positions to any of the study patients.
Comparison	For the control group, a single general dietary and exercise counselling session was provided.
Outcomes measured	The primary outcome measure was the change of AHI. The secondary outcome measures were changes in Quality of Life (QoL), symptoms related to OSA and cardiorespiratory, glucose, and insulin metabolism parameters. Secondary outcomes included changed in weight, waist circumference, blood pressure, serum cholesterol, high-density lipoprotein, triglycerides, and glucose.
Duration of follow-up	The duration of the intervention including follow-up was one year.

Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	B	No blinding reported
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results		
Participants	At baseline mean weight, BMI and waist circumference were significantly higher in the intervention group compared with the control group. There were no other differences between the two treatment groups in baseline characteristics.	
Overall findings	The lifestyle intervention was found to effectively reduce body weight (-10.7 ± 6.5 kg; BMI -3.5 ± 2.1 [mean ± SD]). There was a statistically significant difference in the mean change in AHI between the study groups (P = 0.017). Changes in AHI were strongly associated with changes in weight and waist circumference. The adjusted odds ratio for having mild OSA was markedly lowered (odds ratio, 0.24 [95% CI, 0.08 to 0.72]; P = 0.011) in the intervention group. All common symptoms related to OSA improved after the lifestyle intervention.	
Compliance with treatment	Nine patients dropped out from the study, five from the intervention group and four from the control group. Seven patients dropped out from the study before the 3-month visit; four from the intervention group and three from the control group. In the intervention group, most (four of five) of the dropouts occurred within the first five weeks after the start of the intervention. The reasons for dropouts included a dislike of the VLCD products in two cases, work-related schedule problems in six cases, and a death not related to OSA in one case. There was no difference in compliance between groups and most of the patients who dropped out had reasons not related to the treatment.	

Adverse events	One death unrelated to OSA.
Notes	VLCD combined with active lifestyle counselling resulting in marked weight reduction is a feasible and effective treatment for the majority of patients with mild OSA, and the achieved beneficial outcomes are maintained at 1-year follow-up.

Uusitupa 2009

Characteristics of the study	
Study Citation	Uusitupa M, Peltonen M, Lindstrom J, Aunola S, Ilanne-Parikka P, Keinanen-Kiukaanniemi S, Valle TT, Eriksson JG & Tuomilehto J 2009, 'Ten-year mortality and cardiovascular morbidity in the Finnish Diabetes Prevention Study-secondary analysis of the randomized trial', PLoS One, vol.4, no.5, pp.e5656.
Study Design	RCT
Methods	
N (enrolled)	N = 522 Finnish Diabetes Prevention Study (DPS) Intensive diet-exercise counselling group (N = 265), control group (N = 257) N = 1,881 The FINRISK 1992 survey Normal glucose tolerance (N = 1570), impaired glucose tolerance (IGT) (N = 183), screen-detected type 2 diabetes (T2DM) (N = 59), and previously known T2DM (N = 69)
Inclusion criteria	Study participants were recruited mainly by screening of high-risk groups who voluntarily responded to local advertisements. The inclusion criteria were: (1) aged 40 to 64 years at screening; (2) BMI > 25 kg/m^2 at screening; and (3) the mean value of two 75 g oral glucose tolerance tests (OGTT) in the IGT range based on WHO 1985 criteria.

	The randomisation of participants started in 1993 and continued until 1998. At the enrolment visit the study physician wrote the names of eligible participants on the centrally-produced randomisation list in consecutive order. The study nurse who was responsible for scheduling the visits did not have access to the list. Randomisation was stratified by centre, sex, and the mean 2-hour plasma glucose value (7.8 to 9.4 mmol/L or 9.5 to 11.0 mmol/L).
Exclusion criteria	Exclusion criteria included recent (within six months) cardiovascular disease (CVD) event.
Intervention	Middle-aged, overweight people with IGT were randomised into intensive intervention (including physical activity, weight reduction and dietary counselling), or control ‘‘mini-intervention’’ group. The participants randomised to ILI were given individualised counselling by the study nutritionists to achieve the lifestyle goals. They were also advised to increase their level of physical activity, and voluntary physical activity sessions were offered. The lifestyle goals were: (1) weight reduction of ≥ 5%; (2) < 30% of the daily energy intake from fat; (3) < 10% of the daily energy intake from saturated fat; (4) fibre intake ≥ 15 grams per 1000 kcal; and (5) moderately intense physical activity ≥ 30 minutes per day.
Comparison	The control participants were given general health behaviour information at randomisation. In addition, the authors also presented follow-up data for a population-based ‘‘native control group’’ (the FINRISK 1992 cohort), because due to the study design the control group of the DPS could also be considered as a ‘‘mini-intervention group’’.
Outcomes measured	All participants had an annual OGTT, a medical history, and a physical examination with measurements of height, weight, waist circumference, SBP and DBP. Serum total cholesterol, HDL-cholesterol and triglycerides were determined from fasting samples using an enzymatic assay method.
Duration of follow-up	Median length of the active intervention period was 4 years (range 1 to 6 years) and the mean follow-up was 10.6 years. The FINRISK 1992 survey included a mean follow-up of 13.8 years.

Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	B	Not full follow-up
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	
Results		
Participants	Overweight men and women were randomly allocated to one of the two treatment modalities, the intensive diet-exercise counselling group where the proportion of women was 66% or the control group where the proportion of women was 69%. Mean age at baseline was between 53.7 and 55.9 years; mean BMI was between 26.8 and 31.7 kg/m^2; total cholesterol was between 5.6 and 6.2 mmol/L; SBP was between 136.2 and 150.2 mmHg; DBP was between 84.9 and 88.8 mmHg; Framingham CVD probability (%) was between 13.2 (IGT) and 31.0 (type 2 diabetes).	
Overall findings	The total number of deaths during the follow-up were 214 (11%) in the FINRISK cohort, and 16 (3%) in the DPS cohort. In the DPS cohort, after a median follow-up time of 10.2 years, there were 57/257 new CVD events in the intervention group and 54/248 in the control group. Among the DPS participants who consented for register linkage (N = 505), total mortality in the intervention versus control groups was 2.2 vs. 3.8 per 1,000 person years (hazard ratio (HR) = 0.57, 95% CI 0.21 to 1.58) and cardiovascular morbidity was 22.9 versus 22.0 per 1,000 person years (HR = 1.04, 95% CI 0.72 to 1.51). Compared with the population-based cohort with IGT, adjusted HRs were 0.21 (95% CI 0.09 to 0.52) and 0.39 (95% CI 0.20 to 0.79) for total mortality, and 0.89 (95% CI 0.62 to 1.27) and 0.87 (0.60 to 1.27) for cardiovascular morbidity in the intervention and control groups of the DPS, respectively. The risk of death	

<table>
<tr><td></td><td>in DPS combined cohort was markedly lower than in FINRISK IGT cohort (adjusted HR 0.30, 95% CI 0.17 to 0.54), but there was no significant difference in the risk of CVD (adjusted HR 0.88, 95% CI 0.6 to 1.21).

Between baseline and 1 year, the following changes in CVD risk factors were observed:

<table>
<tr><td></td><td>Intervention
Mean (SD)</td><td>Control
Mean (SD)</td></tr>
<tr><td>Weight (kg)</td><td>-4.5 (5)</td><td>-1 (3.7)</td></tr>
<tr><td>Waist circumference (cm)</td><td>-4.3 (5.2)</td><td>-1.4 (4.9)</td></tr>
<tr><td>Total cholesterol (mmol/L)</td><td>-0.12 (0.73)</td><td>-0.10 (0.72)</td></tr>
<tr><td>Triglycerides (mmol/L)</td><td>-0.19 (0.56)</td><td>-0.02 (0.67)</td></tr>
<tr><td>HDL (mmol/L)</td><td>-0.05 (0.19)</td><td>0.02 (0.17)</td></tr>
<tr><td>SBP (mmHg)</td><td>-5.2 (14.3)</td><td>-1.5 (14.7)</td></tr>
<tr><td>DBP (mmHg)</td><td>-4.7 (8.6)</td><td>-2.8 (9.5)</td></tr>
<tr><td>Glucose (2 hour; mmol/L)</td><td>-0.8 (1.9)</td><td>-0.3 (2.2)</td></tr>
</table>
</td></tr>
<tr><td>Compliance with treatment</td><td>Not stated</td></tr>
<tr><td>Adverse events</td><td>Not stated</td></tr>
<tr><td>Notes</td><td>Lifestyle intervention among persons with IGT did not decrease cardiovascular morbidity during the first 10 years of follow-up.

The DPS lifestyle intervention did result in marked decrease in the incidence of T2DM during a 10-year follow-up.</td></tr>
</table>

Van Gaal 2008

Characteristics of the study	
Study Citation	Van Gaal LF, Scheen AJ, Rissanen AM, Rossner S, Hanotin C & Ziegler O 2008, 'Long-term effect of CB1 blockade with rimonabant on cardiometabolic risk factors: two year results from the RIO-Europe Study', Eur Heart J, vol.29, no.14, pp.1761-71.
Study Design	RCT
Methods	
N (enrolled)	N = 1,507 participants Placebo (N = 305), Rimonabant 5 mg (N = 603), Rimonabant 20 mg (N = 599) Study was conducted in Europe and the US.
Inclusion criteria	Men and women aged 18 years or older. BMI ≥ 30 or > 27 kg/m^2. Diagnosed treated or untreated hypertension and / or dyslipidaemia, Had experienced < 5 kg variation in body weight (BW) during the previous three months.
Exclusion criteria	Patients with clinically significant endocrine disease, diabetes mellitus, cardiovascular or pulmonary disease, hepatic and renal disorders, or clinically significant neurological or psychological illness were excluded.
Intervention	RIO-Europe was a fixed-dose multicentre study conducted at centres in Europe and the USA. After a four week, single-blind, placebo run-in period, patients were randomised to receive placebo, rimonabant 5 mg or rimonabant 20 mg, double-blinded once daily plus a calorie-restricted diet (designed to yield an energy deficit of 600 kcal/day) for two years according to a 1:2:2 ratio.

Comparison	Calorie-restricted diet plus placebo.	
Outcomes measured	Body weight, waist circumference and blood pressure. Lipid profile, fasting glucose, and insulin were measured every three months. Oral glucose tolerance testing (OGTT) was performed at baseline, one year, and two years, and the prevalence of metabolic syndrome determined at the same time points.	
Duration of follow-up	Duration of intervention and follow-up was two years.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% non-completion
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	Medium	
Results		
Participants	Baseline characteristics of the treatment groups were similar: Mean (SD) age of 45.0 (11.5) years Mean (SD) BMI of 36 (5.9) kg/m^2. At baseline, 41% of the patients had hypertension, 61% met the criteria for dyslipidaemia and 41% met the criteria for metabolic syndrome.	
Overall findings	Weight loss from baseline to two years in the intention-to-treat population was significantly greater with rimonabant 20 mg (mean ± SD: -5.5 ± 7.7 kg; P < 0.001) and 5 mg (-2.9 ± 6.5 kg; P = 0.002) than placebo (-1.2 ± 6.8 kg).	

	Rimonabant 20 mg produced significantly greater improvements than placebo in waist circumference (-5.7 cm (SE 0.3 cm) vs -1.8 cm (SE 0.4 cm); P < 0.001), HDL-cholesterol (0.27 (0.27 mmol/L) vs 0.14 (0.23 mmol/L); P < 0.001), triglycerides (-0.17 (0.63 mmol/L) vs 0.00 (0.71 mmol/L); P < 0.001), fasting glucose (-0.03 (0.67 mmol/L) vs 0.08 (0.87 mmol/L); P = 0.032) and insulin levels (-1217 (3691 µIU/ml/min) vs -80 (3162 µIU/ml/min); P < 0.001), insulin resistance (-0.1 (3.1) vs 0.8 (4.5); P = 0.002), and metabolic syndrome prevalence ((21.4% vs 32.1%, P < 0.001). SBP and DBP were reduced following two years of rimonabant 20 mg treatment although the changes were not significantly different from placebo.
Compliance with treatment	Not stated
Adverse events	The overall two year incidence of adverse events was similar in all patient groups and lower during the second year of treatment than during the first year. The most common adverse events were infections (nasopharyngitis, influenza), gastrointestinal disorders (nausea), musculoskeletal and connective tissue disorders (back pain, arthralgia), nervous system disorders (headache, dizziness), and psychiatric disorders (anxiety, depressed mood disorders, and disturbances). The incidence of psychiatric disorders was higher during year 1 in the rimonabant 20 mg group compared with placebo (23.7 vs. 14.8%), but was almost comparable during year 2 (9.9 vs. 8.3%). Depressed mood disorders and disturbances occurred in 19 patients (6.2%) with placebo, 33 patients (5.5%) with rimonabant 5 mg, and 44 patients (7.3%) with rimonabant 20 mg during year 1, but in only five patients (3.0%), 14 patients (3.9%), and 11 patients (3.1%), respectively, during year 2. During the second year of treatment, the rate of withdrawal due to adverse events was lower than in year 1, and similar in all treatment groups. The most common adverse events leading to study discontinuation were psychiatric disorders, gastrointestinal disorders, and nervous system disorders. The rate of withdrawal due to psychiatric disorders was low during year 2 (0.6% with placebo, 1.4% with rimonabant 5 mg, and 1.7% with rimonabant 20 mg). Totaling all withdrawals due to adverse events over 2 years, the same pattern was seen as for year 1, i.e. a higher withdrawal rate with rimonabant 20 mg than with rimonabant 5 mg or placebo. At two years, changes from baseline in the HADS subscores for depression and anxiety were similar to the one year results, with no increase from baseline in mean depression subscores over the two year period in any treatment group. The proportions of patients with clinically significant depression (HADS depression subscore ≥

	11) at any follow-up visit during the two year period were similar in the placebo, rimonabant 5 mg, and rimonabant 20 mg (9.9, 9.9, and 10.2%, respectively); the proportions whose depression subscore rose by > 25% during years 1 and 2 were 50.0, 60.3, and 56.3%, respectively.
Notes	The two year results of RIO-Europe indicate that CB1 receptor blockade with rimonabant reduces body weight and produces durable improvements in several cardio-metabolic risk factors.

Villareal 2011

Characteristics of the study	
Study Citation	Villareal DT, Chode S, Parimi N, Sinacore DR, Hilton T, Armamento-Villareal R, Napoli N, Qualls C & Shah K 2011, 'Weight loss, exercise, or both and physical function in obese older adults', N Engl J Med, vol.364, no.13, pp.1218-29.
Study Design	RCT
Methods	
N (enrolled)	N = 107 participants Study conducted in US.
Inclusion criteria	Participants were eligible for inclusion in the study if they were 65 years of age or older and obese (BMI of 30 kg/m^2 or more), if they had a sedentary lifestyle, if their body weight had been stable during the previous year (i.e. had not fluctuated more than 2 kg), and if their medications had been stable for six months before enrolment. All participants had to have mild-to-moderate frailty, on the basis of meeting at least two of the following operational criteria: a score on the modified Physical Performance Test (in which the total score ranges from 0 to 36, with higher scores indicating better physical status) of 18 to 32; a peak oxygen consumption (VO2peak) of 11 to 18 ml per kilogram of body weight per minute; or difficulty in performing two instrumental activities of daily living or one

	basic activity of daily living.
Exclusion criteria	Persons who had severe cardiopulmonary disease; musculoskeletal or neuromuscular impairments that preclude exercise training; visual, hearing, or cognitive impairments; or a history of cancer, as well as persons who were receiving drugs that affect bone health and metabolism or who were current smokers.
Intervention	In this 1-year, RCT, the authors evaluated the independent and combined effects of weight loss and exercise in 107 adults. Volunteers were recruited through advertisements. Participants were randomly assigned, with stratification according to sex, to one of four groups: a control group, a group that participated in a weight-management program (diet group), a group that received exercise training (exercise group), or a group that received both weight-management instruction and exercise training (diet-exercise group). Participants assigned to the diet group were prescribed a balanced diet that provided an energy deficit of 500 to 750 kcal per day from their daily energy requirement. The diet contained approximately 1 g of high-quality protein per kilogram of body weight per day. Participants met weekly as a group with a dietitian for adjustments of their caloric intake and for behavioural therapy. They were instructed to set weekly behavioural goals and attend weekly weigh-in sessions. Food diaries were reviewed, and new goals were set on the basis of diary reports. The goal was to achieve a weight loss of approximately 10% of their baseline body weight at six months and to maintain that weight loss for an additional six months. Participants in the exercise group were given information regarding a diet that would maintain their current weight and participated in three group exercise-training sessions per week. Each session was approximately 90 minutes in duration and consisted of aerobic exercises, resistance training, and exercises to improve flexibility and balance. The exercise sessions were led by a physical therapist. The aerobic exercises included walking on a treadmill, stationary cycling, and stair climbing. The participants exercised so that their heart rate was approximately 65% of their peak heart rate and gradually increased the intensity of exercise so that their heart rate was between 70 and 85% of their peak heart rate. The progressive resistance training included nine upper-extremity and lower-extremity exercises with the use of weight-lifting machines. Participants performed one or two sets at a resistance of approximately 65% of their one-repetition maximum, with 8 to 12 repetitions of each exercise; they gradually increased the intensity to two to three sets at a resistance of approximately 80% of their one-repetition maximum, with six to eight repetitions of each exercise. Participants in the diet-exercise group participated in both the weight-management and exercise programs

	described above. All participants were given supplements to ensure an intake of approximately 1500 mg of calcium per day and approximately 1000 IU of vitamin D per day.	
Comparison	Participants assigned to the control group did not receive advice to change their diet or activity habits and were prohibited from participating in any weight-loss or exercise program. They were provided general information about a healthy diet during monthly visits with the staff.	
Outcomes measured	The primary outcome was the change from baseline in the score on the modified Physical Performance Test. Secondary outcomes included other measures of frailty, body composition (such as fat and lean body mass), bone mineral density (BMD), specific physical functions and quality of life. BMD was taken of the whole body and at the lumbar spine and total hip were measured with the use of dual-energy x-ray absorptiometry. Thigh muscle and fat volumes were measured with the use of magnetic resonance imaging (MRI).	
Duration of follow-up	All baseline assessments were repeated at six months and 12 months.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	B	13% loss to follow-up
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results		
Overall findings	Body weight decreased in the diet group (-9.7 ± 5.4 kg / -10% bodyweight) and diet-exercise group (-8.6 ± 3.8kg / -9% bodyweight) but not the exercise group (1.8 ± 2.7 kg) or control group (0.9 ± 1.5kg). Bone mineral density at the total hip decreased in the diet-exercise group (-1.1%; -0.01 ± 0.03g/cm^2) and the diet group (-2.6%; -0.03 ± 0.02g/cm^2), increased in the exercise group (1.5%; 0.01 ± 0.02g/cm^2) and did not change in	

	the control group. Strength improved 35% in the diet-exercise group (164 ± 124 lb), 34% in the exercise group (174 ± 166 lb) but not in the diet group (1 ± 85 lb) or control group. Gait speed increased in the diet-exercise group (23%; 16.9 ± 42.3s), the exercise group (14%; 8.2 ± 15.5s) but not the diet or control groups. Quality of life (the physical-component summary score of the SF-36) improved 15% in the diet-exercise group (8.6 ± 9.3 points), 14% in the diet group (8.4 ± 10.1 points) and 10% in the exercise group (5.7 ± 8.0) but did not change significantly in controls. The Physical Performance Test, in which higher scores indicate better physical status, increased more in the diet-exercise group than in the diet group or the exercise group (increases from baseline of 21% vs. 12% and 15%, respectively) compared with the control group (in which the score increased by 1%) ($P < 0.001$ for the between-group differences). The peak oxygen consumption improved more in the diet-exercise group than in the diet group or the exercise group (increases of 17% vs. 10% and 8%, respectively; $P < 0.001$); the score on the Functional Status Questionnaire, in which higher scores indicate better physical function, increased more in the diet-exercise group than in the diet group (increase of 10% vs. 4%, $P < 0.001$).
Compliance with treatment	The median attendance at diet therapy sessions was 83% (79 to 89) in the diet group and 82% (76 to 89) in the diet-exercise group. The median attendance at exercise sessions was 88% (85 to 82) in the exercise group and 83% (80 to 88) in the diet-exercise group.
Adverse events	One participant fell during testing of physical function, and the fall resulted in an ankle fracture. Other adverse events included a small number of exercise-associated musculoskeletal injuries such as back pain, tendon tears and tendonitis and knee pain.
Notes	Findings suggest that weight loss alone or exercise alone improves physical function and ameliorates frailty in obese older adults; however, a combination of weight loss and regular exercise may provide greater improvement in physical function and amelioration of frailty than either intervention alone. Therefore, weight loss combined with regular exercise may be beneficial in helping obese older adults maintain their functional independence.

Villareal 2008

Characteristics of the study	
Study Citation	Villareal DT, Shah K, Banks MR, Sinacore DR & Klein S 2008, 'Effect of weight loss and exercise therapy on bone metabolism and mass in obese older adults: a one-year randomized controlled trial', J Clin Endocrinol Metab, vol.93, no.6, pp.2181-7.
Study Design	RCT
Methods	
N (enrolled)	N = 27 participants Study conducted in US. Twenty-seven frail, obese (BMI = 39 ± 5 kg/m^2), older (age 70 ± 5 years) adults participated in the study. Based on T-scores, no subject had osteoporosis and 40% had osteopaenia.
Inclusion criteria	To be eligible for this study, volunteers had to meet the following criteria: (1) older age (≥ 65 years); 2) obese (BMI ≥ 30 kg/m^2); (3) sedentary (did not participate in regular exercise more than twice a week); (4) stable body weight (± 2 kg) over the past year; and (5) treatment with medications was unchanged for at least six months before enrolment. All subjects had to have mild to moderate frailty, based on meeting at least two of the three following criteria: (1) physical performance test score of 18-32; (2) peak O2 consumption of 11-18 ml/kg min; and (3) difficulty or need for assistance in two instrumental activities of daily living or one basic activity of daily living.
Exclusion criteria	Subjects who had severe cardiopulmonary disease, neuromuscular impairments that preclude exercise training (ET), visual, hearing, or cognitive impairments, history of malignant neoplasm and treatment with bone-acting drugs (e.g. bisphosphonates, glucocorticoids, sex-steroid compounds) during the previous year were excluded from participation.

Intervention	The authors conducted a one-year randomised controlled clinical trial in a university-based research centre. Volunteers were recruited by using local advertisements. All potential subjects completed a comprehensive screening procedure, which included a medical history, physical examination, standard blood and urine chemistries and a treadmill exercise stress test. Eligible volunteers were randomised to receive either 52 weeks of diet and exercise therapy (treatment group; n = 17) or no treatment (control group; n = 10), in an approximately 1.5:1 sequence, by using a computer-generated block random permutation procedure stratified for sex. The treatment group intervention involved a combination of an energy-deficit diet, behaviour therapy and a multi-component exercise therapy. Subjects met weekly as a group with a study dietitian, who was experienced in group behavioural therapy. Standard behavioural techniques were used to change eating habits. Participants were prescribed a balanced diet to provide an energy deficit of 500-750 kcal/day, which contained about 30% of energy as fat, 50% as carbohydrate, and 20% as protein. In addition, subjects were given a daily multivitamin supplement and were counselled to consume adequate dietary calcium and vitamin D (1200-1500 mg Ca/day and 1000 IU vitamin D/day). Total calorie intake was adjusted to prevent more than a 1.5% loss of body weight per week. The goal was to achieve a 10% weight loss at six months, followed by weight maintenance for an additional six months. The exercise program (ET) focused on improving endurance, strength, and balance. ET sessions were conducted as a group on three non-consecutive days each week at the authors exercise facility. Each session lasted about 90 minutes and included 15 minutes of flexibility exercises, 30 minutes of endurance exercise, 30 minutes of strength training and 15 minutes of balance exercises. Endurance exercises included walking on a treadmill, step-ups, stair climbing, stationary cycling, and Stairmaster exercise. Subjects exercised at moderate intensity (~75% of peak heart rate), and the intensity of exercise was gradually increased over several weeks to between 80 and 90% of peak heart rate. Resistance exercises were performed by using weight-lifting machines and free weights. One-repetition maximums (1-RMs), which is the maximal amount of weight subjects lifted one time, were used to adjust resistance exercises. Weight-lifting sessions consisted of one to two sets performed at a resistance of about 65% of 1-RM, which allowed the completion of eight to 12 repetitions. The volume of exercise was gradually increased to two to three sets at a resistance of about 80% of 1-RM, which allowed the completion of six to eight repetitions. These sessions were supervised by a physical therapist.
Comparison	Participants randomised to the control group were instructed to maintain their usual diet and activities during the

	study period and were asked not to participate in any weight-loss or exercise programs.	
Outcomes measured	Primary outcomes included: (1) Body weight was measured at baseline, six months and 12 months in the morning after subjects had fasted for 12 hours. (2) Bone mineral density (BMD) and bone mineral content (BMC) of the lumbar spine, proximal femur and total body were measured at baseline, six months and 12 months by using dual-energy x-ray absorptiometry (DXA). Secondary outcomes included: Changes in bone-related hormones. Venous blood samples were obtained in the morning after subjects fasted for at least 12 hours at baseline, six months and 12 months.	
Duration of follow-up	Outcomes were measured up to 12 months after the commencement of the trial.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	B	No blinding of outcome assessors
Magnitude of effect rating**	High	
Relevance of evidence rating***	Medium	
Results		
Overall findings	At 12 months body weight decreased in the treatment group (-10% ± 2%) but not in the control group (+1 ± 1%). Compared with the control group, the treatment group had greater changes in bone mass, bone markers, and hormones, including: (1) BMD in total hip (-2.4 ± 2.5% versus 0.1 ± 2.1), trochanter (-3.3 ± 3.1% versus 0.2 ± 3.3), and inter-trochanter (-2.7 ± 3.0% versus 0.3 ± 2.7); (2) C-terminal telopeptide (86 ± 92 versus 5 ± 44%) and osteocalcin (47 ± 65 vs. 3 ± 37%); and (3) leptin (2 ± 12 vs. -30 ± 25%) and estradiol (0.1 ± 14% vs. -14 ± 21%).	

	Changes in weight (r = 0.55) and bone markers (r = -0.54) correlated with changes in hip BMD (P < 0.05).
Compliance with treatment	Twenty-four of the 27 participants successfully completed the study; two participants in the treatment group dropped out because of “difficulty with compliance”, and one participant in the control group dropped out because of relocation to another state. The mean attendance by participants at the weekly group behavioural and nutrition education sessions was 81% (± 13%) and at exercise sessions was 83% (± 9%).
Adverse events	Not stated
Notes	The authors conclude that lifestyle-induced weight loss in frail, obese older adults increased bone turnover and caused a decline in hip BMD, despite concomitant exercise. However, it was not known whether the beneficial effects of weight loss and ET on muscle strength, balance, and physical function would lower the overall risk of falls and fractures, despite the decline in BMD.

Wake 2009

Characteristics of the study	
Study Citation	Wake M, Baur LA, Gerner B, Gibbons K, Gold L, Gunn J, Levickis P, McCallum Z, Naughton G, Sanci L & Ukoumunne OC 2009, 'Outcomes and costs of primary care surveillance and intervention for overweight or obese children: the LEAP 2 randomised controlled trial', BMJ, vol.339, pp.b3308.
Study Design	RCT
Methods	
N (enrolled)	N = 258 participants

	Intervention (N = 139), control (N = 119) Study was conducted in Australia.
Inclusion criteria	All children aged 5 years 0 months up to their 10th birthday attending participating practices for any reason during May 2005 to July 2006 were eligible to be invited into the BMI survey. Children who were overweight or obese in accordance with International Obesity Taskforce cut-off points.
Exclusion criteria	Children were excluded if their BMI z-score was ≥ 3.0, on the basis that a brief secondary prevention approach was inappropriate, or if they were receiving an ongoing weight management programme.
Intervention	A non-representative sample of 66 general practitioners in 45 family medical practices was recruited. GPs attended two x 2½ hour group training sessions for instruction in the "stages of change" model and training in brief, solution focused, family therapy. They received a 30 minute DVD, developed for the trial, showing role model scenarios of GPs using solution focused therapy in consultations for healthy family lifestyle. Each GP then conducted two simulated patient sessions (an "initial LEAP2 consultation" of 30 minutes, and a "follow-up consultation" of 20 minutes) during standard working hours supported by a mock patient file and materials. These visits mimicked the forthcoming intervention consultations, except that a child did not attend with the actor portraying the parent. After each consultation, the actor evaluated the GP's performance on 10 items, gave feedback to the GP, and communicated a summed "global score" (out of 10) via text message to the research team. GPs were paid $A100 per simulated patient consultation. The intervention had the same components as in the LEAP1 trial, designed using an intervention mapping technique within a behavioural epidemiology frame-work. GPs used a brief, solution focused approach to set and record appropriate, healthy lifestyle goals, assisted by a 16 page "family folder" written at a 12 year old reading level to be sure that virtually all parents could understand it. This folder included five topic sheets, each targeting one area of behavioural change (sedentary time, physical activity, water consumption, family eating habits, and lower fat options for food). Each sheet summarised supporting evidence, modelled solutions to challenges, and made suggestions as to how each goal might be reached. The intervention included four standard consultations over 12 weeks targeting change in nutrition, physical activity,

	and sedentary behaviour, supported by purpose designed family materials. Intervention families were notified of their trial status by a non-blinded member of the research team and assisted in making the first doctor's appointment.	
Comparison	Control families were notified via letter; general practice records of control children were subsequently audited to assess possible contamination (that is, attendances for discussion of weight). General practitioners knew the assignment status of any of their children who were in the intervention group, but did not otherwise know who among their large client base was enrolled in the survey or trial, so were generally unaware of control group membership.	
Outcomes measured	Primary measure was BMI at six and 12 months after randomisation. Secondary measures were: - mean activity count/minute by 7-day accelerometry, - nutrition score from 4-day abbreviated food frequency diary, and - child health related quality of life. Differences were adjusted for socioeconomic status, age, sex, and baseline BMI.	
Duration of follow-up	Participants were followed for 12 months after randomisation.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	A	
Magnitude of effect rating**	Low	
Relevance of evidence rating***	High	

Results	
Participants	Baseline characteristics of the children were similar in the two trial arms. The intervention group had a mean (SD) age of 7.4 (1.4) years, a mean (SD) BMI of 20.2 (2.3) kg/m^2 and contained 60% females. The control group had a mean (SD) age of 7.6 (1.4) years, a mean (SD) BMI of 20.3 (1.9) kg/m^2 and contained 61% females.
Overall findings	Of 781 eligible children, 258 (33%) entered the trial; attrition was 3.1% at 6 months and 6.2% at 12 months. Adjusted mean differences (intervention - control) at six and 12 months were, respectively:, - BMI, -0.12 (95% CI -0.40 to 0.15, P = 0.4) and -0.11 (-0.45 to 0.22, P = 0.5); - physical activity in counts/minute, 24 (-4 to 52, P = 0.09) and 11 (-26 to 49, P = 0.6); - nutrition score, 0.2 (-0.03 to 0.4, P = 0.1) and 0.1 (-0.1 to 0.4, P = 0.2).
Compliance with treatment	Not stated
Adverse events	There was no evidence of harm to the child.
Notes	Primary care screening followed by brief counselling did not improve BMI, physical activity, or nutrition in overweight or mildly obese 5-10 year olds, and it would be very costly if universally implemented. These findings are at odds with national policies in countries including the United States, United Kingdom, and Australia.

Wifley 2007

Characteristics of the study	
Study Citation	Wilfley DE, Stein RI, Saelens BE, Mockus DS, Matt GE, Hayden-Wade HA, Welch RR, Schechtman KB, Thompson PA & Epstein LH 2007, 'Efficacy of maintenance treatment approaches for childhood overweight: a randomized controlled trial', JAMA, vol.298, no.14, pp.1661-73.
Study Design	RCT
Methods	
N (enrolled)	N = 150 participants Control group (N = 49), behavioral skills maintenance (BSM) (N = 51), and social facilitation maintenance (SFM) (N = 50) Study was conducted in the US.
Inclusion criteria	Children aged 7 to 12 years who were 20% to 100% overweight. At least one parent or guardian with a BMI > 25 kg/m^2 and who was willing to participate with the child.
Exclusion criteria	Either the child or parent was currently involved in psychological or weight loss treatment, was using appetite or weight-affecting medications, or had a psychiatric condition that would interfere with participation.
Intervention	Following completion of standard 5-month state-of-the-art weight loss treatment, children were stratified by sex and ordered by a combination of percentage overweight change during weight loss treatment and randomisation levels of social problems. They were then randomly assigned, in groups of three, to one of three conditions: (1) BSM, (2) SFM, or (3) control. The weight loss treatment focused on dietary modification, physical activity increases, and behaviour change skills.

	Children and parents were taught how to improve dietary quality and reduce caloric intake to approximately 1200 to 1500 calories per day to facilitate weight loss of one-half to one pound per week. Families were encouraged to choose healthy foods consistent with individual, familial, and cultural preferences from food lists classified by the Traffic Light Diet. The physical activity component was mastery based with a maximum goal of 90 minutes of at least moderate-intensity activity per day for children at least five days per week, while also encouraging decreased sedentary activities (e.g. television watching). Other behaviour change skills included using self-monitoring (food and physical activity logs) to set and evaluate behaviour change goals and a family-based reinforcement system that allowed children to earn rewards for meeting program goals. There was no weight loss criterion for continuation into the weight maintenance phase. The small number (19 of 150 (12.7%)) of randomised children in BSM or SFM who gained weight during the weight loss phase were encouraged to lose weight at the beginning of the maintenance intervention to reach their baseline weight. This weight then formed their 3-lb (1.35 kg) maintenance range. The active maintenance intervention conditions were identical in duration and amount of contact (16 weekly sessions). Parents and children in both BSM and SFM were encouraged to (1) modify their caloric intake from weight loss treatment levels to an individualised level consistent with weight maintenance; (2) participate in the frequency, duration, and intensity of physical activity necessary to bring about energy balance, which was increased from the weight loss phase and individualised to partially compensate for increased caloric intake; and (3) maintain a 3 lb (1.35 kg) weight range, 1.5 lb (0.675 kg) above or below their absolute weight at the outset of the weight maintenance treatment. The approach during the weight maintenance phase was targeted toward maintaining absolute and parents in BSM and SFM continued to self-monitor, but the behaviours tracked were treatment-specific. The BSM approach was based on the premise that specific strategies are needed for weight loss maintenance; - Phase 1 (weeks 1-5) focused on enhancing motivation and promoting small changes in eating and physical activity to support weight maintenance. - Phase 2 (weeks 6-11) taught children and parents to (1) identify high-risk situations for overeating or missing physical activity, (2) pre-plan to avoid these situations or problem solve to cope more effectively with them, and (3)

	use cognitive restructuring and positive self-talk to decrease the likelihood that behavioural slips would result in full relapse. - Phase 3 (weeks 12-16), families reassessed their eating and physical activity behaviours and developed plans for permanent life-style change. The SFM approach was based on the premise that relapse results from the absence of a social environment supportive of continued weight control; - Phase 1 (weeks 1-5) guided parents to encourage children to form friendships with physically active peers and / or ensure that children's play-dates with existing friends involved physical activity and healthful eating. - Phase 2 (weeks 6-11) addressed body image concerns (e.g. fear of body exposure) that might limit overweight children from engaging in peer-related physical activity. Families also learned effective strategies to curtail weight-related teasing or criticism. - Phase 3 (weeks 12-16) focused on solidifying children's social support network to maximise its efficacy in promoting long-term behavioural changes. All weight loss, BSM, and SFM sessions included 20-minute family treatment and 40-minute separate child and parent groups. Individual family treatment reinforced the content of group session topics and provided opportunities for individualised behaviour therapy. Group session content was tailored to be age-appropriate yet similar for children and parents, with an added parenting skills component for the latter. One parent was scheduled to consistently attend sessions.
Comparison	The control was a usual-care condition (discontinued contact after the weight loss program). Participants in the control condition did not receive any intervention following the initial weight loss treatment but were contacted to complete their assessments in the clinic at all three follow-up time points.
Outcomes measured	The primary outcome measures were change in children's BMI z-score and percentage overweight. Secondary outcome measures included treatment-specific psychosocial targets of BSM and SFM. BMI was calculated from weight and height. The BMI z-scores of the children were determined using the age-specific and sex-specific median. BMI Percentage overweight was defined as percentage above median BMI.

	The Child Dietary Self-efficacy Scale evaluated children's self-efficacy in choosing healthy, low-fat foods. The Self-efficacy Scale for Children's Physical Activity examined children's perceived self-efficacy in overcoming barriers to achieving weight goals and developing positive alternatives to unhealthy habits. The Child Eating Disorder Examination assessed weight and shape concerns. The Coping with Teasing Scale measured the adequacy of children's responses to teasing. Peer support for diet and physical activity was measured using the Social Support for Eating Habits / Exercise Survey. The levels of social problems of the children were evaluated by using the social problems subscale of the Achenbach Child Behaviour Checklist-Parent Version. Family demographic variables were self-reported at baseline and used to compute the Hollingshead Socio-economic Status Index. Parents classified their child's race / ethnicity using options provided, allowing us to monitor sample representativeness relative to the study's local geographic area.	
Duration of follow-up	Duration of follow-up was for two years.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	Children in the BSM intervention had a mean (SD) age of 9.9 (1.4) years, a mean (SD) BMI of 27.1 (3.3) kg/m^2 and were 72.5% female. Children in the SFM intervention had a mean (SD) age of 9.9 (1.4) years, a mean (SD) BMI of 28.2 (3.3) kg/m^2 and	

	were 70.0% female. Children in the control group had a mean (SD) age of 9.8 (1.2) years, a mean (SD) BMI of 27.3 (3.7) kg/m^2 and were 65.3% female.
Overall findings	Overall, children's relative body weight significantly decreased from baseline to randomisation (mean change, -0.22 (SD 0.17) for BMI z-score; mean change, -10.9 (SD 7.0) for percentage overweight). Children receiving either BSM or SFM maintained relative weight significantly better than children assigned to the control group from randomization to post-weight maintenance (mean changes in BMI z-scores = -0.04, -0.04, -0.05, and 0.05 for BSM alone, SFM alone, BSM and SFM together, and the control group, respectively). Active maintenance treatment efficacy relative to the control group declined during follow-up, but the effects of SFM alone (mean change in BMI z-score = -0.24) and when analysed together with BSM (mean change in BMI z-score = -0.22) were significantly better than the control group (mean change in BMI z-score = -0.06) when examining BMI z-score outcomes from baseline to 2-year follow-up. Children receiving SFM compared with controls significantly improved their perceived self-efficacy in adhering to a low-fat diet, over the short-term and long-term. Additional long-term benefits of SFM relative to control included a greater perceived ability to overcome barriers to physical activity and seek healthy alternatives to situations promoting inactivity. Baseline child social problem scores moderated child relative weight change from baseline to 2-year follow-up, with low social problem children in SFM vs. the control group having the best outcomes.
Compliance with treatment	Not stated
Adverse events	No child or parent adverse events were reported or led to any study withdrawals.
Notes	The addition of maintenance-targeted treatment improves short-term efficacy of weight loss treatment for children relative to no maintenance treatment. However, the waning of effects over follow-up, although moderated by child initial social problems, suggests the need for the bolstering of future maintenance treatments to sustain effects.

Wilson 2010

Characteristics of the study	
Study Citation	Wilson DM, Abrams SH, Aye T, Lee PD, Lenders C, Lustig RH, Osganian SV & Feldman HA 2010, 'Metformin extended release treatment of adolescent obesity: a 48-week randomized, double-blind, placebo-controlled trial with 48-week follow-up', Arch Pediatr Adolesc Med, vol.164, no.2, pp.116-23.
Study Design	RCT
Methods	
N (enrolled)	N = 77 participants Metformin XR (N = 39), placebo (N = 38) Study was conducted in the US.
Inclusion criteria	Adolescents (aged 13 to 18 years) were eligible if they were obese (BMI 95th percentile for age and sex) but weighed < 136 kg (the weight limit for the dual-emission x-ray absorptiometry).
Exclusion criteria	Participants were excluded if they had a previous diagnosis of diabetes mellitus, had ever used a medication to treat diabetes mellitus or insulin resistance, had ever used a medication to aid in weight loss, were taking any medications known to increase metformin levels (e.g. cimetidine), received recent glucocorticoid therapy, had any identified syndrome or medical disorder predisposing to obesity, had surgical therapy for obesity, had attended a formal weight loss program within the previous six months, admitted to significant alcohol use in the past six months, had elevated creatinine (> 1.2 mg/dL) or liver enzymes (AST or ALT > 80 U/L levels), had untreated disorders of thyroid function, had impaired ambulation or mobility, or had ever been pregnant.
Intervention	Following a 1-month run-in period, participants following a lifestyle intervention program were randomised 1:1 to 48 weeks' treatment with metformin hydrochloride XR, 2000 mg once daily, or an identical placebo. Participants were monitored for an

	additional 48 weeks. All participants were prescribed a lifestyle intervention program to increase physical activity level and optimise dietary intake. Beginning with the run-in period, participants were expected to attend 10 individualised “intensive” sessions at weekly intervals, following a specific curriculum. Monthly follow-up sessions were conducted for the remainder of the study. A trained health specialist led the sessions and parents/guardians were invited to attend. The study sample was enriched for participants with a higher likelihood of complying with the protocol using a 4-week placebo run-in phase, during which participants were required to attend at least two of three scheduled lifestyle modification sessions and demonstrate 80% compliance with daily placebo treatment (pill count) for subsequent randomisation. Participants were then randomised 1:1 to treatment with either metformin XR (Glucophage XR) or identical placebo tablets and instructed to take one tablet/day (metformin hydrochloride XR 500 mg or placebo) orally before dinner for two weeks, then two tablets/day for two weeks, then four tablets/day from week eight to week 52. Investigators were permitted to adjust the dose of study drug as follows. If symptoms were mild and tolerable, study drug was continued. Persistent or severe gastrointestinal or other symptoms could lead to a reduction from four tablets/day to one tablet/day; the dose was then increased by one tablet/day in weekly intervals until the subject achieved a tolerable dose level of up to four tablets/day. While healthy eating was a major component of the lifestyle modification program, no specific calorie goal was assigned to the participants. To mitigate the possible impact of diet modification on vitamin and calcium intake, as well as possible effects of metformin on vitamin B metabolism and excretion, participants were also instructed to take a multi-vitamin tablet and 1000 mg of calcium carbonate daily.
Comparison	Lifestyle intervention plus identical placebo tablets.
Outcomes measured	After the baseline visit (day 0) and randomisation at week 4, participants returned at 16, 28, 40, 52, 64, 76, 88, and 100 weeks for a physical examination, anthropometry, and safety laboratory studies, including a pregnancy test for girls. After clinical eligibility was confirmed, diabetes mellitus was excluded at a baseline visit (study day 0) using an oral glucose tolerance test (OGTT). The OGTT, DXA, and abdominal CT were performed at baseline, then at 52 weeks (last dose of study drug) and 100 weeks (completion of study). At each visit, height and weight was measured and the BMI was calculated and converted to a sex- and age- specific z-score. Waist circumference was measured and tanner breast (female), genital (male), and pubic hair (both sexes) staging was assessed by an experienced clinician at each visit.

<table>
<tr><td>Duration of follow-up</td><td colspan="2">Duration of intervention and follow-up was 100 weeks.</td></tr>
<tr><td>Quality of study</td><td>Rating</td><td>Comments</td></tr>
<tr><td>Level of evidence</td><td>II</td><td></td></tr>
<tr><td>Study quality rating*</td><td>C</td><td>> 15% loss to follow-up</td></tr>
<tr><td>Magnitude of effect rating**</td><td>Low</td><td></td></tr>
<tr><td>Relevance of evidence rating***</td><td>High</td><td></td></tr>
<tr><td colspan="3">Results</td></tr>
<tr><td>Participants</td><td colspan="2">Sixty seven percent of the metformin group and 66% of the placebo group were female. The metformin group had a mean (SD) age of 14.8 (1.3) years and BMI of 35.9 (5.7) kg/m^2. The placebo group had a mean (SD) age of 15.0 (1.5) years and BMI of 35.9 (4.7) kg/m^2.</td></tr>
<tr><td>Overall findings</td><td colspan="2">Changes at 52 weeks:
<table>
<tr><td></td><td>Metformin (SE)</td><td>Placebo (SE)</td></tr>
<tr><td>BMI z-score</td><td>-0.09 (0.04)</td><td>-0.01 (0.04)</td></tr>
<tr><td>BMI</td><td>-0.9 (0.5)</td><td>0.2 (0.5)</td></tr>
<tr><td>LDL (mg/dl)</td><td>0 (4)</td><td>0 (4)</td></tr>
<tr><td>HDL (mg/dl)</td><td>1 (1)</td><td>0 (1)</td></tr>
<tr><td>Triglycerides (mg/dl)</td><td>-2 (12)</td><td>1 (12)</td></tr>
</table></td></tr>
</table>

	At 24 weeks after cessation of the metformin no significant effects of metformin on body composition, abdominal fat, or insulin indices were observed.
Compliance with treatment	Compliance with medications was good and similar in both groups (mean [SD] number of missed doses per week, 1.2 [1.7] metformin vs. 1.3 [3.5] control; P = 0.29). Likewise, the mean [SD] number of the lifestyle modification sessions attended was similar in both groups (6.3 [3.1] metformin vs. 6.7 [3.3] control; P = 0.38). Neither the estimate of the number of missed doses nor the number of lifestyle sessions attended were associated with the change in BMI in the metformin group.
Adverse events	During weeks 4 to 52, the following adverse events occurred at least once in 5% or more of participants in either group and five or more percentage points greater in one group relative to the other (metformin vs. placebo): headache (N = 12 [31%] vs. 8 [21%]), nausea (N = 9 [23%] vs. 3 [8%]), vomiting (N = 6 [15%] vs. 1 [3%]), upper respiratory tract infection (N = 18 [46%] vs. 23 [61%]), and musculoskeletal complaints (N = 5 [3%] vs. 7 [18%]). There was no statistically significant difference between the metformin and placebo groups in the incidence of any particular class of adverse events. Two events of nausea in two metformin-treated participants were considered probably related; one participant discontinued taking the study drug. Two participants in the metformin group and one in the placebo group had elevated alanine aminotransferase levels before week 52 and discontinued taking the study drug. There was one severe adverse event (appendectomy, metformin group) considered unrelated to the study drug; all other adverse events were mild or moderate. In total, the dose of study drug was decreased during weeks 4 to 52 for six participants in the metformin group and three in the placebo group. During weeks 52 to 100, headache was more frequent in the group previously treated with metformin XR (N =6 [30%] vs. 5 [24%]; P = 0.73), and there was one severe adverse event (leg vein thrombosis) considered unrelated to previous study drug (metformin) treatment.
Notes	Metformin, in combination with lifestyle modification, had a small but statistically significant effect to reduce BMI in obese adolescents; this effect waned within 12 to 24 weeks of discontinuing metformin treatment. Metformin was safe and tolerated in this population.

Wing 2010

Characteristics of the study	
Study Citation	Wing RR, West DS, Grady D, Creasman JM, Richter HE, Myers D, Burgio KL, Franklin F, Gorin AA, Vittinghoff E, Macer J, Kusek JW & Subak LL 2010, 'Effect of weight loss on urinary incontinence in overweight and obese women: results at 12 and 18 months', J Urol, vol.184, no.3, pp.1005-10.
Study Design	RCT
Methods	
N (enrolled)	N = 338 participants Behavioural weight loss intervention (N = 226), structured education program (control group) (N = 112). Study conducted in US.
Inclusion criteria	Participants at least 30 years old with a BMI of 25 to 50 kg/m^2, reporting at least 10 urinary incontinence (UI) episodes on a 7-day voiding diary at baseline and agreeing not to initiate new treatments for incontinence or weight reduction during the trial.
Exclusion criteria	None stated
Intervention	Eligible participants were randomly allocated in a 2:1 ratio to a 6-month intensive behavioural weight loss program (N = 226) or a control group (N = 112) and followed through 18 months. Participants assigned to the weight loss program received a 6-month, group based behavioural weight loss intervention, after which they underwent a second randomisation with their group to a motivationally focused maintenance program (N = 110) or a standard skills based maintenance approach (N = 111). The secondary randomisation allowed the comparison of two approaches to weight loss maintenance. The primary aim was to compare the long-term effects of the intervention and control groups, and the secondary aim was to compare the effects of motivation and skills based maintenance

	programs on changes in continence. Participants in the behavioural weight loss program (intervention group) received the same self-help incontinence booklet as the control group with no further attention to incontinence during the program. Participants in the intervention met in groups of 10 to 15, with 1-hour sessions held weekly for six months and then biweekly for 12 months. Groups were led by two therapists and followed a structured protocol. The program was designed to produce an average weight loss of 7% to 9% of initial body weight within six months. The program included a calorie and fat restricted diet of 1,200 to 1,800 kcal daily, depending on initial weight, with less than 30% of calories from fat. To improve adherence participants were given sample meal plans and vouchers for meal replacement products (Slim-FastM). Participants were encouraged to gradually increase physical activity to 200 minutes per week of brisk walking or activities of similar intensity and were given pedometers to monitor their daily steps. Behaviour modification techniques, including self-monitoring of diet and exercise, were emphasized throughout the program.
Comparison	Participants in the structured education program (control group) were offered seven, 1-hour group education sessions (months 1, 2, 3, 4, 6, 9 and 15). These sessions followed a structured protocol, and provided general information about weight loss, physical activity and healthy eating. Groups were led by the same therapists who conducted the weight control program. Participants were also given a self-help incontinence behavioural treatment booklet with instructions for improving bladder control, but no further information was provided pertaining to incontinence at the sessions or follow-up visits.
Outcomes measured	Weight, physical activity levels, urinary incontinence (7-day voiding diary). Participants were trained to record the time of each void and each incontinence episode, and to identify each episode as stress (involuntary loss of urine associated with coughing, sneezing, straining or exercise), urge (loss of urine associated with a strong need or urge to void) or other. Voiding diaries were reviewed by assessment staff. As a secondary outcome the authors assessed 24-hour involuntary urine loss with a standardized pad test. Participants were also asked whether, compared to baseline, incontinence episodes were less frequent (yes, no, uncertain), leakage was smaller (yes, no, uncertain) and whether leakage was improved (5-point scale), and were asked to rate overall satisfaction with changes in incontinence (5-point scale).
Duration of follow-up	Study duration including follow-up was 18 months.

Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	B	No blinding
Magnitude of effect rating**	Medium	
Relevance of evidence rating***	High	
Results		
Participants	At baseline women had a mean ± SD age 53 ± 10 years, a mean BMI of 36 ± 6 kg/m^2 and reported a mean of 24 ± 18 incontinence episodes weekly. Of the patients 86% completed 18-month measurements.	
Overall findings	The percent weight loss in the intervention group averaged 8.0%, 7.5% and 5.5% at six, 12 and 18 months, respectively, vs. approximately 1.5% in the control group (all values $P < 0.001$). Compared with controls at 12 months the intervention group reported a greater percent reduction in weekly stress urinary incontinence episodes (65% vs. 47%, $P < 0.001$), and a greater proportion achieved at least a 70% decrease in weekly total and stress urinary incontinence episodes. At 18 months a greater proportion of women in the weight loss intervention group had more than 70% improvement in urge incontinence episodes but there were no significant differences between the groups for stress or total urinary incontinence. The intervention group also reported greater satisfaction with changes in urinary incontinence than the control group at six, 12 and 18 months.	
Compliance with treatment	Not stated	
Adverse events	Not stated	

Notes	A behavioural weight loss intervention was more effective than an educational control program in decreasing stress related UI through 12 months, but the benefits at 18 months were more limited although patient satisfaction had improved.

Wing 2010b

Characteristics of the study	
Study Citation	Wing RR 2010, 'Long-term effects of a lifestyle intervention on weight and cardiovascular risk factors in individuals with type 2 diabetes mellitus: four-year results of the Look AHEAD trial', Arch Intern Med, vol.170, no.17, pp.1566-75.
Study Design	RCT
Methods	
N (enrolled)	N = 5,145 participants ILI (N = 2,570), Diabetes Support and Education (DSE, control group) (N = 2,575) Study conducted in US.
Inclusion criteria	Participants from the Look AHEAD (Action for Health in Diabetes) study were required to be 45 to 76 years of age (increased to 55 to 75 years in year 2 of randomisation) with type 2 diabetes and to have a BMI of ≥ 25 kg/m^2 (≥ 27 kg/m^2 in patients on insulin), HbA1c < 11%, SBP < 160 mmHg and DBP < 100 mmHg. Participants were required to successfully complete a maximal graded exercise test, two weeks of self-monitoring, and attend a Look AHEAD diabetes education session.
Exclusion criteria	Non-compliance with above criteria

Intervention	The ILI included diet modification and physical activity and was designed to induce at least a 7% weight loss at year 1 and to maintain this weight loss in subsequent years. ILI participants were assigned a calorie goal (1200-1800 based on initial weight), with <30% of total calories from fat (<10% from saturated fat) and a minimum of 15% of total calories from protein. To increase dietary adherence, a portion-controlled diet was used, with liquid meal replacements provided free and recommendations to use other portion-controlled items. The goal was at least 175 minutes of physical activity per week, using activities similar in intensity to brisk walking. Behavioural strategies, including self-monitoring, goal setting and problem solving were stressed. Participants in ILI were seen weekly for the first six months and three times per month for the next six months, with a combination of group and individual contacts. During years 2 to 4, participants were seen individually at least once a month, contacted another time each month by phone or email, and offered a variety of centrally-approved group classes. At each session, participants were weighed, self-monitoring records were reviewed, and a new lesson was presented, following a standardised treatment protocol. For participants in both ILI and DSE, the participant's own physicians provided all medical care and made changes in medications, with the exception of temporary changes in diabetes medication during periods of intensive weight loss in ILI.	
Comparison	Participants in DSE were invited to three group sessions each year. These sessions utilised a standardised protocol and focused on diet, physical activity, or social support. Information on behavioural strategies was not presented and participants were not weighed at these sessions.	
Outcomes measured	Outcomes measured included weight, HbA1c, SBP, DBP, total cholesterol, high density lipoprotein cholesterol (HDL-C), triglycerides, and low density lipoprotein cholesterol (LDL-C) (unadjusted and adjusted for medication use).	
Duration of follow-up	This trial included four years of follow-up.	
Quality of study	Rating	Comments
Level of evidence	II	

Study quality rating*	A	
Magnitude of effect rating**	High	
Relevance of evidence rating***	High	
Results		
Participants	Overall, 59% of the participants were women; 37% were from racial or ethnic minorities; 14% reported a history of CVD at baseline, the average age was 58.7 ± 6.8 (Mean ± SD), and the average BMI was 36 ± 5.9 kg/m^2. Over 93% of participants were assessed at each of the four years.	
Overall findings	Averaged across four years of follow-up, participants in ILI had greater percent weight losses than those in DSE (-6.15% vs. -0.88%, P < 0.0001) and greater improvements in HbA1c (-0.36% vs. 0.09%, P < 0.0001), SBP (-5.33 vs. -2.97 mmHg, P < 0.0001), DBP (-2.92 vs. -2.48 mmHg, P < 0.012), HDL-C (3.67 vs. 1.97 mg/dl, P < 0.0001), and triglycerides (-25.56 vs. -19.75 mg/dl, P < 0.0006). Reductions in LDL-C were greater in DSE than ILI (-11.27 vs. -12.84 mg/dl, P = 0.009), but adjusted for medication use, changes in LDL-C did not differ between the two groups. Although the greatest benefits were often seen at one year, ILI participants still had greater improvements than DSE in weight, fitness, HbA1c, SBP, and HDL-C at four years.	
Compliance with treatment	Not stated	
Adverse events	Not stated	
Notes	ILI can produce and maintain significant weight losses and improvements in fitness in individuals with type 2 diabetes. Across four years of follow-up, those in ILI had better overall levels of glycaemic control, blood pressure, HDL-C and triglycerides, and thus spent considerable time with lower CVD risk. Whether this translates to reduction in CVD events will ultimately be addressed by the Look AHEAD study.	

Yanovski 2009

Characteristics of the study	
Study Citation	Yanovski JA, Parikh SJ, Yanoff LB, Denkinger BI, Calis KA, Reynolds JC, Sebring NG & McHugh T 2009, 'Effects of calcium supplementation on body weight and adiposity in overweight and obese adults: a randomized trial', Ann Intern Med, vol.150, no.12, pp.821-9, W145-6.
Study Design	RCT
Methods	
N (enrolled)	N = 340 participants Calcium supplementation (N = 170), placebo capsules (N = 170) Study was conducted in the US.
Inclusion criteria	Men and women age 18 to 80 years were eligible to enrol if they had a BMI of 25 kg/m^2 or more and did not have cerebrovascular, cardiovascular, pulmonary, renal, hepatic, endocrinologic, or other substantial medical disease.
Exclusion criteria	Women were ineligible if they were pregnant, were breastfeeding, or had received a recommendation from a health care professional to take calcium supplements for any condition. The authors excluded persons who regularly used medications known to affect body weight, had a weight loss of 3% or more in the preceding three months, reported total calcium intake in excess of 3.5 g/day, used supplemental calcium in excess of 300 mg/day, used vitamin D supplements in excess of 400 IU/day, or had a history of renal stones.
Intervention	Calcium carbonate (elemental calcium, 1500 mg/day) with meals for two years.
Comparison	Placebo capsules
Outcomes measured	Primary efficacy end points were change in body weight and body fat mass at the end of two years of treatment.

	Secondary outcomes were fasting anthropometric measurements, body composition by dual-energy x-ray absorptiometry, and change in blood pressure, assessed yearly, along with questionnaire data on dietary and supplemental calcium intake. In addition, participants were contacted every three months to complete questionnaires about their adherence to the medication regimen; assess their general health; and obtain self-reports of mood, stress, physical activity, and hunger. Every six months, participants returned to the clinic to exchange their unused study medication for a new supply. The authors used the tally of returned capsules to assess adherence. To examine adequacy of the masking procedure, participants completed a questionnaire at the end of the study that requested they report their best guess about their study group assignment.	
Duration of follow-up	Study duration was for two years.	
Quality of study	Rating	Comments
Level of evidence	II	
Study quality rating*	C	> 15% loss to follow-up
Magnitude of effect rating**	Low	
Relevance of evidence rating***	Low	
Results		
Participants	The adult participants included 245 women and 95 men with 39% classified as overweight (BMI 25 to < 30 kg/m^2) and 61% as obese (BMI ≥ 30 kg/m^2). They had a mean (SD) age of 38.8 (10.5) years. At baseline, age, sex, race or ethnicity, weight, BMI, body fat mass, indices of calcium intake, energy intake, or serum 25-hydroxy vitamin D or parathyroid hormone concentrations did not significantly differ between groups.	
Overall findings	Seventy-five percent of participants completed the trial (78% received calcium; 73% received placebo). There were no statistically or clinically significant differences between the calcium and placebo groups in change in body weight	

	(difference, 0.02 kg [95% CI, -1.64 to 1.69 kg]; P = 0.98), BMI (difference, 0.32 kg/m^2 [CI, -0.41 to 1.02 kg/m^2]; P = 0.39), or body fat mass (difference, 0.39 kg [CI, -1.04 to 1.92 kg]; P = 0.55). Parathyroid hormone concentrations decreased in the calcium group compared with the placebo group (difference, -0.71 pmol/L [CI, -1.28 to -0.13 pmol/L]).
Compliance with treatment	Adherence and change over time in adherence (measured by tallies of returned medication) did not differ between groups at any study interval from six months to two years (P ≥ 0.78 for all). Among all participants, however, adherence decreased significantly during the trial from 92% of prescribed doses at six months to 82% at two years (P = 0.014; 6-month vs. 2-year comparison).
Adverse events	Adverse events leading to study discontinuation were infrequent. Only one clinically significant adverse event that was not attributed to trial participation was observed during the study (foot surgery in a participant who received placebo), and reports of any adverse event during the study did not significantly differ between groups (P > 0.41 for all).
Notes	Supplementation with elemental calcium, 1500 mg/day, did not substantially alter weight or fat gain over two years in overweight and obese adults.

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