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Expert Review: Summary of key issues

NHMRC Draft Information Paper: Evidence on Wind Farms and Human Health

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WORKING TO BUILD A HEALTHY AUSTRALIA

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Expert Reviewers

The *NHMRC Draft Information Paper: Evidence on Wind Farms and Human Health* was critically appraised by six Australian and international reviewers whose expertise covered:

- acoustics;
- aerospace engineering (including aero acoustics);
- mental health and sleep;
- epidemiology; and
- environmental health.

The expert reviewers were asked to consider whether the rationale applied in examining the evidence was clearly explained and whether the evidence was accurately translated into the draft Information Paper. They were also asked to evaluate the appropriateness of the conclusions based on their understanding of the latest evidence in their specific area of expertise.

NHMRC acknowledges the time and expertise provided by the expert reviewers Dr Mathias Basner (Pennsylvania, United States of America), Associate Professor Cornelius Doolan (Adelaide, Australia), Emeritus Professor Colin Hansen (Adelaide, Australia), Professor Lin Fritschi (Perth, Australia), Professor Takayuki Kagayama (Ōita, Japan) and Dr Frits van den Berg (Amsterdam, The Netherlands).

Reference Group consideration and revisions to the Information Paper

The reviewers raised a number of issues, most of which related to wind farm noise. The Wind Farms and Human Health Reference Group gave due regard to expert review comments and, over several meetings, carefully considered issues that were raised. Key issues and the Reference Group's responses are summarised in the table below.

Comment	Reference Group response
Systematic review searches and selection criteria	
The exclusion of some peer-reviewed studies (including case reports and case studies) from the systematic review of evidence was not sufficiently justified and may have led to incorrect conclusions.	The systematic literature review followed internationally recognised processes to identify literature and evaluate the strength of the evidence. The Reference Group reiterated its previous decision not to include case reports and case series in the review. These studies only include participants reporting health effects that they or someone else have attributed to wind farm emissions and therefore provide no comparative analysis (for example of health effects in people exposed or not exposed to wind farms) to inform analysis of causation.

Comment	Reference Group response
A number of relevant studies had been published since the systematic literature review searches were conducted in October 2012.	A repeat of the systematic review search was conducted by independent reviewers to capture evidence published since October 2012. Additional studies cited by the expert reviewers (and in public consultation submissions) were included in the Review of Additional Evidence if they met the inclusion criteria specified during public consultation. This new evidence was reviewed by the Reference Group and incorporated into the Information Paper where relevant.
Critical appraisal of the systematic review evidence	
The text on the critical appraisal of the systematic review evidence was considered to be too academic.	The Reference Group reviewed and revised the language in the section on critical appraisal. The Information Paper was revised to reflect that critical appraisal is a systematic process to identify the strengths and weaknesses of a research study in order to assess the usefulness and validity of the findings.
Low participation rates are not sufficient reason for exclusion.	The Reference Group noted that participation rates were not used as inclusion criteria for the review. The participation rate of each study was considered in assessing the quality of the evidence. As it is well-established that there is a high risk of selection bias in studies that have a low participation rate, no change was made to the Information Paper.
Non-response analysis is one means of addressing selection bias.	The Reference Group reviewed the included studies for information on non-response analyses. The one study that conducted such analysis found no significant difference between responders and non-responders. The Information Paper was revised to note that a non-response analysis was conducted in this study.
Confounders are not always reported and, in any case, it would be impossible to eliminate all confounding factors simultaneously.	The Reference Group agreed that failure to control for confounders could lead to incorrect conclusions either for or against an effect.
The draft Information Paper suggested partiality in that most examples of confounding factors caution for positive results.	The Information Paper was revised to include examples of both negative and positive confounding.
Consistent differentiation between confounders and effect modifiers is needed.	The Reference Group agreed that variables thought to be confounding factors might instead be effect modifiers, which influence the magnitude of (rather than explain) any true association between wind farms and health. The Information Paper was revised to reflect this and to note that effect modification can be difficult to uncover, especially in small studies.

Comment	Reference Group response
Limitations of cross-sectional studies	
Despite the limitations of cross-sectional studies, they are considered an appropriate means of investigating the effects of environmental noise.	The Reference Group agreed that environmental noise studies are almost always cross-sectional in design, given the nature of these studies. The Information Paper was revised to recognise that this is the case.
The weaknesses of cross-sectional study designs on environmental health issues can be lessened in some instances.	While cross-sectional study designs have limitations in providing evidence to establish causation (as the exposure and health effects are assessed at a single point of time and do not provide any indication of the order of events), the Reference Group agreed that these weaknesses can be lessened in some instances. As well as the study design, other methodological features of the studies were considered, including potential bias of the results (due to low participation rates, lack of masking and self-reporting of health effects), confounding factors that provide an alternative explanation for any observed association and the likelihood of results occurring by chance. As the direct evidence studies were of poor quality, bias and confounding factors were possible explanations for the associations observed.
It is difficult to mask the intent of environmental noise studies.	The Reference Group agreed that it is difficult to mask intent in environmental noise studies. The Information Paper was revised to note that these studies are by necessity conducted in the vicinity of a noise source and often in a climate of controversy about the noise it produces.
In environmental health studies it is often not practical to require evidence that exposure preceded effect.	The Reference Group agreed that the sequence of events is not as important in environmental noise studies. The Information Paper was revised to note that conclusions can often be made based on what is known historically of previous exposures and the time of onset of changes in exposed people's health status.
Background evidence on noise	
A-weighted measures do not adequately take into account infrasound and low-frequency noise.	The Information Paper was revised to clarify that A-weighted measures include all frequencies but give less weight in the total measured noise level to low frequencies and infrasound because of their lower audibility.
Wind farms are noise generators of sufficient sound power to need to be regulated to ensure the protection of communities from environmental noise pollution.	The Reference Group sought to make clear that although individuals may perceive aspects of wind farm noise at greater distances under occasional and distinct circumstances, it is unlikely that the wind farm noise level would be considered disturbing at distances greater than 1,500 metres. This information may be useful for regulatory purposes.

Comment	Reference Group response
Various factors contribute to the distance at which wind farm noise can be heard — size and output of individual turbines, wind farm size and layout, terrain and meteorological or atmospheric conditions.	The Reference Group considered evidence on the various factors that contribute to the distance at which wind farm noise may be heard. The Information Paper was revised to provide more information on factors that influence wind farm noise levels at different distances from them.
There are differences between the acoustic characteristics of wind farm noise and those of noise from other sources. As well as level, exposure includes the character of the noise (impulsiveness, frequency content, variability) and its duration. Wind turbines produce low-frequency noise and there are unique characteristics of this noise (variability, amplitude modulation, tonality). Low-frequency noise emissions increase with power-generating capacity, which is important as newer turbines may have a greater generating capacity than those used in studies.	The Reference Group considered evidence on the complex and highly variable characteristics of wind farm noise. The Information Paper was revised to include discussion of amplitude modulation and coherence effects. The Information Paper was also revised to acknowledge the various influences on perception of wind farm noise including tonality, frequency content, impulsivity, duration and individual perception. Further discussion was included on the low-frequency and infrasound components of wind farm noise, which may increase with the power-generating capacity of the turbines and under certain operating and weather conditions.
Health effects associated with environmental noise	
Indirect health effects (e.g. due to disturbed sleep or stress) should be considered.	The Reference Group revised the Information Paper to remove references to "direct" or "indirect" health effects, as these terms are not clearly defined or consistently used in the literature. Members reviewed evidence on health effects associated with stress and disturbed sleep, which informed revisions to the Information Paper. The Reference Group agreed that as sleep disturbance was not objectively measured in the studies, it is unknown whether it was of sufficient duration and intensity to result in health effects. Stress (related to annoyance) was not measured in the studies.
The draft Information Paper gave the impression that the effects of environmental noise from all sources are unimportant or have an inconclusive effect on health. The statement that evidence on the association between noise exposure and cardiovascular disease is limited contradicts the World Health Organization (WHO) findings on the health effects of night-time noise. It is generally accepted that long-term noise exposure contributes to cardiovascular disease.	The Reference Group reviewed the *WHO Night Noise Guidelines for Europe* (2009) and the *WHO report on the Burden of disease from environmental noise* (2011) and considered additional evidence on the association between prolonged exposure to high levels (greater than 55 decibels) of environmental noise and cardiovascular disease. The Information Paper was revised to discuss the effects of environmental noise on cardiovascular health.

Comment	Reference Group response
Formulation of the conclusions of the Information Paper	
The conclusions of the Information Paper could be expressed in a more neutral or balanced way to avoid perception of bias towards the wind farm industry. The lack of consistent evidence that wind farms affect human health may not mean that wind farms have no health effects but rather that more evidence needs to be gathered.	The Reference Group agreed that the conclusions in the Information Paper be revised to emphasise the inconclusive nature of the direct evidence. A statement was included in the summary of the evidence noting that while NHMRC concluded that there is no consistent evidence that wind farms cause adverse health effects in humans, this finding reflects the results and limitations of the direct evidence and also takes into account parallel evidence on the health effects of similar emissions from other sources. The Information Paper was revised to note that given the limitations of the evidence, the lack of a consistent finding that wind farms affect human health may not mean that wind farms have no health effects.
Further research	
The need for further research should occupy a more prominent place in the Information Paper than an appendix. The Information Paper could conclude that existing evidence is poor and more work is required to obtain better quality data.	The Reference Group agreed that high quality research is needed about possible health effects of wind farms and this was noted in the summary of evidence. The discussion of further research in the Information Paper was moved to the body of the document and refined to include suggestions for future research provided by the expert reviewers.
There is a need for community engagement in the definition and interpretation of new studies in order to ensure that factors thought to be important from a public point of view are included in future research.	The Reference Group's recommendations for further research were revised to note that community engagement would be beneficial in ensuring that research is appropriately targeted to the community's areas of concern. Consultation with the community may assist research investigators in designing future research on this issue.