Australian Government
National Health and Medical Research Council

NHMRC

Public Consultation: Summary of key issues

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

February 2015

WORKING TO BUILD A HEALTHY AUSTRALIA

Publication Details

Publication title:	Public Consultation: Summary of key issues. NHMRC Draft Information Paper: Evidence on Wind Farms and Human Health.
Published:	February 2015
Publisher:	National Health and Medical Research Council
NHMRC Publication reference:	EH57D
Online version:	www.nhmrc.gov.au/guidelines/publications/eh57
ISBN Online:	978-1-925129-26-7
Suggested citation:	National Health and Medical Research Council. *2015 Public Consultation: Summary of key issues. NHMRC Draft Information Paper: Evidence on Wind Farms and Human Health*. Canberra: National Health and Medical Research Council; 2015

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Submissions received

The *NHMRC Draft Information Paper: Evidence on Wind Farms and Human Health* was released for public consultation in February 2014. During the consultation period, stakeholders were invited to comment on the contents of the draft paper and the evidence-based approach that was undertaken and to provide any relevant additional evidence for consideration.

Through the consultation process, 36 submissions were received from various individuals and organisations. Interested stakeholders included individuals living in close proximity to an existing or proposed wind farm, researchers and acousticians investigating the health effects of wind farms or other environmental noise sources, energy companies, environmental organisations, regulatory agencies and organisations concerned with health effects of wind farms or environmental noise more generally.

Full submissions from respondents who agreed to publish their comments are available on the NHMRC Public Consultation website.

Reference Group consideration and revisions to the Information Paper

The public consultation submissions raised a number of issues, most of which related to wind farm noise, although some related to noise-induced vibration from wind farms. The Wind Farms and Human Health Reference Group gave due regard to all submissions 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 selection criteria	
The selection criteria in the systematic literature review were too restrictive.	The systematic literature review followed internationally recognised processes to identify literature and evaluate the strength of the evidence. In order to assess whether wind farms cause health effects, studies were selected that specifically examined the relationships between exposure to wind farm emissions and health outcomes. This comparative analysis is important to determine whether there is a difference in health between groups with different levels of exposure to wind farms (e.g. a "near" group and a "far" group) or a difference in exposure between participants who may be experiencing health effects and participants who are not.

Comment	Reference Group response
Anecdotal evidence was not included in the systematic review.	The Reference Group noted the personal stories and opinions submitted by individuals and agreed that, while individual experiences can raise the possibility of health effects from wind farms, only systematic research can provide the necessary evidence to determine whether reported health effects result from exposure to wind farms. The Information Paper was revised to note the high level of concern expressed by some members of the community.
The systematic review should not have excluded work on infrasound done by Kelley in the 1980s.	The Reference Group considered the three Kelley papers submitted during public consultation: • ***Kelley 1987*** — This laboratory study with sound simulations was included as mechanistic evidence in the Review of Additional Evidence. As infrasound in the study was at a considerably higher level than that measured in the vicinity of wind farms, the Reference Group agreed that the study did not inform discussion in the Information Paper. • ***Kelley et al 1985*** — This paper was excluded from the Review of Additional Evidence as the reviewers questioned whether the study was based on systematically collected data. The paper reports on noise measurements from two locations (referred to as "affected homes") in close proximity to a wind farm. Extensive noise measurements at a smaller wind turbine were also conducted in order to test a numerical model of the noise-generation process. The Reference Group noted that no comparative analysis was conducted in this study to determine whether there was a difference in self-reported annoyance at varying distances from the turbine (as both locations were near the turbine) or at different time periods. • ***Kelley et al 1982*** — This paper was excluded from the Review of Additional Evidence as it was a narrative review (i.e. a review without a specific protocol for selecting and appraising the evidence) and was not based on new (or a new analysis of) systematically collected data.
Case reports and case series were not included in the systematic review.	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. Multiple case reports were submitted during public consultation: • ***Pierpont 2009, Harry 2004*** and ***Iser 2004*** —These papers were excluded from the first Independent Review on the basis that they were case reports or case series and provided no comparative analysis. • ***Pierpont 2010*** — This paper was excluded from the Review of Additional Evidence on the basis that it was a narrative review and was not based on new (or a new analysis of) systematically collected data.

Comment	Reference Group response
Animal studies were not included in the review.	The Reference Group noted that animal studies were excluded from the reviews, as the focus was on possible health effects in humans. As several animal studies were submitted during public consultation, additional expert advice was sought in relation to a key animal study by Salt et al 2013. The Reference Group was advised that while animal studies might suggest a possible mechanism by which infrasound and low-frequency noise may cause health effects, the emissions investigated in animal studies differ in level and duration from wind farm emissions. It is also not certain whether the results from animal studies are applicable to humans, given the complex physiology of hearing. It was beyond the scope of work for the Reference Group to examine the possible biological mechanisms that have been suggested through animal studies. The Information Paper was revised to note that while the emissions investigated in animal studies differ from those of wind farms in level and duration and the applicability of these studies to human health is uncertain, it is possible that animal studies might suggest mechanisms to explain how human health effects could be caused by wind farm emissions.
Evidence on vibroacoustic disease was not included in the systematic review.	The Reference Group noted that the body of evidence on vibroacoustic disease was inconsistent. The exposures to low-frequency noise in these studies were in occupational settings and at much higher levels than expected near a wind farm. The Reference Group agreed that the Information Paper should include mention of "vibroacoustic disease" as a poorly understood condition that has been hypothesised to explain how infrasound may cause human health effects but for which the original research is inconsistently corroborated by independent research. However, the Reference Group agreed that further assessment of the literature on human physiological responses to noise is required to determine whether further research in this area is warranted. It was beyond the scope of work for the Reference Group to examine the possible physiological and pathological mechanisms that have been suggested to explain how wind farm noise may lead to human health effects. Three papers on vibroacoustic disease were submitted during public consultation: • ***Alves-Pereira and Branco 2007*** — This paper was excluded from the Review of Additional Evidence as it had already been considered in the Independent Review and excluded due to unsuitable study design. • ***Alves-Pereira and Branco 2013*** — This paper was excluded from the Review of Additional Evidence as it is a letter that refers to previously published findings. • ***Chao et al 2012*** — This paper was included as parallel evidence in the Review of Additional Evidence.

Comment	Reference Group response
References submitted through public consultation	
References cited in the submissions included: • material published in peer-reviewed journals, full conference papers and conference abstracts; • anecdotal evidence or information provided in surveys, planning assessments, information booklets, position statements, submissions to hearings or legal decisions; • studies on the association between noise-related sleep disturbance and cardiovascular disease; • studies on the effect of expectations on perceptions of the health effects of wind farms; and • studies on biological mechanisms by which wind farm noise may adversely affect human health.	Studies cited in public consultation submissions were considered in the Review of Additional Evidence and included if they met the inclusion criteria specified during public consultation. The information considered in the Review of Additional Evidence also included papers meeting the inclusion criteria that were found by a repeat of the systematic review search conducted by the independent reviewers to capture evidence published since October 2012. Six studies were identified as direct evidence in the Review of Additional Evidence. One additional direct evidence paper contained further analysis of data from three studies in the first Independent Review. This new evidence was reviewed by the Reference Group and incorporated into the Information Paper where relevant. Background, parallel and mechanistic evidence provided during public consultation that met the inclusion criteria also informed the revision of the Information Paper.
Background evidence on noise	
Measurements of wind farm noise in A-weighted decibels (expressed as dBA) may be misleading, as most low-frequency noise is excluded from these measurements and this approach assumes that hearing is the only way that infrasound generates physiological effects.	The Information Paper was revised to clarify that A-weighted measures (where noise levels are adjusted to represent the response of the human ear) include all frequencies but give less weight to low frequencies and infrasound in the total measured noise level because it is harder for these frequencies to be heard by humans at the sound levels at which they normally occur. The Information Paper was revised to recommend further analysis of existing literature on the proposed biological mechanisms by which infrasound could affect human health, as this will inform whether further research into such mechanisms is warranted to improve understanding of the effects of infrasound and low-frequency sound from wind farms.
Statements in the draft Information Paper regarding the levels of infrasound in the vicinity of wind farms were based on a study that was published after the literature review cut-off date and was not peer-reviewed. The independence of the authors and the processes used to measure noise and draw conclusions in this study were questionable.	Background evidence was not required to be peer-reviewed and did not have a cut-off date for inclusion in the first Independent Review. The Evans et al 2013 paper was included as background evidence in the review given its relevance to expected levels of infrasound near wind farms and in other environments and was subsequently cited in the Information Paper. The Reference Group reviewed two critiques of the Evans et al 2013 paper, which raised concerns about how it was conducted — specifically the infrasound levels reported when the wind turbines were not operating. The Reference Group noted that the study acknowledges that the wind turbines were not in operation during these measurements but that another wind turbine was operating some distance away. Additional evidence on levels of infrasound in the vicinity of wind farms provided in submissions was included in the Review of Additional Evidence. A number of studies were included as background evidence and informed revision of the background section on noise in the Information Paper.

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 sound characteristics of wind farm noise and those of noise from other sources. The unique characteristics of wind farm noise include amplitude modulation and coherence. As well as level, exposure includes the character of the noise (impulsivity, frequency content, variability) and its duration. 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 sources	
There is a focus on “direct” health effects although “indirect” health effects may lead to similar health outcomes.	The Reference Group revised the Information Paper to remove references to “direct health effects”, “indirect health effects” and “health-related effects”, as these terms are not clearly defined or consistently used in the literature. The Information Paper includes discussion of physical health, mental health, annoyance, sleep and quality of life.
There is a large body of evidence relating to the adverse health consequences of chronic sleep disturbance and chronic stress from exposure to environmental noise.	Members reviewed evidence on health effects associated with stress and disturbed sleep, which informed revision of the Information Paper. The Reference Group considered 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. While stress was not measured as an outcome in the reviewed studies, the Information Paper was revised to include information that prolonged noise-related annoyance may activate stress pathways and that psychological stress may be a risk factor for cardiovascular disease.
Negative expectations about the effect of wind farm emissions may be a possible explanation for symptoms reported by those living in close proximity to wind farms.	The Reference Group noted emerging evidence on negative expectations about the effect of wind farm emissions. Such expectations might confound the association between wind turbine noise and health effects. The Information Paper was revised to include a statement that both negative and positive expectations of the effect of infrasound may influence its perception and should be considered as a possible confounder in wind farm studies.

Comment	Reference Group response
Formulation of the conclusions of the Information Paper	
The absence of evidence is not equivalent to evidence of absence when establishing whether wind farms cause health effects.	The Reference Group agreed that the conclusions in the Information Paper be revised to emphasise the inconclusive nature of the direct evidence. Given the limitations of the direct evidence, the Reference Group considered mechanistic and parallel evidence on the health effects of similar emissions from other sources in forming their overall conclusions. The Information Paper notes that there was no direct evidence of sufficient quality to demonstrate that wind farms cause human health effects and that the parallel evidence indicates there is unlikely to be any significant health effects at distances greater than 1,500 metres from wind farms. 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.
Regulatory issues	
The conclusions of the Information Paper could be reworded to take into account regulatory criteria in Australia.	The Reference Group considered that while the outcomes of NHMRC's review may assist state, territory and local governments to make decisions about the regulation of wind farms, it was beyond the scope of the Information Paper to comment on existing regulatory and legislative requirements.
Further research	
It is important that field studies be carried out at wind farms in Australia.	The Information Paper recognises the need to conduct field studies relevant to the Australian context that consider objectively measured physiological and biochemical characteristics (including sleep), along with self-reported physical and psychological status (including annoyance and stress). The Reference Group recommended further investigation of the broader social and environmental factors that influence annoyance, sleep disturbance, quality of life and health effects that are reported by residents living in close proximity to wind farms. These factors may be context-specific and may include a person's expectations of their environment, perceived loss of control, visual impacts on the landscape, impacts on land values, uneven distribution of financial benefits, local community relationships and exposure to other noise sources.
Research into vibrations from wind farms is needed.	The Reference Group noted the lack of evidence on noise-induced vibration from wind farms. The Information Paper was revised to note that, under certain circumstances, low-frequency noise may result in vibration in some residences in the form of rattling of windows or objects on shelves. Indoor measurement of vibration associated with low-frequency noise was included as an area for further research in the Information Paper.
Areas of concern expressed by people living in close proximity to wind farms should inform research.	The Reference Group's recommendations for further research were revised to note that wider engagement and participation, including by the community, 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.