Results of the Health Canada Wind Turbine Noise and Health Study

EWEA Workshop on wind turbine noise 2014, Malmo
The studies

Health Canada/Statistics Canada - HC

Wind Turbine Noise and Health Study

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Wind Turbines and Health – A Critical Review of the Scientific Literature
Objective:
To establish links between Noise and Health Effects

CanWEA
Review of existing and previously reported evidence

Health Canada
Study based on newly gathered evidence in Canada
The key differences

**CanWEA**

Accumulated data from 8 separate surveys in Netherlands, Denmark, Germany, Sweden, New Zealand, Poland, USA & UK
(total sample size = 4,095)

Reliance on self-reported effects

**HC**

New data from survey across 18 wind farms in Canada
(Ontario, Prince Edward Island)
(total samples size = 1,238)

Measured health related end-effects
+ self-reported effects
+ measured/calculated WTN levels
The CanWEA study - overview

- reliance on previously published peer reviewed data
- 14 studies
- 8 independent datasets

FIGURE 6. The 14 observational epidemiological studies published in peer-reviewed health or medical journals, all of which were determined to be cross-sectional studies or surveys.
The CanWEA study – summary results

- There is no convincing evidence to directly link wind turbine noise (including infrasound and low frequency sound) to any well-defined disease.
- Associations exist between wind farm noise and annoyance.
- Noise levels have been shown to account for only a modest proportion of annoyance.
- Annoyance seems more strongly related to individual characteristics than to the noise from wind turbines.
- Annoyance associated with wind farm noise shows a consistent small to medium adverse effect on self-rated QOL and well-being.
- More work is required on wind turbine noise characterisation.
- Longitudinal (as opposed to cross-sectional) noise impact studies would be useful.
Health Canada Study – context of study

- introduction of wind energy projects into quieter rural environments
- observational and case studies have disclosed a broad range of claimed health effects
  
  headaches, migraines, sleep disturbance, psychological well-being, QOL, etc.

- uncontrolled individual case studies subject to doubt and should not be relied upon without extreme caution

- exposure to prolonged or excessive sound may directly or indirectly affect individual’s health and well-being

- health risks possibly associated with sleep disturbance – long term sleep disturbance may be an indicator of chronic health effects

- to date no field studies have used objectively measured health-related endpoints
Health Canada – self-reporting versus objective end-points

• self-reporting prone to participation/awareness bias (possibly leading to both over-reporting and under-reporting of effects)

    ….. although the statistical odds of self-reporting have been found to be consistently associated with increasing wind turbine noise levels

• objective health end-points could lend support to self-reported effects

• longitudinal studies acknowledged as having outcome benefits over cross-sectional studies, but impractical to implement
Health Canada – study aims at outset

• target 8 to 12 communities around operational wind farms
• target survey sample to include 2000 dwellings from <500m to 10km distance
• ‘control’ group effectively those living at greater (inaudible) distances
• measure objective health related endpoints to include:
  1. automated blood pressure/heart rate assessment
  2. hair cortisol concentrations
  3. sleep actimetry
• collect self-reported data from 30-35 minute face-to-face computer assisted interview at the participants’ homes
• analyse self-reported and measured outcomes in relation to modelled (validated by measurement) WTN levels (e.g. A, C and G weightings)
• investigate the contribution of LFN and infrasound towards adverse reaction
Study seeks evidence that those living in areas with higher calculated levels of wind turbine noise:

1. experience impairments in sleep, as objectively measured with actimetry;
2. have over-activated stress symptoms, as objectively measured using cortisol concentrations and elevated average blood pressure/heart rate
3. have elevated annoyance based on self-reporting;
4. experience impairment in perceived stress, quality of life and sleep quality based on self-reporting

…. and in so doing establish a statistically significant link between self-reported and objectively measured effects
Health Canada – survey population aspirations

- all dwellings within 600m (>40dB(A)) of the closest turbine;
- selection of dwellings at >600m from the closest turbine;
- door-to-door visits made at various times of day to secure different demographic
  e.g. working adults, shift-workers, at-home mothers/fathers, retired persons, students
- random computer selection of one occupant from each property aged 18 to 79 years of age;
- need to complete 30-35 minute questionnaire in French or English;
- various practical exclusion criteria.
Health Canada – objective health related end points

- blood pressure and heart rate measured electronically;
- sleep effects determined using a wrist worn actimeter
  1. 7 days continuous wearing;
  2. sample 1 minute epochs;
  3. correlate with wind farm operation;
  4. concerns over insomniac behaviour addressed;
- hair cortisol analysis used as a chronic biomarker of stress
  (at ~1 cm growth per month)
Health Canada – wind turbine noise level exposure

- outdoor sound levels calculated using various software packages ISO9613-2. Harmonoise, Nord2000, Swedish method;
- predicted levels to be validated by measurements at sample locations;
- turbine source sound power levels to be measured at each site, IEC61400-11 techniques to be extended to ~6.3Hz;
- ‘general’ environmental levels to also be calculated based on road, rail and aircraft traffic noise predictions;
- indoor levels to be established by measurements of typical outdoor to indoor attenuations;
- infrasound to be considered separately out to 10km distance.
Health Canada – acknowledged limitations of results

- results relate to study populations and will not provide definitive answers
- epidemiological study has strength in the multiple outcomes studied, relatively large sample size and measure of self-reported effects;
- cross-sectional study is an observation of one moment in time;
- temporality makes it impossible to establish causality;
- no information as to the effect of time of exposure to wind turbine noise;
- potential bias in self-reported studies;
- but objective measures can provide context to self-reported results.
Health Canada - actual survey sample population

- study undertaken in Ontario (ON) and Prince Edward Island (PEI);
- 12 wind farms (315 turbines) in ON and 6 wind farms (84 turbines) in PEI;
- 2004 potential households;
- 1238 households with similar demographics participated;
- 78.9% participation rate regardless of separation distance – reduced bias.
Health Canada – results of self-reported effects

The following were not found to be associated with WTN exposure:

• self-reported sleep (e.g. general disturbance, use of medication, diagnosed sleep disorders)

• self-reported illnesses (e.g. dizziness, tinnitus, prevalence of migraines and headaches).

• chronic health conditions (e.g. heart disease, high blood pressure and diabetes);

• self-reported perceived stress and quality of life (WHO QOL scale).

The following was found to be statistically associated with WTN exposure:

• annoyance towards several wind turbine features (i.e. noise, shadow flicker, blinking lights, vibrations and visual impacts)
Health Canada – results of community annoyance effects

The relationship between noise and community annoyance is stronger than any other self-reported measure.

Statistically significant exposure-response relationships were found between WTN exposure and the prevalence of self-reported high annoyance:

- at WTN levels of $>40$ dB(A) the percentage of highly annoyed respondents was 16.5% ON and 6.3% PEI – no explanation for differences;
- at WTN levels of $>35$ dB(A) there was a statistically significant increase in annoyance with increasing WTN level;
- reported WTN annoyance was statistically higher in the summer, outdoors and during evening and night-time;
- reported WTN annoyance significantly dropped where background noise exceeded the WTN level by 10 dB or more;
- annoyance was significantly lower among 110 participants who received personal benefit.
WTN annoyance was found to be statistically related to:

- self-reported health effects;
- objectively measured hair cortisol and blood pressure;
- these findings support, but cannot confirm, a potential link between long term high annoyance and health;
- such associations were not dependent on WTN level or separation distances and were equally observed for road traffic noise annoyance.
Health Canada – objectively measured results

- objectively measured health outcomes were consistently and statistically related to self-reported results;

- WTN level was not observed to be related to hair cortisol concentrations, blood pressure, resting heart rate or measured sleep.

- more than 4000 hours of noise measurements supported the calculated levels of A-weighted WTN levels used in the exposure study;

- all findings consistent with the fact that noise levels were below those expected to directly affect health (WHO Community Noise Guidelines 1999)
Results of two new turbine noise and health studies

THANK YOU