Health Impacts and Exposure to Wind Turbine Noise: Research Design and Noise Exposure Assessment

EWFA, Wind Turbine Noise: From Source to Receiver, Oxford, UK
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Dr. David Michaud, Research Scientist, Health Canada
Outline

- Canadian national and provincial context
- Health Canada’s role
- Wind turbine noise and health
- HC Wind Turbine Noise and Health Study
  - Research objectives
  - Study design
  - Complexities for discussion
  - Peer review/consultation of methodology
- Research team
Canadian National and Provincial Context

• The wind turbine industry is steadily expanding in Canada.
• Currently 148 wind turbine installations nationally.
• Wind capacity currently surpassing 5.9 Gigawatts (GW) - enough to power over 1.4 million homes/year.
  • By 2015 capacity is expected to reach 10 GW – a 20 fold increase over 2000 levels.
• Industry target: 20% of Canada’s electricity generation by wind power by 2025.
• Provinces responsible for provincial environmental assessments, approval, siting, zoning, etc. for wind turbine developments.
• Provincial wind energy targets in place for most provinces.
As of December 4, 2012

Canada's current installed capacity: 5,903 MW

[Map showing wind energy capacity by province/territory in Canada]
Health Canada’s Role

- Health Canada is responsible for protecting the health and safety of Canadians from unsafe radiation emitting devices. The *Radiation Emitting Devices Act* definition of radiation includes acoustical energy (i.e. noise), thus noise-emitting devices are considered to be radiation emitting devices.

- In carrying out this responsibility Health Canada:
  - Participates in the development of international noise standards (e.g. ISO and WHO);
  - Provides advice on the potential health effects of noise from proposed development projects including wind turbine projects;
  - Provides advice on potential health effects of certain types of environmental, occupational and recreational noise (e.g. workplace machinery noise and noisy toys).
Concerns have been raised regarding possible health risks to Canadian residents living in close proximity to wind turbine installations.

- Indirect pathway e.g. sleep disturbance, headaches, nausea, tinnitus, annoyance

Suggestions made that low frequency noise contributes to health impacts.

Limited research in this area to conclude whether or not there is a relationship between exposure to wind turbine noise and harm to human health.
Health Canada’s Wind Turbine Noise Study

Health Canada is working with Statistics Canada and a research team with expertise in areas including acoustics, health assessment, sleep disturbance, clinical medicine, bio-statistics and epidemiology. The study will explore the relationship between wind turbine noise and potential impacts on human health and well-being.
Primary Research Objectives

1) Investigate the prevalence of health effects/indicators among a sample of Canadians exposed to wind turbine noise using self-reported & objective measures;

2) Apply statistical modeling to derive exposure response relationships for wind turbine noise levels/distances and self-reported & objective health measures; and

3) Address an uncertainty that exists regarding low frequency noise from wind turbines as a potential contributing factor towards adverse community reaction.

Results will be considered as part of a broader evidence base and will not provide a definitive answer on their own.
Study Design: Sample identification

Locations in Canada: Initial targeted sample 2000 dwellings from 8-12 wind farms

- 30-55 dB (5 dB bins)
- Distances up to 10 km or more
- Subjects recruited through 'cold calls' with multiple follow up
- All dwellings above 40 dB will be visited
- Random selection for dwellings less than 40 dB
- One person (18-79 yrs) randomly selected from each household
- Equal demographic representation
Study Design: Questionnaire

Questionnaire administered in person (25-min)

Modules

Demographics  Perception of outdoor noise sources
Quality of Life  Housing characteristics
Sleep quality  Physical activity
Chronic conditions  Community engagement
Stress & recent life events

Field test completed; n=24
Study Design: Objective Measures

All subjects will be tested following questionnaire administration.

Measures:

• Blood pressure- automated method
• Hair sample for cortisol analysis- assayed using ELISA
• Sleep- Wrist-worn actimeter and sleep diary: 7 consecutive days (pilot study completed, n=27).
Wind turbine noise levels at each dwelling will be calculated using the following:

Noise measurement

- Sound recordings (including LFN) inside and outside selected homes on completion of the survey
- Room dimensions (LFN calculations)
- Mobile weather station for wind speed/ground moisture
- 6 Hz and above

Noise calculations

- Using common internationally accepted sound modeling protocols (Harmonoise; CadnaA); 6 Hz and above

Pilot testing ongoing
Study Design: Addressing Knowledge Gaps

- Large sample size (~1400 subjects)
- Subjective and objective measures
- Indoor and outdoor WTN assessment (>6 Hz)
- Assessment of exposure-response relationships
- Comparing results to existing national prevalence data

- Complemented by an independent authoritative weight-of-evidence review of all literature by the Canadian Council of Academies.
Peer Review/ Consultation on Methodology

- Science Advisory Board (February 2012)
- Expert committee (27 individuals)
- 60 day web-based public consultation of design
  - Approximately 950 submissions including 350 attachments were received
  - Design committee currently reviewing and responding to feedback
  - Responses to be made available on the HC website
- World Health Organization Noise Committee peer review
- Presentation of design at conferences
  - Internoise 2012, New York City, August 19-22, 2012
  - International Conference on Clean Energy, Quebec City, QC, September 10-12, 2012

• Results in 2014
  • Results will be shared with the provinces and territories.
  • Will support decision makers by strengthening the evidence base.
Research Team

David Michaud, PhD Principal Investigator
Tara Bower, M.Sc
Shirley Bryan, PhD
Christopher Duddek, M.Sc.
Kenneth C. Johnson, PhD.
Antoine Lacroix, Eng., M.Sc.
Serge Legault, B.Sc
Leonora Marro, M.Sc
Brian James Murray, MD FRCP
Werner Richarz, Ph.D., P.Eng.
Paul Villeneuve, Ph.D.

James Brooks, M.D., FRCPC
Paul Dockrill, M.Sc.
Katya Feder, Ph.D.
Stephen Keith, Ph.D.
Eric Lavigne, Ph.D.
Tony Leroux, Ph.D.
D'Arcy McGuire, B.A.
Denis Poulin, M.A.
Jason Tsang, P.Eng.
Shelly Weiss, M.D., FRCPC

International Advisors
Roel H. Bakker, Ph.D.
Norm Broner, Ph.D.
Sabine A. Janssen, Ph.D.
Hideki Tachibana, Ph.D.
Dr. David Michaud  
Research Scientist  
Consumer and Clinical Radiation Protection Bureau, ERHSD  
Health Canada  
Tel: 001 613 954 6670