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Diagnostic criteria for adverse health effects in the environs of wind turbines

Robert Y McMurtry^{1,2} and Carmen ME Krogh³

¹Schulich School of Medicine and Dentistry, Western University, London, Canada

²Prince Edward County, Family Health Team, Picton, Canada

³Independent health researcher, Killaloe, Canada

Corresponding author: Robert Y McMurtry. Email: rymcmurtry1@gmail.com

Summary

In an effort to address climate change, governments have pursued policies that seek to reduce greenhouse gases. Alternative energy, including wind power, has been proposed by some as the preferred approach. Few would debate the need to reduce air pollution, but the means of achieving this reduction is important not only for efficiency but also for health protection. The topic of adverse health effects in the environs of industrial wind turbines (AHE/IWT) has proven to be controversial and can present physicians with challenges regarding the management of an exposure to IWT. Rural physicians in particular must be aware of the possibility of people presenting to their practices with a variety of sometimes confusing complaints. An earlier version of the diagnostic criteria for AHE/IWT was published in August 2011. A revised case definition and a model for a study to establish a confirmed diagnosis is proposed.

Keywords

Case definition, clinical diagnosis, wind turbines, adverse health effects, symptoms

Introduction

In an effort to address climate change, governments seek to reduce greenhouse gases. Alternative and/or renewable energy, including wind power, has been proposed by some.^{1,2} In 2008, the World Health Organization (WHO) states that governments must ‘ensure that economic and social policy responses to climate change and other environmental degradation take into account health equity’ while ‘addressing the exclusionary policies and processes that lead to rural poverty, landlessness, and displacement of people from their homes’.³ Have these admonitions been heeded? Evidence from adverse event reports indicates this may not be the case.^{4–6} For this reason, rural physicians in particular must be aware of the possibility of people presenting to them with multisystem complaints that may be initially confusing (see ‘Third-order criteria’ section).⁷ In order that reports become systematic, a uniform case definition is recommended.

Methods

A revised case definition was developed through a variety of methods including a review of self-reporting surveys published in the peer-reviewed literature and other sources; interviews and correspondence with neighbours reporting health effects; incident reports posted on the Internet; testimony under oath during judiciary proceedings of neighbours reporting health effects; personal dialogue with physicians; and grey literature. We searched PubMed and Google Scholar for articles published since 2000 that included the terms ‘wind turbine health’, ‘wind turbine survey’, ‘wind turbine symptoms’, ‘wind turbine self reports’ and ‘wind turbine noise’. A PubMed search with the search term ‘case definition’ obtained additional background relating to case definitions for emerging diagnostic challenges.

Guidelines for deployment of diagnostic criteria

The healthcare practitioner applying the criteria must be licensed to take a medical or health history and to make a diagnosis. Physicians should consider that children are also affected but in ways sufficiently different from adults. This will require a separate discussion.

The most frequent complaints or symptoms are sleep disturbances or difficulty initiating sleep and/or difficulty with sleep disruption and annoyance producing increased levels of stress and/or psychological distress. Another frequent complaint relates to inner ear symptoms.

The variation of terms of complaints should be understood in the context of people using

many different words to describe similar health effects.⁸

Categories of diagnosis

1. Possible: a potential diagnosis is considered in the differential diagnosis.
2. Probable: cause of complaints is more likely than not related to adverse health effects in the environs of industrial wind turbines (AHE/IWT).
3. Presumed: no other explanation for the diagnosis of AHE/IWT can be found by history, physical and after appropriate investigations.
4. Confirmed: other diagnoses are very unlikely i.e. less than one chance in 20.

Probable diagnosis⁷

First-order criteria (all four of the following must be present)

- (a) Domicile within up to 10 km from IWT.⁹
- (b) Altered health status following the start-up of, or initial exposure to, and during the operation of IWT. There may be a latent period of up to six months.
- (c) Amelioration of symptoms when more than 10 km from the environs of IWT.
- (d) Recurrence of symptoms upon return to environs of IWT.

Second-order criteria (at least three of the following occur or worsen after the initiation of operation of IWT)

- (a) Compromise of quality of life.
- (b) Continuing sleep disturbance, difficulty initiating sleep and/or difficulty with sleep disruption.
- (c) Annoyance producing increased levels of stress and/or psychological distress.
- (d) Preference to leave residence temporarily or permanently for sleep and/or restoration.

Third-order criteria

Three or more of the following frequently occur or worsen following the initiation of IWT. If the symptoms described in second-order criteria (b and c) are present, no further symptoms or complaints are required for the probable diagnosis. Based on the

authors' experience,¹⁰ the following list provides an indication of the more common symptoms:

Neurological

- (a) Tinnitus
- (b) Dizziness
- (c) Difficulties with balance
- (d) Ear ache
- (e) Nausea
- (f) Headache

Cognitive

- (a) Difficulty in concentrating
- (b) Problems with recall or difficulties with recall

Cardiovascular

- (a) Hypertension
- (b) Palpitations
- (c) Enlarged heart (cardiomegaly)

Psychological

- (a) Mood disorder, i.e. depression and anxiety
- (b) Frustration
- (c) Feelings of distress
- (d) Anger

Regulatory disorders

- (a) Difficulty in diabetes control
- (b) Onset of thyroid disorders or difficulty controlling hypo- or hyper-thyroidism

Systemic

- (a) Fatigue
- (b) Sleepiness⁷

Presumed diagnosis

If following a fulsome history, physical and completed investigations no alternative explanation is apparent, and the criteria of probable diagnosis have been met, then a presumed diagnosis of AHE/IWT is warranted. AHE/IWT exists until proven otherwise.

Proposed confirmed diagnosis

Sleep disruption

The confirmation of AHE/IWT could be achievable by the following methods:

- Simultaneous monitoring of physiological parameters, i.e. a sleep study as well as noise energy exposure which ideally should be done in the home of both affected and unaffected individuals with simultaneous recording of sound energy inside and outside the home while capturing all frequencies including decibel and infra- and low-frequency noise and sound pressure levels.

- Blinding of the exposed individuals to control for visual impact is accomplished by testing during sleep.
- For sleep disturbance, measurements electro-physiologically¹¹ and by biomarkers.¹²

The complex physiological monitoring equipment required for a sleep study is not readily mobilised. Alternatively, sleep studies could be carried out in an established clinical sleep laboratory with a source of acoustic energy that accurately reflects the person's exposure to IWT.

Epidemiologic studies would be valuable to establishing the incidence and prevalence of AHE/IWT and have been recommended since 2006.¹³ Schomer¹⁴ comments that double-blinded studies could be done if industry co-operated by turning IWT off and on during noise energy and physiological measurements.

Differential diagnosis

An important differentiating point is the timing of the onset, and the impact of being away from home and the environs of IWT.

Significant improvement away from the environs of wind turbines and a revealed preference for sleeping away from home serve to distinguish between AHE/IWT from other conditions. One alternative explanation is a stressful home environment which might lead to restoration being more likely away from home. A history for family discord and other stressors should be elicited and ruled in or out.

Psychological issues and/or mood disorders may be simultaneously or independently present. If the situation appears more complex, then a referral to a clinical psychologist or psychiatrist might be considered.

Another possible consideration is chemical sensitivity or allergic reaction to contents in the home. The key differentiating feature would be the co-relation between the operation of IWT and symptoms. If the home is not a source of complaint or symptoms when IWT are not operating (see 'first-order criteria [b]' section), then chemical sensitivity or allergic response is highly unlikely.

Discussion

An earlier version of a case definition was published in August 2011⁷ and has been cited in other publications.¹⁵

Research and other references have advanced the acknowledgement that symptoms are predictable¹⁶ or can occur in some.^{6,13,17–21}

Case definitions are frequently developed to assist with diagnosis of complex emerging issues. In some cases, establishing diagnostic criteria can be challenging^{22,23} and can evolve over time.²⁴

There are widespread reports of sleep disturbance in environs of IWT.^{6,10,18} The WHO states 'Uninterrupted sleep is a prerequisite for good physiological and mental functioning...'²⁵

Physiological monitoring employed in sleep studies of persons exposed to IWT are proposed to demonstrate measurable changes.²⁶ Quality of sleep, a 'prerequisite for good health'²⁷ can be measured objectively.

International reports of symptoms are consistent, and it is imperative that a systematic approach to diagnosis of AHE/IWT be adopted. The impacts can be significant resulting in many cases of people abandoning their homes temporarily or permanently.^{4,5,17,21} Since Gohlke et al.²⁸ state: 'Wind energy will undoubtedly create noise, which increases stress, which in turn increases the risk of cardiovascular disease and cancer', home abandonment is a reasoned option.

This topic has been surrounded by competing claims and controversy^{5,29–32} and has presented health professionals with management challenges. While the need for definitive evidence of the precise mechanism involved remains, with increased prevalence of wind energy facilities physicians can expect to see increasing numbers of rural patients reporting adverse effects.¹⁷

Conclusions

1. An updated version of the criteria for the diagnosis of AHE/IWT has been presented.
2. A change has been made in the third-order criteria which are commonly present but not necessary for a diagnosis to be made.
3. If the criteria for probable diagnosis are satisfied and investigation reveals no logical alternative to explain the health effects, a presumed diagnosis of AHE/IWT may be made.
4. A model for a study to establish a confirmed diagnosis has been proposed.

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References

- Green Energy and Economy Act. Green Energy and Green Economy Act, S.O. 2009, c. 12 - Bill 150, Government of Ontario 2009.
- CPH 2025. *Climate Plan: A Holistic Plan*. Copenhagen: Denmark. See http://subsite.kk.dk/sitecore/content/Subsites/CityOfCopenhagen/SubsiteFrontpage/Business/Growth_and_partnerships/~/_media/F5A7EC91E7AC4B0891F37331642555C4.ashx (last checked 17 March 2014).
- CSDH. *Closing the Gap in a Generation: Health Equity Through Action on the Social Determinants of Health. Final Report of the Commission on Social Determinants of Health*. Geneva: World Health Organization, 2008: 4. See http://www.who.int/social_determinants/thecommission/finalreport/en/ (last checked 17 March 2014).
- Krogh CME. Industrial wind turbine development and loss of social justice? *Bull Sci Technol Soc* 2011; 31: 321.
- Phillips CV. Properly interpreting the epidemiologic evidence about the health effects of industrial wind turbines on nearby residents. *Bull Sci Technol Soc* 2011; 31: 303.
- Shepherd D, McBride D, Welch D, Dirks KN and Hill EM. Evaluating the impact of wind turbine noise on health related quality of life. *Noise Health* 2011; 13: 333–339.
- McMurtry RY. Toward a case definition of adverse health effects in the environs of industrial wind turbines: facilitating a clinical diagnosis. *Bull of Sci Technol & Soc* 2011; 31: 316.
- Council for International Organizations of Medical Sciences (CIOMS). *Reporting Adverse Drug Reactions, Definitions of Terms and Criteria for Their Use*. Editorial Group: Bankowski Z, Bruppacher R, Crusius I, et al. ISBN 92 9036 071 2. See http://cioms.ch/publications/reporting_adverse_drug.pdf (last checked 17 March 2014).
- Authors' note: The premise of considering effects up to 10 km is the result of adverse event reports up to 10 km and Health Canada's announcement of February 10, 2013 that regarding the Wind Turbine Noise and Health Study, noise measurements at residences will be made at distances up to 10 km from the wind turbines. See http://www.hc-sc.gc.ca/ewh-semt/consult/_2013/wind_turbine-eoliennes/research_recherche-eng.php (last checked 17 March 2014).
- Krogh CME, Gillis L, Kouwen N and Aramini J. WindVOiCe, a self-reporting survey: adverse health effects, industrial wind turbines, and the need for vigilance monitoring. *Bull Sci Technol Soc* 2011; 31: 334.
- World Health Organization. *Burden of Disease From Environmental Noise: Executive Summary*. Geneva: World Health Organization, 2011: xv.
- Möller-Levet CS, Archer SN, Bucca G, Laing EE, Slak A, Kabiljo R, et al. Effects of insufficient sleep on circadian rhythmicity and expression amplitude of the human blood transcriptome. *Proc Natl Acad Sci* 2013; 110: E1132–E1141.
- Chouard CH, Auquier L, Bounhoure J-P, et al. Académie nationale de médecine. Leretissement du fonctionnement des éoliennes sur la santé de l'homme. Rapport et recommandations d'un Groupe de Travail March 14, 2006. See <http://www.academie-medecine.fr/publication100035507/> (last checked 17 March 2014).
- Schomer PD. Comments on recently published article "concerns about infrasound from wind turbines". *Acoust Today* 2013; 9: 4.
- Google Scholar Citations, McMurtry RY, case definition adverse health effects, wind turbines. See https://www.google.ca/search?q=mcmurtry+college&oq=mcmurtry%2C+&aqs=chrome.5.69i57j0l5.10051j0j8&sourceid=chrome&espv=210&es_sm=93&ie=UTF-8#q=mcmurtry%2C+case+definition+adverse+health+effects%2C+wind+turbines (last checked 17 March 2014).
- Howe B. *Low Frequency Noise and Infrasound Associated With Wind Turbine Generator Systems: A Literature Review*. Ontario Ministry of the Environment RFP No. OSS-078696. Mississauga, ON: Howe Gastmeier Chapnik Limited, 2010.
- Jeffery RD, Krogh C and Horner B. Industrial wind turbines and adverse health effects. *Can J Rural Med* 2014; 19: 21–26.
- Nissenbaum MA, Aramini JJ and Hanning CD. Effects of industrial wind turbine noise on sleep and health. *Noise Health* 2012; 14: 237–243.
- Pierpont N. *Wind Turbine Syndrome: A Report on a Natural Experiment*. K-Selected Books: Santa Fe (NM): K Selected Books, 2009.
- Harry A. *Wind Turbines, Noise and Health*, 2007. See http://docs.wind-watch.org/wtnoise_health_2007_a_harry.pdf (last checked 17 March 2014).
- Hansard. Legislative assembly, first session, 39th parliament première session, official report. Standing Committee on Green Energy and Green Economy Act. 2009: G516, G-547. See http://www.ontla.on.ca/web/committee-proceedings/committee_transcripts_details.do?locale=en&Date=2009-04-15&ParlCommID=8856&BillID=2145&Business=&DocumentID=23801#P68_2644 (2009, last checked 24 September 2014).
- Holmes GP, Kaplan JE, Gantz NM, Komaroff A, Schonberger LB, Straus SE, et al. Chronic fatigue

- syndrome: a working case definition. *Ann Int Med* 1988; 108: 387–389.
23. Centers for Disease Control and Prevention. *Diagnosis, Diagnostic Challenges: Autism Spectrum Disorders*. See <http://www.cdc.gov/ncbddd/autism/screening.html> <http://mc.manuscriptcentral.com/jro> (last checked 28 January 2014).
 24. Reeves WC, Lloyd A, Vernon SD, Klimas N, Jason LA, Bleijenberg G, et al. Identification of ambiguities in the 1994 chronic Fatigue syndrome research case definition and recommendations for resolution, and the International Chronic Fatigue Syndrome Study Group. *BMC Health Serv Res* 2003; 3: 25.
 25. World Health Organization. Executive Summary, 3. Adverse health effects of noise. In: Berglund B, Lindvall T and Schwela DH (eds) *Guidelines for Community Noise*. Geneva: World Health Organization, 1999: ix.
 26. Michaud D, Feder K, Bower T, et al. *Health Canada Impacts and Exposure to Sound From Wind Turbines: Updated Research Design and Sound Exposure Assessment*, 2013. See http://www.hc-sc.gc.ca/ewh-semt/consult/_2013/wind_turbine-eoliennes/research_recherche-eng.php (last checked 23 July 2014).
 27. Hanning C and Evans A. Wind turbine noise. *BMJ* 2012; 344: e1527.
 28. Gohlke JM, Hrynokow SH and Portier CJ. Perspectives editorial health, economy, and environment: sustainable energy choices for a nation. The National Institutes of Health (NIH). *Environ Health Perspect* 2008; 116: A236–A237.
 29. Enbom H and Enbom IM. Infrasound from wind turbines: an overlooked health hazard. *Läkartidningen* 2013; 110: 1388–1389.
 30. Salt AN and Lichtenhan JT. How does wind turbine noise affect people? *Acoust Today* 2014; 10: 20–28.
 31. Jeffery RD, Krogh C and Horner B. Adverse health effects of industrial wind turbines. *Can Fam Phys* 2013; 59: 921–925.
 32. Canadian Wind Energy Association. *Addressing Concerns with Wind Turbines and Human Health*, 2009. See <http://windfacts.ca/your-health> (last checked 17 March 2014).