Human response to wind turbine noise –
perception, annoyance and moderating factors

Akademisk avhandling

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av
Eja Pedersen

Fakultetsopponent:
Professor emeritus Sten Ljunggren
KTH, Stockholm

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I Pedersen, E., and Persson Waye, K. Perception and annoyance due to wind turbine noise – a dose-response relationship. Journal of the Acoustical Society of America, 2004, 116, 3460–3470.

II Pedersen, E., Hallberg, L.R.-M., and Persson Waye, K. Living in the vicinity of wind turbines – a grounded theory study. Qualitative Research in Psychology. In press.

III Pedersen, E., and Persson Waye, K. Wind turbine noise, annoyance and self-reported health and wellbeing in different living environments. Occupational and Environmental Medicine. Published online, 1 Mar 2007; doi:10.1136/oem.2006.031039.

IV Pedersen, E., and Larsman, P. The impact of visual factors on noise annoyance among people living in the vicinity of wind turbines. Submitted.

Sahlgrenska akademin
GÖTEBORGS UNIVERSITET

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Eja Pedersen

Occupational and Environmental Medicine, Department of Public Health and Community Medicine, Institute of Medicine, The Sahlgrenska Academy, Göteborg University, Sweden

Aims The aims of this thesis were to describe and gain an understanding of how people who live in the vicinity of wind turbines are affected by wind turbine noise, and how individual, situational and visual factors, as well as sound properties, moderate the response.

Methods A cross-sectional study was carried out in a flat, mainly rural area in Sweden, with the objective to estimate the prevalence of noise annoyance and to examine the dose-response relationship between A-weighted sound pressure levels (SPLs) and perception of and annoyance with wind turbine noise. Subjective responses were obtained through a questionnaire (n = 513; response rate: 68%) and outdoor, A-weighted SPLs were calculated for each respondent. To gain a deeper understanding of the observed noise annoyance, 15 people living in an area were interviewed using open-ended questions. The interviews were analysed using the comparative method of Grounded Theory (GT). An additional cross-sectional study, mainly exploring the influence of individual and situational factors, was carried out in seven areas in Sweden that differed with regard to terrain (flat or complex) and degree of urbanization (n = 765; response rate: 58%). To further explore the impact of visual factors, data from the two cross-sectional studies were tested with structural equation modelling. A proposed model of the influence of visual attitude on noise annoyance, also comprising the influence of noise level and general attitude, was tested among respondents who could see wind turbines versus respondents who could not see wind turbines from their dwelling, and respondents living in flat versus complex terrain.

Results Dose-response relationships were found both for perception of noise and for noise annoyance in relation to A-weighted SPLs. The risk of annoyance was enhanced among respondents who could see at least one turbine from their dwelling and among those living in a rural in comparison with a suburban area. Noise from wind turbines was appraised as an intrusion of privacy among people who expected quiet and peace in their living environment. Negative experiences that led to feelings of inferiority added to the distress. Sound characteristics describing the amplitude modulated aerodynamic sound were appraised as the most annoying (swishing, whistling and pulsating/throbbing). Wind turbines were judged as environmentally friendly, efficient and necessary, but also as ugly and unnatural. Being negative towards the visual impact of the wind turbines on the landscape scenery, rather than towards wind turbines as such, was strongly associated with annoyance. Self-reported health impairment was not correlated to SPL, while decreased well-being was associated with noise annoyance. Indications of possible hindrance to psycho-physiological restoration were observed.

Conclusions Wind turbine noise is easily perceived and is annoying even at low A-weighted SPLs. This could be due to perceived incongruence between the characteristics of wind turbine noise and the background sound. Wind turbines are furthermore prominent objects whose rotational movement attracts the eye. Multimodal sensory effects or negative aesthetic response could enhance the risk of noise annoyance. Adverse reactions could possibly lead to stress-related symptoms due to prolonged physiological arousal and hindrance to psychophysiological restoration. The observed differences in prevalence of noise annoyance between living environments make it necessary to assess separate dose-response relationships for different types of landscapes.

Key words: wind turbines, noise annoyance, sound perception, audio-visual interaction, low-level noise exposure

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