



Noise annoyance and sleep disturbance in the vicinity of five wind farms in Finland

Anu W TURUNEN¹; Tarja YLI-TUOMI¹; Pekka TIITTANEN¹; Pekka TAIMISTO¹; Timo LANKI¹

¹ National Institute for Health and Welfare, Department of Health Protection

Living Environment and Health Unit, Finland

ABSTRACT

Wind turbine noise has become a concern in many countries. Our aim was to study the prevalence of annoyance and sleep disturbance due to wind turbine noise in Finland. A total of 2,828 questionnaires were sent to randomly selected persons living <2.5, 2.5–5, and >5–10 km from five wind farms. The intention of the questionnaire was masked. The response rate was 48 % (n=1,346). Within <2.5 km of the closest turbine, 1.6 % (n=6) of the participants were very or extremely annoyed by wind turbine noise indoors (windows closed) and 4.6 % (n=17) outdoors. Very or extremely high sleep disturbance was reported by 1.6 % (n=6) of the participants living in the closest distance zone. In addition, the prevalence of symptoms, diseases and medications did not differ between the closest and the two further distance zones. High annoyance and severe sleep disturbance due to wind turbine noise were quite rare in the vicinity of five wind farms in Finland. However, this does not exclude the possibility of some local problems in the vicinity of other wind farms.

Keywords: noise annoyance, sleep disturbance, wind turbines, wind farms

I-INCE Classification of Subjects Number(s): 63.2, 63.4, 14.5.4

1. INTRODUCTION

Although wind power is a source of clean and renewable energy that does not contribute to global warming, wind power production is alleged to have adverse health effects mainly due to noise it produces. For example, various non-scientific case-reports among residents living close to wind turbines have listed a multitude of symptoms that are thought to be caused by wind turbine noise. However, epidemiological evidence on the health effects of wind turbine noise is scarce. There seems to be sufficient evidence only to support the association between wind turbine noise and annoyance (1, 2, 3, 4, 5) but no clear dose-response function or a threshold value have been established so far even for annoyance. The evidence is even weaker regarding other potential effects such as sleep disturbance (1, 5, 6) and quality of life (7). However, annoyance can often explain sleep disturbance and other effects better than sound pressure level (1, 3, 5, 8), and noise annoyance has been associated with decreased health-related quality of life (9) and possibly even somatic diseases (10).

Currently, the number of new wind farms is increasing rapidly and many of them will be built close to residential areas. At the same time, the public discussion on the health effects of wind turbine noise is extremely polarised and concerns about the effects wind turbine noise on both soundscape and landscape are increasing in Finland and also globally.

Our primary aim was to study the prevalence of annoyance and sleep disturbance due to wind turbine noise in Finland. In addition, we wanted to see whether the prevalence of symptoms, diseases, and medications differs between the distance zones, and how wind turbine noise is perceived as a health risk.

¹ gf@aaa.com

2. METHODS

Five areas were selected for the questionnaire study based on the number of residential buildings within <2.5 km around the wind farm. The criterion was to have at least 100 residential buildings in the closest zone in order to get enough population for future epidemiological analyses. The residential buildings were identified based on property identifiers from the National Land Survey of Finland, and the Population Register Centre performed the random sampling. One person per residence (a maximum of 200 residents) were selected from each three distance zones (<2.5, 2.5–5, and >5–10 km) around five wind farms. Regarding the farms, the nominal output of the turbines varied between 2 and 3.3 MW and the total nominal output of the farms was 18–53 MW.

A total of 2,828 questionnaires were sent. The purpose of the questionnaire was masked by asking the respondent to assess the effects of several factors in their living environment in addition to wind farms such as busy roads, railroads, industry, neighbours, and farms. The main topics of the questionnaire were e.g., satisfaction with living environment; visibility of and distance from closest human-built structures and their subjective effects on scenery, disturbance, and the value of the dwelling as well as potential direct financial benefit from them; exposure to environmental noise and annoyance (inside, outside, while sleeping); frequency of noise exposure and effect on keeping windows open, spending time outdoors, and choice of residence; noise sensitivity; attitudes and risk perceptions regarding environmental exposures. In addition, the questionnaire included questions on socio-economic status, dwelling characteristics (e.g., ownership, living floor, air conditioning), health status (e.g., symptoms, diseases, medications, stress), and life habits (e.g., smoking, alcohol consumption, physical activity).

3. RESULTS

The response rate ranged between 37 % and 58 % in the five areas, and the overall response rate was 48 % (n=1,346). Within <2.5 km of the closest turbine, 6 % (n=22) of the respondents felt that they were very or extremely exposed to wind turbine noise whereas 66 % (n=244) of the participants perceived no exposure at all. The respective proportions were 1.8 % (n=8) and 91 % (n=413) within 2.5–5 km, and 0.4 % (n=2) and 98 % (n=447) within >5–10 km of the closest turbine. In the closest zone, 3.4 % (n=13) reported hearing wind turbine noise indoors and 12 % (n=45) outdoors at least several times per week. In the second closest zone, two participants reported hearing wind turbine noise indoors and 1.7 % (n=8) outdoors. Regarding the furthest zone, no auditory perception was reported.

In the closest zone, 1.6 % (n=6) of the participants were very or extremely annoyed by wind turbine noise indoors (windows closed) and 4.6 % (n=17) outdoors. Indoors, 87 % (n=319) and outdoors 75 % (n=284) were not annoyed at all. In the two further zones, 95–98 % of the participants were not at all annoyed.

Very or extremely high sleep disturbance was reported by 1.6 % (n=6) of the participants living in the closest distance zone. In the second closest zone, 0.9 % (n=4) of the participants were very or extremely disturbed and 98 % (n=449) had no sleep disturbance due to wind turbine noise. In the most distant zone, one person reported having extremely high sleep disturbance due to wind turbine noise.

Based on self-report, there were no differences between the distance zones with regard to a large array of symptoms (e.g., headache, nausea, dizziness, tinnitus, ear symptoms, arrhythmia, fatigue, anxiety), diseases (e.g., hypertension, cardiovascular diseases, diabetes, lung diseases, depression) or medications.

Wind turbine noise was considered to pose a high or extremely high risk to personal health by 2.5 % (n=9) of the respondents in the closest distance zone, 2.0 % (n=9) of the respondents in the second closest zone and 1.6 % of the respondents in the most distant zone. Regarding human health in general, the respective proportions were 5.8 % (n=21), 7.2 % (n=33), and 10 % (n=45). The majority of the respondents ranked wind turbine noise as not being a risk for their own health and as a small or moderate risk for human health in general. In all three distance zones, 44–47 % (n=175–198) of the respondents were at least somewhat worried about the health risks of wind power production and 19–22 % (n=80–84) considered low-frequency noise produced by wind turbines hazardous.

4. CONCLUSIONS

High annoyance and severe sleep disturbance due to wind turbine noise were quite rare in the vicinity of five wind farms in Finland, even in the closest distance zone. In addition, the prevalence of symptoms, diseases and medications did not differ between the closest and the two further distance zones. However, it is possible that there can be some local problems in the vicinity of other wind farms not investigated in this study. The majority of the respondents seemed to be at least somewhat worried about the health risks of wind energy production although only a few of them were considerably annoyed or disturbed by wind turbine noise.

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