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Relationship between exposure to wind turbine noise and subjective and objective sleep disorder in southern part in Japan – pilot study using new technology in sleep monitoring watch "actigraphy"

Yoshitaka Morimatsu Department of Environmental Medicine, Kurume University School of Medicine, 67 Asahi-machi, Kurume, 830-0011 Japan
E-mail: yoshitaka_morimatsu@med.kurume-u.ac.jp
Kunio Hara Department of Public Health, Graduate School of Medicine, Teikyo University, 2-11-1 Kaga, Itabashi-Ku, Tokyo 173-8605 Japan
E-mail: kunio.hara@med.teikyo-u.ac.jp
Yoshihisa Fujino Department of Public Health, University of Occupational and Environmental Health, 1-1 Iseigaoka, Yahatanishi-Ku, Kitakyushu 807-8555 Japan
E-mail: zenq00@gmail.com
Tatsuhiko Kubo Department of Public Health, University of Occupational and Environmental Health, 1-1 Iseigaoka, Yahatanishi-Ku, Kitakyushu 807-8555 Japan
E-mail: kubo@med.uoeh-u.ac.jp
Yuuki Matsumoto Department of Environmental Medicine, Kurume University School of Medicine, 67 Asahi-machi, Kurume, 830-0011 Japan
E-mail: yuuki_m@med.kurume-u.ac.jp

Nanae Kushino Department of Environmental Medicine, Kurume University School of Medicine, 67 Asahi-machi, Kurume, 830-0011 Japan
E-mail: kushino_nanae@med.kurume-u.ac.jp
Mihoko Mori Department of Environmental Medicine, Kurume University School of Medicine, 67 Asahi-machi, Kurume, 830-0011 Japan
E-mail: kano@med.kurume-u.ac.jp
Hoshiko Michiko Department of Environmental Medicine, Kurume University School of Medicine, 67 Asahi-machi, Kurume, 830-0011 Japan
E-mail: hmichi@med.kurume-u.ac.jp
Tatsuya Ishitake Department of Environmental Medicine, Kurume University School of Medicine, 67 Asahi-machi, Kurume, 830-0011 Japan
E-mail: tishitak@med.kurume-u.ac.jp

Summery

Wind turbine facilities are becoming more remarkable energy after east Japan earthquake. But health effect from exposure to wind turbine is unclear at the present moment. We report a cross-sectional study according to the health-related quality of life of individuals resulting in the southern part with wind farm in Japan. Self-administered questionnaires, which included mental health and sleep disorder, were delivered to all households through post office. Most residents had favorable feeling to wind turbine systems, but statistically significant differences were noted in some domain scores, and some residents exposed to wind turbine noise also reported significantly lower sleep quality. We explored which the subjective and objective evaluation are consistent with situation of sleep. There were some relationship between quality of sleep and the distance from the wind turbine facility. On the other hand, we measured sound level occurred by wind turbine outdoors, and we calculated the correlation with presumptive level of noise and the distance from the wind turbine. Furthermore, some volunteers participated to record of sleep pattern using sleep actigraphy, measures of sleep situation were obtained from 18 volunteers from residents. We report the result of this pilot study that the correlation between the distance from wind turbine and sleep pattern.

1. introduction

People has begun to worry about the health impacts of exposure to a perceived environmental hazards creates symptom expectations after east Japan earthquake “Fukushima” in Japan. Wind energy is a important component of future strategies for clean power supply, but there are some reports that the infrasound produced by wind turbines causes health complaints in nearby

residents[1]. Furthermore, opposition to the construction of turbines is often founded on media reports that a number of people living within the vicinity of wind farms experience a range of nonspecific symptoms such as sleep disturbance, headaches, ear problems, dizziness, nausea, and heart palpitations[2)3)]. Thus increasing numbers of complains about sleep disturbance and adverse health effects have been documented, but there is no report that the mechanism could explain the experience of such nonspecific symptoms for example “annoyance”. In this study we report current situation of south wind farm island in Japan through a cross-sectional study according to the health-related quality of life of individuals residing in the island. Moreover we report the correlation between the distance from wind turbine institution and sleep pattern using sleep senser “actigraphy”.

2. Study design

2.1 Study field “Nagashima-cho” is small island closed to southern island “Kyushu” in Japan. The residency is about 9000 people, most of the area is mountain, and the south area of the island is within 30 km far from atomic energy plant “Sendai”. There are 26 vicinity of wind turbine in this island, its product about 10,000 MW per year. They have pride for wind turbine facility and call their island “the town of wind turbine”.

2.2 Method 1; Questionnaire survey A couple of our original self-administered questionnaires, which included the evaluation of depression (K-6 questionnaires), poor self-rated question, information on sleep quality, and night sleepiness (Table 1)[4)], were delivered to all households in this town through post office. And residencies reply it into a post at will.

2.3 Method 2; Sleep monitoring A total of 40 volunteers from residents (20 women, 20 men) have attached sleep sensor watch “actiwatch 2 ” made by Phillips for a week. We could analyze 18 data of residents (8 women, 10 men) and we had compared two groups by the distance from wind turbine facility and residence. One is the residents who live the area within 1500m of the vicinity of wind turbine, the other is the residents who live without 1500m from wind turbine facility.

2.4 Statistical analysis Multivariate logistic analysis were performed for the symptom of depression and poor self-rated health after controlling for gender, age, during of residence, time of residence on holiday, smoking or non-smoking, be or not be at work, having room in their budget. Model is random section model as 58 area is second level.

3. Results

3.1 Result of questionnaire survey Recovery rate of questionnaires is 19.0% and efficiency percentage is 16.9% after excluding answer which is furniture

vibrated by wind turbine, from reflecting of wind turbine and residency in nursing home. The odds rate of hear wind turbine noise for K6 is high (OR 2.33, 95%CI 1.41-3.84, p=0.001), and for poor self-rated health is high (OR 1.72, 95%CI 1.20-2.48, p=0.003). On the other hand, significant relationship between view of wind turbine and nocturnal awakening were identified. Significant relationship between hear wind turbine noise and early morning awakening (OR 1.871, 95%CI 1.187-2.951, p=0.007) and sleep inertia were identified. But there is no significant relationship according to analysis for 569 residents who answered have agreeable feeling for wind turbine.

3.2 Result of Sleep monitoring Average is 49.7 year old, average sleep hours is 380.5 min, average sleep efficiency is 93.3. The number of residents who live the area within 1500m of the vicinity of wind turbine is 7, the number of residents who live without 1500m from wind turbine facility is 11. There is no significant relationship between distance from wind turbine facility and sleep hours, sleep efficiency.

4. Conclusions

This study demonstrated that viewing information about southern small island with the vicinity of wind turbines. The residents of this island are interested in energy because they live within about 30 km from atomic energy institution. Thence most residents in this island hope the change energy source from atomic energy to renewable energy. This is one of the reason that high rate of favorite impression for wind turbine system.

Low frequency sound is consistently present in the environment caused variously by air turbulence, ocean waves, traffic, and other machinery. It may be audible at sufficiently high pressure levels, but it sometimes occurs when the frequency of a sound wave is below the low frequency limit of audible sound (approximately 20 Hz). Some findings according to wind turbine noise on media reports are nonspecific symptom, there is no scientific evidence which support a direct pathophysiological link between the generation of infrasound by wind turbine and health complains. Actually, we couldn't measure unknown sound by vicinity of wind turbine. From the above, the main problem by low frequency sound from wind turbine is audible low frequency sound (approximately 20～100 Hz). Low frequency sound from wind turbine institution is intermittent, residents are exposed to its 24 hours. The agreeable opinion for infrasound is change by the method of pre-information proved by sham-study[5)]. Furthermore, agreeable feelings for audible low frequency sound affected by other factor, for example residents in Denmark have favorable impression for wind turbine facility because of its economical benefits. And hence, the impression for wind turbine system depends on the timing and method of giving information for residents.

Given the lack of evidence for a direct pathogenic link between any aspect of the operation of wind turbines and symptom reporting, this study suggests promising

future direction for future research and we expect that the decision making the minimum set back distance for wind turbines from residences in Japan.

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