



Residents' attitude towards air traffic and objective sleep quality are related

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ABSTRACT

Annoyance and physiological responses induced by traffic noise exposure vary greatly among residents. Recently, differences in aircraft noise induced awakening reactions during sleep have partly been explained by stable individual vulnerabilities to noise.

In 2012 as part of the NORAH sleep study, we investigated in a sample of 81 residents near Frankfurt Airport the relationship between attitude towards air traffic and sleep quality recorded polysomnographically at home. By using five-point rating scales the participants assessed their attitude towards air traffic (from 1 = negative to 5 = positive) and evaluated its necessity (from 1 = not necessary to 5 = highly necessary).

Residents with a negative attitude towards air traffic (score < 3; N=28) took longer to fall asleep, spent more time awake after sleep onset, had a reduced sleep efficiency and less deep sleep. Participants who evaluated air traffic to be of no or moderate necessity (score < 4; N=22) slept less deeply.

These statistically significant differences suggest that residents' sleep quality and subjective evaluation of air traffic are related. The causality of this relationship, however, i.e. whether a negative attitude leads to more severe sleep disturbances or, conversely, whether poor sleep quality triggers a negative attitude towards air traffic, remains unclear.

Keywords: Aircraft Noise, Sleep, Polysomnography, attitude
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1. INTRODUCTION

Frankfurt Airport is one of Germany's high traffic density airports. Residents frequently report being disturbed as well as annoyed, and fear negative health implications. As part of a mediation process among the different stakeholders at Frankfurt airport the NORAH (Noise-Related Annoyance, Cognition, and Health) study investigated from 2011-2015 the impact of aircraft noise on health, sleep disturbances, quality of life, and the mental development of children living in the vicinity of Frankfurt Airport (1, 2). The investigation started before a new runway together with a nightly flight ban between 11 p.m. and 5 a.m. was put into operation in October 2011.

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Aircraft noise interferes with residents' lives in multifaceted ways ranging from interrupted activities and communication during work and leisure time to disrupted sleep and long-term associations with cardiovascular diseases (3, 4). The severity of physiological reactions to nightly aircraft noise including sleep disruptions like arousals or awakenings varies among individuals (5). This inter-individual variance cannot be explained exclusively by age or gender.

Therefore, we hypothesized that a person's attitude towards air traffic and sleep quality might be related.

2. METHODS

As part of the NORAH sleep study, we investigated in total 81 residents near Frankfurt Airport in 2012.

Participants underwent polysomnographic measurements during two to three nights each in their home environment. Sleep EEG (F4/A1, C4/A1, O2/A1) was recorded including the electrooculogram (EOG), the electromyogram (EMG), the 2-lead electrocardiograms (ECG), respiratory movements of thorax and abdomen, and finger pulses. Sleep and wake epochs were determined according to standard criteria (6).

In addition, participants rated their attitude towards air traffic (from 1 = negative to 5 = positive) and evaluated its necessity (from 1 = not necessary to 5 = highly necessary) on five-point scales.

Data of seventy-four residents were available for analyses. Twenty-eight residents (18 female) with a mean age of 44 ± 16 (SD) years had a negative attitude towards air traffic (score ≤ 2). They contributed 66 polysomnographically investigated nights. Forty-six participants (29 female) reported a moderate to positive attitude (score > 3 , mean age 44 ± 15 years) and were examined during 108 nights. Twenty-two participants (15 female) judged air traffic as having no to moderate necessity (score ≤ 3 , mean age 45 ± 10 years) and were investigated during 54 nights, whereas 52 residents (32 female) indicated a high necessity (score > 3 , mean age 43 ± 17 years) contributing 120 nights.

Generalized estimating equations (GEE) adjusting for age and gender were used for analyses. Primary outcome parameters of sleep were total sleep time (TST), sleep onset duration (SOL), wake duration after sleep onset (WASO), sleep efficiency (SE), deep sleep, and REM sleep duration.

3. RESULTS AND DISCUSSION

Residents whose attitude towards air traffic was negative took significantly longer to fall asleep (17.3 min) than participants whose attitude was not negative (11.7 min). A negative attitude was also associated with a longer WASO (42.0 min vs. 29.7 min), a lower SE (88% vs. 91%), and a shorter deep sleep duration (98.0 min vs. 111.7 min). The two groups were not significantly different regarding TST or REM sleep duration.

Residents who evaluated air traffic as being of no to moderate necessity had a significantly shorter deep sleep duration (96.1 min) compared to participants who judged air traffic as highly necessary (111.2 min). TST, SOL, SE, WASO, and REM sleep did not differ significantly between the two groups.

These results suggest an association between attitude towards air traffic and objective sleep quality that cannot be explained exclusively by age and gender. The values that we obtained for the investigated sleep parameters, however, were within the normal range for this age group (7), and this

was the case for both, residents with negative and residents with positive attitude. Dang-Vu et al. (8) proposed that inter-individual differences in reaction probability to noise can be explained by a high sleep spindle rate as marker for sleep stability under noisy conditions. It remains to be explored whether residents with a negative attitude towards air traffic also show a smaller sleep spindle rate than residents with a positive attitude towards air traffic.

4. CONCLUSIONS

These statistically significant differences suggest that residents' sleep quality and subjective evaluation of air traffic are related. The causality of this relationship, however, i.e. whether a negative attitude leads to more severe sleep disturbances or, conversely, whether poor sleep quality triggers a negative attitude towards air traffic, remains unclear.

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