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Noise and somatic symptoms: A role for personality traits?

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ABSTRACT

Objectives: We investigated the role of a stress-sensitive personality on relations between noise, noise annoyance and somatic symptom reporting. First, we investigated the cross-sectional association of road traffic noise exposure and somatic symptoms, and its modification by hostility and vulnerability to stress. Second, we investigated the cross-sectional association of noise annoyance from eight sources (e.g. road traffic, aircraft, neighbours) and somatic symptoms, and it's confounding by hostility and vulnerability to stress.
Methods: Data were obtained from LifeLines, a general population cohort from the Netherlands. Road traffic noise was estimated using the Common Noise Assessment Methods in Europe (CNOSSOS-EU) noise model. Noise annoyance, hostility, vulnerability to stress, and somatic symptoms were assessed with validated questionnaires.
Results: Poisson regression models adjusted for demographic and socioeconomic variables indicated no association of noise exposure and somatic symptoms (incidence rate ratio (IRR) 1.001; 95% confidence interval (CI) 1.000–1.001; $n = 56{,}937$). Interactions of noise exposure and hostility and vulnerability to stress were not statistically significant. Small positive associations were found for noise annoyance from each of the eight sources and somatic symptoms, when adjusted for demographic and socioeconomic variables (e.g. for road traffic noise annoyance IRR 1.014, 95% CI 1.011–1.018; $n = 6177$). Additional adjustment for hostility and vulnerability to stress resulted in small decreases of the IRRs for noise annoyance from each of the eight sources, but the associations remained statistically significant.
Conclusions: Personality facets hostility and vulnerability to stress did not modify the relation between road traffic noise exposure and somatic symptom reporting, or confound relations between noise annoyance and symptoms.

Introduction

Around 140 decibels (dB), sound exposure passes the pain threshold (Basner et al., 2014). But does sound have to be that loud to hurt? Evidence showing that sound at lower levels can have effects on health already exists. Environmental noise has been associated with a variety of adverse health effects, including hearing loss, cardiovascular disease (Basner et al., 2014) and impaired neurocognitive function (Tzivian et al., 2015). Not only the actual exposure to noise, but also an individual's annoyance from noise and noise sensitivity contribute to adverse health effects (Van Kamp and Davies, 2013). Some studies suggest it may not be the noise itself that is associated with adverse health for certain outcomes, but instead the individual's annoyance from noise. This is demonstrated by a recent study showing that noise annoyance was strongly associated with somatic symptoms, such as headaches and fatigue, while modelled road traffic noise exposure was not (Héritier et al., 2014). Similar findings were also reported in studies from Norway and Sweden (Fyhri and Klæboe, 2009; Öhrström et al., 2006). A strong predictor of noise annoyance is noise sensitivity, which refers to an increased reaction to noise. Individuals that are noise sensitive pay more attention to sound, are more likely to evaluate it negatively, and have stronger emotional reactions to noise (Stansfeld, 1992). Noise sensitivity has been associated with lower health-related quality of life (Shepherd et al., 2010), and depressive symptoms (Stansfeld and Shipley, 2015). In addition, noise sensitivity is related to other environmental sensitivities, including environmental chemosensory responsivity (Karnekull et al., 2011),

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to susceptibility to stress in general (Nordin et al., 2013), and to personality traits such as neuroticism (Belojevic and Jakovljevic, 2001). These results lead to the hypothesis that noise sensitivity reflects a more general susceptibility to stressors (Schreckenberg et al., 2010). If noise sensitivity is part of a more general tendency to be susceptible to stressors, how is such a trait influencing the relation between noise and somatic symptoms? We aim to investigate the role a stress-sensitive personality has on the relations between noise, noise annoyance and somatic symptom reporting. Our research questions are as follows: First, is there a relationship between noise and somatic symptoms in persons who are vulnerable to stressors? We hypothesize that noise exposure may be related to somatic symptoms, but only in a subgroup who are vulnerable to stress. Second, is there a relationship between noise annoyance and somatic symptoms because persons vulnerable to stressors report both more noise annoyance and more symptoms? In other words, can this relationship be explained by a confounding effect of a general trait of vulnerability to stress? We hypothesize that sensitive persons will report more noise annoyance (Stansfeld, 1992) and also more symptoms as a result (Rosmalen et al., 2007).

The general trait of vulnerability to stress is captured in the personality trait neuroticism. Neuroticism can be described as the tendency to experience negative and distressing emotions, and is positively correlated with noise annoyance (Öhrström et al., 1988; Thomas and Jones, 1982), and noise sensitivity (Stansfeld et al., 1985). Neuroticism is considered to be a broad personality trait composed of six facets: anxiety, hostility, depression, self-consciousness, impulsiveness, and vulnerability to stress. Some argue that research is needed on the level of neuroticism's facets instead of the trait in general (Ormel et al., 2013). When investigating noise, noise annoyance and somatic symptoms, the neuroticism facets hostility and vulnerability to stress seem relevant to these relations, while the remaining facets might be less appropriate to study. Studying facets of neuroticism that are theoretically more related to the relationship tested here, may provide a better insight in the relation of noise, noise annoyance, somatic symptoms and personality. We tested these associations in LifeLines, a large population based cohort from the Netherlands (Scholtens et al., 2014).

Methods

Study design and participants

LifeLines is a multi-disciplinary prospective population-based cohort study examining in a unique three-generation design the health and health-related behaviours of 167,729 persons living in the North East region of The Netherlands. It employs a broad range of investigative procedures in assessing the biomedical, socio-demographic, behavioural, physical and psychological factors which contribute to the health and disease of the general population, with a special focus on multi-morbidity and complex genetics (Stolk et al., 2008). Inclusion of study participants began in 2006 via general practitioners and also self-enrolment. All participants provided written informed consent. The study protocol was carried out in accordance to the Declaration of Helsinki, and was approved by the medical ethical review committee of the University Medical Center Groningen. A detailed description of the LifeLines Cohort Study has been published elsewhere (Scholtens et al., 2014).

Baseline measurements were performed between 2006 and 2013 and approximately three years thereafter a follow up questionnaire was sent out. The present study included baseline data with road traffic noise estimates available for 75,304 participants, aged between 18 and 92 years. At the time of our study follow up measurements were still ongoing, and follow up data were released for 61,967 participants. Data obtained during baseline and follow up measurements were used in this study, resulting in different sample sizes for the main constructs. Modelled road traffic noise was estimated for home addresses at the time of baseline measurements. Noise annoyance was assessed during the follow up measurements. Baseline data (n = 56,937) were used to investigate the association between road traffic noise exposure and somatic symptoms, and the modification of this association by hostility and vulnerability to stress. Follow up data (n = 46,558) were used for evaluation of the association between noise annoyance and somatic symptoms and its confounding by hostility and vulnerability to stress. Participants with incomplete data regarding somatic symptoms (baseline n = 2365; follow up n = 1372), hostility (baseline n = 5402; follow up n = 5544), vulnerability to stress (baseline n = 5114; follow up n = 5318), and household equivalent income (baseline n = 9904; follow up n = 9343) were excluded. The sample size at follow up differed for the various analyses depending on the number of missing data for the noise annoyance questions.

Road traffic noise

Road traffic noise was estimated using a new implementation of the CNOSSOS-EU noise modelling framework (Kephalopoulos et al., 2012). Briefly, the noise level is estimated on road segments within 500 meters of a receptor. Noise propagation to the receptor is assessed with a consideration of possible attenuation due to refractions on buildings, absorption by the atmosphere and interactions with reflective or absorbent land cover surfaces. The CNOSSOS-EU framework contains empirically derived equations to determine both the initial noise level based on traffic flow and also the sound attenuation based on known environmental factors and physical processes. To estimate source noise on road segments in the Netherlands, information is used of hourly flow of passenger cars, heavy goods vehicles and their average speeds. The sound propagation model is based on the CORINE landcover dataset that has a European wide coverage. Traffic data originated from year 2009 and landcover data from 2006. The final sound level is expressed as the day-evening-night time (Lden) annual average in A weighted decibels (dB(A)) (Morley et al., 2015). Lden is the average A-weighted noise level, estimated over a 24 h period, with a 10 dB(A) penalty added to the night (23.00–07.00 h), and a 5 dB(A) penalty added to the evening period (19.00–23.00 h) noise level. The penalties are added to indicate people's extra sensitivity to noise during the night and evening.

Noise annoyance

Noise annoyance from eight different sources was assessed using a standardized questionnaire (International Organization for Standardization (ISO), 2003). Participants were asked whether the noises were audible in their homes, and if so, to what extent they were bothered, disturbed or annoyed by the noise. The sources of annoyance include noise from road traffic, railroad, aircraft, industrial sources, wind turbines, construction and demolition activities, shops and restaurants, and neighbours. Annoyance could be indicated on a scale ranging from "0: not bothered" to "10: extremely bothered" (International Organization for Standardization (ISO), 2003). When participants indicated that the noise from a specific source was not audible in their home, the value for annoyance was set to zero. Noise annoyance was assessed during follow up measurements. The item regarding road traffic noise annoyance was implemented in the questionnaire at a later stage than the other noise annoyance questions, and was therefore available for a smaller sample (n = 6162).