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Noise sensitivity: Symptoms, health status, illness behavior and co-occurring environmental sensitivities

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ABSTRACT

Epidemiological evidence on the symptomatic profile, health status and illness behavior of people with subjective sensitivity to noise is still scarce. Also, it is unknown to what extent noise sensitivity co-occurs with other environmental sensitivities such as multi-chemical sensitivity and sensitivity to electromagnetic fields (EMF). A cross-sectional study performed in the Netherlands, combining self-administered questionnaires and electronic medical records of non-specific symptoms (NSS) registered by general practitioners (GP) allowed us to explore this further. The study sample consisted of 5806 participants, drawn from 21 general practices. Among participants, 722 (12.5%) responded "absolutely agree" to the statement "I am sensitive to noise", comprising the high noise-sensitive (HNS) group. Compared to the rest of the sample, people in the HNS group reported significantly higher scores on number and duration of self-reported NSS, increased psychological distress, decreased sleep quality and general health, more negative symptom perceptions and higher prevalence of healthcare contacts, GP-registered NSS and prescriptions for antidepressants and benzodiazepines. These results remained robust after adjustment for demographic, residential and lifestyle characteristics, objectively measured nocturnal noise exposure from road-traffic and GP-registered morbidity. Co-occurrence rates with other environmental sensitivities varied between 9% and 50%. Individuals with self-declared sensitivity to noise are characterized by high prevalence of multiple NSS, poorer health status and increased illness behavior independently of noise exposure levels. Findings support the notion that different types of environmental sensitivities partly overlap.

1. Introduction

Noise sensitivity refers to the internal states of any individual which increase their degree of reactivity to noise in general (Job, 1999) through pathways related to physiological, psychological, including attitudinal characteristics or pathways related to life style or activity patterns. There are a number of competing and complementary hypotheses regarding the etiology of noise sensitivity and its potential role (van Kamp et al., 2013): It could be a result of physical illness, injury, psychological disorder, a partial indicator of genetically related vulnerability or acquired vulnerability to environmental stressors, or even a side-effect of prescribed medication (van Kamp and Davies, 2013). Noise sensitivity might directly influence health or moderate the relationship between noise and well-being (Stansfeld, 1992; Heinonen-Guzejev et al., 2007; Fyhri et al., 2009; Kishikawa et al., 2009). It has been linked to poor perceived health and increased psychological distress, morbidity, medication use and risk of disability pension (Stansfeld et al., 1993; Heinonen-Guzejev et al., 2004, 2013; Stansfeld and Shipley, 2015). There is also the notion that noise sensitivity could be part of the broader spectrum of subjective environmental sensitivities attributed to low, compared to the established safety limits, exposure levels to environmental agents such as chemicals and electromagnetic fields (EMF) (Nordin et al., 2013; Palmquist et al., 2014).

People with these environmental sensitivities are often characterized by increased report of non-specific symptoms (NSS) (Das-Munshi et al., 2006; Staudenmayer et al., 2003). Such symptoms occur in various organ systems and can be caused by multiple factors, often unknown and unrelated to the attributed (environmental) cause. When presented in primary care, between 30% and 50% of NSS cannot be explained by a medical diagnosis (Kroenke and Price, 1993; Barsky and Borus, 1999). The term "medically unexplained" is often used to describe such complaints in clinical practice (Henningsen et al., 2011). Decreased physical functioning, increased illness behavior (particularly related to alternative therapies) and negative symptom perceptions have also

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been observed in some environmentally sensitive groups (Baliatsas et al., 2014).

However, it is not clear yet whether these features are also common in people with noise sensitivity. Noise-sensitive groups have been understudied, are generally underrepresented in study populations and evidence on differential characteristics is scarce (van Kamp and Davies, 2013), since there is limited research on their symptomatic profile, psychological relevant characteristics and co-occurrence with other environmental sensitivities. The present study addresses three main questions: (1) Do people with self-reported noise sensitivity experience more symptoms and symptoms of longer duration compared to the broader population? (2) Do noise-sensitive individuals differ from the broader population in terms of symptom report, symptom perceptions, health status indicators and illness behavior? (3) To what extent do noise- sensitive people report other environmental sensitivities as well?

2. Materials and methods

2.1. Participants and procedure

Two data collection methods were combined in a population study conducted in 2011 in the Netherlands, originally designed to assess the association between EMF and NSS (Baliatsas et al., 2015): a questionnaire survey entitled "Living environment, technology and health" and electronic medical records (EMR) of adult citizens registered in 21 general practices. It is obligatory for every citizen in the Netherlands to be registered at a general practice; the population listed in family practice can be used as the denominator in epidemiological studies. (van der Lei et al., 1993). Practices in different regions were selected from the primary care database of the Netherlands Institute for Health Services Research (NIVEL). The final number of respondents were n = 5933 (response rate: 46%). The privacy regulation of the study was approved by the Dutch Data Protection Authority. According to the Dutch Medical Research Involving Human Subjects Act, ethical approval was not required for this study. More details on the study population and sampling process are described in earlier publications (Baliatsas et al., 2014, 2015).

2.2. Case definition for noise sensitivity

A single item on noise sensitivity was used, formatted on a five-point scale, which was part of a list assessing sensitivity to diverse environmental stressors, adapted from Stansfeld et al. (1985). Participants who reported "strongly agree" on the statement: "I am sensitive to noise", formed the high noise sensitivity (HNS) group. The rest of the sample was considered as the low(er)-sensitive (control) group (LNS).

2.3. Case definitions for other environmental sensitivities

Similar to the case definition for HNS, respondents who answered "strongly agree" to questions regarding other environmental stressors such as chemical substances, materials, smells in general, light, colors, scented detergents, warm/cold environment, temperature changes were defined as being highly environmentally sensitive. The case definition of electromagnetic (hyper)sensitivity/idiopathic environmental intolerance attributed to EMF (IEI-EMF) was based on the approach of Baliatsas et al. (2014) ("quite agree" or "strongly agree" on the statements: "I am sensitive to mobile phone base stations and devices related to communication systems" and "I am sensitive to electrical devices").

2.4. Self-reported NSS and associated perceptions

To assess NSS in terms of prevalence/number and duration, the corresponding subscales of the Symptoms and Perceptions (SaP) questionnaire (Yzermans et al., 2016) were used. The SaP questionnaire combines the assessment of 28 symptoms with an adapted version of the brief Illness Perception Questionnaire (B-IPQ) (Broadbent et al., 2006). A higher sum score on the symptom items indicates increased report and longer duration of NSS. The 28th item ("Hypersensitivity to light or noise") was omitted due to overlap with the case-definition for the HNS group. The B-IPQ items refer to the symptom that was perceived as the most severe/important by the respondents, with a higher score reflecting more negative perceptions/beliefs.

2.5. GP-registered NSS and prescribed medication

Non-specific physical symptoms in EMR were registered by the general practitioners based on the international classification of primary care (ICPC) (Lamberts and Wood, 1987). The evaluation of the clinical judgment of the practitioner on the symptoms was based on "episodes of care" (WONCA Classification Committee, 1995). An episode was defined as "non-specific"/unexplained if there was no registered diagnosis for the symptoms, during the year before the completion of the study. Registered NSS corresponded to the symptom items of the self-reported list; when applicable, similar symptoms in the EMR were clustered (e.g headache and tension headache).

The prevalence of GP-registered prescriptions related to painkillers, benzodiazepines and antidepressants was also examined, using the Anatomical Therapeutic Chemical Classification system (ATC) (WHO, 2003).

2.6. Health status indicators

General health was assessed with the corresponding subscale of the RAND-36 Health Survey questionnaire (Van der Zee and Sanderman, 1993). A higher score indicates better perceived health. Moreover, participants completed a 10-item version of the Sleep Quality Scale (Visser et al., 1978) and the 12-item version of the General Health Questionnaire (GHQ-12), using the 4-point Likert-type scoring method (Goldberg, 1973; Hoeymans et al., 2004). Higher total scores on these two scales indicate increased levels of sleep problems and psychological distress respectively.

2.7. Indicators of illness behavior

Participants reported whether they contacted a general practitioner and/or a psychologist or psychotherapist and/or an alternative therapist (e.g. homeopathist, acupuncturist or paranormal therapist) and also whether they used medication that did not require a medical prescription within the past year.

2.8. Noise exposure and other covariates

For each address, total night-time exposure to road traffic was estimated by means of the Standard Model Instrumentation for Noise Assessments (STAMINA) (Schreurs et al., 2010, 2011) and expressed in L_{night}, which is an unweighted indicator for an eight-hour night period. The STAMINA model was developed at the National Institute for Public Health and the Environment (RIVM), and is an instrument to map environmental noise in the Netherlands. It uses the standard Dutch Calculation method for traffic and industrial noise, which is used in the Netherlands to implement the European Environmental Noise Directive (European Commission, 2002). The calculations were done using information