Non-specific physical symptoms and related functioning in people with self-reported noise sensitivity

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ABSTRACT

There is not much epidemiological evidence on the symptomatic profile, functional status and illness behavior of people with increased sensitivity to noise. An epidemiological study combining self-administered questionnaires and electronic medical records of non-specific physical symptoms (NSPS) registered by general practitioners (GP) allows such investigation. The study sample consisted of 5933 participants, drawn from 21 practices within the Dutch Primary Care Database. Among participants, 722 (12.5%) responded "absolutely agree" to the statement "I am sensitive to noise". Compared to the rest of the sample, the noise sensitive group reported significantly higher scores on number and duration of self-reported NSPS and indicators of functional impairment and illness behavior. There was also a higher prevalence of GP-registered NSPS among noise sensitive respondents. Results remained consistent after adjustment for demographic characteristics and GP-registered morbidity. Noise sensitivity was strongly associated with various other sensitivities such as those to chemical substances, odors and electromagnetic fields. Individuals with high levels of noise sensitivity share characteristics similar to those of people with other self-reported sensitivities. These findings add to the notion that different types of sensitivities might share a common (psycho) physiological basis.

Keywords: Noise sensitivity, Non-specific symptoms, Idiopathic environmental intolerance, General Practice

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1. INTRODUCTION

Noise sensitivity (NS) refers to the increased individual reactivity to environmental noise, through pathways related to physiological, psychological and attitudinal characteristics. There is a number of competing and complementary hypotheses regarding the etiology of and role of NS (1): it could be a result of physical illness, injury, psychiatric disorder, a partial indicator of genetically related vulnerability or acquired vulnerability to environmental stressors, or even a side-effect of prescribed medication. Noise sensitivity could directly influence health and well-being or moderate the relationship between noise and health effects.

There is also the notion that noise sensitivity belongs to the broad spectrum of subjective environmental sensitivities attributed to low (in relation to the established safety limits) exposure levels to environmental agents (1,2). Even when there is no convincing evidence for a causal dose-response association (3,4), people with such sensitivities are often characterized by the report of non-specific physical symptoms (NSPS), decreased physical functioning, increased illness behavior (particularly related to alternative therapies) and negative symptom perceptions (5). Recent evidence also suggests that increased number and duration of self-reported NSPS in people with general environmental sensitivity and idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF), constitute important indicators of symptom severity (5). However, it is not clear yet whether this is the case for NSPS reported by people with increased noise sensitivity.

Before assessing the risk of noise effects in the population, it is important to have a concise picture of health characteristics of potentially susceptible groups and quantify these differences in terms of noise levels. Noise-sensitive groups have been understudied, are generally underrepresented in study populations and evidence on differential characteristics is scarce (6), since there is limited research on their symptomatic profile, clinically relevant characteristics and co-occurrence with other sensitivities.

The present study addressed the following questions: 1) Do people with high levels of self-reported noise sensitivity experience more NSPS and NSPS of longer duration compared to participants with lower levels of noise sensitivity? 2) Do the two groups differ in symptom report, functional status, illness behavior and symptom perceptions? 3) What is the association between self-reported NSPS and functional impairment, illness behavior, symptom perceptions and EMR-based NSPS among individuals with high noise sensitivity? 4) What is the association between noise sensitivity and other environmental sensitivities?

2. METHODS

2.1 Participants and procedure

Two data collection methods were combined in a population study conducted in 2011: a questionnaire survey entitled “Living environment, technology and health” and electronic medical records (EMRs) of adult citizens registered in 21 general practices across the Netherlands. Such a comparison between self-reported and GP registered is possible since in the Netherlands every citizen is enlisted with a GPPractices were selected from NIVEL Primary Care Database, formerly known as LINH, of the Netherlands Institute for Health Services Research (NIVEL). Because the primary focus of the survey was the association between EMF and NSPS, invited participants (n=13,007) were stratified based on preliminary estimates of (low, medium and high) exposure to mobile phone base stations (7). The final number of respondents was 5933 (46%of those invited). The privacy regulation of the study was approved by the Dutch Data Protection Authority. More details on the study population and sampling process are described in a previous publication (5).

2.2 Case definition for noise sensitivity

One item on noise sensitivity was used (formatted on a five-point scale), from a list assessing sensitivity to diverse environmental stressors, adapted from Stansfeld et al. (8). Participants who reported “strongly agree” on the statement “I am sensitive to noise” formed the highly noise-sensitive group (HNS). 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 chemical substances, materials, smells (in general), light, colors, scented detergents, warm/cold environment, temperature changes and sources of electromagnetic fields (EMF) were defined as being highly sensitive to these stressors.

2.4 Self-reported and EMR-based NSPS and other indicators of functional status

To assess NSPS in terms of prevalence, number and duration, the sum score of 23 items from the Symptoms and Perceptions (SaP) scale (5, 9) were used. Higher scores indicate increased symptom number and longer duration.

Non-specific physical symptoms in EMR were registered by the general practitioners based on the international classification of primary care (ICPC) (10). The evaluation of the clinical judgment of the practitioner on the symptoms was based on "episodes of care" (11). 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. We also compared the symptoms in the self-reported list with potentially corresponding NSPS in the medical records of the participants, in order to examine the association between self-reported and EMR-based NSPS (5).

The prevalence of EMR-based prevalence of prescriptions related to painkillers, benzodiazepines and antidepressants was also examined, using the Anatomical Therapeutic Chemical Classification system (ATC) (12).

Physical functioning was assessed with the General Health subscale of the RAND-36 Health Survey questionnaire (13). A higher score indicates better physical functioning.

Moreover, participants completed a 10-item version of the Sleep Quality Scale (14) and the 12-item version of the General Health Questionnaire (GHQ-12) (using the 4-point Likert-type scoring method) (15,16). Higher total scores on these two scales indicate increased levels of sleep problems and mental distress respectively.

2.5 Indicators of illness behavior and symptom perceptions

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.

Symptom perceptions were assessed using the items "consequences" and "emotional response" from the Brief Illness Perceptions Questionnaire (Brief-IPQ) (17,18). These referred to the symptom that was perceived as the most severe/important. A higher score reflects a greater influence of the symptom on life and a more negative emotional response respectively.

2.6 Descriptive information and covariates

Information was obtained on various demographic, residential and lifestyle characteristics and EMR-based somatic and psychiatric morbidity.

2.7 Data analysis

Cramer's V, the unpaired samples t-test and the chi-squared test were conducted for the descriptive analyses; the latter was also used to assess the prevalence of other sensitivities within the HNS group. To examine potential differences between the HNS group and controls in NSPS, functional status, illness behavior and symptom perceptions, linear (for the continuous outcomes) and logistic (for the dichotomous outcomes) regression were performed to control for demographic, residential and lifestyle characteristics and somatic and psychiatric morbidity. Pearson's and Spearman's correlation were used to examine the associations between symptom scores and indicators of functional status, illness behavior and symptom perceptions and also the association between sensitivities to different environmental stressors. The examined continuous scores did not exceed the proposed acceptable values for skewness and kurtosis (19). In addition, the Variance Inflation Factor (VIF) did not show risk for multicollinearity in the regression models. When self-reported NSPS were used as a sum score, participants with more than five missing items were excluded from the analyses. Missing values in the rest of the measures were treated according to

previous publications on these measures. Statistical analyses were carried out using IBM SPSS Statistics (SPSS Inc version 20, Chicago IL, USA).

3. RESULTS

3.1 Non-response analysis

Results from the non-response analysis are thoroughly described elsewhere (5). In short, participants were younger, higher educated and reported better general health; there was no significant difference regarding gender distribution.

3.2 Descriptive analysis

After excluding cases with incomplete responses related to the case definition of the examined groups, 5806 respondents were available for analysis of which 722 (12.5%) comprised the HNS group. Compared to the LHS group, the subjects in the HNS group were statistically significantly older (mean age 56.0 yrs, SD 16.5 vs. 51.3 yrs, SD 17.2, $p<.05$) and less satisfied with their residency (mean on a scale between 0-4: 3.2, SD .77 vs. 3.3, SD .69). They were also more often unemployed or unable to work (14% vs. 7.6%, $p<.05$), living on a busy street (36.6% vs. 32%, $p<.05$) and had more often a foreign ethnic background (18% vs 11.7%, $p<.05$). Furthermore, most of the participants in the HNS group were women (67.6% vs 57%, $p<.05$) and had higher levels of somatic (32% vs. 25%, $p<.05$) and psychiatric morbidity (8% vs 3%, $p<.05$) and also alcohol/substance abuse (> 6 months) (5% vs. 2%, $p<.05$). LHS people in the were living more often in less urbanized areas (e.g. living in not urbanized areas: 17.8% vs 14.5%, $p<.05$). There were no significant differences in terms of education, smoking habits and body mass index (BMI).
Individuals with HNS reported a mean of 7.1 (SD 4.54) NSPS. The prevalence of EMR-based NSPS in this group was 44%. Furthermore, the prevalence of EMR-based painkillers, benzodiazepines and antidepressants was 21.9%, 18.3% and 14.7% respectively.

3.3 Comparing functional status, illness behavior and symptom perceptions in people with high and lower noise sensitivity

Compared to LNS people in the HNS group reported worse sleep quality and physical functioning, higher levels of mental distress, increased illness behavior and more negative symptom perceptions (Table 1). Furthermore, they had higher sum scores on number and duration of self-reported NSPS and a higher prevalence of EMR-based NSPS and prescribed medication. These differences remained statistically significant after adjustment for demographic and residential characteristics, lifestyle and morbidity (Table 1).

Table 1 – Unadjusted and adjusted differences (regression coefficients & OR) [a] between groups on determinants of functional status, illness behavior, symptom perceptions & symptom score

	HNS vs. LNS [b]	
	Unadjusted	Adjusted
Functional status		
Regression coefficient (95% CI)		
General health	-7.4 (-8.86–5.95) *	-4.57 (-6.0 – -3.12) *
Sleep quality	1.00 (0.78–1.22) *	.65 (.42–0.88) *
Psychological distress	1.82 (1.4–2.24) *	.95 (.5 –1.39) *
Number of self-reported NSPS	1.94 (1.62–2.26) *	1.38 (1.05–1.7) *
Duration of self-reported NSPS	6.83 (5.82–7.85) *	4.79 (3.77–5.8) *
OR (95% CI)		
Registered NSPS	1.46 (1.25–1.71) *	1.22 (1.02–1.47) ⊤
Prescribed painkillers	1.1 (.91–1.32)	.91 (.72–1.14)
Prescribed benzodiazepines	2.25 (1.82–2.79) *	1.63 (1.24–2.13) *
Prescribed antidepressants	2.33 (1.85–2.95) *	1.49 (1.07–2.07) ǂ
Illness behavior & symptom perceptions		
Regression coefficient (95% CI)		
Consequences †	1.07 (.83–1.31) *	.69 (.43–0.95) *
Emotional response †	1.42 (1.14–1.7) *	1.02 (.72–1.31) *
OR (95% CI)		
Consulting a GP	1.81 (1.47–2.22) *	1.48 (1.17–1.87) ǂ
Consulting a psychologist	2.17 (1.76–2.67) *	1.86 (1.44–2.40) *
Consulting an alternative therapist	1.77 (1.39–2.25) *	1.82 (1.39–2.38) *
Unprescribed medication	1.29 (1.09–1.51) ǂ	1.28 (1.06–1.55) ǂ

[a] Between-group differences were adjusted for age, gender, occupational status, ethnic background, residential satisfaction, living on a busy street, degree of urbanization, medical morbidity, psychiatric morbidity, alcohol/substance abuse. [b] Reference group. † Referring to the most important/severe symptom among the ones reported. Abbreviations: OR, Odds ratio; CI, Confidence interval. Note: ⊤ p <.05; ǂ p <.01; *p<.001.

3.4 Comparing symptom prevalence and duration and associated functioning in people with high and lower noise sensitivity

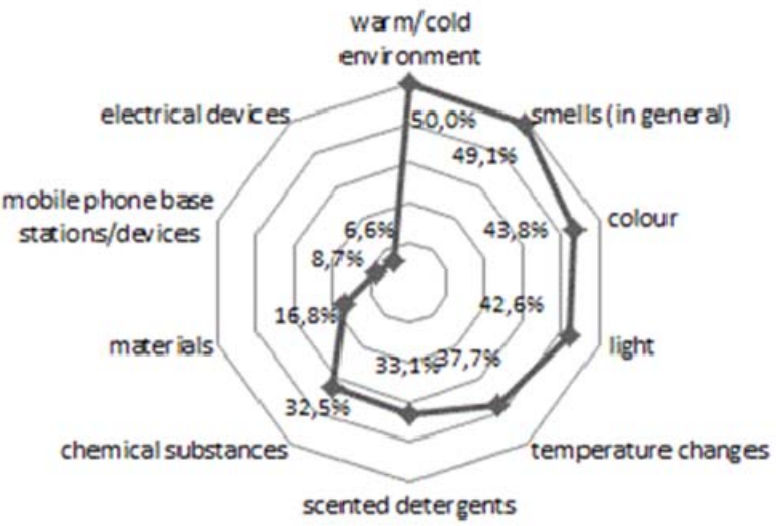
Compared to the LNS group, participants with HNS had a higher prevalence of all self-reported NSPS experienced in the past month and also a higher prevalence of more chronic symptoms (≥ 4 months).
The most prevalent symptoms experienced in the past month were: fatigue (68%), neck/shoulder pain (46%), and headache and sleep problems (45%). The most prevalent symptoms with duration more than four months were: fatigue (39%), neck/shoulder symptoms, sleep problems and leg/hip/knee/foot symptoms (30%). The adjusted prevalence was significantly higher as well for the majority of the symptoms in the HNS group. Differences in neurological and cardiovascular symptoms were particularly pronounced. The number and duration of self-reported NSPS were significantly associated with all the examined health

indicators; the strongest associations were observed with decreased general health and sleep quality (r =-.5)

3.5 Association between noise sensitivity and other environmental stressors in the total sample and within the HNS group

Figure 1 shows the co-occurrence of these sensitivities in the HNS group; the most prevalent environmental sensitivities are presented on the right side of the graph. Half of the respondents in this group reported to be sensitive to warm/cold environment and smells as well. Particularly high co-occurrence was observed also with sensitivity to colors, light, temperature changes, scented detergents and chemical substances, ranging between 32.5 and 44%.

Figure 1 – Prevalence of various other (high) environmental sensitivities within the HNS group



4. DISCUSSION

The aim of this study was not to investigate etiological associations but to give insight into the symptomatic profile and health characteristics of people with high levels of self-reported noise sensitivity. Overall, individuals with HNS had increased levels of functional impairment and illness behavior and more negative symptom perceptions compared to those with LNS. The prevalence of self-reported and EMR-based NSPS was considerably higher in the HNS group. Additionally, the symptoms reported by the HNS group seemed to be more chronic. Between-group differences remained significant after adjustment for demographic and residential and lifestyle characteristics, and somatic and psychiatric morbidity.

The reported number and duration of NSPS were significantly associated with decrease in functional status, increase in illness behavior, negative symptom perceptions and prevalence of GP-registered NSPS. Results are in line with findings from epidemiological studies on disaster survivors, people with IEI-EMF and general environmental sensitivity (5,20).

To our knowledge this is the largest epidemiological study to date on symptoms and related characteristics of noise-sensitive individuals. It is also the first on this topic to address the self-reported assessment of number and duration of NSPS in combination with real-life general practice data. Given that there are no established diagnostic criteria for environmental sensitivities (4,21) we used a case-definition that was independent of symptom attribution, targeting to an objective exploration of symptom profiles and characteristics. Furthermore, since we controlled for somatic and psychiatric morbidity, it is unlikely that the high symptom report in the HNS group and the consistently significant between-group differences are the result of a medical disorder.

Some study limitations should be reported. We did not adjust for actual noise exposure levels, although we took into account proxies of noise annoyance such as living on a busy street and residential satisfaction. Second, it cannot be ruled out that not all symptoms presented by the patients were registered in the EMRs by the general practitioner or the practitioner used an ICPC code that we did not consider as corresponding to the self-reported NSPS; these could lead to an underestimation of the prevalence of EMR-based NSPS. Moreover, an episode was labelled as "non-specific" if it was not related with a diagnosis during the year before the completion of data collection for the questionnaire survey. Some respondents might have been diagnosed with a medical condition a few days after the set timeframe. Finally, since the participants reported a higher score on perceived health compared to the non-respondents, the prevalence of symptoms might be underestimated in the sample, to some degree.

5. CONCLUSION

The view that different types of environmental sensitivities might be part of one, broader condition , such as general environmental sensitivity or idiopathic environmental intolerance (IEI) is corroborated by the current findings; these are in line with recent evidence that environmentally sensitive groups share common characteristics (2,5,22) such as: 1) increased functional impairment, illness behavior and the more negative symptom perceptions, 2) higher prevalence and duration of all NSPS in different organ systems, even after adjusting for morbidity; 3) prominence of neurological symptoms, and 4) high co-occurrence rate.

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