Science of the Total Environment 520 (2015) 114–119

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Noise sensitivity and future risk of illness and mortality

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HIGHLIGHTS

- Research is scarce on whether noise sensitivity is a risk factor for illness
- Noise sensitivity did not show main effects on CVD morbidity or mortality
- Noise sensitivity did predict angina pectoris in low employment grades
- Noise sensitivity did predict the risk of future psychological distress

ARTICLE INFO

Article history:
Received 9 February 2015
Received in revised form 12 March 2015
Accepted 13 March 2015
Available online 22 March 2015

Editor: P. Kassomenos

Keywords:
Noise
Depression
Coronary heart disease
Mortality
Annoyance
Sensitivity

ABSTRACT

Aircraft and road traffic noise exposure increase the risk of cardiovascular disease (CVD). Noise annoyance is the most frequent response to environmental noise. Noise annoyance has been shown to modify the association of transport noise exposure on CVD and noise sensitivity moderates the annoyance response to noise. This study uses prospective data from phases 1, 3, 5, 7 and 9 in 3630 male and female civil servants from the UK Whitehall II Study to examine whether a single question on noise sensitivity measured by annoyance responses to noise in general predicts physical and mental ill-health and mortality. Non-fatal myocardial infarction and stroke morbidity over the follow-up were defined by MONICA criteria based on study ECGs, hospital records, hospital admission statistics or General Practitioner confirmation. Depressive symptoms were measured by the Center for Epidemiologic Studies Depression Scale (CES-D) and psychological distress by the General Health questionnaire (GHQ). There was no association between noise sensitivity and CVD morbidity or mortality except in people from lower employment grades where there was an association with angina. Noise sensitivity was a consistent predictor of depressive symptoms and psychological distress at phases 3, 5 and 7. High noise sensitivity scores at baseline predicted GHQ caseness at phase 3 adjusting for age, sex, employment grade, self-rated health and GHQ caseness at baseline (OR = 1.56 95% CI 1.29–1.88). Noise sensitivity has been identified as a predictor of mental ill-health. More longitudinal research is needed including measures of noise exposure.

1. Introduction

Recently there have been several studies linking prolonged aircraft noise exposure to increased risk of cardiovascular and stroke mortality (Huss et al., 2010; Hansell et al., 2013). These studies are part of accumulating evidence that both aircraft noise exposure and road traffic noise exposure are related to an increased risk of cardiovascular disease and mortality (Sorensen et al., 2011, 2012; Floud et al., 2013). The putative mechanism behind these associations is thought to relate to the stress hypothesis where prolonged noise exposure leads to increased stress responses, hypertension and increased risk of cardiovascular disease (Babisch, 2008; Jarup et al., 2008; Munzel et al., 2014).

The most frequent response to environmental noise is annoyance, which is a mixture of reported discomfort, anger and feelings of intrusion. Exposure response relationships have been found for road, rail and aircraft noise in which the degree of annoyance rises with increasing noise levels (Miedema and Vos, 1998). Annoyance has also been suggested as a possible moderating factor of the effects of noise on cardiovascular disease — as a subjective indicator of the degree of disturbance from noise that amplifies the stress response to sound (Babisch et al., 2013). However, noise annoyance levels are probably inadequate as a proxy for noise levels in associations with health outcomes. This is because there are non-acoustic factors, that may account for at least 35% of the variance in annoyance such as personality factors, attitudes

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http://dx.doi.org/10.1016/j.scitotenv.2015.03.053
0048-9697/

to the noise source and perceptions of malfeasance related to the source of the noise (Job, 1988). Despite this, noise annoyance is associated with health outcomes, especially psychiatric disorder. In cross sectional studies it has been suggested that prior ill-health may lead to increased levels of annoyance and not the other way round (Tarnopolsky et al., 1980; Stansfeld et al., 1993). This has been explained as people who feel unwell being likely to be less tolerant of environmental discomfort.

Noise sensitivity, as a stable response to noise in general, is an independent predictor of the annoyance response to environmental noise (Job, 1999; Paunović et al., 2009; van Kamp et al., 2004). It has been postulated that noise sensitivity might be an indicator of vulnerability to environmental stressors, so that highly sensitive people might be more prone to develop illness when exposed to environmental noise (Stansfeld, 1992).

It is of interest to understand whether noise sensitivity does indicate vulnerability to ill-health, especially that attributable to noise, as this has implications for public health policy on reducing noise and advising noise sensitive individuals of the potential consequences of noise exposure. This is best attempted in longitudinal analyses. A single question on annoyance to noise in general was included in the first phase of the Whitehall II Study of British civil servants. We examined whether this question, which is an indicator of noise sensitivity (Job, 1999), is a predictor of future cardiovascular morbidity and mortality and psychiatric disorder. We hypothesised that with increased levels of noise sensitivity there would be a greater risk of both cardiovascular disease and psychiatric morbidity adjusting for ill-health at baseline.

2. Materials and methods

2.1. Participants

The Whitehall II study was established between 1985 and 1988 with a target population of all male and female civil servants, aged between 35 and 55 years, in twenty London based civil service departments. 10,308 civil servants were examined in phase 1 of the study — 6895 men and 3413 women with a response rate of 73%, the true response rate was higher because around 4% of the invited employees had moved before the study and were not eligible for inclusion. The noise sensitivity question was only included in the first version of the questionnaire in a sample of 3630. We analysed data from phase 1 (1985–88, self-report questionnaire and screening), phase 3 (1991–3, self-report questionnaire and screening), phase 5 (1997–9, self-report questionnaire and screening), phase 7 (2003–4, self-report questionnaire and screening) and phase 9 (2008–9, self-report questionnaire and screening) (Marmot and Brunner, 2005). Each of these phases included a clinic visit with measurement of biological variables, such as height, weight, blood pressure, electrocardiograph and a self-completion questionnaire covering demographic details, risk factors and physical and mental health outcomes. Our analyses are based on participants for whom complete data on covariates were available. Although most study respondents were white-collar employees, a wide range of employment grades (and salaries) from office support staff to the most senior government servants were covered.

2.2. Measures

Noise sensitivity was measured by a single question: 'Taking all sorts of noise together how much are you bothered by noise in general? A great deal, somewhat, little, not at all'. Responding as either 'a great deal' or 'somewhat annoyed' was classified as highly sensitive.

Age was divided into four categories between 34 and 55 years. Ethnicity was classified as White, South Asian, Black or Other. Employment grade was classified as high (administrative and professional), medium (executive), or low (clerical and support grades). Self-rated health at baseline at Phase 1 was assessed by a single item on self-rated health 'very good, good, average, poor/very poor'.

2.3. Cardiovascular outcomes

Angina pectoris was measured by the Rose Angina Questionnaire between Phase 1 and Phase 9 (Rose, 1962). Definite angina included ECG changes suggestive of ischaemia. Mortality was identified through linkage to the NHS Central Register and was available up to August 2012. Morbidity measures included non-fatal myocardial infarction and stroke morbidity over the follow-up and were defined following MONICA criteria based on study ECGs, hospital records of ECGs and cardiac enzyme levels and validated using discharge diagnoses from NHS Hospital Episode Statistics data or General Practitioner confirmation, or retrieval of hospital medical records up to the end of Phase 9.

2.4. Psychiatric morbidity

Psychological distress was measured by the 30-item General Health Questionnaire (GHQ), a screening measure for anxiety and depressive disorders, at baseline, Phase 3 and Phase 7 (Goldberg, 1972). It was classified into non-cases and cases at threshold 4/5 based on a prior validation study. Depressive symptoms were measured by the Center for Epidemiologic Studies Depression Scale at Phase 7 (Radloff, 1977). Major depressive episodes at Phase 5 were measured by a self-completion computerised version of the Composite International Diagnostic Interview (Kessler et al., 1998).

2.5. Analysis

Initially, the association of sociodemographic factors and self-rated health with the noise sensitivity question was analysed at baseline. In addition, the cross-sectional association between psychological distress at baseline and noise sensitivity was examined adjusting for age, sex, employment grade and self-rated health. Cox proportional hazard models were used to examine the association between sensitivity and subsequent mortality adjusting for age, sex, employment grade and then, additionally, adjusting for self-rated health and psychological distress. We examined interactions with age, gender and employment grade. Logistic regression analysis was used to examine whether sensitivity at baseline predicted mental health outcomes at Phase 3, 5 and 7 adjusting for age, sex, low employment grade and subsequently additionally adjusting for self-rated health and GHQ caseness at baseline. Prediction of GHQ caseness at Phase 3 and Phase 7 was repeated in a sample from which baseline GHQ cases were excluded. We examined interactions with age, gender and employment grade. We repeated the analyses for key outcomes using a stricter threshold for noise sensitivity to examine whether this changed the associations with health outcomes.

3. Results

There were 3630 individuals in the sample, 49% were men. Overall, 48% of participants were sensitive, being highly bothered by noise in general. Noise sensitivity or being highly bothered by noise was more common in the 50–55 year age group (OR = 1.20 (95% CI 1.01–1.43)) relative to the 34–39 year age group. Women tend to be more sensitive relative to men (OR = 1.21 (95% CI 1.06–1.39)). Those in the lowest employment grade tend to be less sensitive than those in the highest employment grade (OR = 0.63 (95% CI 0.51–0.78)).

The odds of reporting high sensitivity increased with reporting average and poor self-rated health (Table 1). High sensitivity was cross-sectionally associated with increased odds of psychological distress which was maintained even after adjusting for self-rated health at baseline (OR = 1.67 (95% CI 1.43–1.95) (Table 1)).

There was no association between noise sensitivity and incident coronary heart disease outcomes, either non-fatal myocardial infarction or stroke morbidity, angina pectoris or mortality, adjusting for age, sex, low employment grade, self-rated health and psychological distress