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PERCEPTIONS OF AIRCRAFT NOISE EXPOSURE, NOISE SENSITIVITY? SLEEP DISTURBANCE AND HEALTH: RESULTS FROM THE BRISTOL NOISE, SLEEP AND HEALTH STUDY

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ABSTRACT
The aim of the present research was to examine associations between perceptions of noise exposure, noise sensitivity, sleep disturbance and health in an area where aircraft noise is not particularly prevalent (Bristol, UK). A questionnaire was mailed to a random community sample and 543 responses were received. This sample was found to be a representative sample of the general population. Preliminary analyses suggested that perceptions of aircraft noise while trying to sleep, noise sensitivity and noise-disturbed sleep were all having significant effects on subjective health. The effects of noise exposure and noise sensitivity were entirely due to neuroticism. However, sleep disturbance due to noise was still related to health even when negative affectivity was co-varied. This confirms results obtained with another sample and investigations of noise exposure in general. Further research is considering whether a similar pattern holds when exposure levels are higher. A longitudinal study is desirable to determine the causal relationships linking noise disturbed sleep and health.

1 - INTRODUCTION

Annoyance caused by noise is a major source of complaint to local environmental health offices. Indeed, it is an undisputed fact that people are annoyed by a wide range of external noise events. It is also clear that non-auditory factors such as noise sensitivity and attitudes to noise are important in determining the level of annoyance [1]. Subjective health and noise have been examined in a variety of ways. For example, there have been studies of noise and psychological symptoms both in the workplace [2] and general population [3]. Other research has examined noise and psychiatric morbidity in the community [4]. Noise annoyance is associated with noise level and with reporting of symptoms. What is unclear is the relationship between noise exposure, disturbed sleep, annoyance and noise sensitivity and psychiatric disturbance. Some simple relationships between these factors can be largely ruled out by earlier findings. For example, both noise and psychiatric disturbance are associated with annoyance, but it appears to be psychiatric morbidity influencing annoyance rather than the other way around [5]. There is evidence of both objective and subjective sleep disturbance by noise [6]. There is some evidence that noise effects on sleep may habituate over time, but research also suggests that small deficits may persist for years [7]. Noise exposure during sleep is considered to increase awakening or cause shifts from deeper to lighter sleep stages (see [8] for a review). Noise during the day may also reduce REM sleep [9] which shows that noise can influence sleep in several different ways. There has been specific interest in the effects of aircraft noise at night on sleep [10] and the present article reports data on this topic.

The present research assesses the impact of community noise on sleep and on subjective reports of health [11]. Measures of noise sensitivity are recorded as are general noise annoyance and annoyance produced by specific noise exposures. The study from which this paper is derived was conducted in the Bristol area, to determine the general effects of noise on sleep and health. As such, it was not designed to enquire into

aircraft noise effects specifically, but contained a number of relevant items, within the context of general noise. Bristol, although it has an airport and an aircraft manufacturing industry, is not regarded as a high aircraft-noise area; response patterns were expected to show a range, but with greater concentrations at the lower end of the spectrum. As such, it would provide a basis for comparison with areas around airports where aircraft noise might be seen as a contentious issue.

2 - METHODOLOGY

The study consisted of a postal survey. A questionnaire, with a covering letter, was mailed to 2,000 people, randomly selected from the electoral register for the Bristol area. A cutoff point of eight weeks for the return of questionnaires was decided. The questionnaire contained demographic questions, questions regarding lifestyle, sleep patterns, noise sensitivity [4], [12], perceptions of frequency and intensity of a range of noises, at various times of the day. In addition, two validated questionnaires were included: The General Health Questionnaire [13] and Eysenck's Personality Inventory [14] for the measurement of negative affectivity. Further details of the study are given in Hayward [15].
543 respondents completed questionnaires. Ages ranged from 20 to 98 years. There were 256 males and 287 females. The mean age for males was 52.1 years, for females, 47.2 years. Demographic data supplied by the respondents was compared with the 1991 Census data for the area, and the sample found to be a representative one. From the questionnaire data collected, variables of interest in a study pertaining to aircraft noise were identified, in order that analyses might be conducted. Aircraft noise exposure, noise sensitivity, health measures and sleep measures were all identified, and factor analyses were conducted for each of these groups of variables separately, in order to select the most appropriate variables to include in subsequent analyses.

3 - RESULTS

3.1 - Effects of frequency of aircraft noise when trying to sleep on health and sleep

Significant differences were found between 'high noise' and 'low noise' groups, in many areas of health and sleep. However, it must be noted that the "low noise" group, from a range of responses from 0-4, were divided at the median of 1, thereby including only two categories of response in that group. The frequency of aircraft noise when trying to sleep showed significant effects on symptoms in the preceding 14 days (factor and total scores − see Table 1); this included items such as cough and cold symptoms, pains in the head, chest and back, and digestive upsets. There was a highly significant effect on mental health measures of anxiety, severe depression and social dysfunction, as measured by the General Health Questionnaire, also on the total GHQ score. Aircraft noise exposure at night exerted a highly significant effect on the measure of noise interfering with going to sleep; this measure is used as an independent variable in other investigations as it is of major interest to this study. There was also a highly significant effect on morning tiredness and curtailed sleep.

3.2 - The main effects of noise sensitivity factors on health and sleep

Significant differences were found between 'high sensitivity' and 'low sensitivity' groups, for both measures of sensitivity used in analyses, affecting many areas of health and sleep. There were significant differences between 'high sensitivity' respondents and 'low sensitivity' respondents in respect of all categories of self-reported health total scores: chronic health, 12 months problems and 14 day symptoms (see Table 1). Similarly, there were highly significant effects on mental health measures of somatic perceptions, anxiety, severe depression and social dysfunction, as measured by the General Health Questionnaire, also on the total GHQ score. Noise sensitivity also had a significant effect on morning tiredness, curtailed sleep and dreams.

3.3 - Effects of aircraft noise interfering with sleep on health and sleep factors

Significant differences were found between "high sleep disturbance" and "low sleep disturbance" groups, in many areas of health and sleep. The frequency of aircraft noise interfering with sleep showed significant effects on self-reported health in the past 12 months and symptoms in the preceding 14 days (see Table 1). There was a highly significant effect of noise disturbed sleep on mental health measures of somatic perceptions, anxiety, severe depression and social dysfunction, as measured by the General Health Questionnaire, and also on the total GHQ score. Not surprisingly, noise disturbed sleep had a significant effect on curtailed sleep, morning tiredness and dreams.

Variable	Low group	High Group	F, (df), p values
Aircraft noise at night	3.59 (0.16)	4.69 (0.32)	F=10.5 (1,465), p <0.001
Noise sensitivity	3.46 (0.17)	4.37 (0.25)	F=9.5 (1,451), p< 0.005
Noise disturbed sleep	3.02 (0.17)	4.68 (0.23)	F=35.8 (1,469), p<0.00001

Table 1: Effects of frequency of aircraft noise at night, noise sensitivity and noise disturbed sleep on total symptom scores for the last 14 days (scores are the means, s.e.s in parentheses; maximum score=18).

3.4 - Age and negative affectivity

Both age and negative affectivity were found to have highly significant effects on sleep and health. They were, therefore, entered as covariates in new analyses examining noise exposure, noise sensitivity, noise disturbed sleep and health.

3.5 - Analyses of covariance

When age and negative affectivity were co-varied none of the effects of aircraft noise exposure while trying to sleep were significant (see Table 2 for total 14 day symptom scores). Similarly, the effects of noise sensitivity were no longer apparent (see Table 2 for total 14 day symptom scores). In contrast to this noise disturbed sleep was still significantly associated with sleep problems (morning tiredness, curtailed sleep and dreams) and greater health problems (see Table 2 for total 14 day symptom scores).

Variable	Low group	High group	F, (df), p values
Aircraft noise at night	3.78 (0.1)	3.91 (0.2)	F < 1
Noise sensitivity	3.93 (0.2)	3.61 (0.2)	F=1.6 NS
Noise disturbed sleep	3.44 (0.2)	4.16 (0.2)	F=8.4 (1,441), p < 0.005

Table 2: Effects of frequency of aircraft noise at night, noise sensitivity and noise disturbed sleep on total symptom scores for the last 14 days when age and negative affectivity are co-varied (scores are the adjusted means, s.e.s in parentheses).

4 - DISCUSSION

The present study examined the relationships between subjective perceptions of aircraft noise at night, noise sensitivity, disturbed sleep by aircraft noise and reports of health. Initial analyses showed that reports of noise exposure, noise sensitivity and noise disturbed sleep were associated with reports of impaired health. All of the factors of interest were found to be related to health and there were few interactions between the variables. The health measures were also found to be influenced by age and negative affectivity. Analyses of covariance, with age and negative affectivity as covariates, revealed that most of the associations between reported aircraft noise exposure, noise sensitivity and health disappeared. The major influence on health was negative affectivity and this factor accounted for the earlier associations between noise exposure, noise sensitivity and health.

Noise disturbed sleep was associated with reported health in a more robust way and many of the associations still remained when negative affectivity and age were co-varied. However, it should not be concluded that the present data shows that noise disturbed leads to impaired health. The causality could actually be the other way around, with those with impaired health being more sensitive to disturbed sleep from aircraft noise at night. Only a longitudinal study will give an indication of the causal mechanisms linking sleep disturbance produced by aircraft noise and reports of impaired health.

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