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Health-related quality of life is impacted by proximity to an airport in noise sensitive people

David WELCH[1], Kim N. DIRKS[2], Daniel SHEPHERD[3] and David MCBRIDE[4]

[1, 2] University of Auckland, New Zealand

[3] Auckland University of Technology, New Zealand

[4] University of Otago, New Zealand

ABSTRACT

The health-related quality of life of people in two socioeconomically matched areas of Wellington city (New Zealand) was assessed in 2012 and 2015 using the World Health Organisation instrument (WHOQOL-Bref). One area was very close to Wellington International Airport and the other was distant from the airport and other major sources of noise such as motorways, railways, etc. Noise sensitivity was self-rated on a three-point scale: non-noise-sensitive, moderately noise-sensitive, or highly noise-sensitive. Noise-sensitive people had significantly poorer health-related quality of life than others when they lived near an airport but not when they lived in the control area. The same effect was present at both the time points assessed suggesting that it is a general finding. Furthermore, this finding with noise due to aeroplanes parallels our previous findings in people dwelling near motorways.

Health-related quality of life is impacted by proximity to an airport in noise-sensitive people.

Keywords: Aircraft noise, Noise sensitivity, Health

I-INCE Classification of Subjects Numbers: 62.5, 63.2, 66.2

1. INTRODUCTION

We have previously published findings suggesting that noise around people's dwellings reduces their health-related quality of life (HRQOL) (1-3). These studies measured people's annoyance with noise from either surrounding road traffic or aeroplanes and showed that the level of annoyance at the noise correlated with HRQOL as measured by the World Health Organisation Quality of Life instrument (WHOQOL). These findings are in line with other reports that environmental noise, especially from transport, may be detrimental to health (e.g. 4-6).

Noise sensitivity is a personality trait which predicts noise annoyance (4-6). The key characteristics of noise sensitive individuals are that they are more likely to attend to sound and evaluate it negatively (e.g., find it threatening or annoying), and they have stronger emotional reactions to noise, and, as a consequence, have greater difficulty habituating (7). Noise sensitivity has a large impact on noise annoyance ratings, lowering annoyance thresholds by up to 10 dB (4). A criticism of noise sensitivity is that it may really reflect a greater tendency to poor health or vulnerability (8). Under this hypothesis, people with noise sensitivity would be expected to have poorer health measures, irrespective of their degree of noise exposure.

In our previous study (3), we used a natural experiment to address this criticism by showing that noise-sensitive people only had poorer self-reported health if they lived in a noisy environment (near a motorway). If they lived in quieter (but socio-economically matched) areas, distant from major noise sources such as large roads, airports, trains, or industry, noise sensitive people did not differ in their self-reported health from non-noise-sensitive people.

[1] d.welch@auckland.ac.nz
[2] k.dirks@auckland.ac.nz
[3] daniel.shepherd@aut.ac.nz
[4] david.mcbride@otago.ac.nz

The present research applied the same methodology used previously (3) to address two sources of doubt around those findings. The first is the possibility that the findings were specific to motorway noise, which we addressed by considering people living near an airport. The second is the possibility that the findings were temporary or would not be sustained over time. This is addressed by considering two sets of data, collected in the same areas but three years apart.

2. METHOD.

2.1 Sample

Data for this study were collected in Wellington City, New Zealand in 2012 and 2015. Questionnaires were delivered to the mailboxes of residents living within 250 metres of Wellington Airport (Airport Group) or living in a socio-economically matched Wellington suburb (Non-Airport Group) which was not near the airport or aircraft flight paths. Socio-economic matching was done using data from the New Zealand Deprivation Index which assesses socioeconomic status based on car and telephone access, receipt of means-tested benefits, unemployment, household income, sole parenting, educational qualifications, home ownership, and home living space (9). Participants over the age of 18 years were invited to participate by completing the questionnaires anonymously and returning them using a postage-paid envelope.

2.2 Wellington International Airport

Wellington's airport is built close to surrounding residential areas (Figure 1). Flight numbers have remained fairly constant through Wellington Airport between 2012 and 2015, with 90000 total aircraft movements in 2012 increasing slightly to 93000 in 2015 (10).

Figure 1: Wellington International Airport runway and surrounding dwellings.

2.3 Questionnaire

The questionnaire was entitled 'Wellbeing and Neighbourhood Survey' and was designed to disguise the true intent of the study, with potential participants invited to participate in research investigating their place of living and their wellbeing. The survey contained 58 items categorised as health-related quality of life (HRQOL: 26 items), amenity (2 items), neighbourhood issues (14 items), environmental annoyances (7 items), demographic information (8 items), and one item estimating noise sensitivity.

To measure health, we employed the short form of the WHO's health-related quality of life (WHOQOL) scale, called the WHOQOL-BREF, which adheres to the WHO's definition of health as "a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity". The WHOQOL adopts a multi-dimensional profile of HRQOL, dividing it into four domains: physical health (7 items), psychological wellbeing (6 items), social relationships (3 items), and environmental factors (8 items). Two additional items assess overall quality-of-life and self-rated health. Each item is scored on a 5-point scale, where a low score corresponds to a negative assessment of that aspect of life and a high score corresponds to a positive assessment. Example questions include: 'do you have enough energy for everyday life?' (physical), 'how often do you have negative feelings such as blue mood, despair, anxiety or depression?' (psychological), 'how satisfied are you with the support you get from your friends?' (social), and 'how satisfied are you with the conditions of your living space?' (environmental).

Amenity and neighbourhood problems items were included primarily to 'camouflage' our interest in noise exposures and are not used in the present analyses. We asked the respondents how much they agreed with two questions: "I am satisfied with my neighbourhood/living environment", and "My neighbourhood/living environment makes it difficult for me to relax at home". The neighbourhood problem scale consisted of 14 distracter items that were not included in our analysis.

Of the 7 annoyance items, 4 asked about air quality, while 3 asked about annoyance to aircraft, other neighbours, or other sources of noise. The annoyance to noise items were based on recommendations issued by the International Commission on the Biological Effects of Noise [28] and in our own previous research (1-3). Respondents are asked to consider the last six months and how annoyed they are by noise from traffic, neighbours, and 'other' sources. Responding for each item was on a five-point scale from 1 (not annoyed at all) to 5 (extremely annoyed).

Noise Sensitivity was assessed using a three-point measure where each participant was asked to rate themselves as not noise sensitive, moderately noise sensitive, or very noise sensitive. This question was placed near the end of the questionnaire form amongst the demographic questions.

Demographic information was collected. Information was gathered on gender, ethnicity, age, highest level of education completed, current employment status, and whether the respondent was currently ill or had a known medical condition.

2.4 Data Analyses

Five separate analyses of variance were conducted for the overall WHOQOL score and for each of the four WHOQOL Domains (physical, psychological, social, and environmental). Year (2012 and 2015), Area (Airport and Non-airport), and noise sensitivity (Not, Moderate, Very) were modelled as the factors, with WHOQOL scores as the dependent variables. Evidence for a differential effect of noise sensitivity on health for different noise environments would be a significant two-way interaction between noise sensitivity and Area. Evidence for a change in this relationship over time would be a significant three-way interaction between Year, Area, and noise sensitivity.

On the basis of preliminary analyses using chi-squared tests, Table 1 shows disparities between the areas in education completed (both years) and current illness (2015). All analyses were carried out controlling statistically for these factors.

3. RESULTS

The two areas were closely matched demographically, except that members of the Airport Group tended to be less well educated in both 2012 and 2015 than in the Non-Airport Group, and the Airport Group was more likely to have current illness or a medical condition in 2015 compared with 2012 (Table 1). There was no difference in the noise sensitivity profile of the two groups in either year (Table 1).

Table 1: Group demographics by year. Pearson's χ^2 was used to test disparities (criterion α=0.05).

	2012			2015		
	Airport (n=87)	**Non-airport (n=91)**	**χ^2-test sig.**	**Airport (n=86)**	**Non-airport (n=103)**	**χ^2-test sig.**
Variables	*N** (%)	*N** (%)		*N** (%)	*N** (%)	
Sex			NS			NS
Male	28 (33)	29 (32)		31 (38)	34 (33)	
Female	58 (67)	62 (68)		51 (62)	67 (69)	
Age groups (years)			NS			NS
18-20	3 (4)	2 (2)		2 (2)	3 (3)	
21-30	7 (8)	8 (9)		5 (6)	6 (6)	
31-40	16 (19)	18 (20)		15 (18)	22 (21)	
41-50	16 (19)	19 (21)		13 (15)	28 (27)	
51-60	14 (16)	20 (22)		22 (26)	19 (18)	
61-70	16 (19)	16 (18)		15 (18)	17 (17)	
70+	14 (16)	7 (8)		13 (15)	8 (8)	
Education (completed)			P<0.05			P<0.05
Secondary School	29 (36)	18 (20)		42 (49)	16 (16)	
Technical College	20 (25)	16 (17)		12 (14)	9 (9)	
University Degree	32 (40)	57 (63)		31 (37)	77 (76)	
Employment Status			NS			NS
Full time	38 (44)	42 (47)		47 (55)	53 (52)	
Part time	20 (23)	23 (26)		6 (7)	18 (18)	
Retired	17 (20)	8 (9)		20 (23)	17 (17)	
Student	5 (6)	8 (9)		2 (2)	5 (5)	
Unemployed	2 (2)	1 (1)		3 (4)	2 (2)	
Leave/Sick leave	1 (1)	1 (1)		0 (0)	1 (1)	
Own household	1 (1)	0 (0)		2 (2)	0 (0)	
Other	2 (2)	7 (8)		6 (7)	6 (6)	
Current Illness			NS			P<0.05
Yes	36 (42)	35 (39)		40 (47)	33 (32)	
No	49 (58)	56 (62)		46 (54)	70 (68)	
Noise Sensitivity			NS			NS
None	40 (46)	38 (42)		31 (36)	38 (37)	
Moderate	33 (38)	41 (45)		48 (56)	57 (55)	
Severe	14 (16)	12 (13)		7 (8)	8 (8)	

* Totals may differ due to missing data, NS = not statistically significant

There was a two-way (Area by noise sensitivity) interaction ($F(2,353)=4.06$, $p=0.018$), suggesting that noise sensitivity had a differential effect on WHOQOL score depending on the area of residence (Figure 1). This shows that noise sensitivity was not associated with WHOQOL score in people living in the non-airport area, whereas for those living near the airport, the more noise sensitive people tended to have lower WHOQOL scores. There was no three-way (Area by Year by noise sensitivity) interaction ($F(2, 342)=1.16$, $p=0.314$), suggesting that the effect did not change over time (Figure 2).

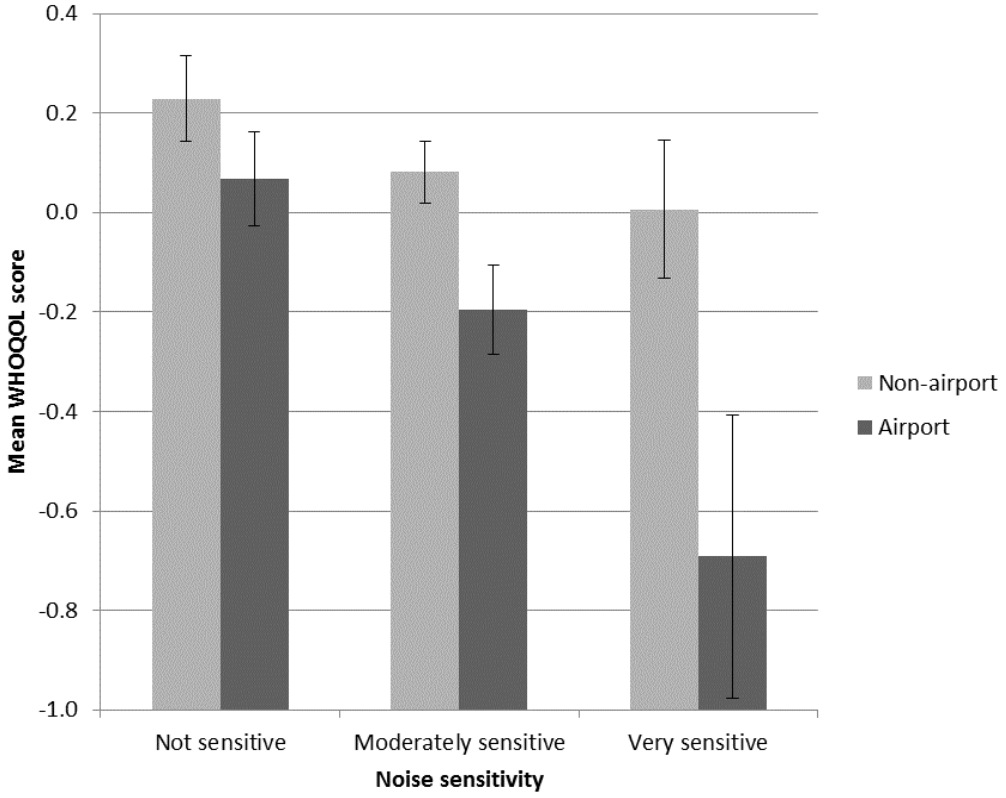

Figure 1: Overall mean WHOQOL score for each noise sensitivity group and in each area of residence. Error bars represent one standard error of the mean.

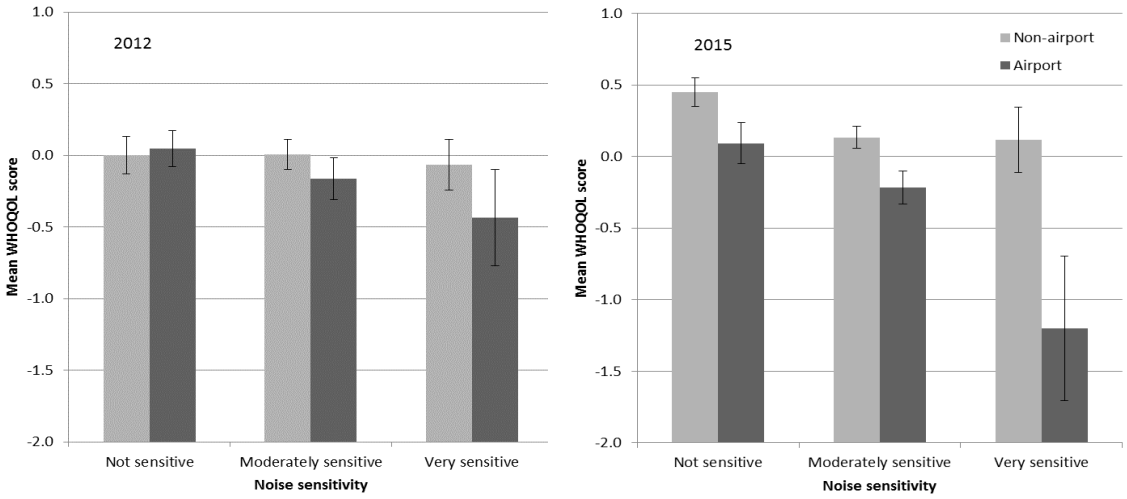

Figure 2: Mean WHOQOL Score by noise sensitivity and in each area of residence presented separately for each of the two years. Error bars represent one standard error of the mean.

The four WHOQOL Domains (physical, psychological, social, and environmental) were analysed separately and using the same approach as for the overall WHOQOL score. In no case was there a three-way (Area by Year by noise sensitivity) interaction (all $p>0.25$), implying that the pattern of effects of noise sensitivity by area remained the same across the years. There was a two-way (Area by noise sensitivity) interaction for physical ($F(2,338)=3.30$, $p=0.038$) and social ($F(2,341)=3.67$, $p=0.027$), marginally for psychological ($F(2,338)=2.35$, $p=0.097$), and no interaction for environmental ($F(2,338)=1.62$, $p=0.199$). All of the two-way interactions are displayed in Figure 3.

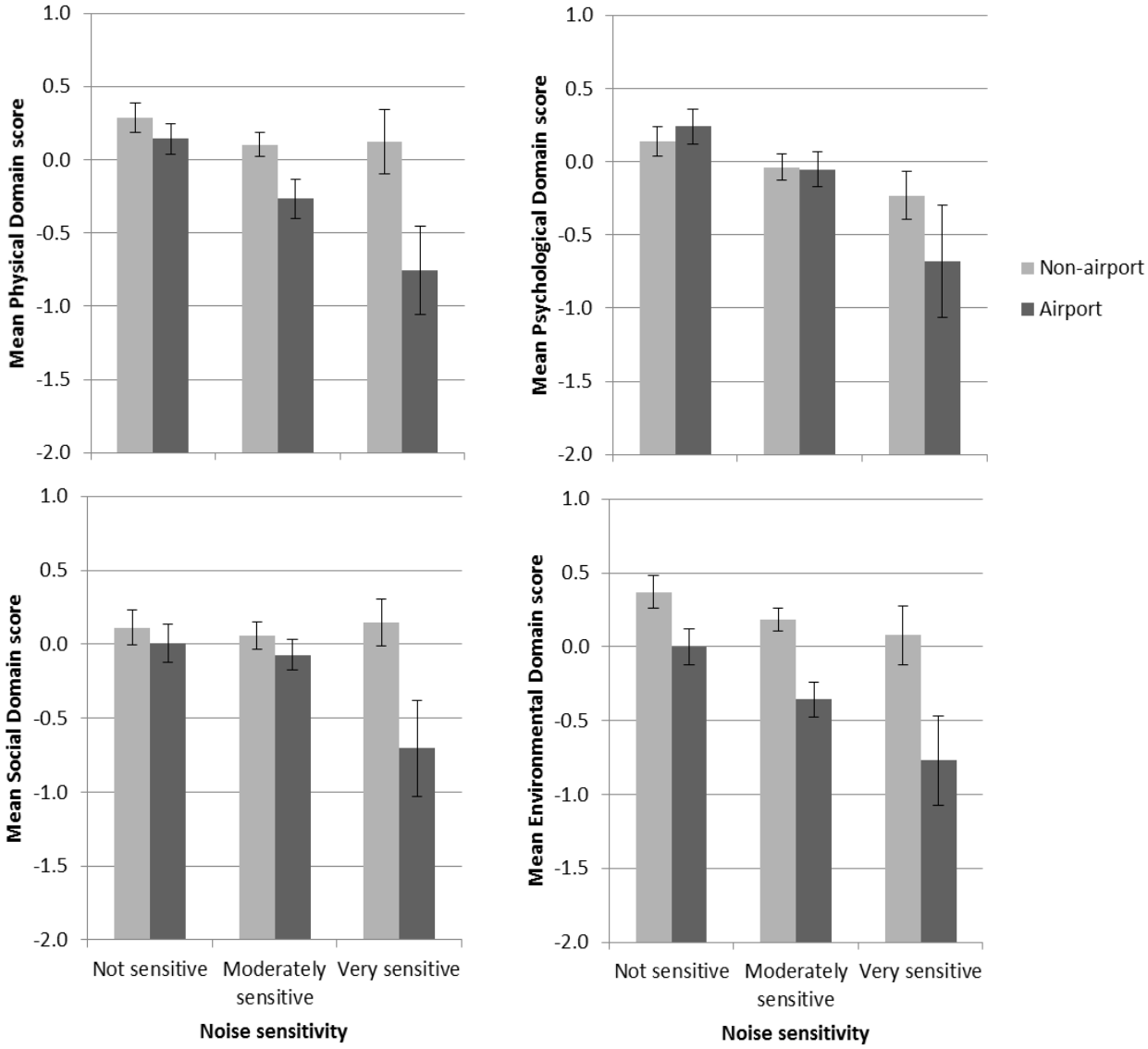

Figure 3: WHOQOL Domain (Physical, Psychological, Social, Environmental) score for each noise sensitivity group and in each area of residence. Error bars represent one standard error of the mean.

5. DISCUSSION

Overall, WHOQOL scores were poorer amongst noise-sensitive people who lived near the airport. This effect was sustained across the three-year period. Similar effects were shown for the WHOQOL Domains, though in some (Psychological and Environmental), statistical significance was not obtained.

The findings are important in that they confirm our earlier findings from people living near motorways (3) in a different noise environment, and show that similar findings are obtained in the same areas across a three-year period.

As in our previous research, the proportion of noise-sensitive and non-noise-sensitive people in each of the areas was very similar. This appears surprising; why would a person who reports themselves to be highly sensitive to noise live in a noisy area? We suspect that the cultural norms around noise sensitivity may govern this: since noise is regarded as acceptable and unavoidable by New Zealand society at large, those who are noise sensitive may feel that the annoyance and health effects that they experience are not sufficiently important to raise when making a decision about choice of dwelling, particularly given the numerous other factors that also need to be considered when making such a decision. Qualitative research investigating this is called for.

One limitation of this research, and a possible reason for some of the weaker effects, is that the people in the non-airport area sometimes complained of noise too. The effects may have been clearer had the control area been truly quiet; however the use of a real-world control and with matched socioeconomic status allowed a fair comparison that showed the impact of noise from aeroplanes over and above other forms of noise. Another limitation was the difference in educational and health status of the two groups. Despite careful matching on the basis of the socioeconomic status of each area, the respondents differed somewhat on these demographic indicators. Nonetheless, statistical control could be applied and findings were therefore not contaminated by these sampling differences.

6. CONCLUSIONS

Noise-sensitive people who are exposed to noise from aircraft have poorer health than non-noise-sensitive people with the same exposure, and noise-sensitive people who are not so exposed. We have replicated our previous findings relating to noise exposure from motorways in a different (airport) setting, and have also demonstrated that the effect is sustained over a three-year period.

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