Long-term aircraft noise and Cardiovascular disease Hospitalisation and Mortality near major airports in the United Kingdom, 2006-2015

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Introduction

Transport noise in Europe has an associated disease burden reported as next highest after air pollution, but most studies to date relate to road traffic noise. We quantified associations between long-term aircraft noise and cardiovascular disease hospitalizations and deaths due to all cardiovascular disease (CVD), coronary heart disease (CHD) and stroke in a population of 3.1 million living near four major English airports in 2006-15, following up from a 2013 BMJ study[1] investigating aircraft noise and CVD near Heathrow airport 2001-2005.

Methods

We obtained CVD-related hospital admission and mortality data and Civil Aviation Authority (CAA) annual average aircraft noise exposures for weighted 24-hour average day/evening/night time (Lden ≥ 50dB) and night time (Lnight ≥45dB) noise in 2006 and 2011, obtained for 9,860 census output areas (COAs) near London Heathrow (8,147 COAs), London Gatwick (228 COAs), Manchester (898 COAs), and Birmingham (587 COAs) airports. We investigated associations between long-term aircraft noise and health outcomes using Bayesian hierarchical Poisson regression at small area level adjusted for spatial random effects, and for confounders including age, sex, deprivation, ethnicity, road traffic noise, rail noise and NO_2. We compared results with those from our 2013 Heathrow study.

Results

Aircraft noise exposure for day-evening-night time (Figure 1) 10th and 90th percentiles were 50dB and 60dB and corresponding values of 45dB and 54dB respectively for night time noise (Figure 1), with a reduction in populations exposed to high aircraft noise (>60dB) over the years (Figure 2), and exposed minority populations (Figures 3).

We found increased risk of hospitalization due to CHD per 5dB increase in Lden and Lnight, but not for stroke or all CVD (Table 1) .

For a London Heathrow-specific analysis comparing 2006-15 results with the previous study[1], we saw less clear risks of CVD hospitalization and no increased risk of stroke unlike in 2001-05 (Figure 3) and no significant associations with mortality in 2006-15 (Table 1) compared with significant associations with CVD, CHD and stroke mortality in 2001-5 (not shown).

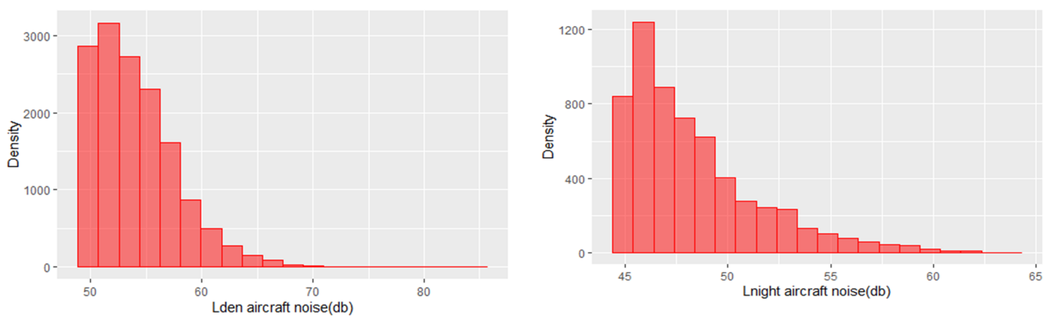

Figure 1. Histogram of aircraft noise exposure for day-evening-night time noise (Lden) and night time noise (Lnight)

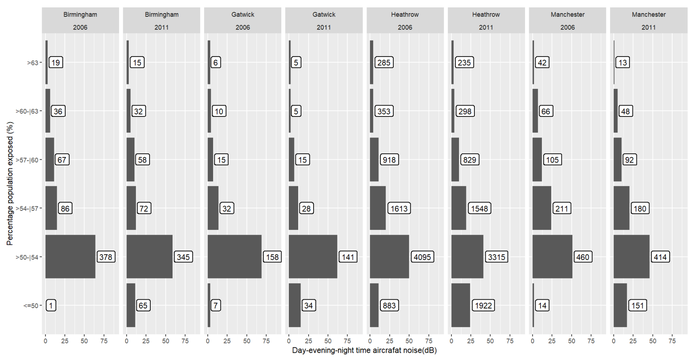

Figure 2. Exposure metrics for 24-hour weighted annual average day-evening-night time (Lden) and night time (Lnight) aircraft noise at Census Output Area (COA) level by airport

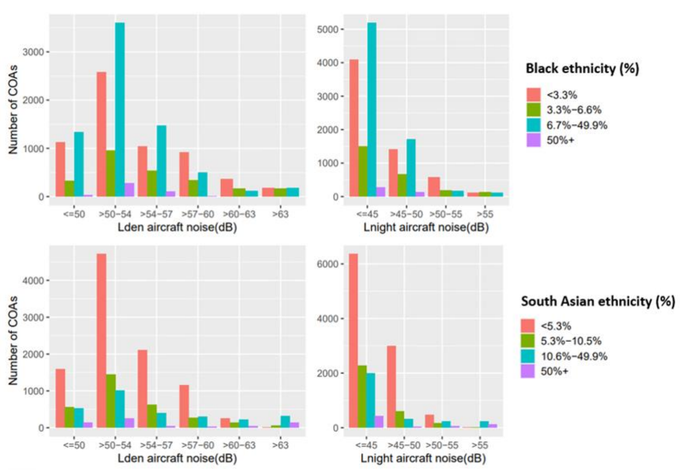

Figure 3. Histogram distribution of A-weighted annual average day-evening-night time (Lden) and night time (Lnight) aircraft noise exposure by the proportion of Black ethnicity (top panel) and proportion of South Asian ethnicity(bottom panel) in Census Output Areas (COAs) near London Heathrow airport, 2006-2015

Table 1. Relative Risk (95% Credible Intervals) for associations between Lden (≤50 vs >63dB) and Lnight air night time noise (Lnight) (≤45 vs >55dB) aircraft noise and hospitalization and mortality due to all cardiovascular disease, coronary heart disease, and stroke for all airports per 5dB increase in noise, 2006-2015.

Outcome	All CVD		CHD		Stroke	
	Unadjusted RR(95%CrI)	Adjusted RR(95%CrI)	Unadjusted RR(95%CrI)	Adjusted RR(95%CrI)	Unadjusted RR(95%CrI)	Adjusted RR(95%CrI)
Hospitalisation						
L_{den}	1.106; (1.085,1.126)	0.994; 0.963,1.025	1.424; 1.380,1.470	1.154; 1.093,1.217	0.964; 0.901,1.031	0.876; 0.808,0.949
L_{night}	1.077; 1.056,1.098	0.965; 0.933,0.999	1.407; 1.362,1.454	1.118; 1.056,1.184	0.984; 0.915,1.058	0.883; 0.809,0.964
Mortality						
L_{den}	1.082; 1.033,1.135	0.980; 0.917,1.047	1.116; 1.043,1.195	0.975; 0.898,1.059	1.102; 0.988,1.228	0.960; 0.837,1.101
L_{night}	1.080; 1.027,1.135	0.983; 0.916,1.056	1.116; 1.038,1.199	0.986; 0.903,1.077	1.095; 0.977,1.228	0.936; 0.808,1.084

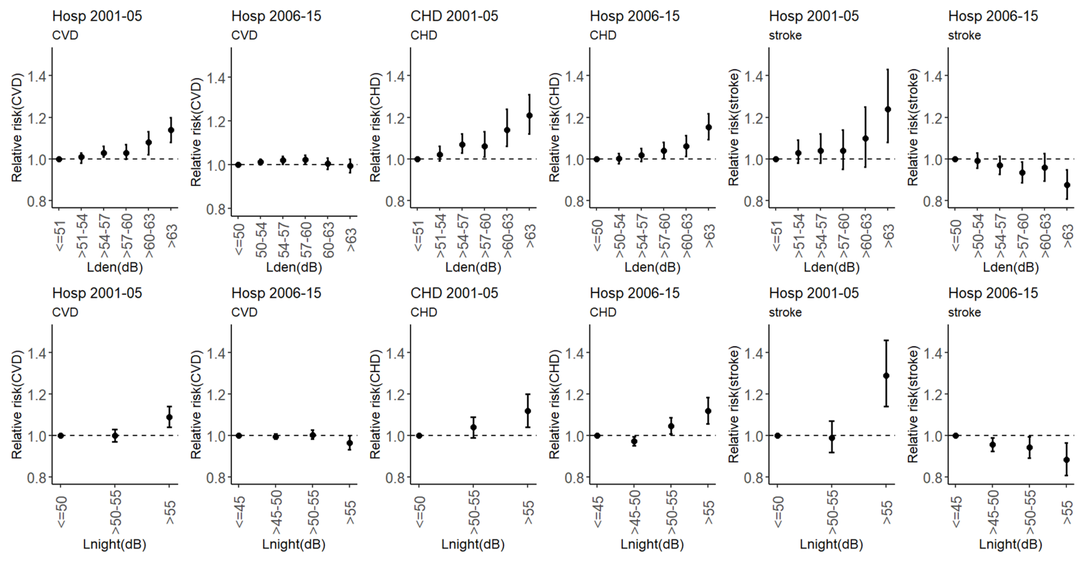

Figure 4. Comparison of estimates of association between aircraft noise and hospitalization in small area population near Heathrow airport in 2001-05 (from Hansell et al, 2013)[1] versus 2006-15 (the present study)

Discussion

We found a significant positive association between long-term aircraft noise exposure and CHD hospital admission in populations resident near major UK airports with relative risks of **1.154 (1.093,1.217)** and **1.118 (1.056,1.184)** per annual average 5dB increase in Lden and Lnight respectively, but no significant associations with mortality.

Findings are inconsistent with a Swiss study[2] using the Swiss National Cohort that found associations between aircraft noise and CVD mortality.

Estimates from our study were higher than WHO[3] reported relative risk of 1.09 (95% CI 1.04-1.15) for incident coronary heart disease per annual average 10dB increase in Lden noise for the European Region.

We used a similar study design for 2006-15 to a previous study looking at aircraft noise near Heathrow in 2001-5[1] but found risk reduction in CVD and stroke-related admission risk at the highest Lden and Lnight aircraft noise levels. Potential explanatory factors include reduction in the number of areas exposed to high noise levels, especially in deprived areas with the highest proportion of black ethnicity around Heathrow airport (Figure 2), and targeted noise interventions in over 6,000 households exposed to noise levels >63dB during 2006-15. A recent 2019 analysis on noise forecasts from the CAA (CAP 17314) anticipates that by 2050 the geographical area exposed to noise around all UK airports may shrink but that the total number of people exposed to aircraft noise will increase.

Studies investigating the same airport(s) over time provide indirect evidence about the effectiveness of initiatives to reduce noise pollution around major airports with important implications for aircraft noise and health policies.

References

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3. Kempen, E,V., Casas, M., Pershagen, G., & Foraster, M. WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Cardiovascular and Metabolic Effects: A Summary. Int J Environ Res Public Health.15(2),379. (2018)