Does Exposure to Aircraft Noise Increase the Risk of Hypertension near French Airports?

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Summary
Background: The HYENA study (HYpertension and Exposure to Noise near Airports) has evidenced an association between aircraft noise exposure and hypertension. Objective: The objective of our study was to investigate the relationship between the risk of hypertension and aircraft noise exposure around French airports. Methods: The longitudinal study included in the DEBATS research program aims to follow-up during four years 1,244 residents around three French airports: Paris-Charles de Gaulle, Toulouse-Blagnac, and Lyon Saint-Exupéry. Overall annoyance and health status (in terms of sleep disturbances, cardiovascular diseases, and anxiety and depressive disorders) were assessed by a face-to-face questionnaire performed at the place of residence of the participants. The interviewer also measured the systolic (SBP) and the diastolic (DBP) blood-pressure (BP) of the participants. The individuals were classified as hypertensive if they had either BP levels above the World Health Organization cut-off points (a SBP $\geq$ 140 or a DBP $\geq$ 90) or a diagnosis of hypertension by a physician in conjunction with the use of antihypertensive medication, as reported in the interview questionnaire. Aircraft noise exposure was evaluated in terms of L_{den} for each participant's home address using noise maps calculated with the Integrated Noise Model (INM). The major potential confounders being risk factors for hypertension were included in the logistic regression models: age, gender, body mass index, physical activity, occupational activity and alcohol consumption. Results: After adjustment for major confounders, an exposure-response relationship was found between the risk of hypertension and aircraft noise exposure for men only, not for women. Conclusions: A slight increase in risk of hypertension due to aircraft noise exposure was evidenced for men. This result confirms the findings of the HYENA study suggesting that the effect of aircraft noise on the risk of hypertension is stronger in men than in women.

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1. Introduction

A national survey carried out in 2005 by the French National Institute for Transport and Safety Research (Inrets[2]) shows that 6.6% of the French population is annoyed by aircraft noise [1]. Many surveys carried out both in France and abroad address aircraft noise annoyance [2,3,4] or report adverse effects on sleep quality [5,6]. The largest study to date, the HYENA study (HYpertension and Exposure to Noise near Airports), has evidenced an association between the aircraft noise exposure and hypertension [7].

Health issues related to airport noise pollutions became over the last years one of the key-questions which public policies want more to take into account. In 2004, the French "Conseil Supérieur d'Hygiène Publique" (CSHPF) delivered its recommendation related to the health protection of people exposed to airport noise: noise around airports is considered as a public health problem. CSHPF recommended that the knowledge of the French health situation resulting from aircraft noise exposure is improved by performing epidemiological studies. Further to this recommendation, the French Ministry of Health (DGS), in co-operation with the Airport Pollution Control Authority (Acnusa) asked the French Institute of Science and Technology for Transport, Development and Networks (Ifsttar) to implement an epidemiological research program named "Discussion sur les Effets du Bruit des Aéronefs Touchant la Santé" (DEBATS).

2. Methods

DEBATS is an on-going research program (2011-2018) involving adult residents around three French airports [8,9]: Paris-Charles de Gaulle, Toulouse-Blagnac, and Lyon Saint-Exupéry (Cf. Figure 1). DEBATS includes a longitudinal field study that consists in following-up 1,244 of the above-mentioned airports residents during four years.

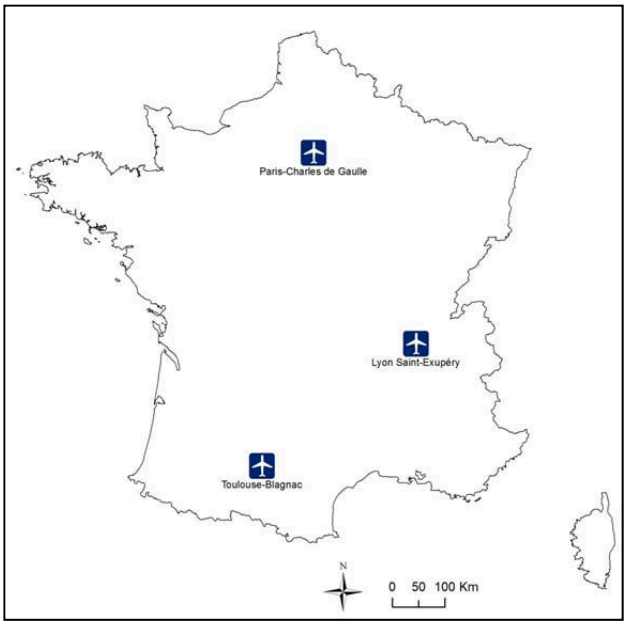

Figure 1. The three airports included in the DEBATS research program.

The study area was defined on the basis of noise maps produced with the 'Integrated Noise Model' (INM). These maps consist of three areas (Cf. Figure 2). The first area indicates a very high level of noise pollution limited by the L_{den} 70 index curve; the second one indicates a high level of noise pollution between the L_{den} 70 and L_{den} 65 index curves; and the last one indicates a moderate level of noise pollution between the L_{den} 65 and L_{den} 55 index curves. Within the frame of DEBATS, the French Civil Aviation Authority has assessed a fourth area which indicates a low level of noise pollution between the L_{den} 55 and L_{den} 50 index curves. Noise level for each participant's home was estimated with a 1-dB(A) resolution using these maps.

Participants filled out a questionnaire during a face-to-face interview at their place of residence. Information was collected by an interviewer on demographic variables, socioeconomic status, lifestyle factors including smoking and alcohol consumptions and physical activity, personal medical history, medication use, and finally annoyance due to the noise exposure. Anthropometric measurements (weight, height and waist circumference) were recorded on the participants. The interviewer also measured the systolic (SBP) and the diastolic (DBP) blood-pressure and the heart rate (HR) of the participants.

[2] Inrets became Ifsttar (French institute of science and technology for transport, development and networks) on the first of January 2011.

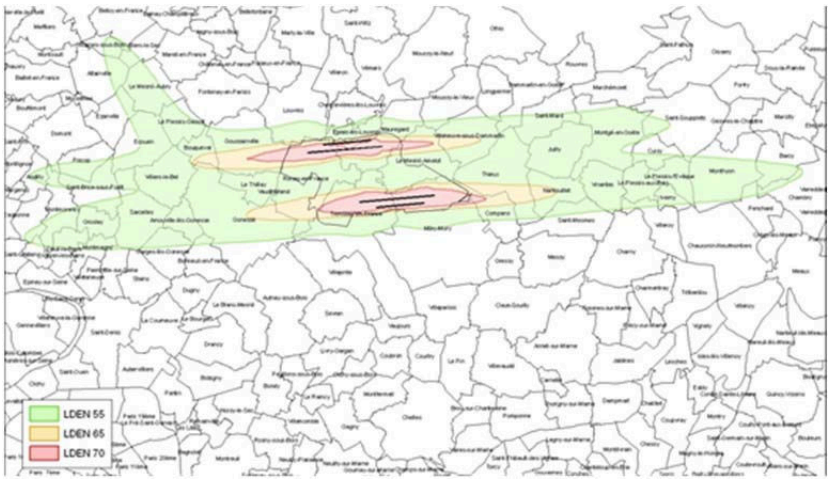

Figure 2. Paris-Charles de Gaulle airport noise exposure map.

BP and HR were assessed three times: the first measurement was recorded in the beginning of the interview, after five minutes rest, a second measurement was recorded after a further one minute rest. A third measurement was taken at the end of the interview (approximately one hour).

The mean of the first two readings was used to define SBP and DBP for the subsequent analyses. Hypertension was defined according to the World Health Organization [10]: a SBP ≥ 140 or a DBP ≥ 90. In the analyses, participants were classified as hypertensive if they had either BP levels above the WHO cutoff points or a diagnosis of hypertension by a physician in conjunction with use of antihypertensive medication, as reported in the interview questionnaire. Participants were considered to have a diagnose of hypertension if they answered 'yes' to the question 'during the last twelve months, have you ever been told by a doctor or health professional that you had hypertension?'. Treatment of BP was defined by use of antihypertensive agents during the last twelve months.

The age-adjusted prevalence for hypertension was calculated for each gender and both gender together using, as standard population, the age structure of the French population in 2014, derived from the latest French national census.

Logistic regression models with hypertension as the outcome variable, and exposure variables and confounders as covariates were used to assess the independent associations of potential factors with hypertension. 95% confidence intervals (CIs) for each effect estimate were calculated. Variables a priori considered to be the major potential confounders, being risk factors for hypertension as well as possibly associated with noise exposure were included in the models: age, gender, body mass index (body weight divided by height squared), physical activity, alcohol consumption and occupational activity.

3. Results

1,244 participants between 18 and 90 years of age were interviewed. The participants were slightly different from the population of the study area. 56% of participants were females (Cf. Table I). The participants were older. 36% of them were between 55 and 74 years of age (22% of the population of the study area). 63% of the participants were married (44% of the population of the study area). The education level of the study participants was higher: 46% had a certificate higher than the French high-school certificate (22% of the population of the study area). In terms of employment, 60% had an occupational activity. 70% owned their housing (41% of the population of the study area).

The age-adjusted prevalence of hypertension (to the French population in the study) was 32% in men and 26% in women. The sex- and age-adjusted prevalence of hypertension was 29%.

Table 2 shows the OR for hypertension related to aircraft noise among men. After adjustment for the main potential confounders, an exposure-response relationship was evidenced between the risk of hypertension and aircraft noise exposure for men, not for women. A 1-dB increase in L_{den} was

associated with an odds-ratio (OR) of 1.04 [95%CI, 1.00–1.07]. No association was found for women with an OR of 0.99 [95% CI, 0.96–1.02].

4. Discussion

The DEBATS study is the first one which investigates the impact of aircraft noise on hypertension in France. After adjustment for major confounders, an association was found between the risk of hypertension and aircraft noise exposure for men only, not for women.

The participants were slightly different from the population of the study area: they were older and more educated. This selection bias is very similar to that observed in other epidemiological studies carried out in France.

The age-adjusted (to the French population) prevalence of hypertension in men and in women were very similar to those observed in the ENNS study (National Nutrition Health Survey) in subjects between 18 and 74 years of age in France in 2006: 34% in men and 28% in women [11].

5. Conclusions

A slight increase in risk of hypertension due to aircraft noise exposure was evidenced for men, not for women. This result confirms the findings of the HYENA study suggesting that the effect of

Table I. Sociodemographic characteristics of the participants.

	Participants	Study area
Sex		
Female	56%	52%
Male	44%	48%
Age		
18-25 years	6%	18%
26-34 years	11%	17%
35-44 years	19%	19%
45-54 years	21%	17%
55-64 years	21%	14%
65-74 years	15%	8%
≥ 75 years	6%	8%
Marital status		
Single	20%	43%
Divorced	11%	7%
Married	63%	44%
Widowed	6%	6%
Educational level		
< French high-school certificate	36%	61%
French high-school certificate	17%	17%
> French high-school certificate	46%	22%
Housing occupancy status		
Owner occupant	70%	41%
Tenant	30%	59%

aircraft noise on the risk of hypertension is stronger in men than in women.

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