



AIRCRAFT NOISE EFFECT ON SELF-REPORTED HEALTH THROUGH NOISE ANNOYANCE: CAUSAL MEDIATION ANALYSIS IN THE DEBATS LONGITUDINAL STUDY IN FRANCE

Minon'tsikpo kossi KODJI^{1*}, Émilie LANOY², Lise GIORGIS-ALLEMAND¹, Anne-Sophie EVRARD¹

¹Université Lyon, Université Gustave Eiffel, Ifsttar, Université Lyon 1, Umrestte, UMR T_9405, Bron, France

²Sorbonne Université, INSERM, Institut Pierre Louis d'Épidémiologie et de Santé Publique (IPLESP), Paris, France

ABSTRACT

This study aims to investigate aircraft noise annoyance as a mediator of the causal effect of aircraft noise on self-reported health status (SRHS) using a causal inference approach. The DEBATS (Discussion on the health effects of aircraft noise) longitudinal study included in 2013, 1,244 participants aged over 18 years and living around three French airports. These participants were followed up in 2015 and 2017. They self-reported their perceived health status, aircraft noise annoyance, and noise sensitivity via a questionnaire during the three visits. Noise maps were used to estimate outdoor aircraft noise levels in four zones: <50, 50-54, 55-59 and ≥ 60 dBA in L_{den} . A causal mediation analysis based on inverse probability weighting was performed to evaluate the mediation effect of aircraft noise annoyance. The causal effect of aircraft noise levels on SRHS impairment was significant only for high exposure (≥ 60 vs <50). Our results confirm the mediation effect of aircraft noise annoyance in this causal effect.

Keywords: *epidemiology; aircraft noise exposure; general health; self-reported health; mediation analysis*

1. INTRODUCTION

SRHS is defined as a subjective measure of health in which an individual considers all aspects of their health. SRHS is

*Corresponding author: minon.kodji@univ-eiffel.fr

Copyright: ©2023 First author et al. This is an open-access article distributed under the terms of the Creative Commons Attribution 3.0 Unported License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

often used in health research as a predictor of mortality and overall health [1].

The causal effect of aircraft noise on SRHS impairment remains unclear. Aircraft noise annoyance seems to mediate aircraft noise effect on SRHS impairment. That is, increased noise levels directly affect noise annoyance, which in turn leads to impaired SRHS. Few previous studies on SRHS are cross-sectional and used standard statistic inference approaches that may be insufficient to control for confounding biases and thus may provide biased estimates. The relationships between aircraft noise levels, aircraft noise annoyance and SRHS seem complicated by the potential reciprocal relationships among these variables. Causal marginal structural models (MSMs) have emerged as a valuable tool to address the challenges of confounding factors and provide more reliable causal estimates. Mediation analysis aims to understand the underlying mechanism by which noise affect health. In this study, we conducted a mediation analysis using causal inference methods to investigate the mediation role of aircraft noise annoyance on this potential causal effect.

2. METHODS

This study is based on the 881 participants who participated in all three visits (2013, 2015 and 2017) of the DEBATS longitudinal study conducted around three French airports [2]. Noise maps were used to estimate aircraft noise levels outside participants' homes by linking noise levels to participants' addresses (categorized: <50; 50-54, 55-59, and ≥ 60 dBA in L_{den}). Participants self-reported their health by answering the following question 'In general, would you say that your health is excellent, good, fair, or poor? Participant reported fair or poor were compared to those reported good or excellent. Noise annoyance was assessed using the following question: 'Thinking about the last 12

months, when you are here at home, how much does aircraft noise bother, disturb, or annoy you? Others individual factors such as noise sensitivity, lifestyles and demographic characteristics were also assessed during the interview.

For causal mediation analysis, we used marginal structural models based on the inverse probability weighting (IPW) estimator to adjust for confounding factor [3]. Indeed, the IPW allowed us to estimate the causal effect of aircraft noise levels on SRHS by mimicking a hypothetical randomized experiment through the creation of a pseudo-population in which exposed and non-exposed subjects were exchangeable within levels of the available confounders. We estimated the cumulative causal effects (total effect, direct effect and indirect effect through annoyance) of aircraft noise levels over time on SRHS at the end of follow-up. We compared aircraft noise effect in the three highest aircraft noise categories to the effect in the lowest aircraft noise category (<50 dBA in L_{den}).

3. RESULTS

The number of participants in each category of aircraft noise levels was relatively equal (around 25%). At the Baseline, 14% of participant reported fair or poor health and this proportion remain similar during follow-ups. 18% of participant reported to be highly annoyed at the baseline and this proportion increase to 25% in the two follow-ups. 46% of participant were men. This study showed that the causal effect of aircraft noise levels on SRHS impairment was significant only for high exposure to aircraft noise (≥ 60 dBA) over time compared to the aircraft noise exposure reference group (<50 dBA). Our results confirm that this causal effect was mediated by aircraft noise annoyance.

4. DISCUSSION

In this study, we evaluate the cumulative effect of aircraft noise exposure on SRHS impairment. To our knowledge, this is the first study using causal inference approaches for mediation analysis on the topic. In addition, it is one of the few studies to assess the role of aircraft noise annoyance in this association. Some cross-sectional studies that suggested an association between aircraft noise exposure and SRHS impairment for a 10 dBA increase in aircraft noise. Our study showed noise effect only for exposure to high aircraft noise levels over time and confirm the hypothesis of a mediating effect of aircraft noise annoyance.

5. FUNDING

This study was supported by funds from the French Ministry of Health, the French Ministry of the Environment, the French Civil Aviation Authority, and the Airport Pollution Control Authority (Acnusa). The authors would like to thank them.

6. COMPETING INTERESTS

None declared.

7. ETHICS APPROVAL

This study was approved by two national authorities in France, the French Advisory Committee for Data Processing in Health Research (CCTIRS 11-405) and the French National Commission for Data Protection and the Liberties approved this study (DR 2012-361).

8. ACKNOWLEDGMENTS

The Airport Pollution Control Authority (Acnusa) requested the French Institute of Science and Technology for Transport, Development and Networks (Ifsttar) to carry out this study. The authors would like to thank them for their confidence. The authors are grateful to all the participants in the study and their interviewers. The authors also thank Paris Airports and the French Civil Aviation Authority for providing noise exposure maps, and are also grateful to Inès Khati and Marie Lefèvre for their participation in the implementation of the study.

9. REFERENCES

1. Idler EL, Benyamini Y. Self-Rated Health and Mortality: A Review of Twenty-Seven Community Studies. *J Health Soc Behav.* [American Sociological Association, Sage Publications, Inc.]; 1997;38:21–37.
2. Baudin C, Lefèvre M, Champelovier P, Lambert J, Laumon B, Evrard A-S. Self-rated health status in relation to aircraft noise exposure, noise annoyance or noise sensitivity: the results of a cross-sectional study in France. *Am J Epidemiol.* Springer; 2021;21:1–11.
3. VanderWeele T, Tchetgen Tchetgen EJ. Mediation analysis with time varying exposures and mediators. *J R Stat Soc Ser B Stat Methodol.* 2017;79:917–38.



10th Convention of the European Acoustics Association
Turin, Italy • 11th – 15th September 2023 • Politecnico di Torino

4647

