



DOES AIR POLLUTION MODERATE THE ASSOCIATION BETWEEN AIRCRAFT NOISE EXPOSURE AND BLOOD PRESSURE IN THE FRENCH LONGITUDINAL DEBATS STUDY?

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ABSTRACT

A possible mechanism explaining the association between cardiovascular diseases and both aircraft noise and air pollution may be increased blood pressure (BP). In the French DEBATS longitudinal study, aircraft noise was associated with increased systolic and diastolic BP.

Our objective was to investigate the moderating role of air pollution in this association.

In the DEBATS study, 1,244 participants living near three major airports answered detailed face-to-face interviews including BP measurements in 2013, 2015 and 2017. At each home addresses, aircraft noise maps were used to estimate noise levels and nearest monitoring station was used to estimate exposure to nitrogen dioxide (NO₂) and particulate matter (PM₁₀) during the month preceding each BP measurement. Adjusted mixed models with random intercept were used.

Increased NO₂ levels were associated with increased BP, but not PM₁₀. The association between aircraft noise and BP remained statistically significant after adjustment for NO₂. Although the interaction term between aircraft noise and NO₂ was not statistically significant, the association between aircraft noise and BP was higher in the lowest NO₂ tercile.

In our study, air pollution appears to be a moderator in the relationship between aircraft noise and BP. These results deserve further investigation.

Keywords: aircraft noise, blood pressure, air pollution, moderation analyses.

1. INTRODUCTION

Several epidemiological studies have raised evidence that transportation noise pollution [1] and air pollution [2] are both associated with cardiovascular diseases. In the French DEBATS longitudinal study, aircraft noise was associated with increased systolic and diastolic BP [3], however, the role of air pollution in this association was not explored.

Our objective was to investigate the moderating role of air pollution in the association between aircraft noise exposure and increased BP in DEBATS.

2. METHODS

In the French DEBATS longitudinal study, 1,244 participants living near three major airports (Paris-Charles de Gaulle, Toulouse-Blagnac, Lyon-Saint Exupéry) answered detailed face-to-face interviews in 2013, 2015 and 2017. Blood pressure was measured three times during each interview by the interviewer using an automated upper arm blood pressure monitor (Omron® M6 comfort). The mean of the first two measurement was used in the statistical analyses.

At each home addresses, aircraft noise maps developed using the Integrated Noise Model [4] were used to estimate noise levels. Measurements from the air quality monitoring station closest to the participants' homes were used to estimate exposure to nitrogen dioxide (NO₂) and particulate matter (PM₁₀) during the month preceding each BP measurement. Adjusted linear mixed models with random

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intercept were used to estimate the association between BP and aircraft noise. The potential moderator role of air pollution in this association was assessed following Baron and Kenny recommendations [5].

3. RESULTS

Increased NO₂ levels were associated with increased BP, but not PM₁₀. The association between aircraft noise and BP remained statistically significant after adjustment for NO₂. Although the interaction term between aircraft noise and NO₂ was not statistically significant, the association between aircraft noise and BP was higher in the lowest NO₂ tercile.

4. DISCUSSION

In our study, air pollution appears to be a moderator in the association between aircraft noise and BP. In the literature on co-exposure to transportation noise and air pollution in association with BP, although several studies assessed confounding with little supporting evidence, none assessed interaction (as shown by the review by Eminson *et al* [6]). The results from this study deserve further investigation to better understand the health effects of co-exposure to aircraft noise and air pollution near airports.

5. FUNDING

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6. COMPETING INTERESTS

None declared.

7. ETHICS APPROVAL

This study was approved by 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).

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9. REFERENCES

- [1] T. Münzel, M. Sørensen, and A. Daiber, 'Transportation noise pollution and cardiovascular disease', *Nat. Rev. Cardiol.*, vol. 18, no. 9, Art. no. 9, Sep. 2021, doi: 10.1038/s41569-021-00532-5.
- [2] J. de Bont, S. Jaganathan, M. Dahlquist, Å. Persson, M. Stafoggia, and P. Ljungman, 'Ambient air pollution and cardiovascular diseases: An umbrella review of systematic reviews and meta-analyses', *J. Intern. Med.*, vol. 291, no. 6, pp. 779–800, Jun. 2022, doi: 10.1111/joim.13467.
- [3] A. Kourieh, L. Giorgis-Allemand, L. Bouaoun, M. Lefèvre, P. Champelovier, J. Lambert, B. Laumon, and A.-S. Evrard, 'Incident hypertension in relation to aircraft noise exposure: results of the DEBATS longitudinal study in France', *Occup. Environ. Med.*, vol. 79, no. 4, pp. 268–276, Apr. 2022, doi: 10.1136/oemed-2021-107921.
- [4] H. He, E. Boeker, and E. Dinges, *Integrated Noise Model (INM) Version 7.0 User's Guide*, vol. FAA-AEE-07-04. Washington, USA: Federal Aviation Administration, Office of Environment and Energy, 2007.
- [5] R. M. Baron and D. A. Kenny, 'The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations', *J. Pers. Soc. Psychol.*, vol. 51, pp. 1173–1182, 1986, doi: 10.1037/0022-3514.51.6.1173.
- [6] K. Eminson, Y. Chen, B. Fenech, G. Rodgers, and A. Hansell, 'Does air pollution confound associations between environmental noise and cardiometabolic outcomes?—A systematic review', in *Proc. of the 13th ICBEN Congress on Noise as a Public Health Problem*, (Sweden, Stockholm), 2021. [Online]. Available: http://www.icben.org/2021/ICBEN%202021%20Papers/full_paper_33840.pdf