



# Annoyance to transportation noise and risk of physical inactivity

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## Summary

One pathway through which noise contributes to cardiovascular diseases could relate to noise annoyance, impaired sleep, and reduced physical activity. We investigated the association of long-term annoyance to residential transportation noise with physical activity and its change over time. We assessed 3,622 participants (age 38-80) that attended all visits of the population-based Swiss SAPALDIA cohort. Physical activity was defined as being at least sufficiently active (i.e. > 150 min/week, Yes/No) and as the change from visit 2 to 3: remaining active/inactive or becoming active/inactive. Participants reported noise annoyance to 24-hour transportation noise (all visits) and to specific sources at night, i.e. road traffic, railway, and aircraft (visit 3) on an ICBEN-type 11-point scale. Long-term transportation noise annoyance was calculated as the average across visits. We used multivariate and multinomial logistic regression for cross-sectional and longitudinal analyses, respectively, and evaluated effect modification by sex, sleep deprivation, and noise sensitivity. Models consistently indicated that annoyance to transportation noise, mainly related to road traffic, were associated with a reduction in being physically active at visit 3, or becoming or remaining active from visit 2 to 3. Effect estimates with night-time road traffic noise annoyance tended to be stronger among individuals reporting sleep deprivation. Transportation noise annoyance could contribute to cardiometabolic diseases through physical inactivity, particularly among individuals with impaired sleep. PACS no. 43.50.Lj 43.50.Qp

## 1. Introduction

Among the diverse effects of noise on health, there is substantial evidence indicating that transportation noise leads to cardiovascular morbidity and mortality [1], [2]. The proposed biological mechanism consists of noise-induced stress reactions, which may produce homeostatic deregulations in the long-term, particularly during resting periods. Although it is suggested that exposure to noise levels may have a major contribution while sleeping and unconscious, the perception of noise while awake could also well constitute a relevant pathway towards cardiovascular disease. Noise annoyance has been associated with cardiovascular disease too [3], [4]. One pathway could relate to noise annoyance, impaired sleep, and reduced physical activity, being the latter two important contributors to cardiometabolic diseases. In turn, residential noise annoyance could reduce the willingness to exercise in the neighborhood.

We investigated the association of residential transportation noise annoyance with physical activity and its change over time in the SAPALDIA cohort, a population-based sample of adults in Switzerland, following both cross-sectional and longitudinal designs.

## 2. Methodology

We assessed 3,622 participants of 38 to 80 years of age that took part in all three visits (years 1991, 2001, and 2011) of the Swiss population-based SAPALDIA cohort.

Physical activity was assessed in visits 2 and 3 and defined as being sufficiently active (at least 150 minutes per week of self-reported moderate physical activity). For longitudinal analyses, we assessed the change in physical activity as a 4-category outcome for remaining active, remaining inactive, becoming active, or becoming inactive from visit 2 to 3. Noise annoyance was reported on an ICBEN-type 11-point scale. Source-specific noise annoyances at the bedroom at night were asked in visit 3, namely road traffic, railway, and aircraft. General transportation noise annoyance at home was asked in visits 1, 2, and 3. All noise annoyances were assessed as 1-year annoyances at visit 3 in cross-sectional analyses. Long-term annoyance to general transportation noise was assessed as the average of reported transportation noise annoyance across visits, namely: 10-year

average (from visits 1 to 2) and 20-year average (from visits 1 to 3).

We used multivariate and multinomial logistic regression for cross-sectional and longitudinal analyses, respectively, adjusting for age, sex, socioeconomic status, lifestyles, body mass index, and consecutively for air pollution annoyance, study area, comorbidities, traffic proximity, sleep deprivation, and noise sensitivity. We evaluated effect modification by sex, sleep deprivation, and noise sensitivity.

## 3. Results

A total of 16.4 %, 7.4 %, 3.1 %, and 1.1 % were annoyed (score  $\geq 5$ ) by transportation and night-time road, aircraft, and railway noise at visit 3, respectively.

In longitudinal analyses, 10-year long-term transportation noise annoyance up to visit 2 prevented from becoming or remaining active from visit 2 to visit 3 at equal rates (for fully adjusted model: RRRs=0.98, 95%CI: 0.96-1.00, per 1-annoyance point) compared to remaining inactive.

Cross-sectional analyses were consistent with longitudinal analyses and suggested associations for 1-year noise annoyance to general transportation noise, night-time road traffic transportation noise and night-time aircraft noise with reductions in being sufficiently physically active. These results did not always reach statistical significance. Furthermore, we observed a statistical significant association between long-term noise annoyance to transportation noise (20-year average from visit 1 to 3) and a reduction in being sufficiently active at visit 3.

Physical inactivity tended to be stronger among individuals reporting sleep deprivation, particularly for night-time annoyance to road traffic noise. No effect modification by sex or noise sensitivity on the studied associations was observed. Estimated effect sizes were robust to all adjustment sets.

## 4. Conclusions

To our knowledge, this is the first study to explore the impact of transportation noise annoyance on physical activity. Transportation noise annoyance, particularly from night-time road traffic, could contribute to cardiometabolic diseases through physical inactivity. This risk could be particularly relevant among individuals with impaired sleep. Furthermore, the longitudinal analyses provide additional evidence against reverse causality. These findings could be very relevant to public

health, because of the importance of physical activity for health. Further studies are needed to confirm our results and to ascertain the involved pathways.

### **Acknowledgement**

This study was undertaken in the framework of the SAPALDIA (Swiss study on Air Pollution and Lung Disease in adults) and SiRENE (Short and Long Term Effects of Transportation Noise Exposure) projects. SAPALDIA and SiRENE are supported by funding from the Swiss National Science Foundation SNF-SAPALDIA and SNF-SiRENE (CRSII3\_147635) and the Federal Office of Public Health. SAPALDIA is also supported by the EU Funding Agency (EU 7th Framework; Horizon 2020), Federal Office of Public Health, Cantons & Lung Leagues. The authors gratefully acknowledge the financial support given by the funders, and the scientific input and advice of colleagues working on SAPALDIA and SiRENE.

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