

## SiRENE-Survey Part 1: Exposure-effect relationships for transportation noise annoyance in Switzerland

Mark BRINK<sup>1</sup>; Jean-Marc WUNDERLI<sup>2</sup>

<sup>1</sup> Swiss Federal Office for the Environment, Bern, Switzerland

<sup>2</sup> Empa Swiss Federal Laboratories for Materials Science and Technology, Dübendorf, Switzerland

### Extended ABSTRACT

The aim of the SiRENE study's extensive population survey (1) was to establish exposure-response relationships reflecting the percentage highly annoyed (%HA) as functions of road traffic, railway, and aircraft noise exposure, as well as to elucidate the degree to which the acoustic indicator Intermittency Ratio (IR), which reflects the "eventfulness" of a noise situation, can explain noise annoyance (see paper "SiRENE-Survey Part 2" in the same session).

We conducted a mixed-mode representative population survey in a stratified random sample of 5592 residents exposed to transportation noise all over Switzerland. Source-specific noise exposure, measured as day-evening-night level (Lden), was calculated for each floor and each façade based on comprehensive traffic data. Exposure assessment was validated with measurements in about 100 survey respondent's homes. Noise annoyance was measured using the ICBEN 11-point scale. To be able to control for seasonal effects, the survey was carried out in 4 waves in the years 2014 and 2015, which were spaced 3 months apart. A potential non-response bias was investigated by comparing the distributions of noise exposure and noise annoyance and a few further variables between all survey responders and a random sample (N= 483) of initial nonresponders of the third wave.

For all noise sources, results revealed significant associations between Lden and %HA after controlling for confounders and independent predictors such as IR (measured over 24 hours), exposure to other transportation noise sources, sex and age, language, home ownership, education level, living duration, temperature, and access to a quiet side of the dwelling.

We observed a marked difference of %HA for railway and aircraft noise as compared to the "EU standard curves", corroborating earlier findings that annoyance to these sources has increased in the last decades. Aircraft noise annoyance scored markedly higher than annoyance to road traffic and railway noise at the same Lden level.

As railway noise elicited slightly higher percentages of highly annoyed persons than road traffic noise, our results point to the conclusion that a "railway bonus" is not warranted any longer.

We could also demonstrate that annoyance decreased with increasing sound level difference between the loudest and the faintest facade point of the dwelling. Residents thus seem to benefit from having a quiet side on their house or apartment.

Furthermore, %HA, depending on noise source, showed significant association with age (older respondents being more annoyed), outside temperature before the date of fill-out (higher temperatures associated with higher percentages of HA), home ownership (owners being more annoyed by, specifically, aircraft noise), and the eventfulness of the noise source, details of which are presented in Part 2.

Keywords: Transportation noise, Annoyance, Exposure-response relationship, Noise metric

### Reference:

1. Brink M, Schäffer B, Vienneau D, et al. A survey on exposure-response relationships for road, rail, and aircraft noise annoyance: Differences between continuous and intermittent noise. *Environment International* 2019 2019/04/01/;125:277-90.

<sup>1</sup> mark.brink@bafu.admin.ch

<sup>2</sup> jean-marc.wunderli@empa.ch