

Publication

A survey on exposure-response relationships for road, rail, and aircraft noise annoyance: differences between continuous and intermittent noise

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The aim of the present study is to establish exposure-response relationships reflecting the percentage highly annoyed (%HA) as functions of road traffic, railway, and aircraft noise exposure, measured as day-evening-night level (Lden), as well as to elucidate the degree to which the acoustic indicator Intermittency Ratio (IR), which reflects the "eventfulness" of a noise situation, predicts noise annoyance. 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 was calculated for each floor and each façade based on comprehensive traffic data. Noise annoyance was measured using the ICBEN 11-point scale. The survey was carried out in 4 waves at different times of the year. We hypothesized that in addition to Lden, the effects of noise on annoyance can be better explained when also considering the intensity of short-term variations of noise level over time. We therefore incorporated the acoustic indicator IR in the statistical models. 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/h), 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. Aircraft noise annoyance scored markedly higher than annoyance to railway and road traffic noise at the same Lden level. Railway noise elicited higher percentages of highly annoyed persons than road traffic noise. Results furthermore suggest that for road traffic noise, IR has an additional effect on %HA and can explain shifts of the exposure-response curve of up to about 6/dB between low IR and high IR exposure situations, possibly due to the effect of different durations of noise-free intervals between events. For railway and aircraft noise annoyance, the predictive value of IR was limited.

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