

Do characteristics of short term transportation noise exposure fluctuation better predict self-reported sleep disturbances than Leq-based average noise metrics?

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Extended ABSTRACT

We report on a study that aimed at establishing exposure-response relationships reflecting the percentage highly sleep disturbed (%HSD) as functions of road traffic, railway, and aircraft noise at night time, measured by various night time noise exposure indicators at both the loudest and faintest facade point of dwellings. We therefore conducted a mixed-mode (paper&pencil as well as online) representative population survey in a stratified random sample of 5592 residents exposed to transportation noise all over Switzerland, together with high temporal resolution noise exposure calculations. Source-specific noise exposure was calculated for each floor and each façade based on comprehensive traffic data. Exposure assessment was validated with measurements in 180 survey respondent's homes. Sleep disturbance due to noise at night was measured using an ICBEN-like 5-point verbal scale.

In a first step, we established fully adjusted causal risk-factor models for the probability to be highly sleep disturbed (HSD) as a function of road, railway or aircraft noise exposure respectively, which will serve current activities of updating the legal noise exposure limits in the Swiss noise abatement ordinance. In this part, we also explored the role of a range of coping strategies taken against noise and the potential benefit of the availability of a quiet side of the dwelling. For all noise sources, results revealed significant associations between LNight and %HSD.

In the second part, we hypothesized that in addition to average exposure metrics (e.g. Lnight), the effects of noise on self-reported sleep disturbance can be better explained when also considering the intensity of short-term variations of noise level over time, parametrized in the Intermittency Ratio (IR) metric, which expresses the "eventfulness" of noise exposure situations as the energetic contribution of individual noise events relative to the total sound energy in a given measurement period. Reason behind the development of the IR metric was the fact, that the application of equivalent levels to predict the impact of noise on sleep has not met with much success so far. Thus, the IR descriptor may be used as an additional exposure metric alongside established ones like the Leq. We investigated effect modification by stratified categorical analysis of IR.

Keywords: Transportation noise, Sleep disturbance, Exposure-response relationship, Noise metric

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