Universität Basel

Research Project

Transportation noise, annoyance, sleep and cardiometabolic risk: an integrated approach on short- and long-term effects

Third-party funded project

Project title Transportation noise, annoyance, sleep and cardiometabolic risk: an integrated approach on short- and long-term effects
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Background: Little is known about how acute and short-term noise effects, especially those that are observed during sleep, translate into long-term health consequences. In particular, it is unclear which acoustical characteristics of noise from different sources are most detrimental for human health and wellbeing. Aims: The overall goal of this project is to investigate the acute, short- and long-term effects of road, railway and aircraft noise exposure on annoyance and coping responses, sleep disturbances and cardiometabolic risk by mutually combining human experimental research in the laboratory with population-based epidemiological methods. The project specifically aims at identifying the noise exposure patterns that most strongly affect individuals during sleep and that may result in long-term health consequences, in particular, in cardiovascular diseases and metabolic syndrome. Besides the effect of noise exposure, the role of individual characteristics such as age and gender, noise sensitivity and genetic predispositions will be elucidated. Methods: This interdisciplinary study consists of three sub-projects. Sub-project 1 focuses on the modelling of road, railway and aircraft noise exposure and its effects on annoyance and coping responses in the Swiss population. Exposure modelling will be considerably refined to reflect not only average exposure, but additional exposure characteristics such as the degree of intermittence of noise events that we hypothesise to be a relevant predictor of detrimental effects of noise during sleep. Furthermore, realistic transportation noise exposure scenarios will be compiled in Sub-project 1 and played back in sleep laboratory experiments in Sub-project 2. In Sub-project 2 acute (e.g. awakening reactions) and short-term (e.g. cardiometabolic and cognitive effects on the subsequent day) consequences of nocturnal noise exposure scenarios will be investigated in a well controlled environment by employing a counterbalanced randomised cross-over design with 48 volunteers constantly monitored during 6 nights and 5 days. In Sub-project 3 data of two on-going large SNF-funded population-based epidemiological studies (SAPALDIA biobank and Swiss National Cohort) will be used to investigate long-term cardiometabolic risk with high statistical power and by considering relevant co-factors. The three Sub-projects are designed to closely interact in an interdisciplinary manner. Sub-project 1 will provide the noise exposure scenarios and exposure set-up for Sub-project 2 and the exposure modelling for Sub-project 3. The same cardiometabolic outcomes of Sub-project 3 available from several thousand SAPALDIA study participants will also be collected in Sub-project 2 with high time resolution under controlled experimental conditions. Significance: Mutually combining human experimental and epidemiological research to systematically address acute, short- and long-term noise effects on sleep and cardiometabolic outcomes is an asset of this study and has rarely been done in noise effect research before. Experimental research allows for evaluating the effects of well

defined acoustical noise exposure scenarios in a controlled environment on carefully selected, representative individuals. The use of ongoing large-scale population-based epidemiologic studies enables cost-efficiently addressing the full range of variability in the population and in exposure circumstances that occur in our environment. This will be the first study on transportation noise effects that considers genetic variations, which will provide a better understanding of relevant biological pathways. Systematic consideration of transportation noise exposure levels as well as other noise characteristics, such as the distribution of noise events during the night, is a unique feature of this project and is highly relevant for adequate regulation of noise emissions of different transportation modes. It is estimated that Switzerland, by about 2020, will have invested a substantial >5 billion Swiss francs in noise abatement measures. Thus, beyond scientific there is a high policy interest in our research questions and the results of this project are expected to have a broad impact by revealing evidence-based measures of action in order to most effectively invest these resources.

Keywords noise annoyance, human experiment, aircraft noise, epidemiology, sleep, transportation noise, cardiovascular diseases, railway noise, noise modeling, road traffic noise, metabolic syndrome, acoustics

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