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Health effects of transportation noise on children and adolescents in Europe: An Umbrella+ review

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ABSTRACT

A considerable number of studies have shown statistically significant associations between chronic exposure to transportation noise and various adverse health outcomes. However, evidence-syntheses for effects in children and adolescents are still limited. Thus, we aim to conduct an Umbrella+ review to provide a comprehensive overview of the literature on the relation between transportation noise and various physical and mental health outcomes in children and adolescents, including cognitive functioning, behaviour, annoyance, sleep disturbance, cardiovascular outcomes, metabolic effects and adverse birth outcomes. The Umbrella+ review method involves a literature search, in several databases, of both recent reviews and new evidence not yet captured in those reviews. We query PubMed and Web of Science, to identify English-language reviews and individual studies published after 2015, thus not part of the World Health Organization's Environmental Noise Guidelines for the European Region. An adapted version of the AMSTAR 2 assessment tool is used for the quality evaluation of reviews. Only reviews with strong and moderate quality are considered, possibly supplemented with high quality original study results published after the review papers. Based on the compiled literature, evidence for an association between transportation noise sources and physical and mental health outcomes is evaluated. This work will be used to quantify the burden of disease from transportation noise for children and adolescents.

Keywords: Umbrella review, transportation noise, children and adolescents, non-auditory health effects

INTRODUCTION

Transportation noise is considered one of the top environmental risks to health, affecting a large proportion of the population globally. Several adverse health effects (annoyance, sleep disturbance, cardiovascular effects and cognitive impairment in children) were found to be

significantly associated with long-term exposure to transportation noise (World Health Organization Europe, 2018). Evidence is emerging that provides new insights into the links between transportation noise and the established health effects mentioned above, including the cardiovascular outcomes ischemic heart disease and hypertension, as well as evidence of additional health effects, e.g. diabetes, depression, stroke and adverse birth outcomes, that may be associated with transportation noise.

Despite the considerable amount of research on the association between transportation noise and health effects, most studies and reviews have focused on adults. As a result, the extent of the health effects of noise on children and adolescents is largely unknown. Nevertheless, more literature is emerging that indicates adverse health effects of noise on the physical and mental health of children and adolescents. Such evidence could be of relevance for the estimation of the impact of transportation noise on public health. Thus, we aim to conduct an Umbrella+ review to provide a comprehensive overview of the literature on the association between transportation noise and various physical and mental health outcomes in children and adolescents.

MATERIALS AND METHODS

We used the method of an Umbrella+ review, which includes most recent systematic reviews and pooled analyses as well as recent original studies not yet included in these reviews. Thus, the + allows for the possibility that reviews are not yet available for some outcomes due to a small number of studies (Castro et al., 2022).

Literature search

We searched PubMed and Web of Science to identify peer-reviewed reviews and papers using keywords and search terms, including “birth weight”, “congenital abnormalities”, ”behaviour”, “anxiety”, and “cognition” as the outcome, and “transportation noise”, ”road noise”, ”railway noise”, and ”airplane noise” as the exposure.

Reference lists of identified reviews were also used as a source of information. Furthermore, high-level review reports from international environmental and health agencies such as the World Health Organization (WHO), the European Environmental Agency (EEA) and the European Environment Information and Observation Network (EIONET) were considered.

Results of the literature search and the article screening are presented in a PRISMA flow diagram following the approach by Page et al. (2021).

Study eligibility

The Umbrella+ review was conducted using the PECOS (Population, Exposures, Comparators, Outcomes and Study design) approach (Morgan et al., 2018). Table 1 shows the criteria to consider in the inclusion or exclusion of literature applying the PECOS approach.

The study population is limited to children and adolescents under 18 years of age. Reviews and original studies in English language that were published not earlier than 2015 and provide insights into the association of at least one exposure-outcome combination were considered. Exposure consists of the three main sources of transportation noise: road, rail and air traffic. Outcomes covered by the literature search include behaviour, cognitive impairment (reading and oral comprehension), adverse birth outcomes (preterm birth, congenital anomalies, low birth weight), mental health problems (depression, anxiety), cardiovascular outcomes (heart rate, blood pressure), metabolic diseases, and diabetes. We performed an initial search to identify reviews including systematic reviews, meta-analyses, reviews and key reports. If the evidence from the identified reviews was insufficient or there was no review, we conducted a second search to identify high quality original studies from Europe that would contribute to the evidence base.

Table 1: Criteria for inclusion and exclusion of literature based on population, exposure, comparator, outcome and study design)

PECOS	Inclusion	Exclusion
Population	Children and adolescents (i.e., individuals under 18 years of age)	Adults, non-human populations (in vivo, in vitro, other)
Exposure	Transportation noise exposure from road, rail, and aircraft	Community, occupational or leisure noise
Comparator	Noise exposure (i.e., sound pressure level) as measured in decibel. Typical transportation noise levels in the range of the WHO guidelines	
Outcome	Health outcomes including sleep disturbance, annoyance, behaviour, cognitive impairment (reading and oral comprehension), adverse birth outcomes (preterm birth, congenital anomalies, low birth weight) , mental health problems (depression, anxiety), cardiovascular outcomes (heart rate, blood pressure), diabetes, metabolic diseases (obesity, changes in body mass index and changes in waist circumference)	Outcomes of unclear clinical health relevance, e.g., epigenetics, methylation
Study type	Key reports, systematic reviews with and without meta-analysis or major pooled analyses representative for Europe including cohort studies, case-control, cross-sectional, observational or experimental studies. Umbrella reviews, scoping reviews, and burden of disease studies. Reviews that are published (or accepted for publication i.e., in press) after 2015 and written in English. In case of insufficient evidence from systematic reviews, original studies from Europe of high quality not included in a review might be included.	Narrative reviews, qualitative studies, studies reporting only unadjusted results, studies with clear evidence of an analytical error, and studies using noise annoyance as a surrogate for noise exposure or no assessment of noise exposure. Intervention studies, controlled exposure studies as well as studies with focus on exposure only. Grey literature, notes, editorials, letters and unpublished data.

Data collection

For each review and original study that met the PECOS criteria and the evidence quality assessment criteria described below, we extracted the main details and recorded them in a Microsoft Excel file.

Assessment of Evidence Quality

We used a condensed version of AMSTAR 2, a tool developed for evaluating the quality of systematic reviews that include observational studies, randomized or non-randomized studies of healthcare interventions (Shea et al., 2017), to determine the quality of each review. The focus was on the following AMSTAR 2 criteria: a) Adequacy of the literature search (clearly defined search terms, relevant databases considered), b) Adequate consideration of risk of bias from individual studies being included in the review, c) Adequacy of meta-analytical methods (Appropriateness of data extraction, statistical methods). Only reviews with strong and moderate quality, i.e. those meeting the condensed AMSTAR 2 criteria, were considered

for deriving exposure-response functions using meta-analysis.

In addition, the original studies to be included had to fulfil certain criteria, e.g. prospective, cohort study, consistent exposure assessment and confounding factors are taken into account.

Based on the compiled literature including high quality reviews and, possibly, original study results published after the review papers, we evaluated the evidence for an association between transportation noise sources and physical and mental health outcomes using the same criteria as in the WHO noise guidelines. We summarised the evidence in four classifications using the terms strong, moderate, low and very low. The evidence for a health effect was rated as high if at least two prospective cohort studies were included that showed an increased risk of disease or death associated with noise and a low risk of bias. The evidence was classified as moderate if only one prospective cohort study of high quality was available. A health outcome is considered critical for assessing the public health impact of transportation noise if the evidence was classified as high or medium.

RESULTS & DISCUSSION

Although only a limited number of reviews exist concerning the link between transportation noise and adverse health effects in children and adolescents, we expect a larger body of evidence on the health outcomes related to cognition and behaviour. The results of this Umbrella+ review are of relevance for health impact assessments and burden of disease studies and should be considered in future studies.

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