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NORAH - field study: The Effects of chronic exposure to traffic noise (aircraft, railway and road traffic) on hypertension

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ABSTRACT

Based on the concept that noise may trigger repeatedly unavoidable autonomous physiological reactions, which each can cause an increase of blood pressure, the study examined the effects of chronic traffic noise exposure (outside) on hypertension.

Study region includes areas near Frankfurt airport within the 40 dB(A) equivalent continuous sound level contours of aircraft noise for day and night-time, targeting on voluntary adults residing in the defined region. Participants performed 2 daily (morning, night) self blood pressure measurements for 21 days. Additionally they completed questionnaires with reference to current health, medications, lifestyle, and individual factors. Those with values systolic >140 and/or diastolic >90 mmHg (daily mean) and/or antihypertensive medication were classified as hypertensives.

Separate logistic regression models (n=844 (58.4% w; 41.6% m) were performed for all three sources ($L_{pA,eq,18\text{-}06h}$ aircraft, railway and road traffic), and hypertension as outcome. All models were adjusted for age, gender and socio-economic status. Additional influencing variables were added if they met fitting model requirements. We found no significant increased risk for hypertension (all p-values > 0.05).

Overall this result in our study – no evidence for increased risk of hypertension as dichotomous outcome due to traffic noise –stands in line with scientific literature indicating mixed results.

Keywords: NORAH, Transportation Noise, self-measured blood pressure (SBPM), telemedical blood pressure device, health, field study, hypertension. I-INCE: 62.5, 66.2.

1. INTRODUCTION

The module “Blood Pressure Monitoring” is part of the research project NORAH (noise-related annoyance, cognition, and health) and aimed at investigating the effects of chronic noise exposure on blood pressure in adults. It was conducted in the period from 2012 to 2014 in the Rhine-Main-Area near Frankfurt (FRA) airport. Linked references to the detailed reports of the entire project modules are given below (1-7), additional information can be found at http://www.norah-studie.de/publikationen.epl or http://www.laermstudie.de/.

The study design took into consideration previous studies and meta-analyses on effects of noise on health, and in particular on the cardio-vascular system (8, 9, 10). It is based on the model that noise on

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a regular basis acts as a stressor on the body and thus triggers repeatedly unavoidable autonomous physiological reactions, which each can cause an increase of the blood pressure. This study was designed to examine the effects of chronic noise from different traffic sources as a stressor on blood pressure as a measurable physical response. The result presented here focus on the secondary endpoint of hypertension as a dichotomous variable, while the main results of the study are shown elsewhere (see INTERNOISE 2016/202 (14))

2. METHODS

2.1 Recruitment

Study region included areas near Frankfurt airport within the 40 dB(A) equivalent continuous sound level contours of aircraft noise for day and night-time. Voluntary adults of both genders residing at the time of the investigations (2012-2014) in the defined area were the target group.

Recruitment was done among participants of NORAH module 1, excluding those who reported diagnosed hypertension at this state of the project already (n=1824).

2.2 Exposure

Noise exposure (aircraft, railway and road traffic noise) was assigned to the respective addresses of the participants of the investigation. The equivalent continuous sound pressure level $L_{pA,eq,18\text{-}06h}$, (combined evening night time slice, outside) was primarily set as exposure variable for each investigated traffic noise source. To represent chronic exposure the $L_{pA,eq,18\text{-}06h}$ was calculated over a duration of 12 months ahead of participants' individual start of blood pressure measurements providing the outcome parameter of interest.

2.3 Procedure

Telemedical blood pressure devices handed to study participants were issued for the self-blood-pressure-measurement (SBPM). All participants were trained in the self-blood-pressure-measurement before they were allowed to perform SBPM each morning and evening during the following period of 21 days. Ahead of the SBPM-coaching an additional questionnaire with reference to current health, lifestyle, individual factors, as well as noise sensitivity (NoiSeQ-R) was completed. The measurements were carried out in two sections: observation period 1 (BP1) from July 2012 to June 2013, observation period 2 (BP2) took place from July 2013 to June 2014.

2.4 Data analyses

Modelling the influence of continuous sound pressure level of noise from aircraft, railway and road traffic at the residential address on the dichotomous endpoint hypertension using logistic regression was conducted. Participants whose systolic blood pressure was ≥ 140 mmHg and/ or mean diastolic blood pressure ≥90 mmHg and/ or had taken any antihypertensive medication in the last seven days before measurements started were classified as hypertensive.

Logistic regression models included fixed factors (age, gender, socio-economic status). Further influencing variables were added if they met fitting model requirements (see (14) and our study report (1)) separately for each source of exposure were applied.

3. RESULTS

3.1 Descriptive Data

Data analyses included n=844 persons (58.4% w; 41.6% m) in total. Descriptive analyses show that reliable blood pressure measurements as well as the questionnaire and data are overall completed at a very high level. According to the definition given above n=132 (15.6%) of the participants were classified as hypertensive.

According to aircraft noise most participants were exposed to $L_{pA,eq,18\text{-}06h\ (aircraft)}$ = 50.1-55.0 dB (n=237). Sound pressure levels for railroad and road were lower, most participants were exposed to $L_{pA,eq,18\text{-}06h\ (railway)}$ = 45.1-50.0 dB (n=228) and $L_{pA,eq,18\text{-}06h\ (road\ traffic)}$ = 40.1-45.0 dB (n=235).

3.2 Results of Logistic Regression Models

Figure 1 shows the results (odds ratios with 95%-confidence intervals) of the logistic regression analyses the hypertension variable vs. the three traffic noise exposures.

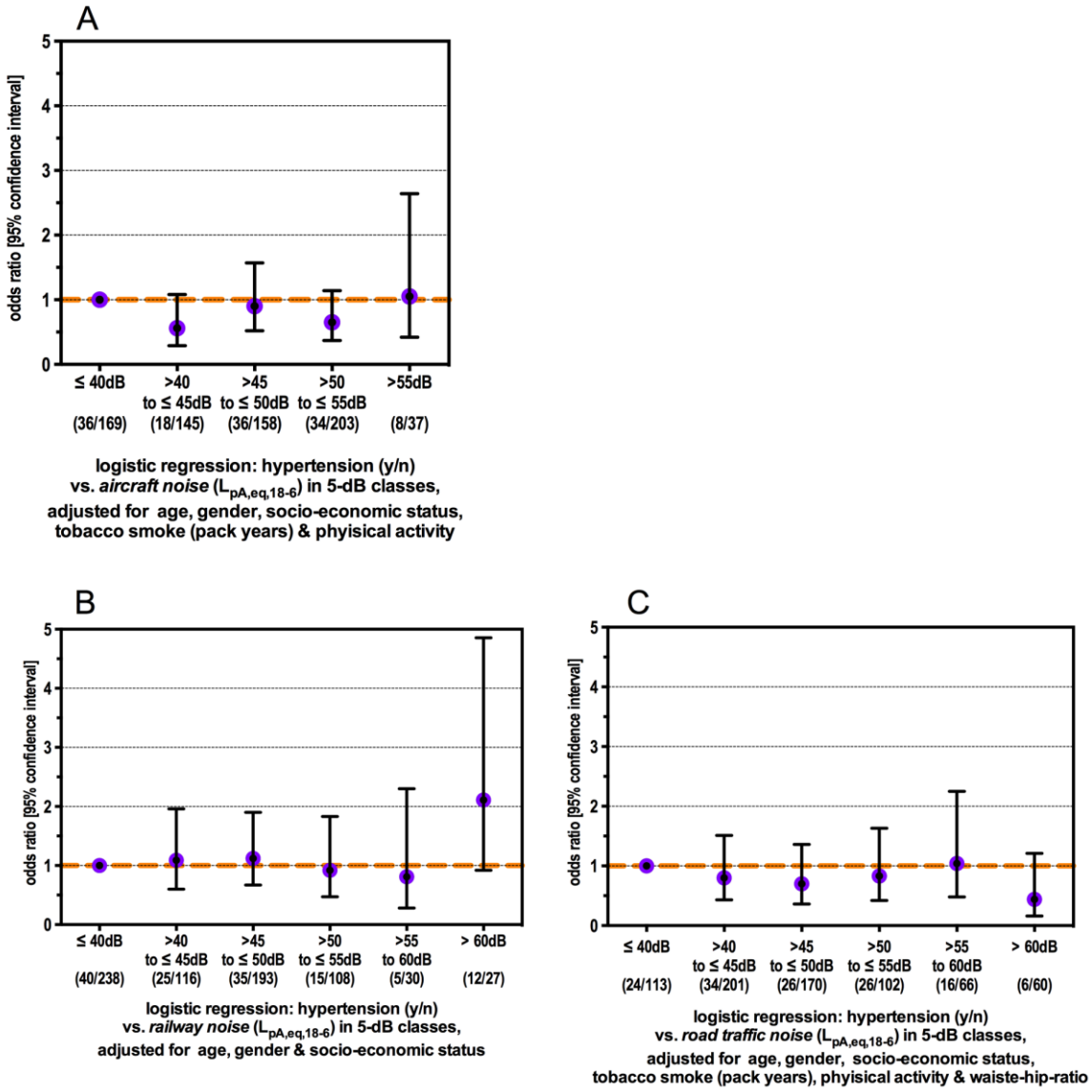

Figure 1 – results of multiple logistic regression analyses for the three traffic noise exposures (aircraft (A), railway (B), road traffic (C)) studied vs. hypertension variable (generated from measurement results) of the NORAH blood pressure study (© Justus-Liebig-Universität Gießen)

4. SUMMARY

Logistic regression models with outcome hypertension including age, gender, socio-economic status, pack years, physical activity, and waiste-hip-ratio as influencing variables result no systematic elevation with increasing sound pressure levels (5-dB(A) classes) of any traffic noise source in our study.

Overall, this result is in line with scientific literature indicating mixed evidence (9, 10, 11, 12, 13). New scientific questions that have been emerged in the course of the study, suggest a need for further research specifically focused on the evaluation of potential vulnerable groups, as well as analyses, that take into account of the data of other NORAH modules (annoyance & life quality as well as sleep study).

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