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Associations between residential traffic noise exposure and smoking habits and alcohol consumption—A population-based study☆

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ABSTRACT

Background: Traffic noise stresses and disturbs sleep. It has been associated with various diseases, and has recently also been associated with lifestyle. Hence, the association between traffic noise and disease could partly operate via a pathway of lifestyle habits, including smoking and alcohol intake.
Objectives: We investigated associations between modelled residential traffic noise and smoking habits and alcohol consumption.
Methods: In a cohort of 57,053 participants, we performed cross-sectional analyses using data from a baseline questionnaire (1993-97), and longitudinal analyses of change between baseline and follow-up (2000-02). Smoking status (never, former, current) and intensity (tobacco, g/day) and alcohol consumption (g/day) was self-reported at baseline and follow-up. Address history from 1987-2002 for all participants were found in national registries, and road traffic and railway noise was modelled 1 and 5 years before enrolment, and from baseline to follow-up. Analyses were performed using logistic and linear regression, and adjusted for demographics, socioeconomic variables, leisure-time sports, and noise from the opposite source (road/railway).
Results: Road traffic noise exposure 5 years before baseline was positively associated with alcohol consumption (adjusted difference per 10 dB: 1.38 g/day, 95% confidence interval (CI): 1.10–1.65), smoking intensity (adjusted difference per 10 dB: 0.40 g/day, 95% CI: 0.19–0.61), and odds for being a current vs. never/former smoker at baseline (odds ratio (OR): 1.14; 95% CI: 1.10–1.17). In longitudinal analyses, we found no association between road traffic noise and change in smoking and alcohol habits. Railway noise was not associated with smoking habits and alcohol consumption, neither in cross-sectional nor in longitudinal analyses.
Conclusion: The study suggests that long-term exposure to residential road traffic is associated with smoking habits and alcohol consumption, albeit only in cross-sectional, but not in longitudinal analyses.
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1. Introduction

Smoking and alcohol consumption have profound impact on global public health: According to the World Health Organization, 3.8% of all deaths in 2004 were attributable to alcohol intake, and additionally, causal links have been found with a range of diseases, including cancer, cardiovascular disease, and diabetes (World Health Organization, 2011). Smoking accounted for 12% of all adult deaths in 2012 (World Health Organization, 2012), and is the leading risk-factor for cancer and chronic respiratory diseases, as well as heavily involved in cardiovascular disease etiology (Collaborators GBDT, 2017).

Traffic noise is a ubiquitous exposure in modern-day urban settings, and has been associated with a number of adverse health effects, including e.g. cardiovascular diseases (Babisch, 2014; Basner et al., 2014) and metabolic conditions (Sorensen et al., 2013; Pyko et al., 2015; Christensen et al., 2015; Recio et al., 2016). One pathway through which traffic noise may affect the development of these diseases is stress, as noise exposure is known to provoke a stress response with activation of the hypothalamus-pituitary-adrenal (HPA) axis and increased secretion of stress

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hormones (Babisch, 2011; Selander et al., 2009; Haralabidis et al., 2011; McEwen, 1998; Babisch et al., 2001). Both smoking and alcohol consumption have been associated with stress: More than half a century ago it was hypothesized that alcohol drinking may function as a relief in response to stress (Conger, 1956), and subsequently it has been reported that people consume more alcohol during and after stressful life events (Jose et al., 2000). Additionally, studies indicate that people drink as a mean of coping with economic stress, job stress, and marital problems, and that the more severe and chronic the stressor, the greater the alcohol consumption (Pohorecky, 1991). Evidence from animal studies similarly show that alcohol is consumed to relieve stress (Spanagel et al., 2014). Similarly, perceived stress has been associated with the decision to commence smoking in adolescence (Byrne et al., 1995; Torres and O'Dell, 2016), difficulty quitting smoking, as well as with relapse (Torres and O'Dell, 2016; Cohen and Lichtenstein, 1990), and work stress has been associated with both smoking status and intensity (Kouvonen et al., 2005).

Another pathway through which traffic noise has been proposed to affect disease development, is by means of sleep disturbance (World Health Organization, 2009; Pirrera et al., 2010; Miedema and Vos, 2007). It has been proposed that individuals who experience daytime sleepiness as a result of short or disrupted sleep may be less likely to engage in healthy lifestyle behaviors. Several cross-sectional studies have found an association between impaired sleep and smoking and alcohol consumption (Chaput et al., 2012; Stein and Friedmann, 2005; Wetter and Young, 1994; Phillips and Danner, 1995). In addition, a large Finnish study found that onset of impaired sleep was associated with subsequent lower odds for quitting smoking among smokers, and initiating high-risk alcohol consumption in a longitudinal study design (Clark et al., 2015).

Finally, two recent studies of traffic noise found an association between exposure and another unhealthy lifestyle-behavior; namely physical inactivity (Foraster et al., 2016; Roswall et al., 2017a). This suggest that an association may also exist between traffic noise and other unhealthy lifestyle-behaviors.

On this background, we hypothesized that traffic noise may adversely affect smoking and alcohol habits, and hence the objective of the present study is to investigate the associations between residential traffic noise exposure and smoking and alcohol consumption, both cross-sectionally and longitudinally, in a cohort of middle-aged Danes.

2. Methods

2.1. Study population

This study is conducted in the Danish Diet, Cancer and Health cohort, which invited 160,725 persons to participate from 1993 to 1997. Inclusion criteria were residence in the greater Copenhagen or Aarhus Area, no history of cancer in the Danish Cancer Registry, and an age between 50 and 64 years. Details are available in (Tjonneland et al., 2007). In total, 57,053 accepted the invitation, representing 7% of the Danish population in this age group.

Participants filled in a lifestyle questionnaire at baseline, and again between 1999 and 2002. In total, 45,271 persons filled in the second questionnaire, and could participate in the longitudinal part of the study. Reasons for non-participation (N = 11,782) were death (14.6%), emigration (3.8%), and no reply to the questionnaire (81.7%).

The study was approved by the local ethical committees of Copenhagen and Frederiksberg Municipalities (Approval no: (KF) 01-345/93). All participants provided written informed consent, and the study was conducted according to the Helsinki Declaration.

2.2. Smoking and alcohol assessment

Information regarding baseline smoking status (never, former, current), and type and number of tobacco products (cigarettes, cigars, pipe, cheroots) smoked daily, and type and number of alcoholic beverages (beer, wine, spirits) consumed, were obtained from detailed questionnaires completed and validated by interviewers at the time of enrollment. Baseline smoking status was defined as either non-smokers (never and former smokers) and smokers. Further, we calculated smoking intensity among smokers at baseline (grams of tobacco per day) from number of tobacco products and information regarding tobacco content in the different tobacco types (cigarette = 1 g; cheroot = 3 g; cigar = 4.5 g; pipe = 3 g). From information regarding alcohol content in the different types of alcoholic beverages and units consumed daily, we calculated a continuous baseline alcohol variable (grams of alcohol per day).

At follow-up, participants completed mailed questionnaires and reported information regarding smoking and alcohol consumption based on questions that were similar to the baseline questions: At follow-up, participants were asked about smoking status and intensity in one question, rather than two, but as the wording was the same as at baseline, they were operationalized in the same way as the baseline questions. Regarding alcohol, the question was worded slightly different, but the content was the same, and thus we were again able to operationalize the responses in the same way at baseline and follow-up. The follow-up information in conjunction with the baseline information thus enabled us to identify who quit smoking during follow-up, as well as calculate change in smoking intensity among smokers (g/day) and change in alcohol consumption (g/day) between baseline and follow-up.

2.3. Traffic noise assessment

Assessment of traffic noise exposure has been described for the Diet, Cancer and Health cohort previously: (Sorensen et al., 2013). Briefly, we collected residential address history for all participants between July 1st, 1987 and end of follow-up through the Danish civil registration system (Pedersen, 2011). Using SoundPLAN, which implements the joint Nordic prediction method (Bendtsen, 1999), we calculated road traffic and railway noise exposure. This allows calculation of equivalent noise levels for each address, based on information on several traffic and topographic parameters. For the present study, input variables into the model included: Points for noise estimation (geographical coordinate and height (floor) for each address), building polygons, traffic information on road links (data on annual average daily traffic, vehicle distribution (light/heavy), travel speed, and road type) and railway links (annual average daily train lengths and types, travel speed, and noise barriers along the railway). Traffic data was included for all roads with >1000 vehicles/day from a national road and traffic database (Jensen et al., 2009), whereas, information on noise barriers or road surfaces was not available. Values below 40 dB were set to 40 dB as this was considered a realistic lower limit of ambient noise. For both road traffic and railway noise, the terrain was assumed flat, which is a reasonable assumption in Denmark. Urban areas, roads, and areas with water were assumed to be hard surfaces, whereas all other areas were considered acoustically porous. Traffic noise was calculated as the equivalent continuous A-weighted sound pressure level (L_{Aeq}) at the most exposed facade of the address for day (L_d; 7 AM-7PM), evening (L_e; 7PM-10PM) and night (L_n; 10PM-7AM), and expressed as L_{den} (den = day, evening, night). 5 and 10 dB penalties was added to evening and night, respectively. In the present study, we investigated noise exposure in 1- and 5-year time-periods before baseline, as well as exposure from baseline to follow-up.

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