Ambient air pollution, traffic noise and adult asthma prevalence: a BioSHaRE approach

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Background

Asthma is a complex respiratory illness which affects around 334 million people worldwide in 2014. An increasing prevalence of asthma was seen in some parts of the developed world at least until the late 1990s, after which the temporal trend varied across countries. Air pollution may be one of the potential risk factors that explain these prevalence trends although previous studies are inconsistent with respect to the associations between long-term air pollution and adult asthma prevalence. Also, there are no studies investigating whether individual exposure to traffic noise, generally seen as an environmental stressor and mostly coexisting with air pollution in road traffic settings, would affect adult asthma morbidity.

Objective

This study was to investigate the effects of both ambient air pollution and traffic noise on adult asthma prevalence, using harmonised data on exposures and health from three large European biobanks established in 2006–2013, namely HUNT3 (Norway), Lifelines (the Netherlands) and UK Biobank.

Methods

For all three biobanks, residential exposures to ambient air pollution (particulate matter with aerodynamic diameter ≤10 µm (PM_{10}) and nitrogen dioxide (NO_2)) were estimated by a pan-European Land Use Regression model for 2007. Traffic noise for 2009 was modelled at home addresses by adapting a standardised noise assessment framework (CNOSSOS-EU).
Age, sex, body mass index (BMI), education level, paid employment, smoking and years at current address were harmonised retrospectively across the three biobanks. A cross-sectional analysis of 646,731 participants aged ≥20 years was undertaken using DataSHIELD, a novel statistical platform to virtually pool data for individual-level analysis *via* a "compute to the data" approach. Multivariate logistic regression models were fitted to assess the effects of each exposure on lifetime and current asthma prevalence.

Results

I. PM_{10} or NO_2 higher by 10 µg/m^3 was associated with 12.8% (95% CI 9.5% to 16.3%) and 1.9% (95% CI 1.1% to 2.8%) higher lifetime asthma prevalence (Table 1), respectively, independent of confounders (Model 3). Long-term PM_{10} exposure, but not NO_2, was significantly associated with current asthma.

II. PM_{10} effects on lifetime asthma prevalence were larger in those aged ≥50 years, ever-smokers and less educated (Figure 1).

III. Noise exposure was not significantly associated with asthma prevalence.

Conclusions

This study suggests that long-term ambient PM_{10} exposure is associated with asthma prevalence in western European adults. Traffic noise is not associated with asthma prevalence, but its potential to impact on asthma exacerbations needs further investigation.

Figure 1. Associations (Odds Ratio and 95%CI) between long-term PM_{10} and lifetime asthma prevalence: subgroup analysis based on Model 3

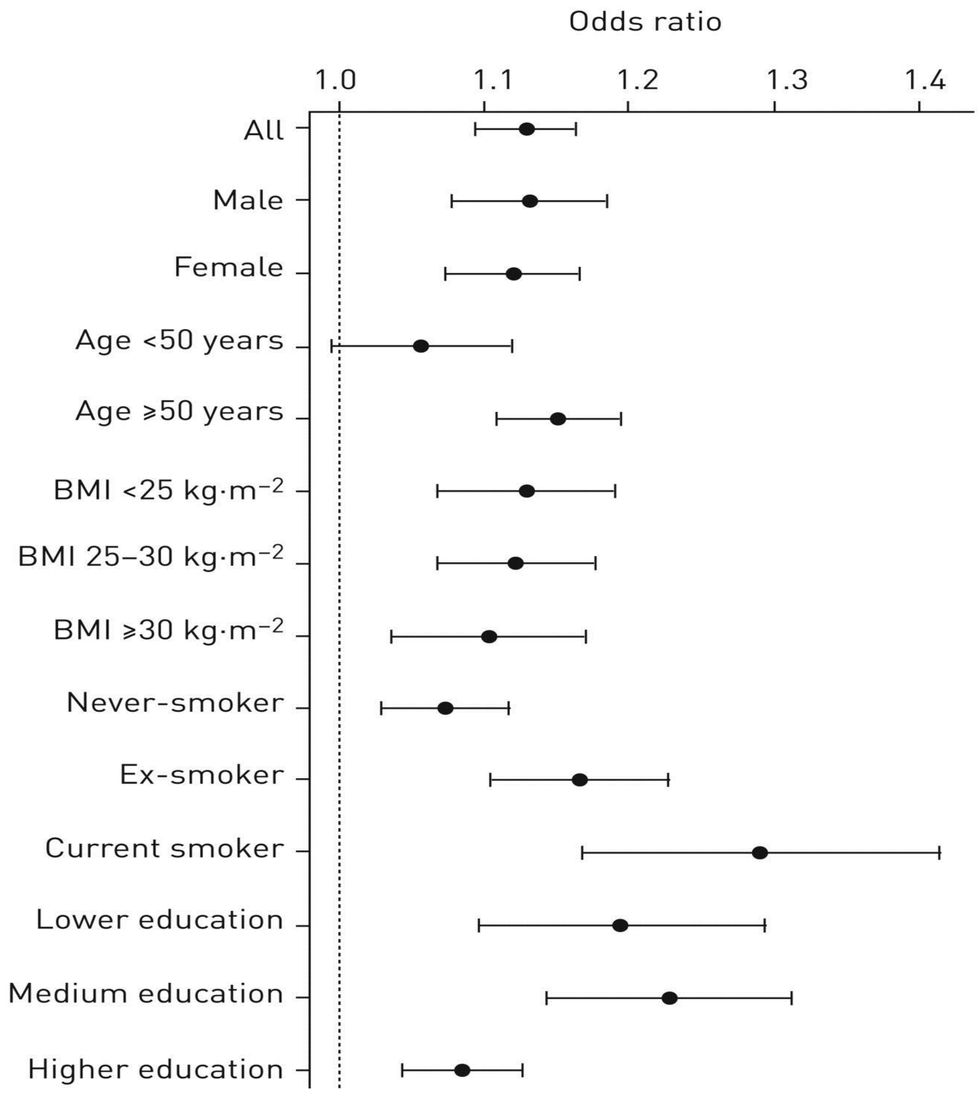

Table 1. Associations (Odds Ratio and 95%CI) between long-term air pollution and asthma prevalence: a pooled analysis of three biobanks

	PM_{10} per 10 µg·m^{-3}				NO_2 per 10 µg·m^{-3}			
	Ever-had asthma		Current asthma		Ever-had asthma		Current asthma	
	Subjects	OR (95% CI)	Subjects	OR (95% CI)	Subjects	OR (95% CI)	Subjects	OR (95% CI)
Model 1	604 414	1.145 (1.112–1.179)	597 201	1.063 (1.012–1.115)	605 852	1.025 (1.017–1.033)	598 627	0.991 (0.978–1.004)
Model 2	604 414	1.118 (1.085–1.151)	597 201	1.050 (1.000–1.102)	605 852	1.019 (1.011–1.027)	598 627	0.988 (0.975–1.001)
Model 3	566 175	1.128 (1.095–1.163)	559 245	1.064 (1.012–1.119)	567 485	1.019 (1.011–1.028)	560 543	0.988 (0.975–1.002)
Model 3 + day-time noise[#]	562 706	1.131 (1.097–1.166)	555 776	1.067 (1.015–1.123)	564 014	1.020 (1.011–1.028)	557 072	0.988 (0.974–1.002)

Data are presented as n, unless otherwise stated. OR: odds ratio. Model 1: adjusted for study; Model 2: adjusted for study, sex, age; Model 3: further adjusted for education, employment status, smoking status and body mass index. [#]: day-time (07:00–19:00 h) continuous noise level in dB(A).

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