Road traffic noise exposure and development of body mass index from birth to adolescence

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Summary

Aim: To investigate body mass index (BMI) development from birth to adolescence in relation to exposure to road traffic noise.

Method: A birth cohort of Swedish children was followed with repeated measurements of height and weight at 13 time points until age 16 years (n=2015). Road traffic noise levels at the most exposed façade were estimated for all residences of each study subject. Quantile regression was used to estimate associations between time-weighted average exposure levels to road traffic noise and BMI at different ages.

Results: Overall, no consistent associations were evident between road traffic noise exposure and BMI development from birth to adolescence. However, we observed statistically significant increases in BMI related to road traffic noise exposure at ages 4-8 and 8-12 years ($p<0.001$). In contrast, noise exposure from birth until 4 years of age was associated with a decreased BMI.

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1. Introduction

Traffic noise exposure has recently been associated with markers of obesity in adults [1-3]. Suggested causal pathways include biological mechanisms related to physiological stress and sleep disturbance. However, studies on children and adolescents are limited. A cross-sectional study on children in a Danish cohort found an association between residential road traffic noise exposure and overweight in 7-year olds [4]. On the other hand, development of body mass index (BMI) was not related to road traffic noise exposure in a longitudinal study on Norwegian children from birth to 8 years of age [5].

In this longitudinal study we investigated the development of BMI from birth to adolescence in relation to exposure to road traffic noise.

2. Methods

The study was based on the BAMSE cohort (Swedish for Child, Allergy, Milieu, Stockholm, and Epidemiology). Briefly, children born 1994-1996 in pre-defined areas of Stockholm County were recruited and followed-up over time by repeated questionnaires, clinical examinations and biological sampling [6]. Data on environmental and lifestyle exposures were collected at 7 time points between the ages of 2 months up to 16 years of age.

To assess the study subject's longitudinal exposure to road traffic noise a noise database was constructed for Stockholm County. The database contains data from several national, regional and local authorities. Briefly, geographical coordinates of an individual's address were linked to the database to obtain the estimated noise exposure level at the most exposed façade of the address point. A time-weighted noise exposure was calculated based on the different residential addresses of an individual during follow-up. A penalty of 3.4 dB was added to the 24-h A-weighted equivalent continuous sound level to express noise levels as L_{den} [7].

Information on height and weight at 13 pre-defined ages from birth to 16 years was available based on health care records, clinical examinations, or self-reported information. The child's BMI (kg/m^2) was calculated for each age, with a BMI of <25 considered as normal weight and ≥25 as overweight.

The association between road traffic noise exposure from birth to adolescence and longitudinal BMI development was modelled at different ages using quantile regression models. All models were adjusted for various potential confounders, including parental occupation, passive smoking during infancy, maternal occupational noise exposure during pregnancy, municipality at birth and maternal BMI.

3. Results

Time-weighted lifetime road traffic noise exposure levels ranged from 23.4 to 70.2 dB(A) (Figure 1). A majority of the study subjects were exposed to time-weighted noise levels from road traffic below 50 dB(A).

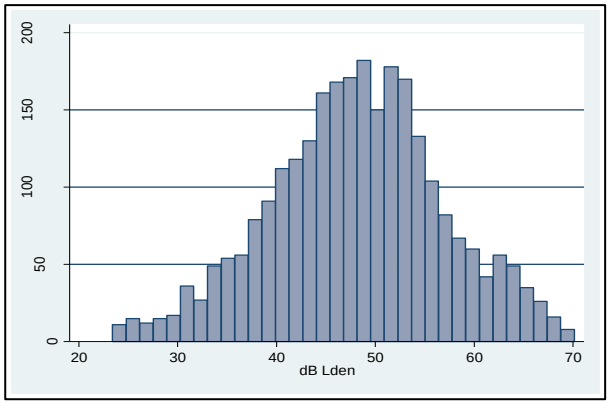

Figure 1. Distribution of time-weighted road traffic noise exposure from birth to adolescence.

Some background characteristics of the study sample are shown in Table I in relation to normal and overweight (Table I).

Table I. Selected background characteristics of the study sample in relation to normal and overweight.

	Normal weight n (%)	*Overweight n (%)*	*p-value**
Female	1,412 (49.7)	603 (48.9)	0.65
Municipality at birth			0.01
Sthlm	863 (30.5)	338 (27.5)	
Järfälla	774 (27.4)	393 (32.0)	
Solna	770 (27.3)	300 (24.4)	
Sundbyberg	419 (14.8)	197 (16.0)	
Maternal Overweight	743 (26.2)	522 (42.4)	<0.001
Parental occupation			0.04
Blue collar worker	456 (16.1)	90 (19.3)	
White collar worker	2,336 (82.6)	322 (79.2)	
Other	36 (1.3)	6 (1.5)	

* P-values from Chi2-test for differences between categories of the various characteristics.

High BMI was related to a higher proportion of maternal overweight and parental blue collar occupations as well as to recruitment area.

No changes in BMI development were observed in relation to lifetime residential road traffic noise exposure following adjustment for age group, parental occupation, passive smoking during infancy, maternal BMI and municipality at birth (Table II).

Table II. Changes in BMI (kg/m^2) from birth to adolescence in relation to road traffic noise exposure per 10dB at different time points.

Age groups	Change in BMI
	50th percentile
	β* (CI 95%)
<1 year	0.00 (-0.01; 0.01)
1 to <4 years	-0.15 (-0.21; -0.09)
4 to <8 years	0.47 (0.37; 0.56)
8 to <12 years	0.76 (0.66; 0.87)
12 to ≥16 years	-0.13 (-0.52; 0.26)
Lifetime (0-16 years)	-0.00 (-0.00; 0.01)

* Adjusted for age group, maternal occupational noise exposure during pregnancy, parental occupation, passive smoking during infancy, maternal BMI, and municipality at birth

However, after stratification into time windows for predefined age groups, BMI significantly decreased between the ages 1-4 years in relation to road traffic noise exposure ($p<0.001$). On the other hand, at the ages 4 to <8 years and 8 to <12 years, the BMI increased in relation to road traffic noise exposure by 0.47 and 0.76 kg/m^2, respectively ($p<0.001$). No significant changes were associated with exposure at the ages 12 to 16 years.

4. Discussion

We found significant changes in median BMI development that varied during different age periods from birth to adolescence in relation to residential road traffic noise exposure. However, no significant association was observed between lifetime road-traffic noise exposure and BMI up to 16 years of age.

At present, only two studies are available on BMI or weight in relation to environmental noise exposure in children. In their cross-sectional study on Danish children Christensen et al. (2016) found an association with overweight at age seven in relation to residential road-traffic noise exposure [4]. However, the association to BMI was not significant. A recent Norwegian longitudinal study did not find a relation between road traffic noise exposure and BMI development in children up to 8 years of age. Overall, there does not seem to be consistent evidence of a role for road traffic noise exposure in BMI development in children. In adults the evidence primarily point to an effect by noise on waist circumference [1], which may imply different mechanisms than for BMI. Unfortunately, we did not have information on waist circumference. Furthermore, it is possible that imprecision in the noise exposure assessment is considerable in children and adolescents since the school environment was not considered. A recent study in our cohort did not indicate a clear relation between residential road traffic noise exposure and saliva cortisol levels in adolescence [8].

5. Conclusion

No consistent associations between road traffic noise exposure and BMI development from birth to adolescence were observed, although statistically significant relationships appeared in some age groups.

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