

# The association of road traffic noise with behaviour in adolescents: A cohort study

Louise Tangermann<sup>1,2</sup>, Apolline Saucy<sup>1,2</sup>, Danielle Vienneau<sup>1,2</sup>, Beat Schäffer<sup>3</sup>, Jean Marc Wunderli<sup>3</sup>, Martin Röösli<sup>1,2</sup>

<sup>1</sup> Swiss Tropical and Public Health Institute, Basel, Switzerland

<sup>2</sup> University of Basel, Basel, Switzerland

<sup>3</sup> Empa, Swiss Federal Laboratories for Materials Science and Technology, Dübendorf, Switzerland

## Background & Aims

Transportation noise is a widespread source of environmental stress and has been associated with several health related outcomes, including cardiovascular diseases, sleep and behavioural outcomes in all age groups.

Different studies on the effect of noise on children's behaviour show a variety of outcomes that report associations for some and not others.

A recent systematic review and meta-analysis based on three included studies concluded that the hyperactivity/inattention score significantly increased by 11% (95% Confidence Interval 4% to 19%) per 10 dB road traffic noise exposure (1).

The objective of this study is to show the cross-sectional and longitudinal association of road traffic noise and behaviour of the Hermes cohort of 882 Swiss adolescents.

## Methods

### Measurements

The data was collected in the form of questionnaires that were distributed in classrooms to adolescent students of the mean age of 14 in schools in central Switzerland and the Basel area. The measurements took place in two separate waves (two separate cohorts) in the time frames of 2012-2014 and 2014-2016 at two points in time: Baseline (abbr.: BL) and Follow-up (abbr.: FU).

### Strength and Difficulties Questionnaire (SDQ)

The SDQ consists of five scales, each comprising five items that are answered on a 3-point Likert scale. Four of the five scales are negative: *emotional problems*, *conduct problems*, *hyperactivity/inattention problems*, *peer relationship problems* and one is positive: *prosocial behaviour* (range: 0-10). The four problem scales are added up into the *total difficulties score* (range: 0-40).

### Exposure Variable and Covariates

Home Road traffic noise ( $L_{den}$ ). Models are adjusted for: sex, age, drink, smoke, parents education, nationality, school level, physical activity,  $PM_{10}$ , screentime in minutes, orientation of bedroom towards street, difference in height (only used as covariate in longitudinal analysis as a proxy for puberty).

### Multiple Imputation (MI)

MI was used to impute all variables in the model. 5% of data was missing at follow-up, 19% of parents education was missing, screentime data was missing 28% at BL and 16% at FU. <1% of data was missing for all other variables.

### Analysis

Associations per 10 dB  $L_{den}$  road traffic noise at home:

**Cross-sectional:** Joint analysis of baseline and follow-up data, using mixed-effect models with the individual as random intercept, adjusted for variables described above.

**Longitudinal:** Change of follow-up score minus baseline score, adjusted for variables described previously.



## Results

Across both cohorts, 886 students participated in baseline measurements and 854 in the follow-up (participation-rate from follow-up: 95%). Mean age was 14 with a range from 10 to 17.

### Cross-Sectional and Longitudinal analysis of modelled noise at home ( $L_{den}$ ) with SDQ score and difference in SDQ score respectively.

	Cross-sectional multilevel analysis		Longitudinal change score analysis	
	Coefficient (95% CI) SDQ score per 10dB	SDQ score stratified by variable <u>orientation of bedroom towards street</u>	Coefficient (95% CI) Change in SDQ score in a year per 10dB	Change in SDQ score stratified by variable <u>orientation of bedroom towards street</u>
Total difficulties	0.2 (-0.2, 0.5)	<b>0.5 (0.1, 1.0)</b>	0.1 (-0.6, 0.3)	0.4 (-0.2, 1.1)
Emotional problems	0.0 (-0.1, 0.2)	0.1 (-0.1, 0.3)	0.1 (-0.1, 0.3)	-0.1 (-0.4, 0.2)
Conduct problems	0.1 (-0.1, 0.2)	0.1 (-0.0, 0.3)	0.0 (-0.1, 0.2)	0.1 (-0.2, 0.2)
Hyperactivity/inattention	-0.2 (-0.2, 0.1)	<b>0.2 (0.0, 0.4)</b>	-0.2 (-0.4, 0.0)*	<b>0.3 (0.0, 0.6)</b>
Peer problems	<b>0.2 (0.0, 0.3)</b>	0.1 (-0.1, 0.2)	-0.1 (-0.1, 0.1)	0.1 (-0.1, 0.4)
Prosocial skills	-0.1 (-0.2, 0.1)	-0.1 (-0.3, 0.0)	0.1 (-0.1, 0.2)	-0.1 (-0.0, 0.2)

Adjustments: sex, age, drink, smoke, parents education, nationality, school level, physical activity,  $PM_{10}$ , orientation of bedroom towards street

Note: Significant results at the 95% CI level are highlighted in bold; SDQ, Strengths and Difficulties Questionnaire;  $L_{den}$  (00:00-24:00), 5 dB(A) penalty for the evening measurements (18:00-23:00) and 10 dB(A) penalty for the night measurements (23:00-07:00); \*not significant at significance level of 0.05 before rounding.

### Cross-sectional multilevel analysis

For every 10 dB increase in noise at home, peer relationship problem score increased by 0.2 (95%CI: 0.0, 0.3) units within a range of 0-10 (only for total difficulties the score ranges up to 40). Total difficulties score and hyperactivity and inattention was increased ((0.5 (95% CI: 0.01, 1.00), and 0.2 (95%CI: 0.0, 0.4)) units if the child's bedroom faced the loudest street.

### Longitudinal change score analysis

In the longitudinal analyses, change in SDQ scales between baseline and follow up was not associated with road traffic noise, except for a borderline protective effect on hyperactivity/inattention (-0.2; 95%CI: -0.4, 0.0). Inversely, a higher hyperactivity/inattention score was found for children whose bedroom faced the loudest street (0.3; 95%CI: 0.0, 0.6).

## Discussion & Conclusions

We found some indications that mostly peer problems was associated with road traffic noise at home, although not confirmed in longitudinal analyses with one year of follow-up. Strikingly, orientation of the bedroom to a major street was significantly associated with hyperactivity/inattention in both the cross-sectional and the longitudinal analysis independent of the modelled road traffic noise.

Future studies should further research and include impact of noise exposure related behaviour (orientation bedroom, windows open/closed).

References 1, Schubert, M., Hegewald, J., Freiberg, A., Starke, K. R., Augustin, F., Riedel-Heller, S. G., . . . health, p. (2019). Behavioral and emotional disorders and transportation noise among children and adolescents: a systematic review and meta-analysis. 16(18), 3336.