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Road Traffic, Location of Rooms and Hypertension

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Abstract

We compared the prevalence of hypertension in subjects that lived on main roads with those that lived in side streets. An odds ratio of 1.310 (95% CI = 1.052-1.631) was found for those who lived on the main roads. In this traffic-exposed subgroup, subjects that had the living and the bedroom facing the road an odds ratio of 1.736 (CI = 0.673-1.882) was found in comparison with those who had both rooms on the rear side of the house. In subjects that lived on side streets the location of the rooms was meaningless (OR = 1.102, CI = 0.648-1.874).

Keywords: Road traffic noise; Hypertension; Room orientation; Location of rooms; Quiet side

We have recently published the results of a cross-sectional study on the relationship between road traffic noise (noise indicator L_{DEN}) and the prevalence of high blood pressure (hypertension) in Environmental Research [1]. The prevalence of hypertension was assessed in 1770 subjects that lived on 7 major trunk roads or adjacent parallel side streets that were completely shielded by terraced 3-4 storey apartment buildings. The study was carried out in a south-western district of the city of Berlin, Germany. Multiple logistic regression analyses were carried out to assess the relationship between the road traffic noise level and the prevalence of hypertension. Odds ratios were carculated as an indicator of the relative risk [2]. All study results are adjusted for age, gender, education, body mass index, physical activity at leisure, alcohol intake, family history of hypertension and occupants per room which showed an impact on the association between road traffic noise and hypertension in a multiple model where only potentially confounding covariates were considered. Background air pollution was very similar in all street areas according to the Berlin air pollution monitoring network. Major trunk roads and adjacent side streets were within a distance of approximately 200 m from one another. For more technical and methodological details we refer to the main paper. A significant 11% increase of the risk of hypertension per increment of 10 dB(A) of the road traffic noise level was found. When the analyses were stratified according to the location of the living and the bedroom, the location of rooms (front or rear side) turned out to be an effect modifier of the association between road noise and high blood pressure [3].

However, the analyses were only stratified by the location of rooms but not by to the type of road (major trunk road versus side street). This means that low noise conditions were either due to the shiedling of rooms from major trunk roads (rooms on the rear side) or due to the location of houses in side streets. However, the impact of shielding (sound attenuation) due to the location of rooms, particularly, on major trunk roads may be of importance for traffic and noise mitigation measures, architecture and urban planning. We therefore carried out additional analyses using the same statistical models as for the noise related analyses, including the same covariates for adjustment for potential confounding. However, we replaced the sound level by the type of road as an indicator of exposure (major trunk road or side street).

Firstly, we compared the prevalence of hypertension in subjects that lived on major trunk roads (n=753) with those that lived in side streets (n=1017, reference group) (Tables 1 and 2). An odds ratio of 1.310 (95% confidence interval CI=1.052-1.631, p=0.016) was found for those who lived on the major trunk roads, which means that those subjects had a 31% higher risk of hypertension compared with those who lived in side streets. Secondly, we stratified the association according to the location of the rooms (as assessed by questionnaire). Table 3 shows the relative prevalence of hypertension (odds ratios) of subjects with different living and bedroom orientations towards the roads. Subjects where both rooms were located on the rear side of the house (the least traffic exposed condition) are considered as a reference group (odds ratio=1). The table shows the results for both subgroups (subjects that lived on major trunk roads and in side streets). In the subgroup of subjects that lived on major roads an odds ratio of OR=1.736 (CI=1.005-2.997, p=0.048) was found for the extreme comparison between both rooms on the front or the rear side of the house, which was significant. In subjects that lived on side streets the location of the rooms was irrelevant; an odds ratio of OR=1.102 (CI=0.648-1.874, p=0.721) was found. Looking at the intermediate groups (either the bedroom or the living room facing the street) revealed that the location of the living room had a stronger influence on the risk of high blood pressure than the location of the bedroom. The comparison of subjects that lived on major trunk roads but had both rooms on the rear side of the house (quiet side) with subjects that lived in side streets (regardless of which side) revealed no major difference in the prevalence of hypertension (OR=1.051, CI=0.689-1.601, p=0.818). Road traffic noise may be the most plausible reason for the observed effects because the shielding due to terraced buildings may be more effective for sound than for air pollutants that penetrate over the buildings.

Conclusions

In subjects that live on busy roads, the location of rooms - in particular, the orientation of the living room towards the road - is associated with a higher risk of hypertension. Subjects that are shielded from traffic exposures when having their rooms located on the rear side of the house are largely protected from adverse effects on the cardiovascular system. On busy roads sensitive rooms should be located on the rear side of the house.

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Variable	Category	Major trunk road	Side street	Chi²-test
		N (%)	N (%)	P-value
Gender	Women	401 (53.3)	612 (60.2)	0.004
	Men	352 (46.7)	405 (39.8)	
Education	Elementary/primary school	29 (3.9)	16 (1.6)	0.000
	Apprentice, trade school	133 (17.7)	127 (12.5)	
	Secondary school	167 (22.2)	227 (22.3)	
	Professional school	101 (13.4)	108 (10.6)	
	High school (diploma)	153 (20.3)	249 (24.5)	
	University	170 (22.6)	290 (28.5)	
Professional status	Retired	243 (32.5)	367 (36.3)	0.088
	Unemployed, housewife/-husband	79 (10.6)	87 (8.6)	
	Working daytime only	308 (41.2)	434 (42.9)	
	Shift worker daytime only	73 (9.8)	79 (7.8)	
	Shift worker including nights	45 (6.0)	44 (4.4)	
Smoking	Never smoking	283 (37.6)	437 (43.1)	0.000
	Former smoker	258 (34.3)	377 (37.1)	
	≤ 10 cigarettes, ≤ 1pipe/cigar per day	89 (11.8)	93 (9.2)	
	>10 cigarettes, >1pipe/cigar per day	123 (16.3)	108 (10.6)	
Physical activity	Never	133 (17.7)	122 (12.0)	0.002
	Not regularly	118 (15.7)	137 (13.5)	
	Moderately 1-3 times per week	135 (17.9)	167 (16.4)	
	Moderately >3 times per week	155 (20.6)	250 (24.6)	
	Strenuous 1-3 times per week	147 (19.5)	239 (23.5)	
	Strenuous >3 times per week	65 (8.6)	102 (10.0)	
Family history of	Yes	328 (43.6)	479 (47.1)	0.139
hypertension	No	425 (56.4)	538 (52.9)	

Table 1: Characteristics of subjects that lived on major trunk roads (n=753) and in adjacent side streets (n=1,017) – categorial variables.

Variable	Major trunk road	Side streets	Mann-Whitney Test
	Mean ± SD	Mean ± SD	P-value
Age (years)	54.8 ± 10.7	55.8 ± 10.5	0.062
Body mass index (kg/m^2)	26.8 ± 7.6	25.7 ± 4.4	0.000
Alcohol intake (units per day)	4.3 ± 7.8	4.0 ± 6	0.125
Occupants per room	0.75 ± 0.44	0.67 ± 0.26	0.000
Traffic noise level L_{DEN} (dB(A))	67.3 ± 7.2	49.4 ± 4.7	0.000
Traffic noise level L_{Day} (dB(A))	65.9 ± 7.3	47.6 ± 4.9	0.000
Traffic noise level L_{Night} (dB(A))	59.2 ± 7.1	41.6 ± 4.5	0.000
Traffic noise level $L_{DEN,front}$ (dB(A)) [a]	67.9 ± 7.7	48.1 ± 4.5	0.000
Traffic noise level $L_{Day,front}$ (dB(A)) [a]	66.5 ± 7.7	46.3 ± 4.8	0.000
Traffic noise level $L_{Night,front}$ (dB(A)) [a]	59.8 ± 7.6	40.4 ± 4.4	0.000
Traffic noise level $L_{DEN,rear}$ (dB(A)) [a]	49.7 ± 5.1	46.6 ± 3.7	0.000
Traffic noise level $L_{Day,rear}$ (dB(A)) [a]	47.9 ± 5.2	44.7 ± 3.9	0.000
Traffic noise level $L_{Night,rear}$ (dB(A)) [a]	42.0 ± 5.1	38.8 ± 3.7	0.000
Background PM_{10} (µg/m^3)	22.10 ± 0.13	22.01 ± 0.04	0.000
Background $PM_{2.5}$ (µg/m^3)	18.03 ± 0.08	18.00 ± 0.01	0.000
Background NO_2 (µg/m^3)	17.49 ± 0.65	17.10 ± 0.13	0.000

[a]Only subjects not having living or bedrooms sideward to the road (major trunk road: n=554, side street: n=710).

Table 2: Characteristics of subjects that lived on major trunk roads (n=753) and in adjacent side streets (n=1,017) – continuous variables.

Model (subjects living on major trunk roads) Logistic regression	**Number of subjects N**	**OR (95% CI)**	**P-Value**
Living room on the rear side of the house bedroom on the rear side of the house	129	1.000 (reference)	
Living room on the rear side of the house bedroom facing the road	78	1.040 (0.547-1.978)	0.904
Living room facing the road bedroom on the rear side of the house	194	1.611 (0.961-2.699)	0.070
Living room facing the road bedroom facing the road	152	1.736 (1.005-2.997)	0.048
Other conditions (e. g. rooms sideward)	198	1.126 (0.673-1.882)	0.651
Model (subjects living in side streets) Logistic regression	**Number of subjects N**	**OR (95% CI)**	**P-Value**
Living room on the rear side of the house bedroom on the rear side of the house	119	1.000 (reference)	
Living room on the rear side of the house bedroom facing the road	139	0.968 (0.552-1.699)	0.911
Living room facing the road bedroom on the rear side of the house	251	0.986 (0.598-1.641)	0.958
Living room facing the road bedroom facing the road	202	1.102 (0.648-1.874)	0.721
Other conditions (e. g. rooms sideward)	304	1.061 (0.650-1.732)	0.812

Adjusted for age, gender, education, body mass index, physical activity at leisure, alcohol intake, family history of hypertension and occupants per room

Table 3: Associations between the location of rooms with respect to the road and the prevalence of hypertension.

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