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Supplemental Material

Transportation Noise and Risk of Tinnitus: A Nationwide Cohort Study from Denmark

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Table S1. Baseline characteristics of the study population (Denmark, 2000 – 2017) according to road traffic noise exposure at the most exposed façade.

Baseline characteristics	**Entire population (N = 3,520,926)**	**>55 dB road traffic noise (N = 2,164,287)**	**≤55 dB road traffic noise (N = 1,356,639)**
Sex (N, men)	1,728,572	1,070,709	657,863
Age (mean ± standard deviation)	46.5 ± 14.7	43.8 ± 14.7	50.7 ± 13.7
Country of origin (N)			
Denmark	3,485,837	2,140,291	1,345,546
Other Western country	14,712	9,178	5,534
Non-Western country	20,377	14,818	5,559
Civil status (N)			
Married or cohabiting	2,579,176	1,508,679	1,070,497
Widow(er)	162,413	87,728	74,685
Divorced	206,651	132,881	73,770
Single	572,686	434,999	137,687
Individual income (N) [a]			
Q1	714,373	451,019	263,354
Q2	741,285	473,514	267,771
Q3	740,373	474,696	265,677
Q4	696,527	421,780	274,747
Q5	628,368	343,278	285,090
Occupational status (N)			
Blue collar	1,408,445	886,299	522,146
Low level white collar	622,475	397,455	225,020
High level white collar	435,448	276,915	158,533
Unemployed	213,277	148,814	64,463
Retired	841,281	454,804	386,477
Highest attained education (N)			
Mandatory education	1,156,084	668,095	487,989
Secondary or vocational education	1,667,850	1,033,161	634,689
Medium or long education	696,992	463,031	233,961
High quality green space (N)			
≥ 15 % in 150 m radius	688,303	399,306	288,997
≥ 20 % in 1000 m radius	854,232	489,779	364,453
Area-level factors (mean ± standard deviation) [b]			
% of population with low income (1st quartile)	4.7 ± 2.3	5.0 ± 2.5	4.2 ± 1.9
% unemployed in population	1.6 ± 0.6	1.6 ± 0.6	1.6 ± 0.6
% of population in manual labour	14.7 ± 4.0	13.9 ± 4.1	15.9 ± 3.5
% of population with only basic education	12.1 ± 3.8	11.6 ± 3.9	13.0 ± 3.5
% population with criminal record	0.5 ± 0.3	0.5 ± 0.4	0.5 ± 0.3
% single-parent families	5.2 ± 1.8	5.2 ± 1.8	5.1 ± 1.8

Note: Data were complete for all variables.

[a] Individual income quintiles were standardized by calendar year and sex.

[b] Based on the 2160 parishes available in Denmark

Table S2. Spearman correlations between road and railway traffic noise (10-y mean) at baseline.

	Road $L_{den, max}$	**Road $L_{den, min}$**	**Railway $L_{den, max}$**	**Railway $L_{den, min}$**
Road L_{den}max	1	0.49	0.28	0.22
Road L_{den}min		1	0.28	0.32
Railway L_{den}max			1	0.91
Railway L_{den}min				1

Table S3. Associations between 1-, 5-, and 10-year mean residential exposure to road traffic and railway noise (linear, per 10 dB) and risk of incident tinnitus: i) for the entire population; ii) considering only primary diagnosis of tinnitus; and iii) excluding individuals with previous diagnosis for outer and middle ear diseases.

Noise exposure per 10 dB	**Entire population [a] HR (95% CI)**	**Only primary tinnitus diagnosis [b] HR (95% CI)**	**Excluding individuals with previous diagnosis for outer and middle ear diseases [c] HR (95% CI)**
Road traffic, $L_{den, max}$			
1-year exposure	1.008 (0.995, 1.021)	1.039 (1.010, 1.069)	1.008 (0.995; 1.021)
5-year exposure	1.016 (1.003, 1.029)	1.048 (1.018, 1.079)	1.017 (1.003; 1.031)
10-year exposure	1.018 (1.005, 1.032)	1.055 (1.024, 1.087)	1.020 (1.006; 1.034)
Road traffic, $L_{den, min}$			
1-year exposure	1.044 (1.025, 1.062)	1.046 (1.006, 1.087)	1.046 (1.027;1.066)
5-year exposure	1.052 (1.033, 1.071)	1.058 (1.018, 1.101)	1.055 (1.036; 1.075)
10-year exposure	1.056 (1.037, 1.075)	1.071 (1.029, 1.114)	1.059 (1.039; 1.079)
Railway, $L_{den, max}$			
1-year exposure	1.008 (0.978, 1.038)	0.994 (0.936, 1.057)	1.009 (0.978; 1.040)
5-year exposure	1.003 (0.976, 1.030)	0.970 (0.919, 1.024)	0.999 (0.972; 1.028)
10-year exposure	0.992 (0.967, 1.016)	0.971 (0.925, 1.019)	0.988 (0.964; 1.014)
Railway, $L_{den, min}$			
1-year exposure	1.016 (0.977, 1.057)	1.003 (0.925, 1.087)	1.018 (0.978; 1.059)
5-year exposure	0.999 (0.963, 1.036)	0.966 (0.897, 1.041)	0.996 (0.959; 1.035)
10-year exposure	0.994 (0.960, 1.029)	0.965 (0.900, 1.034)	0.993 (0.958; 1.029)

Note: CI, confidence interval; HR, hazard ratio. Models were adjusted for age (underlying time scale), sex, calendar year, civil status, income, country of origin, occupational status, education, proportion of high quality green areas within 150 and 1000 m buffers, and a number of area-level socioeconomic variables: percent population with low income, with only basic education, who are unemployed, with manual labour, who are single-parent and with a criminal record, as well as mutual road traffic and railway noise adjustment.

[a] 40,692 cases; total N = 3,520,926

[b] Only cases with a primary tinnitus diagnosis: 8,792 cases; total N = 3,489,026.

[c] Excluding individuals with diagnosis for outer and middle ear diseases: 38,284 cases; total N = 3,455,725.

Table S4. Associations between categories of 10-year mean residential exposure to road traffic and railway noise at the most (L_{den}max) and least (L_{den}min) exposed façade and risk of tinnitus.

	L_{den}max			L_{den}min		
10-year noise exposure	**Category (dB)**	**N cases**	**HR (95% CI)**	**Category (dB)**	**N cases**	**HR (95% CI)**
Road traffic	41.9	4786	1	37.0	9151	1
	46.5	3150	1.032 (0.987, 1.080)	41.6	6907	1.027 (0.995, 1.060)
	49.6	4094	1.041 (0.998, 1.086)	44.4	7412	1.034 (1.001, 1.067)
	52.5	5065	1.056 (1.014, 1.099)	47.4	6323	1.068 (1.032, 1.105)
	55.5	5376	1.042 (1.002, 1.084)	50.3	4534	1.034 (0.995, 1.074)
	58.5	5760	1.040 (1.000, 1.082)	53.3	3335	1.100 (1.054, 1.149)
	61.3	5386	1.060 (1.018, 1.103)	56.2	1870	1.122 (1.064, 1.184)
	64.3	3765	1.062 (1.016, 1.111)	59.1	788	1.206 (1.118, 1.301)
	67.2	2029	1.045 (0.990, 1.104)	62.9	372	1.122 (1.008, 1.249)
	70.2	899	1.046 (0.972, 1.126)			
	73.3	382	1.051 (0.945, 1.169)			
Railway	35.0	30069	1	35.0	32477	1
	42.9	1090	0.979 (0.922, 1.041)	42.5	3001	0.988 (0.952, 1.026)
	47.8	1783	1.005 (0.958, 1.054)	47.4	2666	1.002 (0.962, 1.043)
	52.6	2555	1.027 (0.986, 1.070)	52.2	1735	0.956 (0.909, 1.005)
	57.4	2347	0.975 (0.934, 1.017)	56.7	666	1.009 (0.932, 1.093)
	62.1	1761	0.986 (0.938, 1.036)	61.9	147	0.927 (0.786, 1.094)
	66.8	880	1.004 (0.937, 1.076)			
	71.5	207	0.932 (0.811, 1.070)			

Note: Hazard ratio (95% confidence interval). Results were based on the fully adjusted model (i.e. adjusted for age (underlying time scale), sex, calendar year, civil status, income, country of origin, occupational status, proportion of high quality green areas within 150 and 1000 m buffers, and a number of area-level socioeconomic variables: percent population with low income, with only basic education, who are unemployed, with manual labor, who are single-parent and with a criminal record, as well as mutual road traffic and railway noise adjustment). All covariates, apart from sex and region of origin, were included in the model as time-varying variables. Categories were given as the median of each exposure category.

Table S5. Effect modification analysis of associations between 10-y exposure (linear, per 10 dB) of road traffic noise at the most exposed façade and risk for incident tinnitus by sex, education, and hearing loss.

	N cases	HR (95% CI) L_{den}max	HR (95% CI) L_{den}min
Hearing loss			
Yes	32,913	0.979 (0.965; 0.993)	0.957 (0.938; 0.976)
No	7,779	1.106 (1.074; 1.138)	1.253 (1.209; 1.299)
Sex			
Men	23,764	0.983 (0.967; 1.000)	0.987 (0.965; 1.010)
Women	16,928	1.072 (1.051; 1.093)	1.160 (1.131; 1.190)
Education			
Low	13,176	0.999 (0.978; 1.021)	1.036 (1.007; 1.067)
Medium	19,327	1.012 (0.993; 1.031)	1.039 (1.014; 1.065)
High	8,189	1.071 (1.041; 1.102)	1.132 (1.092; 1.173)
Income			
Low	9,785	0.996 (0.972; 1.021)	1.024 (0.991; 1.057)
Medium	23,938	1.018 (1.001; 1.035)	1.048 (1.025; 1.072)
High	6,969	1.055 (1.023; 1.088)	1.130 (1.087; 1.175)
Green space (150m)			
Yes	32,313	1.021 (0.994; 1.049)	1.055 (1.019; 1.091)
No	8,379	1.018 (1.003; 1.033)	1.056 (1.035; 1.078)
Occupation – Blue collar			
Yes	22,766	1.011 (0.994; 1.028)	1.047 (1.023; 1.071)
No	14,179	1.037 (1.015; 1.060)	1.088 (1.058; 1.119)
Comorbidity			
Yes	8,240	1.002 (0.975; 1.029)	1.028 (0.993; 1.065)
No	32,452	1.021 (1.006; 1.036)	1.061 (1.040; 1.083)

Note: Hazard ratio (95% confidence interval). Results were based on the fully adjusted model (i.e. adjusted for age (underlying time scale), sex, calendar year, civil status, income, country of origin, occupational status, proportion of high quality green areas within 150 and 1000 m buffers, and a number of area-level socioeconomic variables: percent population with low income, with only basic education, who are unemployed, with manual labor, who are single-parent and with a criminal record, as well as mutual road traffic and railway noise adjustment). All covariates, apart from sex and region of origin, were included in the model as time-varying variables.

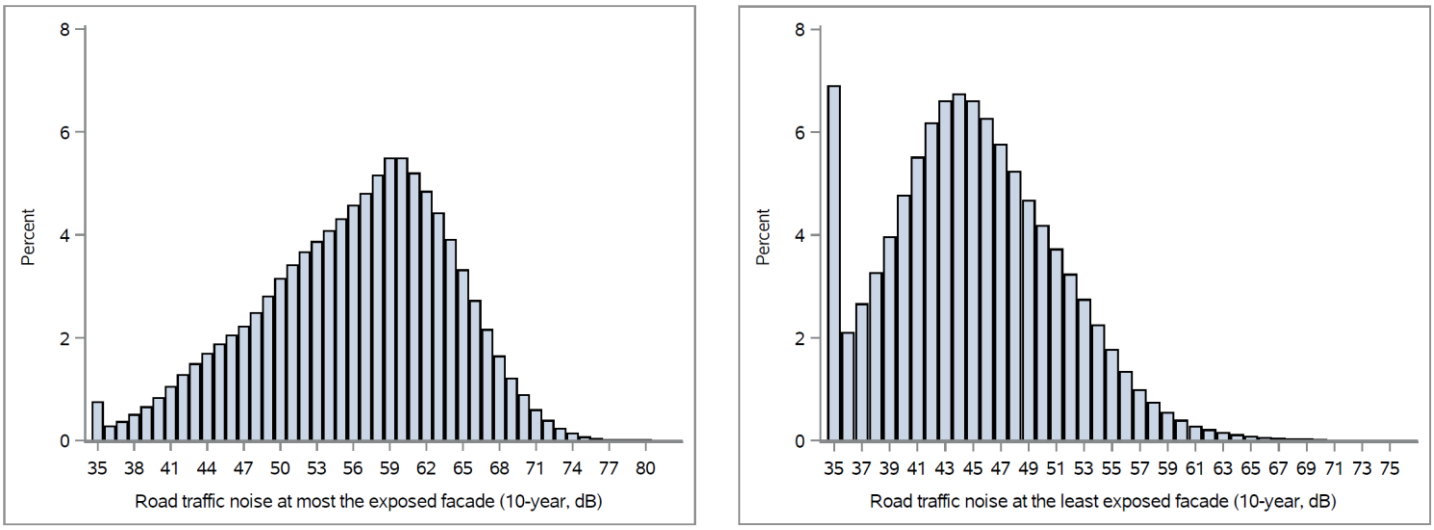

Figure S1. Distribution of road traffic noise at the most and least exposure façade (10-year mean at baseline, i.e. time-fixed) for the entire study population (N = 3,520,926).

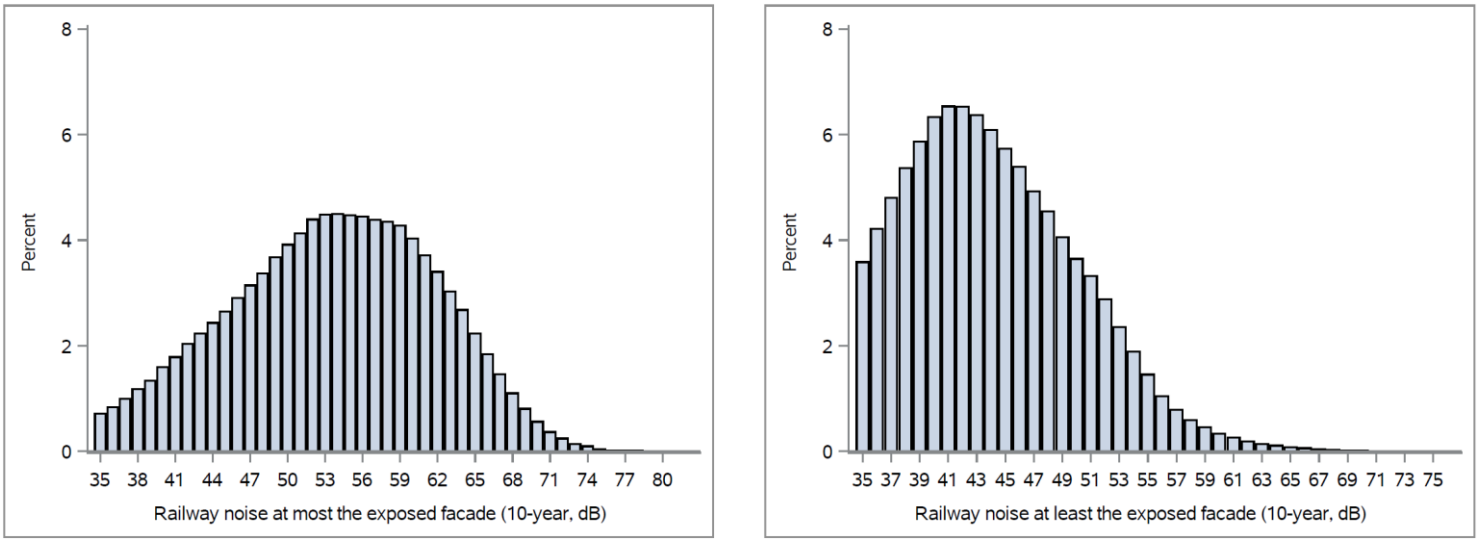

Figure S2. Distribution of railway noise at the most and least exposure façade (10-year mean at baseline, i.e. time-fixed) for all individuals exposed to railway noise ≥ 35 dB (N = 1,577,184 and N = 1,416,509 for most and least exposed façades, respectively).

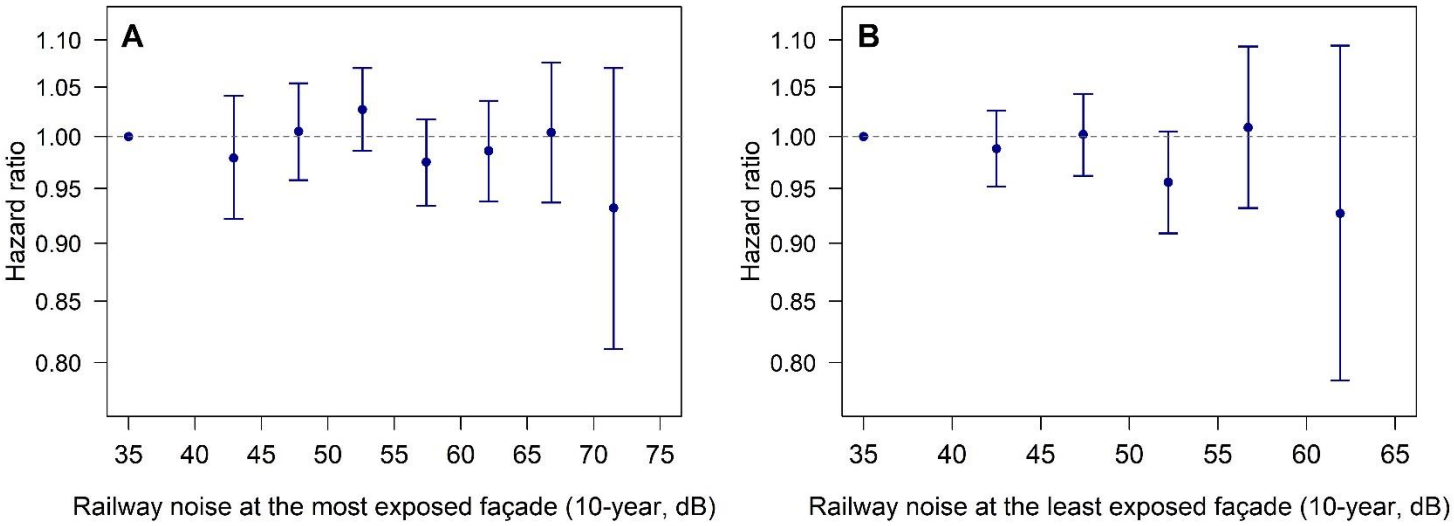

Figure S3. Association between 10-year mean exposure to railway noise at the most (A) and least (B) exposed façades and risk of tinnitus using the fully adjusted model. The vertical bars show hazard ratios with 95 % confidence interval at the median of the exposure categories compared with the reference category. Reference category was <40 dB. Risk estimates and number of cases for each exposure category are shown in Table S4.