

Supplement

Assessment of air pollution

Fine particulate matter (PM) of aerodynamic diameter less than $2.5\ \mu\text{m}$ ($\text{PM}_{2.5}$) was measured at 20 sites, and nitrogen oxides (NO_2) was measured at 40 sites in three separate two-week periods (to cover different seasons) over one year (Beelen et al. 2013; Eeftens et al. 2012). Annual averages of measured pollutant concentrations at the monitoring sites and predictor variables derived from European-wide and local Geographic Information System databases were used to develop the study-specific LUR model and to predict concentrations at each participant's address. In the Ruhr Area, the models explained 88% of the variability in the annual concentrations of $\text{PM}_{2.5}$ and 89% of that for NO_2 (Beelen 2013; Eeftens et al. 2012; Hennig et al. 2016).

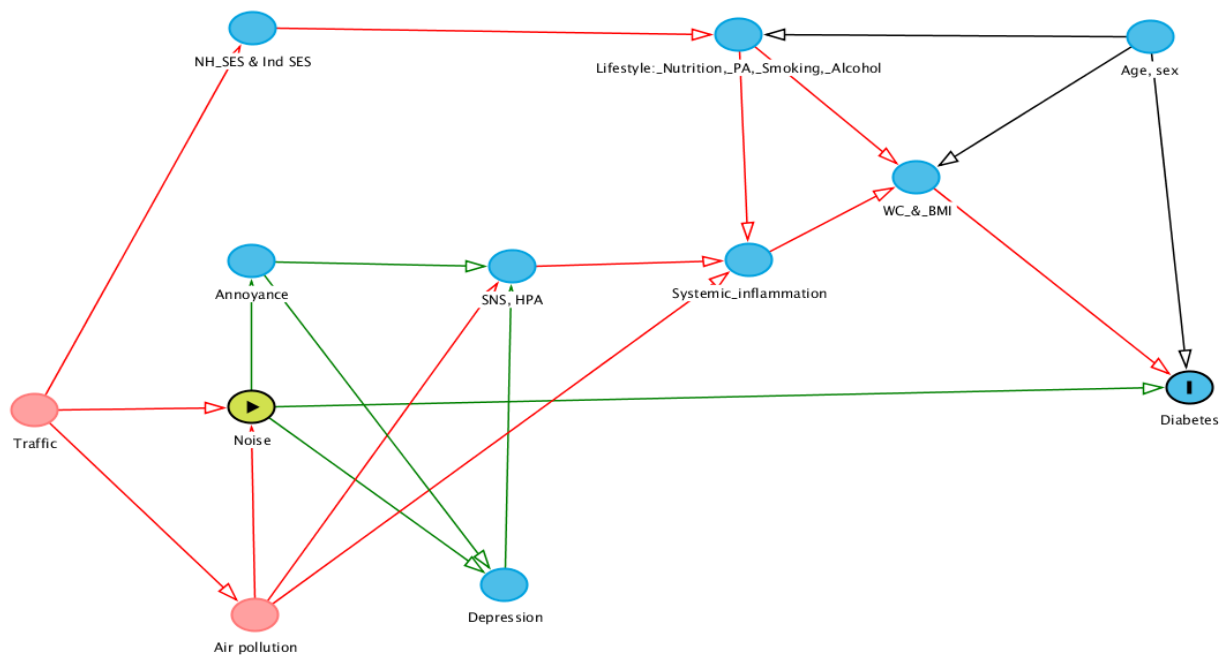


Figure S1: Directed acyclic graph (DAG) for the relationship between Noise and T2D

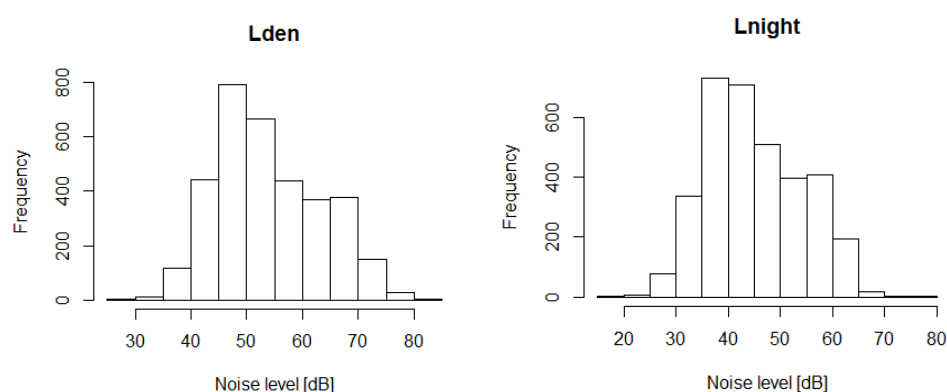


Figure S2: Distribution of the outdoor noise levels L_{den} and L_{night} in the main study population (3,646)

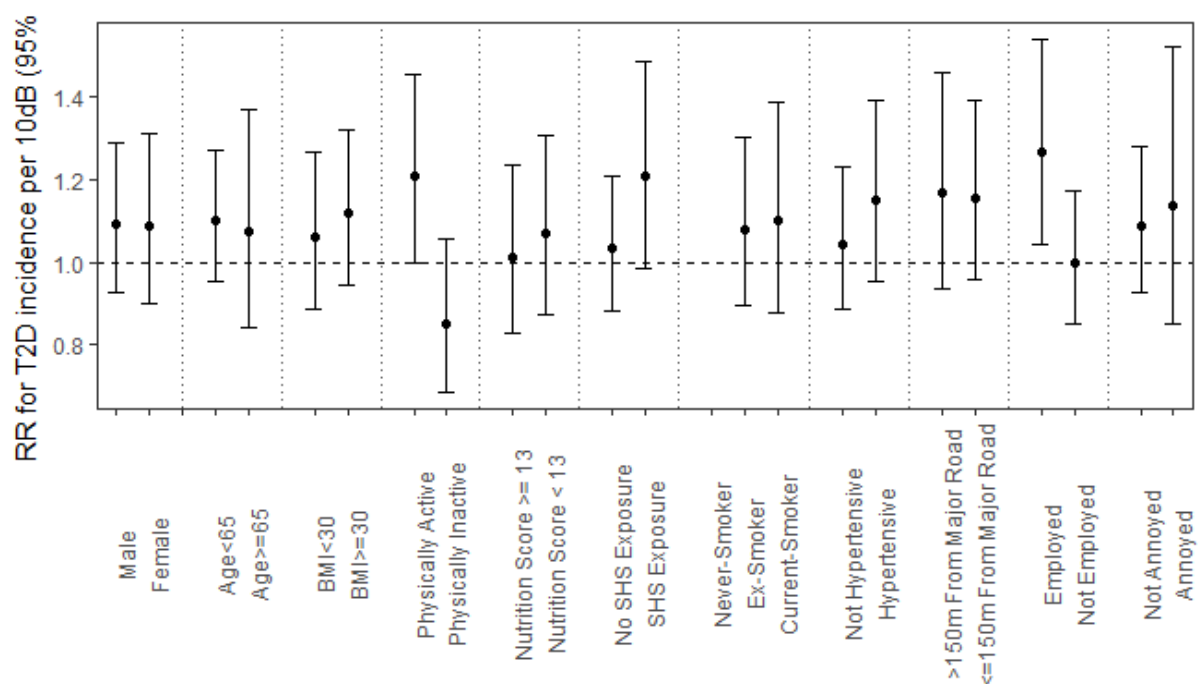


Figure S3: Interaction-based relative risks (RR (95% CI)) for T2DM per 10 dB increase of L_{night} in the study population ($n=3,396$). Models with versus without interaction terms were compared using Wald tests. P-values < 0.05 were considered as an indicator for effect modification.

Table S1: Comparison of the main study population and those participants excluded due to missing exposure and covariate data (3,646)

Baseline Characteristics	Main study population (n=3,396)	Missing values	Participants excluded due to missing data (n=250)	Missing values	P-value ^a
Age [years]; mean \pm SD	58.8 \pm 7.6	0	61.2 \pm 8.0	0	<0.001
Sex (male); N (%)	1,618 (47.6)	0	108 (43.2)	0	0.196
Education years, N (%)					
≤ 10 years	299 (8.8)	0	58 (23.7)	5	<0.001
11-13 years	1,912 (56.3)		126 (51.4)		
14-17 years	768 (22.6)		45 (18.4)		
≥ 18 years	417 (12.3)		16 (6.5)		
Unemployment rate in neighborhood; mean \pm SD	12.3 \pm 3.4	0	13.0 \pm 3.6	0	<0.01
BMI [kg/m ²]; mean \pm SD	27.5 \pm 4.3	0	27.9 \pm 4.6	15	0.14
BMI < 25; N (%)	1,030 (30.3)	0	65 (27.7)	15	0.48
BMI 25-30; N (%)	1,604 (47.2)		110 (46.8)		
BMI > 30; N (%)	762 (22.4)		60 (25.5)		
Waist circumference [cm]; mean \pm SD	92.6 \pm 12.6	0	94.2 \pm 14.2	10	0.09
Weekly physical activity; N (%)	1,977 (58.2)	0	119 (47.6)	0	<0.01
Metabolic effective activity/week [hours]; mean \pm SD	11.8 \pm 23.4	0	8.6 \pm 18.9	11	<0.05
Nutrition index; mean \pm SD	12.6 \pm 3.1	0	13.2 \pm 3.4	55	<0.05
Smoking status; N (%)					
Non-smoker	1,482 (43.6)	0	106 (42.4)	0	0.93
Ex-smoker	1,161 (34.2)		87 (34.8)		
Current smoker	753 (22.2)		57 (22.8)		
Packyears; mean \pm SD	14.9 \pm 24.0	0	15.1 \pm 22.0	28	0.92
Secondhand smoke; N (%)	1,216 (35.8)	0	81 (33.1)	5	0.42
Annoyance day; N (%)					
Not annoyed	1,580 (52.0)	360	116 (58.3)	51	0.22

Slightly/ moderately annoyed	1,296 (42.7)	73 (36.7)
Very/ extremely annoyed	160 (5.3)	10 (5.0)

Annoyance night; N (%)

Not annoyed	2,202 (72.7)	366	158 (77.8)	47	0.19
Slightly/ moderately annoyed	752 (24.8)		39 (19.2)		
Very/ extremely annoyed	76 (2.5)		6 (3.0)		

^aP-values were derived from a) Student's t-tests for continuous variables and b) Wilcoxon signed-rank tests for categorical variables

Table S2: Correlations between noise and AP exposures at baseline (n=3,396)

	L_{den}	L_{night}	L_{den}, indoor	L_{night}, indoor	PM_{2.5}	NO₂
L _{den}	1	0.99	0.50	0.43	0.30	0.37
L _{night}		1	0.50	0.43	0.31	0.37
L _{den} , indoor			1	0.42	0.18	0.22
L _{night} , indoor				1	0.15	0.18
PM _{2.5}					1	0.65
NO ₂						1

PM_{2.5}: Fine particulate matter, NO₂: Nitrogen dioxide

Table S3: Relative risks (95% CI) for T2D per 10 dB increase in the Heinz-Nixdorf-Recall study population after excluding movers between baseline and follow-up examinations (n=2,836)

	L_{den}	L_{night}
Crude	1.15 (1.01-1.31)	1.15 (1.00-1.31)
M1 ^a	1.13 (0.98-1.29)	1.12 (0.98-1.29)
M2 ^b	1.14 (0.99-1.30)	1.13 (0.99-1.30)

Multi-pollutant analyses

M2+ PM _{2.5}	1.13 (0.99-1.30)	1.13 (0.99-1.30)
M2+ NO ₂	1.15 (0.99-1.33)	1.15 (0.99-1.33)

<i>Mediation analyses</i>		
M2+ WC	1.11 (0.97-1.27)	1.11 (0.97-1.27)
M2+ BMI	1.12 (0.98-1.29)	1.12 (0.98-1.29)
M2+ Depressive symptoms	1.14 (0.99-1.30)	1.14 (0.99-1.30)

PM_{2.5}: Fine particulate matter, NO₂: Nitrogen dioxide

^aadjusted for age and sex, education and neighborhood unemployment rate, ^badditionally adjusted for nutrition, alcohol consumption, smoking status, pack-years, SHS, physical activity (yes/ no), weekly metabolic physical activity.

Table S4: Relative risks (95% CI) for T2D per 10 dB increase in the Heinz-Nixdorf-Recall study population (n=3,396) with higher outdoor noise thresholds

	L_{den} t55^d	L_{night} t45^e
Crude	1.19 (0.99-1.42)	1.18 (0.99-1.41)
M1 ^a	1.15 (0.95-1.38)	1.14 (0.95-1.37)
M2 ^b	1.15 (0.95-1.39)	1.14 (0.95-1.37)

Multi-pollutant analyses

M2 ¹ + PM2.5	1.15 (0.95-1.39)	1.14 (0.95-1.37)
M2+ NO2	1.18 (0.97-1.44)	1.18 (0.97-1.43)

Mediation analyses

M2+ WC	1.13 (0.94-1.36)	1.12 (1.94-1.34)
M2+ BMI	1.15 (0.96-1.38)	1.14 (0.95-1.36)
M2+depressive symptoms	1.15 (0.95-1.39)	1.14 (0.95-1.37)

PM_{2.5}: Fine particulate matter, NO₂: Nitrogen dioxide

^aadjusted for age and sex, education and neighborhood unemployment rate, ^badditionally adjusted for nutrition, alcohol consumption, smoking status, pack-years, SHS, physical activity (yes/ no), weekly metabolic physical activity.

, ^dt55: threshold value: 55 dB, ^et45: threshold value: 45dB

Table S5: Relative risks (95% CI) for exposure to L_{den} on T2D per categorical analysis (quantiles; reference category: <46.7 dB) of the Heinz-Nixdorf-Recall study participants (n=3,396).

	$46.7 \leq L_{den} < 52.2$ dB	$52.2 \leq L_{den} < 61.1$ dB	$L_{den} \geq 61.1$ dB
Crude	0.80 (0.56-1.14)	1.10 (0.79-1.51)	1.22 (0.89-1.68)
M1 ^a	0.78 (0.55-1.12)	1.07 (0.78-1.48)	1.15 (0.78-1.48)
M2 ^b	0.79 (0.55-1.13)	1.07 (0.78-1.48)	1.18 (0.85-1.63)
<i>Multi-pollutant analyses</i>			
M2 + PM _{2.5}	0.78 (0.55-1.12)	1.06 (0.76-1.47)	1.16 (0.83-1.62)
M2 + NO ₂	0.79 (0.56-1.13)	1.07 (0.78-1.49)	1.19 (0.85-1.66)
<i>Mediation analyses</i>			
M2+ WC	0.72 (0.54-1.09)	0.98 (0.75-1.41)	0.97 (0.80-1.51)
M2+ BMI	0.79 (0.55-1.13)	1.05 (0.76-1.45)	1.16 (0.84-1.59)
M2 + depressive symptoms	0.79 (0.56-1.13)	1.07 (0.78-1.49)	1.18 (0.85-1.63)

PM_{2.5}: Fine particulate matter, NO₂: Nitrogen dioxide

^aadjusted for age and sex, education and neighborhood unemployment rate, ^badditionally adjusted for nutrition, alcohol consumption, smoking status, pack-years, SHS, physical activity (yes/ no), weekly metabolic physical activity.