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## **Supplemental Material**

# **Associations of Residential Long-Term Air Pollution Exposures and Satellite-Derived Greenness with Insulin Resistance in German Adolescents**

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**Table S1.** Associations of air pollution exposure (annual average concentrations) and NDVI (based on data from 2003) with HOMA-IR including additional adjustment for other exposure variables. Results of generalized additive models fitted separately for each exposure.

Exposure <sup>a</sup>	% difference (95% CI)	p
<b>Further adjusted model<sup>b</sup></b>		
NDVI (500m)	-5.5 (-11.3, 0.8)	0.084
NDVI (1000m)	<b>-7.4 (-13.3, -1.1)</b>	<b>0.023</b>
NO <sub>2</sub>	<b>11.4 (4.4, 18.9)</b>	<b>0.001</b>
PM <sub>10</sub>	<b>11.4 (0.4, 23.7)</b>	<b>0.042</b>
PM <sub>2.5</sub>	14.6 (-2.5, 34.6)	0.099
PM <sub>2.5</sub> abs.	4.7 (-4.2, 14.3)	0.313
<b>Plus adjustment for NDVI (500m)</b>		
NDVI (500m)		
NDVI (1000m)	-12.2 (-24.6, 2.3)	0.094
NO <sub>2</sub>	<b>10.8 (3.0, 19.3)</b>	<b>0.007</b>
PM <sub>10</sub>	8.8 (-3.0, 22.1)	0.151
PM <sub>2.5</sub>	11.0 (-6.2, 31.3)	0.226
PM <sub>2.5</sub> abs.	2.5 (-6.5, 12.3)	0.603
<b>Plus adjustment for PM<sub>10</sub></b>		
NDVI (500m)	-3.5 (-10.0, 3.5)	0.319
NDVI (1000m)	-5.8 (-12.4, 1.4)	0.112
NO <sub>2</sub>	<b>11.3 (2.5, 20.8)</b>	<b>0.011</b>
PM <sub>10</sub>		
PM <sub>2.5</sub>	6.9 (-11.6, 29.3)	0.491
PM <sub>2.5</sub> abs.	-3.0 (-13.7, 9.0)	0.610
<b>Plus adjustment for PM<sub>2.5</sub></b>		
NDVI (500m)	-4.4 (-10.6, 2.1)	0.181
NDVI (1000m)	-6.5 (-12.7, 0.1)	0.056
NO <sub>2</sub>	<b>10.5 (3.0, 18.5)</b>	<b>0.005</b>
PM <sub>10</sub>	9.0 (-3.6, 23.4)	0.171
PM <sub>2.5</sub>		
PM <sub>2.5</sub> abs.	-0.1 (-10.3, 11.3)	0.986
<b>Plus adjustment for PM<sub>2.5</sub> abs.</b>		
NDVI (500m)	-5.2 (-11.3, 1.3)	0.114
NDVI (1000m)		
NO <sub>2</sub>	<b>-7.3 (-13.5, -0.6)</b>	<b>0.032</b>
PM <sub>10</sub>	<b>13.8 (5.4, 22.9)</b>	<b>0.001</b>
PM <sub>2.5</sub>	14.7 (-0.3, 31.9)	0.054
PM <sub>2.5</sub> abs.	16.2 (-4.9, 41.9)	0.142

<sup>a</sup> estimates per 2SD increase in the exposure variables: 0.2 NDVI units NDVI (500m) and (1000m) 0.2 NDVI units, 8.9 µg/m<sup>3</sup> NO<sub>2</sub>, 6.7 µg/m<sup>3</sup> PM<sub>10</sub>, 4.4 µg/m<sup>3</sup> PM<sub>2.5</sub>, and 0.5 10<sup>-5</sup>/m PM<sub>2.5</sub> abs.

<sup>b</sup> adjusted for: study area, cohort, sex, age, BMI, smoking by the adolescent, maternal and paternal education levels, second hand smoke at home, physical activity, income, pubertal scale

**Table S2.** Associations of air pollution exposure (annual average concentrations) and NDVI (based on data from 2003) with HOMA-IR including additional adjustment for short term (7-day average) air pollution concentrations. Results of generalized additive models fitted separately for each exposure.

<b>Exposure<sup>a</sup></b>	<b>% difference (95% CI)</b>	<b>p</b>
<b>Further adjusted model<sup>b</sup></b>		
NDVI (500m)	-5.5 (-11.3, 0.8)	0.084
NDVI (1000m)	<b>-7.4 (-13.3, -1.1)</b>	<b>0.023</b>
NO <sub>2</sub>	<b>11.4 (4.4, 18.9)</b>	<b>0.001</b>
PM <sub>10</sub>	<b>11.4 (0.4, 23.7)</b>	<b>0.042</b>
PM <sub>2.5</sub>	14.6 (-2.5, 34.6)	0.099
PM <sub>2.5</sub> abs.	4.7 (-4.2, 14.3)	0.313
<b>Plus adjustment for 7-day average NO<sub>2</sub></b>		
NDVI (500m)	-5.7 (-11.6, 0.5)	0.071
NDVI (1000m)	<b>-7.6 (-13.6, -1.3)</b>	<b>0.0198</b>
NO <sub>2</sub>	<b>11.7 (4.7, 19.3)</b>	<b>0.0009</b>
PM <sub>10</sub>	<b>12.1 (0.9, 24.5)</b>	<b>0.033</b>
PM <sub>2.5</sub>	15.5 (-1.8, 35.8)	0.081
PM <sub>2.5</sub> abs.	5.5 (-3.6, 15.4)	0.243
<b>Plus adjustment for 7-day average PM<sub>10</sub></b>		
NDVI (500m)	-5.4 (-11.3, 0.8)	0.085
NDVI (1000m)	<b>-7.4 (-13.3, -1.1)</b>	<b>0.023</b>
NO <sub>2</sub>	<b>11.2 (4.2, 18.6)</b>	<b>0.0013</b>
PM <sub>10</sub>	<b>11.7 (0.7, 24.0)</b>	<b>0.036</b>
PM <sub>2.5</sub>	15.4 (-1.7, 35.5)	0.080
PM <sub>2.5</sub> abs.	6.3 (-2.9, 16.3)	0.186
<b>Plus adjustment for 7-day average PM<sub>2.5</sub></b>		
NDVI (500m)	-5.4 (-11.2, 0.8)	0.087
NDVI (1000m)	<b>-7.4 (-13.3, -1.0)</b>	<b>0.024</b>
NO <sub>2</sub>	<b>11.3 (4.3, 18.7)</b>	<b>0.0012</b>
PM <sub>10</sub>	<b>11.7 (0.7, 24.0)</b>	<b>0.036</b>
PM <sub>2.5</sub>	15.5 (-1.6, 35.6)	0.079
PM <sub>2.5</sub> abs.	6.3 (-2.9, 16.3)	0.185

<sup>a</sup> estimates per 2SD increase in the exposure variables: 0.2 NDVI units NDVI (500m) and (1000m) 0.2 NDVI units, 8.9 µg/m<sup>3</sup> NO<sub>2</sub>, 6.7 µg/m<sup>3</sup> PM<sub>10</sub>, 4.4 µg/m<sup>3</sup> PM<sub>2.5</sub>, and 0.5 10<sup>-5</sup>/m PM<sub>2.5</sub> abs.

<sup>b</sup> adjusted for: study area, cohort, sex, age, BMI, smoking by the adolescent, maternal and paternal education levels, second hand smoke at home, physical activity, income, pubertal scale

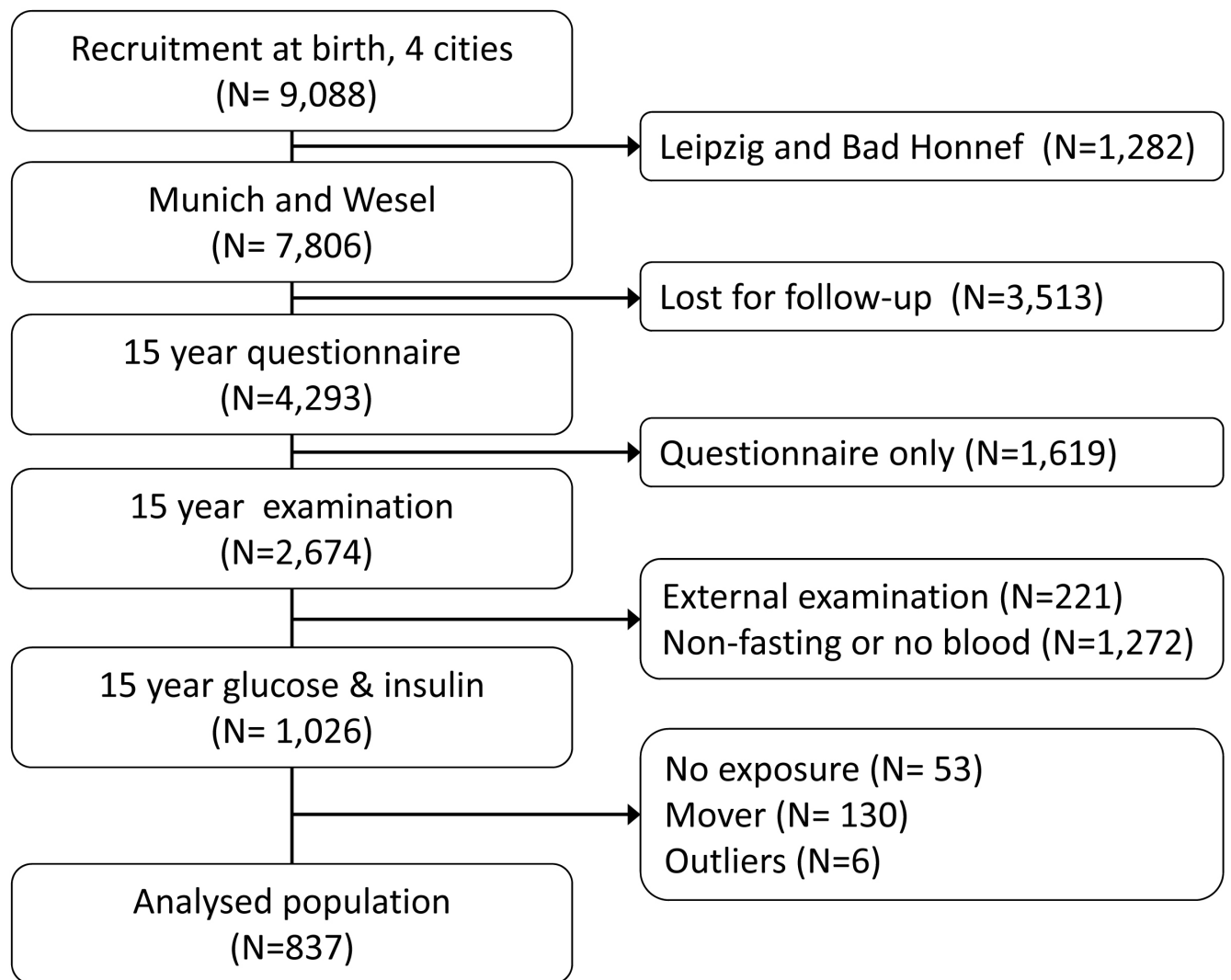
**Table S3.** Associations of air pollution exposure (annual average concentrations) and NDVI (based on data from 2003) with HOMA-IR restricted to participants who have not moved since birth (n=414). Results of generalized additive models fitted separately for each exposure.

<b>Exposure<sup>a</sup></b>	<b>% difference (95% CI)</b>	<b>p</b>
<b>Basic model<sup>b</sup></b>		
NDVI (500m)	-3.1 (-11.4, 6.0)	0.492
NDVI (1000m)	-5.8 (-14.3, 3.5)	0.217
NO <sub>2</sub>	<b>10.6 (0.9, 21.4)</b>	<b>0.033</b>
PM <sub>10</sub>	12.2 (-4.6, 31.9)	0.166
PM <sub>2.5</sub>	14.2 (-10.1, 45.1)	0.275
PM <sub>2.5</sub> abs.	8.1 (-5.4, 23.6)	0.252
<b>Further adjusted model<sup>c</sup></b>		
NDVI (500m)	-4.0 (-12.3, 5.2)	0.385
NDVI (1000m)	-6.5 (-15.1, 3.0)	0.176
NO <sub>2</sub>	<b>12.2 (2.1, 23.3)</b>	<b>0.017</b>
PM <sub>10</sub>	13.2 (-4.1, 33.6)	0.143
PM <sub>2.5</sub>	17.6 (-7.8, 49.9)	0.192
PM <sub>2.5</sub> abs.	10.2 (-3.8, 26.2)	0.161
<b>Plus adjustment for NO<sub>2</sub></b>		
NDVI (500m)	1.8 (-8.2, 12.9)	0.730
NDVI (1000m)	-1.4 (-11.8, 10.3)	0.804
NO <sub>2</sub>		
PM <sub>10</sub>	1.2 (-18.3, 25.3)	0.913
PM <sub>2.5</sub>	8.6 (-17.3, 42.6)	0.556
PM <sub>2.5</sub> abs.	0.5 (-15.1, 19.0)	0.953
<b>Plus adjustment for NDVI (1000m)</b>		
NDVI (500m)	10.0 (-10.3, 34.9)	0.360
NDVI (1000m)	-6.5 (-15.1, 3.0)	0.176
NO <sub>2</sub>	11.4 (-0.1, 24.2)	0.052
PM <sub>10</sub>	9.0 (-10.1, 32.2)	0.379
PM <sub>2.5</sub>	12.1 (-13.6, 45.5)	0.392
PM <sub>2.5</sub> abs.	7.0 (-8.0, 24.6)	0.381

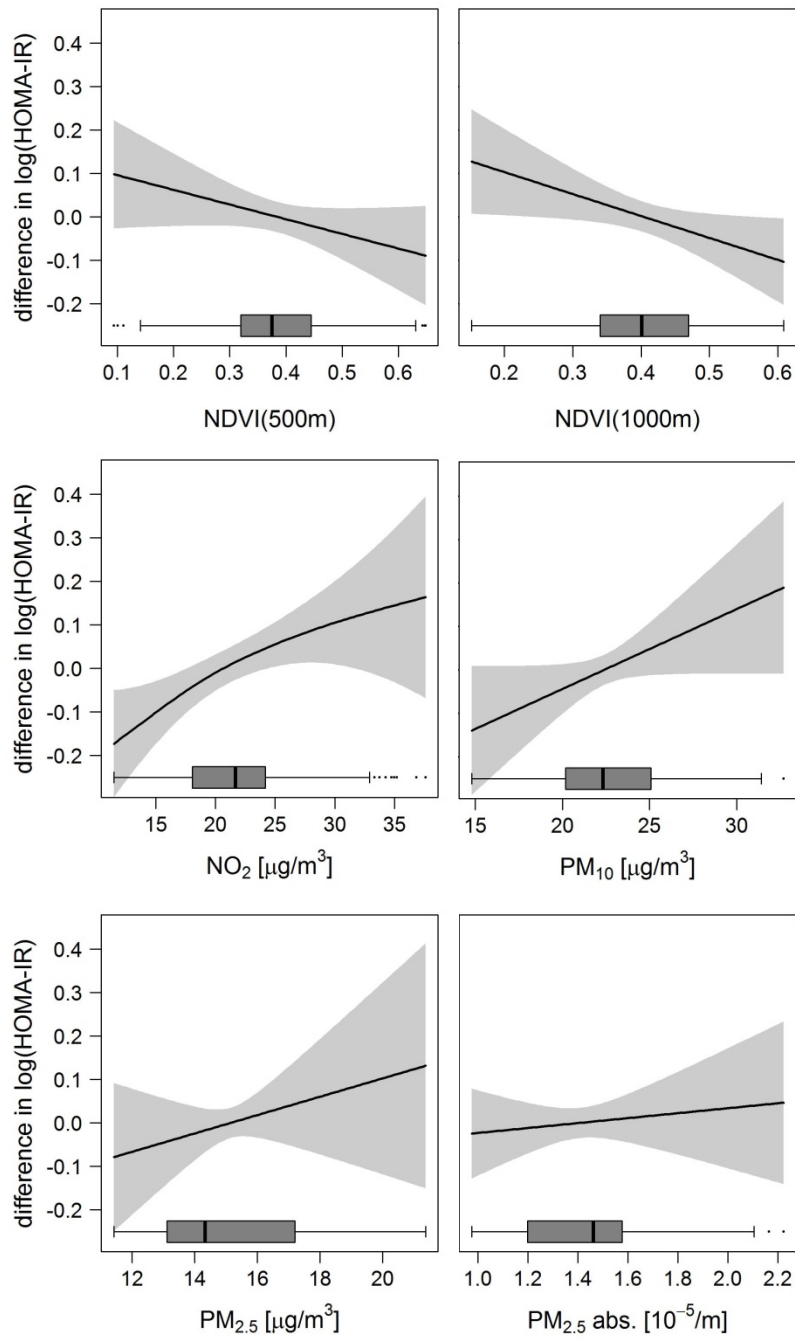
<sup>a</sup> estimates per 2SD increase in the exposure variables: 0.2 NDVI units NDVI (500m) and (1000m) 0.2 NDVI units, 8.9 µg/m<sup>3</sup> NO<sub>2</sub>, 6.7 µg/m<sup>3</sup> PM<sub>10</sub>, 4.4 µg/m<sup>3</sup> PM<sub>2.5</sub>, and 0.5 10-5/m PM<sub>2.5</sub> abs.

<sup>b</sup> adjusted for: study area, cohort, sex, age, BMI

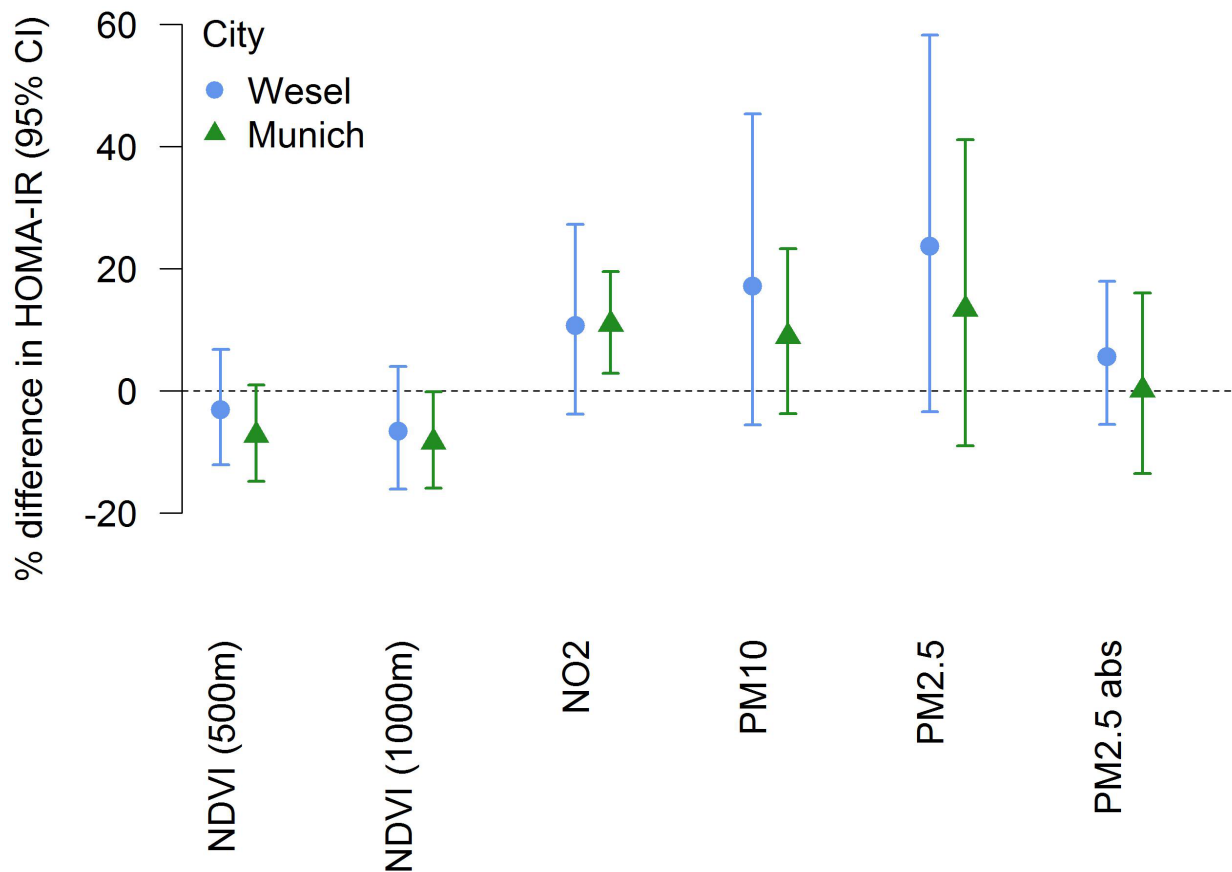
<sup>c</sup> adjusted for: study area, cohort, sex, age, BMI, smoking by the adolescent, maternal and paternal education levels, second hand smoke at home, physical activity, income, pubertal scale



**Figure S1.** Flow chart of the study population

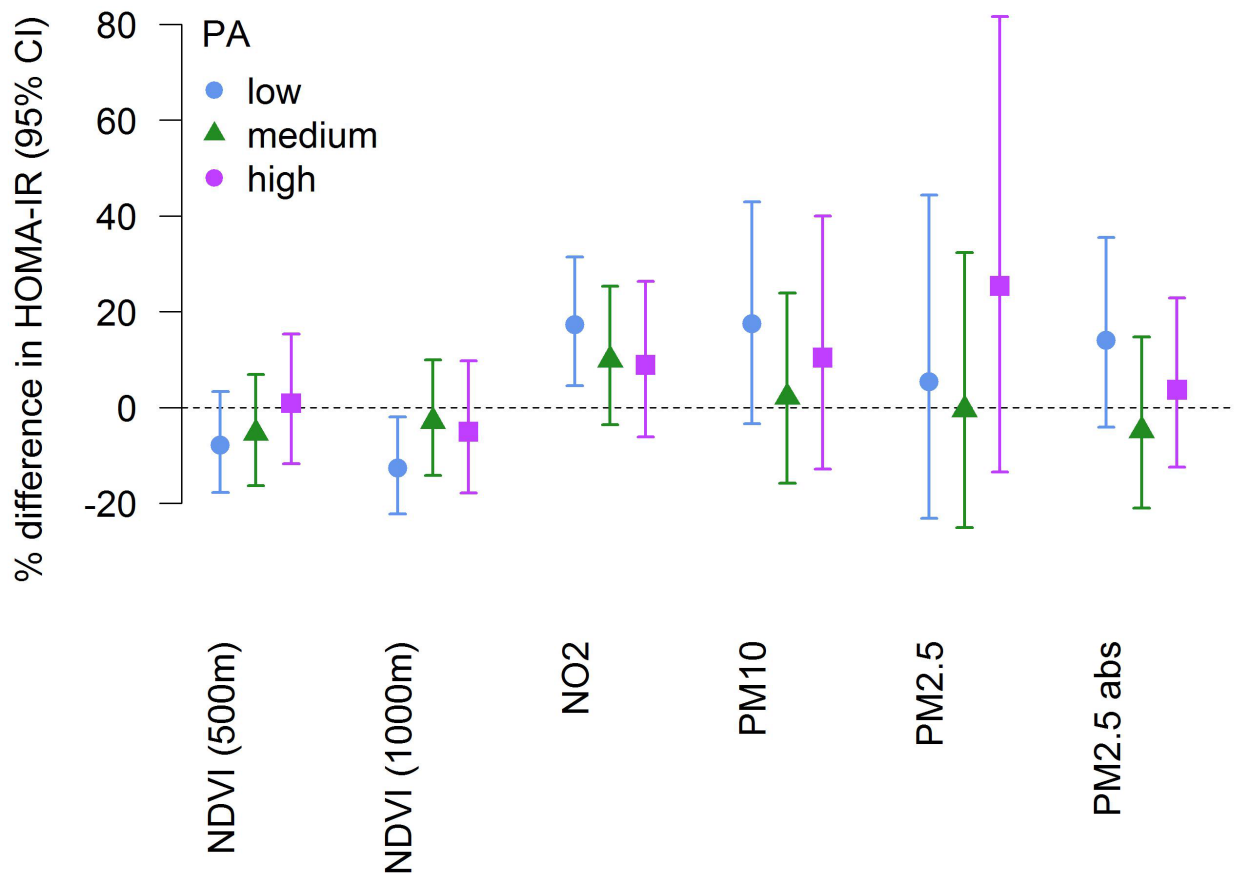


**Figure S2.** Smoother plots showing the linear association between air pollutants (annual average concentrations) and NDVI (based on data from 2003) and insulin resistance. Gam models adjusted for city, cohort, sex, age, BMI.

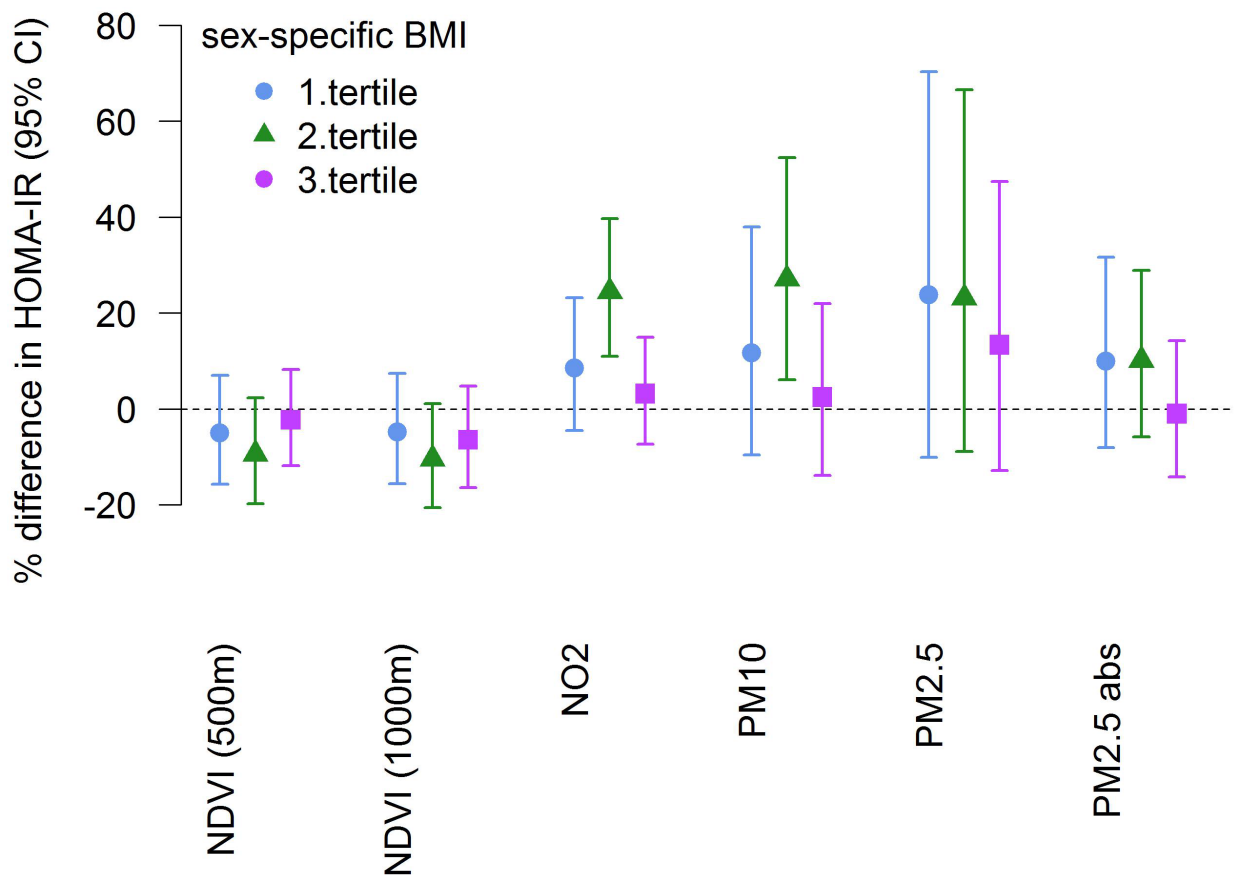


**Figure S3.** Comparable effect estimates in both cities. Gam models adjusted for cohort, sex, age, BMI, smoking by the adolescent, paternal and maternal education level, secondhand smoke in the home, physical activity, pubertal state, city-specific equivalent net income tertiles. P-values for the interaction with study area: NDVI (500m):  $p=0.241$ , NDVI (1000m):  $p=0.475$ , NO<sub>2</sub>:  $p=0.3077$ , PM<sub>10</sub>:  $p=0.655$ , PM<sub>2.5</sub>:  $p=0.718$ , PM<sub>2.5</sub> abs.:  $p=0.816$ .





**Figure S4.** Gam models stratified for physical activity level adjusted for cohort, city, sex, age, BMI, smoking by the adolescent, paternal and maternal education level, secondhand smoke in the home, pubertal state, city-specific equivalent net income tertiles. P-values for the interaction with physical activity: NDVI (500m):  $p=0.933$ , NDVI (1000m):  $p=0.966$ ,  $\text{NO}_2$ :  $p=0.378$ ,  $\text{PM}_{10}$ :  $p=0.433$ ,  $\text{PM}_{2.5}$ :  $p=0.474$ ,  $\text{PM}_{2.5}$  abs.:  $p=0.926$ .



**Figure S5.** Gam models stratified for sex-specific BMI tertiles adjusted for cohort, city, sex, age, smoking by the adolescent, paternal and maternal education level, secondhand smoke in the home, pubertal state, physical activity, city-specific equivalent net income tertiles. P-values for the interaction with BMI: NDVI (500m):  $p=0.432$ , NDVI (1000m):  $p=0.668$ ,  $\text{NO}_2$ :  $p=0.788$ ,  $\text{PM}_{10}$ :  $p=0.630$ ,  $\text{PM}_{2.5}$ :  $p=0.585$ ,  $\text{PM}_{2.5}$  abs.:  $p=0.107$ .