

Supplementary material

Residential exposure to air pollution and access to neighborhood greenspace in relation to hair cortisol concentrations during the second and third trimester of pregnancy

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Table S1. Univariate analysis of variance of possible covariates of hair cortisol concentrations

Covariates of HCC	2nd trimester HCC	3rd trimester HCC
	<i>p</i> -value	<i>p</i> -value
Maternal age	0.929	0.898
Parity	0.448	0.670
Pre-existing diseases	0.310	0.211
Pre-pregnancy Body Mass Index	0.336	0.267
Smoking before pregnancy	0.628	0.540
Alcohol consumption before pregnancy	0.776	0.413
Educational attainment	0.741	0.912
Pre-pregnancy employment	0.176	0.366
Ethnic background	0.106	0.504
Area Deprivation Index	0.661	0.388
Residential noise exposure (L_{den})	0.871	0.200
Daily hair washing	0.009	0.272
Gestational week at sampling	0.990	0.343
Season of 2 nd trimester sampling	0.047	n/a
Season of 3 rd trimester sampling	n/a	0.367

Note: Pre-existing chronic diseases include diabetes, asthma, cardiovascular diseases. The highest educational attainment of the mother is categorized as low (basic level)/intermediate (secondary school)/high (higher education). Ethnic background is evaluated as European/non-European. Noise exposure is evaluated as exposure above the WHO health-based guideline of 53 dB L_{den} (day–evening–night noise level). ADI, area deprivation index; HCC hair cortisol concentrations, n/a not applicable

Table S2. Interactions of air pollutant exposure, distance to major roads with access to neighborhood greenspace in relation to hair cortisol concentrations

Second pregnancy trimester	Model I (n = 133)	Model II (n = 133)
Interaction	p-interaction value	p-interaction value
3-month mean PM _{2.5} x access to small NHGS	0.428	0.445
3-month mean PM _{2.5} x access to large NHGS	0.302	0.325
3-month mean NO ₂ x access to small NHGS	0.905	0.938
3-month mean NO ₂ x access to large NHGS	0.957	0.600
3-month mean BC x access to small NHGS	0.537	0.759
3-month mean BC x access to large NHGS	0.919	0.974
Distance to major road x access to small NHGS	0.096	0.120
Distance to major road x access to large NHGS	0.021	0.034
Third pregnancy trimester	Model I (n = 81)	Model II (n = 81)
Interaction	p-interaction value	p-interaction value
3-month mean PM _{2.5} x access to small NHGS	0.493*	0.348*
3-month mean PM _{2.5} x access to large NHGS	0.565*	0.858*
3-month mean NO ₂ x access to small NHGS	0.555*	0.341*
3-month mean NO ₂ x access to large NHGS	0.396*	0.390*
3-month mean BC x access to small NHGS	0.552*	0.312*
3-month mean BC x access to large NHGS	0.269*	0.297*
Distance to major road x access to small NHGS	0.200	0.284
Distance to major road x access to large NHGS	0.073	0.080

Note: Linear regression model I is unadjusted, model II is adjusted for season of sampling, p-values of the interaction terms are presented. *Results for 78 participants. All data is based on the maternal residential address. Major roads include E- or N-roads. Access to small neighborhood greenspace is defined as access to > 0.2 hectares (ha) of greenspace within a travel distance of 400 meters (m) from residence, access to large neighborhood greenspace is defined as access to > 10 ha of greenspace within a travel distance of 800 m from residence. CI, confidence interval; NHGS, neighborhood greenspace; NO₂, nitrogen dioxide; PM_{2.5}, fine particulate matter with an aerodynamic diameter ≤ 2.5 μm; BC, black carbon. Significant interactions are marked in bold.

Table S3. Associations of 1-year mean residential air pollutant concentrations with hair cortisol concentrations

Second trimester HCC (n = 133)		Model I		Model II	
Exposure (p25 - p75)	p-value	β coefficient (95% CI)	p-value	β coefficient (95% CI)	
1-year mean PM _{2.5} (11.96 - 14.44 $\mu\text{g}/\text{m}^3$)	0.975	1.00 (0.83, 1.20)	0.706	0.97 (0.80, 1.16)	
1-year mean NO ₂ (20.36 - 29.37 $\mu\text{g}/\text{m}^3$)	0.425	1.07 (0.91, 1.26)	0.322	1.00 (0.92, 1.28)	
1-year mean BC (1.04 - 1.56 $\mu\text{g}/\text{m}^3$)	0.558	1.06 (0.88, 1.27)	0.525	1.06 (0.89, 1.27)	
Third trimester HCC (n = 78)		Model I		Model II	
Exposure (p25 - p75)	p-value	β coefficient (95% CI)	p-value	β coefficient (95% CI)	
1-year mean PM _{2.5} (11.96 - 13.66 $\mu\text{g}/\text{m}^3$)	0.462	1.11 (0.84, 1.45)	0.704	1.07 (0.75, 1.53)	
1-year mean NO ₂ (20.17 - 30.49 $\mu\text{g}/\text{m}^3$)	0.013	1.49 (1.09, 2.04)	0.024	1.44 (1.05, 1.99)	
1-year mean BC (1.06 - 1.62 $\mu\text{g}/\text{m}^3$)	0.046	1.39 (1.01, 1.93)	0.083	1.36 (0.96, 1.92)	

Note: Linear regression model I is unadjusted, model II is adjusted for season of sampling. Estimates (β) are presented as a factor increase in hair cortisol concentrations for a factor increase in exposure from the 25th to the 75th percentile (p75/p25). All data is based on the maternal residential address. CI, confidence interval; HCC, hair cortisol concentrations; NO₂, nitrogen dioxide; PM_{2.5}, fine particulate matter with an aerodynamic diameter $\leq 2.5 \mu\text{m}$; BC, black carbon.

Table S4. Associations of residential exposures with hair cortisol concentrations, models additionally adjusted for daily hair washing

2 nd trimester HCC, model adjusted for season and hair washing frequency (n = 103)		
Exposure (p25 - p75)	p-value	β coefficient (95% CI)
3-month mean PM _{2.5} concentrations (9.66 - 13.39 µg/m ³)	0.352	0.88 (0.68, 1.15)
3-month mean NO ₂ concentrations (18.27 - 28.62 µg/m ³)	0.622	1.05 (0.85, 1.30)
3-month mean BC concentrations (0.84 - 1.40 µg/m ³)	0.941	1.01 (0.80, 1.27)
Distance to major roads (135 - 618 m)	0.006	0.77 (0.64, 0.92)
Access to small NHGS	0.074	0.59 (0.33, 1.05)
Access to large NHGS	0.071	0.72 (0.51, 1.03)
3 rd trimester HCC, model adjusted for season and hair washing frequency (n = 68)		
Exposure (p25 - p75)	p-value	β coefficient (95% CI)
3-month mean PM _{2.5} concentrations (9.71 - 13.44 µg/m ³)	0.245	1.19 (0.88, 1.61)
3-month mean NO ₂ concentrations (19.24 - 29.30 µg/m ³)	0.018	1.50 (1.07, 2.10)
3-month mean BC concentrations (0.89 - 1.50 µg/m ³)	0.038	1.48 (1.02, 2.14)
Distance to major road (138 - 603 m)	0.064	0.75 (0.56, 1.02)
Access to small NHGS	0.144	0.53 (0.22, 1.25)
Access to large NHGS	0.015	0.55 (0.34, 0.89)
Interaction second trimester	p-interaction value	
Distance to major roads * access to large NHGS	0.020	
Interaction third trimester	p-interaction value	
Distance to major roads * access to large NHGS	0.098	

Note: Linear regression models adjusted for season of sampling and daily hair washing. Estimates (β) are presented with their 95% confidence intervals (95%CI) as a factor increase in hair cortisol concentrations for a factor increase in exposure from the 25th to the 75th percentile (p75/p25). All data is based on the maternal residential address. Major roads include E- or N-roads. Access to small neighborhood greenspace is defined as access to > 0.2 hectares (ha) of greenspace within a travel distance of 400 meters (m) from residence, access to large neighborhood

greenspace is defined as access to > 10 ha of greenspace within a travel distance of 800 m from residence. CI, confidence interval; HCC, hair cortisol concentrations, NHGS, neighborhood greenspace; NO₂, nitrogen dioxide; PM_{2.5}, fine particulate matter with an aerodynamic diameter ≤ 2.5 μm; BC, black carbon. Significant associations and interactions are marked in bold.

Table S5. Associations of residential exposures with hair cortisol concentrations, models additionally adjusted for age, pre-pregnancy BMI, personal and neighborhood SES

2nd trim HCC, models adjusted for season, age, pre-pregnancy BMI and SES (n = 102)		
Exposure (p25 - p75)	p-value	β coefficient (95% CI)
3-month mean PM _{2.5} concentrations (9.68 – 13.41 µg/m ³)	0.215	0.84 (0.63, 1.11)
3-month mean NO ₂ concentrations (18.40 – 28.82 µg/m ³)	0.298	1.14 (0.89, 1.47)
3-month mean BC concentrations (0.84 – 1.40 µg/m ³)	0.643	1.07 (0.81, 1.41)
Distance to major road (131 – 618 m)	0.010	0.76 (0.62, 0.94)
Access to small NHGS	0.051	0.53 (0.29, 1.01)
Access to large NHGS	0.124	0.74 (0.51, 1.09)
3rd trim HCC, models adjusted for season, age, pre-pregnancy BMI and SES (n = 69)		
Exposure (p25 - p75)	p-value	β coefficient (95% CI)
3-month mean PM _{2.5} concentrations (9.47 – 13.33 µg/m ³)	0.211	1.30 (0.86, 1.96)
3-month mean NO ₂ concentrations (19.13 – 29.75 µg/m ³)	0.009	1.65 (1.14, 2.38)
3-month mean BC concentrations (0.89 – 1.50 µg/m ³)	0.016	1.64 (1.10, 2.45)
Distance to major road (105 – 603 m)	0.038	0.72 (0.53, 0.98)
Access to small NHGS	0.091	0.46 (0.19, 1.14)
Access to large NHGS	0.004	0.47 (0.28, 0.77)
Interaction second trimester	p-interaction value	
Distance to major roads * access to large NHGS	0.025	
Interaction third trimester	p-interaction value	
Distance to major roads * access to large NHGS	0.180	

Note: Linear regression models adjusted for season of sampling, maternal age, pre-pregnancy BMI ≥ 25, personal SES (educational attainment) and neighborhood SES (ADI > 16.4%). Estimates (β) are presented with their 95% confidence intervals (95%CI) as a factor increase in hair cortisol concentrations for a factor increase in exposure from the 25th to the 75th percentile (p75/p25). All data is based on the maternal residential address. Major roads include E- or N-roads. Access to small neighborhood greenspace (NHGS) is defined as access to > 0.2 hectares (ha) of greenspace within a travel distance of 400 meters (m) from residence, access to large neighborhood greenspace (NHGS) is defined as access to > 10 ha of greenspace within a travel distance of 800 m from

residence. CI, confidence interval; HCC, hair cortisol concentrations; NHGS, neighborhood greenspace; NO₂, nitrogen dioxide; PM_{2.5}, fine particulate matter with an aerodynamic diameter ≤ 2.5 μm; BC, black carbon, ADI area deprivation index, BMI body mass index. Significant associations and interactions are marked in bold.

Table S6. Associations of residential exposures with hair cortisol concentrations, participants of non-European origin excluded

2nd trimester HCC, model adjusted for season of sampling (n = 102)		
Exposure (p25-p75)	p-value	β coefficient (95% CI)
3-month mean PM _{2.5} concentrations (9.66 – 13.42 µg/m ³)	0.091	0.80 (0.62, 1.04)
3-month mean NO ₂ concentrations (18.12 – 28.11 µg/m ³)	0.919	1.03 (0.81, 1.26)
3-month mean BC concentrations (0.83 – 1.41 µg/m ³)	0.690	0.95 (0.75, 1.21)
Distance to major road (136 – 635 m)	0.009	0.77 (0.64, 0.94)
Access to small NHGS	0.065	0.57 (0.33, 1.04)
Access to large NHGS	0.231	0.80 (0.56, 1.15)
3rd trimester HCC, model adjusted for season of sampling (n = 68)		
Exposure (p25 – p75)	p-value	β coefficient (95% CI)
3-month mean PM _{2.5} concentrations (9.29 – 12.98 µg/m ³)	0.219	1.27 (0.86, 1.87)
3-month mean NO ₂ concentrations (17.89 – 28.11 µg/m ³)	0.020	1.53 (1.07, 2.18)
3-month mean BC concentrations (0.82 – 1.39 µg/m ³)	0.036	1.53 (1.03, 2.27)
Distance to major road (138 – 651m)	0.075	0.76 (0.56, 1.03)
Access to small NHGS	0.083	0.47 (0.20, 1.11)
Access to large NHGS	0.046	0.61 (0.38, 0.99)
Interaction model second trimester	<i>p</i> -interaction value	
Distance to major roads * access to large NHGS	0.036	
Interaction model third trimester	<i>p</i> -interaction value	
Distance to major roads * access to large NHGS	0.145	

Note: Linear regression models adjusted for season of sampling. Estimates (β) are presented with their 95% confidence intervals (95%CI) as a factor increase in hair cortisol concentrations for a factor increase in exposure from the 25th to the 75th percentile (p75/p25). All data is based on the maternal residential address. Major roads include E- or N-roads. Access to small neighborhood greenspace (NHGS) is defined as access to > 0.2 hectares (ha) of greenspace within a travel distance of 400 meters (m) from residence, access to large neighborhood greenspace (NHGS) is defined as access to > 10 ha of greenspace within a travel distance of 800 m from residence. CI, confidence interval; HCC, hair cortisol concentrations; NHGS, neighborhood greenspace; NO₂, nitrogen dioxide; PM_{2.5}, fine particulate matter with an aerodynamic diameter ≤ 2.5 µm; BC, black carbon, ADI area deprivation index, BMI body mass index. Significant associations and interactions are marked in bold.