Supporting Information

Associations of Ambient Particulate Matter with Maternal Thyroid Autoimmunity and Thyroid Function in Early Pregnancy

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65   Table S1. Previous studies of associations of PM with thyroid autoimmunity or thyroid function biomarkers during pregnancy.

author, year	study design	study population	sample size	ambient particulate matters	thyroid hormones	main findings
Janssen et al., 2017[1]	Cohort	Belgium	431	$PM_{2.5}$	FT3; FT4; TSH; FT4/FT3	Third-trimester $PM_{2.5}$ exposure was inversely but not significantly associated with maternal blood FT4 levels collected 1 day after delivery.
Zhao et al., 2019[2]	Cohort	China	8077	$PM_{2.5}$	FT4; TSH; TPOAb; hypothyroxinemia	FT4 levels were significantly inversely associated with $PM_{2.5}$ exposure; $PM_{2.5}$ associated with elevated odds of hypothyroxinemia. The associations of air pollution exposure with FT4 levels were stronger in TPOAb positive women.
Ghassabian et al., 2019[3]	Cohort	Netherlands Spain Greece America	9931	$PM_{2.5}$, $PM_{2.5-10}$, PM_{10}	Hypothyroxinemia; high TSH; TPOAb	Higher exposure to $PM_{2.5}$ was associated with higher odds of hypothyroxinemia; $PM_{2.5}$ was significantly associated with thyroid autoimmunity only in one of the four cohorts
Wang et al., 2019[4]	Cohort	China	433	$PM_{2.5}$, OM, BC, SO_4^{2-}, NO_3^-, and NH_4^+ and soil dust	FT4; TSH; TPOAb	Maternal exposure to $PM_{2.5}$ in the first trimester inversely associated with FT4 but positively associated with TPOAb levels in the second trimester.
Ilias et al., 2020[5]	Case only study	Greece	293	$PM_{2.5}$, PM_{10}	TSH	A dose-response relationship between $PM_{2.5}$ and TSH was shown.

Li et al., 2021[6]	Cohort	China	551	PM$_{2.5}$	FT3; FT4; TSH; FT4/FT3	PM$_{2.5}$ exposure during preconception and the first trimester was significantly associated with decreased maternal FT4 level.
Zhang et al., 2022[7]	Cohort	China	921	PM$_{2.5}$; PM$_{10}$	FT3; FT4; TSH; FT4/FT3	Higher ambient PM$_{2.5}$, not PM$_{10}$, exposed during the first trimester of pregnancy were associated with a significant decrease in maternal serum FT4 concentrations and FT4/FT3 ratio.
Qiu et al., 2022[8]	Cohort	China	2528	PM$_{2.5}$ and its bound metals, PM$_{10}$	FT3; FT4; TSH; TPOAb; TgAb	PM$_{2.5}$ and PM$_{10}$ were associated with decreased FT3 and FT4 concentrations, and TPOAb or TgAb status had no effect modification on the observed associations.
Zhou et al., 2022[9]	Cohort	China	1060	PM$_{2.5}$ and its constituents	FT3; FT4; TSH; FT4/FT3	Early pregnancy PM$_{2.5}$ exposure was positively associated with maternal TSH but negatively associated with FT4 and the FT4/FT3 ratio.

66 PM: particulate matter; FT4, free thyroxine; FT3, free triiodothyronine; TSH, thyroid-stimulating hormone; OM, organic matter; BC, organic matter; SO$_4^{2-}$, sulfate; NO$_3^-$,

67 nitrate; NH$_4^+$, ammonium; TPOAb, thyroid peroxidase antibodies; and TgAb, thyroglobulin antibody.

68 Table S2. Comparison of characteristics among pregnant women who included and excluded in this study.

variables	all participants (n = 20,008)	participants included (n = 15,664)	participants excluded (n = 4344)	P value
age, mean (SD), years	31.81 (3.85)	31.78 (3.82)	31.93 (4.05)	0.315
prepregnancy BMI, mean (SD), kg/m^2	21.83 (3.27)	21.72 (3.17)	22.01 (3.57)	0.061
annual household income, n (%)				0.439
< 200,000 CNY	7334 (36.7)	5683 (36.3)	1651 (38.0)	
≥ 200,000 CNY	12,674 (63.3)	9981 (63.7)	2693 (62.0)	
ethnicity, n (%)				0.762
Han	18,411 (92.0)	14,449 (92.2)	3962 (91.2)	
Minority	1597 (8.0)	1215 (7.8)	382 (8.8)	
educational levels, n (%)				0.884
< 16 years	4408 (22.0)	3448 (22.0)	960 (22.1)	
≥ 16 years	15,600 (78.0)	12,216 (78.0)	3384 (77.9)	
smoking status, n (%)				0.635
Yes	661 (3.3)	492 (3.1)	169 (3.9)	
No	19,347 (96.7)	15,172 (96.9)	4175 (96.1)	
alcohol consumption, n (%)				0.578
Yes	898 (4.5)	720 (4.6)	178 (4.1)	
No	19,110 (95.5)	14,944 (95.4)	4166 (95.9)	
gravidity, n (%)				0.627
1	10,673 (53.3)	8375 (53.5)	2298 (52.9)	
≥2	9335 (46.7)	7289 (46.5)	2046 (47.1)	
season of enrollment, n (%)				< 0.001
spring	5084 (25.4)	4024 (25.7)	1060 (24.4)	

summer	4551 (22.7)	3582 (22.8)	969 (22.3)	
autumn	5017 (25.1)	3883 (24.8)	1134 (26.1)	
winter	5356 (26.8)	4175 (26.7)	1181 (27.2)	
PM_1, median (Quartile), $\mu g/m^3$	33.90 (27.28, 38.84)	33.83 (27.14, 38.55)	33.99 (26.64, 39.30)[1]	0.514
$PM_{2.5}$, median (Quartile), $\mu g/m^3$	45.07 (36.23, 53.17)	45.04 (36.12, 52.75)	45.21 (35.86, 53.41)[1]	0.857

69   [1]Due to 772 participants missing residential address, only 3572 participants included in the analyses. SD, standard difference; BMI, body mass index; CNY, Chinese

70   yuan. PM_1, particulate matter with an aerodynamic diameter less than or equal to 1 μm; and $PM_{2.5}$, particulate matter with an aerodynamic diameter less than or

71   equal to 2.5 μm.

72   Table S3. Likelihood ratio test between nonlinear model and linear model.

outcome variables	air pollutants	AIC of nonlinear model	AIC of linear model	P value
TPOAb positive	PM_1	11008.80	11005.60	0.461
TPOAb positive	$PM_{1-2.5}$	11008.56	11005.13	0.335
TPOAb positive	$PM_{2.5}$	11009.77	11005.37	0.206
FT4	PM_1	64059.25	64081.71	0.000
FT4	$PM_{1-2.5}$	64061.27	64112.96	0.000
FT4	$PM_{2.5}$	64062.91	64137.37	0.000
TSH	PM_1	48821.32	48825.09	0.022
TSH	$PM_{1-2.5}$	48822.54	48825.35	0.028
TSH	$PM_{2.5}$	48822.77	48825.87	0.029

73   Both nonlinear model and linear model were adjusted for maternal age, prepregnancy BMI, annual
74   household income, ethnicity, educational levels, smoking status, alcohol consumption, gravidity,
75   seasons of enrollment, and gestational week. AIC, Akaike information criterion; TPOAb, thyroid
76   peroxidase antibodies; FT4, free thyroxine; TSH, thyroid-stimulating hormone; PM_1, particulate
77   matter with an aerodynamic diameter less than or equal to 1 μm; $PM_{1-2.5}$, particulate matter with
78   an aerodynamic diameter between 1 and 2.5 μm; and $PM_{2.5}$, particulate matter with an
79   aerodynamic diameter less than or equal to 2.5 μm.

80   Table S4. Adjusted associations between PM_1, $PM_{1-2.5}$, $PM_{2.5}$ and thyroid autoimmunity with TPOAb positive, stratified by potential modifiers.

variables	PM_1		$PM_{1-2.5}$		$PM_{2.5}$	
	OR (95% CI)	$P_{interaction}$	OR (95% CI)	$P_{interaction}$	OR (95% CI)	$P_{interaction}$
maternal age		0.874		0.781		0.575
≥ 35 years	1.06 (0.82, 1.29)		1.15 (1.05, 1.25)		1.07 (0.90, 1.24)	
< 35 years	1.05 (0.98, 1.13)		1.15 (1.09, 1.21)		1.06 (1.01, 1.12)	
prepregnancy BMI		0.744		0.581		0.639
≥ 25 kg/m²	1.07 (0.86, 1.24)		1.17 (0.94, 1.38)		1.10 (0.87, 1.33)	
< 25 kg/m²	1.04 (0.96, 1.12)		1.13 (1.07, 1.19)		1.05 (1.00, 1.10)	
education level, years		0.549		0.668		0.894
< 16 years	1.06 (0.85, 1.27)		1.16 (1.01, 1.31)		1.07 (0.88, 1.26)	
≥ 16 years	1.02 (0.92, 1.13)		1.13 (0.99, 1.27)		1.05 (0.97, 1.13)	
annual household income		0.087		< 0.001		0.008
< 200,000 CNY	1.07 (0.90, 1.24)		1.21 (1.09, 1.33)		1.09 (1.03, 1.17)	
≥ 200,000 CNY	1.01 (0.92, 1.11)		1.12 (1.01, 1.23)		1.00 (0.91, 1.09)	
gravidity		0.119		0.768		0.855
1	1.07 (0.95, 1.18)		1.18 (1.05, 1.31)		1.06 (0.99, 1.12)	
≥2	0.99 (0.87, 1.09)		1.14 (1.01, 1.27)		1.05 (0.98, 1.12)	

81   All models were adjusted for the maternal age, prepregnancy BMI, annual household income, ethnicity, educational levels, smoking status, alcohol consumption,
82   gravidity, seasons of enrollment, and gestational week, unless the one used as a modifier. PM_1, particulate matter with an aerodynamic diameter less than or equal
83   to 1 μm; $PM_{1-2.5}$, particulate matter with an aerodynamic diameter between 1 and 2.5 μm; $PM_{2.5}$, particulate matter with an aerodynamic diameter less than or
84   equal to 2.5 μm; BMI, body mass index; and CNY, Chinese Yuan.

Table S5. Estimated changes and 95% CIs of thyroid function biomarkers at 50th, 75th, and 95th percentiles of PM exposure against the minimal percentile of PM in natural cubic splines.

	Min[1]	50th, [2]	75th, [3]	95th, [4]
FT4 (pmol/L)				
PM_1	Ref	-0.42 (-0.79, 0.04)	-0.57 (-0.97, -0.18)	-0.90 (-1.29, -0.51)
$PM_{1\text{-}2.5}$	Ref	-1.31 (-1.69, -0.98)	-0.95 (-1.29, -0.61)	-0.73 (-1.09, -0.37)
$PM_{2.5}$	Ref	-0.77 (-1.05, -0.49)	-0.76 (-1.05, -0.48)	-0.86 (-1.15, -0.57)
TSH (mIU/L)				
PM_1	Ref	0.22 (-0.01, 0.45)	0.17 (-0.07, 0.41)	0.20 (-0.04, 0.44)
$PM_{1\text{-}2.5}$	Ref	0.13 (-0.06, 0.32)	0.16 (-0.04, 0.36)	0.15 (-0.02, 0.32)
$PM_{2.5}$	Ref	0.26 (0.09, 0.43)	0.30 (0.13, 0.48)	0.30 (0.12, 0.48)

All models were adjusted for the maternal age, prepregnancy BMI, annual household income, ethnicity, educational levels, smoking status, alcohol consumption, gravidity, seasons of enrollment, and weeks of gestation. PM_1, particulate matter with an aerodynamic diameter less than or equal to 1 µm; $PM_{1\text{-}2.5}$, particulate matter with an aerodynamic diameter between 1 and 2.5 µm; $PM_{2.5}$, particulate matter with an aerodynamic diameter less than or equal to 2.5 µm; Min, minimum; Ref, reference; FT4, free thyroxine; and TSH, thyroid-stimulating hormone.

[1] The minimum of PM_1, $PM_{1\text{-}2.5}$ and $PM_{2.5}$ are 6.92 µg/m^3, 0.02 µg/m^3 and 9.64 µg/m^3 respectively.

[2] The 50th percentile of PM_1, $PM_{1\text{-}2.5}$ and $PM_{2.5}$ are 33.83 µg/m^3, 13.26 µg/m^3 and 45.04 µg/m^3 respectively.

[3] The 75th percentile of PM_1, $PM_{1\text{-}2.5}$ and $PM_{2.5}$ are 38.55 µg/m^3, 19.23 µg/m^3 and 52.75 µg/m^3 respectively.

[4] The 95th percentile of PM_1, $PM_{1\text{-}2.5}$ and $PM_{2.5}$ are 42.53 µg/m^3, 23.46 µg/m^3 and 58.31 µg/m^3 respectively.

100 Table S6. Association between PM$_1$ exposure and FT4, stratified by potential modifiers.

air pollution	50th		75th		95th	
	β (95% CI)	$P_{interaction}$	β (95% CI)	$P_{interaction}$	β (95% CI)	$P_{interaction}$
age		0.405		0.453		0.510
≥ 35 years	-0.09 (-0.96, 0.78)		-0.26 (-1.18, 0.66)		-0.63 (-1.53, 0.28)	
< 35 years	-0.50 (-0.91, -0.08)		-0.65 (-1.08, -0.22)		-0.96 (-1.39, -0.54)	
prepregnancy BMI		0.453		0.467		0.365
≥ 25 kg/m^2	-0.77 (-1.74, 0.19)		-0.93 (-1.94, 0.07)		-1.35 (-2.35, -0.35)	
< 25 kg/m^2	-0.37 (-0.78, 0.03)		-0.53 (-0.95, -0.10)		-0.85 (-1.27, -0.43)	
education level		0.950		0.897		0.715
< 16 years	-0.42 (-0.83, 0.00)		-0.58 (-1.02, -0.14)		-0.94 (-1.37, -0.50)	
≥ 16 years	-0.39 (-1.22, 0.45)		-0.51 (-1.38, 0.35)		-0.76 (-1.62, 0.11)	
annual household income		0.022		0.011		0.029
< 200,000 CNY	-1.05 (-1.71, -0.39)		-1.29 (-1.98, -0.61)		-1.53 (-2.22, -0.85)	
≥ 200,000 CNY	-0.11 (-0.56, 0.33)		-0.22 (-0.69, 0.25)		-0.61 (-1.08, -0.14)	
gravidity		0.722		0.838		0.995
1	-0.35 (-0.88, 0.19)		-0.52 (-1.09, 0.04)		-0.90 (-1.45, -0.34)	
≥2	-0.48 (-1.00, 0.03)		-0.60 (-1.14, -0.07)		-0.90 (-1.44, -0.36)	
TPOAb status		0.699		0.763		0.775
negative	-0.56 (-0.98, -0.13)		-0.88 (-1.30, -0.47)		-0.87 (-1.38, -0.36)	
positive	-0.73 (-1.76, 0.31)		-1.05 (-2.07, -0.02)		-1.16 (-1.89, -0.43)	

101 The model was adjusted for the maternal age, prepregnancy BMI, annual household income, ethnicity, educational levels, smoking status, alcohol consumption,
102 gravidity, seasons of enrollment, and weeks of gestation, unless the one used as a modifier. PM$_1$, particulate matter with an aerodynamic diameter less than or equal
103 to 1 μm; BMI, body mass index; CNY, Chinese Yuan; and TPOAb, thyroid peroxidase antibodies. The reference of PM$_1$ exposure is 6.92 μg/m^3. The 50th, 75th and 95th
104 percentile of PM$_1$ exposure is 33.83 μg/m^3, 38.55 μg/m^3 and 42.53 μg/m^3.

105 Table S7. Association between $PM_{1-2.5}$ exposure and FT4, stratified by potential modifiers.

air pollution	50th		75th		95th	
	β(95% CI)	$P_{interaction}$	β(95% CI)	$P_{interaction}$	β(95% CI)	$P_{interaction}$
age		0.897		0.472		0.309
≥ 35 years	-1.30 (-1.93, -0.67)		-0.98 (-1.68, -0.28)		-0.65 (-1.37, 0.07)	
< 35 years	-1.32 (-2.01, -0.63)		-0.90 (-1.60, -0.21)		-0.79 (-1.51, -0.06)	
prepregnancy BMI		0.573		0.359		0.792
≥ 25 kg/m²	-1.33 (-2.05, -0.61)		-0.61 (-1.41, 0.19)		-0.71 (-1.42, 0.01)	
< 25 kg/m²	-1.28 (-2.03, -0.53)		-0.79 (-1.10, -0.49)		-0.76 (-1.47, -0.05)	
education level		0.398		0.426		0.501
< 16 years	-1.32 (-1.91, -0.73)		-1.03 (-1.72, -0.34)		-0.77 (-1.47, -0.07)	
≥ 16 years	-0.99 (-1.85, -0.13)		-0.92 (-1.60, -0.24)		-0.63 (-1.33, 0.07)	
annual household income		< 0.001		< 0.001		< 0.001
< 200,000 CNY	-1.46 (-2.18, -0.74)		-1.11 (-1.76, -0.46)		-1.04 (-1.74, -0.37)	
≥ 200,000 CNY	-0.95 (-1.69, -0.21)		-0.77 (-1.47, -0.07)		-0.55 (-1.26, -0.16)	
gravidity		0.591		0.678		0.826
1	-1.37 (-2.07, -0.67)		-0.96 (-1.65, -0.27)		-0.73 (-1.45, -0.01)	
≥2	-1.25 (-1.95, -0.55)		-0.92 (-1.61, -0.23)		-0.75 (-1.56, 0.06)	
TPOAb status		0.322		0.514		0.317
negative	-1.24 (-1.96, -0.52)		-0.86 (-1.56, -0.16)		-0.69 (-1.39, 0.01)	
positive	-1.41 (-2.13, -0.69)		-1.03 (-1.73, -0.33)		-0.81 (-1.51, -0.11)	

106 The model was adjusted for the maternal age, prepregnancy BMI, annual household income, ethnicity, educational levels, smoking status, alcohol consumption,
107 gravidity, seasons of enrollment, and weeks of gestation, unless the one used as a modifier. $PM_{1-2.5}$, particulate matter with an aerodynamic diameter between 1 and
108 2.5 μm; BMI, body mass index; CNY, Chinese Yuan; and TPOAb, thyroid peroxidase antibodies. The reference of $PM_{1-2.5}$ exposure is 0.02 μg/m³. The 50th, 75th and
109 95th percentile of $PM_{1-2.5}$ exposure is 13.26 μg/m³, 19.23 μg/m³ and 23.46 μg/m³.

Table S8. Association between PM$_{2.5}$ exposure and FT4, stratified by potential modifiers.

air pollution	50th β (95% CI)	50th $P_{interaction}$	75th β (95% CI)	75th $P_{interaction}$	95th β (95% CI)	95th $P_{interaction}$
age		0.979		0.841		0.974
≥ 35 years	-0.76 (-1.41, -0.11)		-0.70 (-1.38, -0.03)		-0.86 (-1.54, -0.17)	
< 35 years	-0.77 (-1.08, -0.46)		-0.78 (-1.10, -0.46)		-0.87 (-1.19, -0.55)	
prepregnancy BMI		0.952		0.672		0.862
≥ 25 kg/m^2	-0.80 (-1.57, -0.03)		-0.61 (-1.41, 0.19)		-0.81 (-1.61, -0.01)	
< 25 kg/m^2	-0.78 (-1.07, -0.48)		-0.79 (-1.10, -0.49)		-0.89 (-1.20, -0.57)	
education level		0.786		0.796		0.449
< 16 years	-0.78 (-1.10, -0.46)		-0.75 (-1.09, -0.42)		-0.92 (-1.26, -0.59)	
≥ 16 years	-0.69 (-1.25, -0.14)		-0.67 (-1.23, -0.10)		-0.67 (-1.24, -0.09)	
annual household income		0.037		0.023		0.052
< 200,000 CNY	-1.18 (-1.66, -0.69)		-1.19 (-1.68, -0.70)		-1.27 (-1.78, -0.77)	
≥ 200,000 CNY	-0.55 (-0.89, -0.21)		-0.49 (-0.85, -0.14)		-0.66 (-1.02, -0.31)	
gravidity		0.844		0.574		0.905
1	-0.74 (-1.13, -0.34)		-0.65 (-1.06, -0.24)		-0.89 (-1.30, -0.47)	
≥2	-0.79 (-1.19, -0.40)		-0.82 (-1.22, -0.41)		-0.85 (-1.26, -0.44)	
TPOAb status		0.552		0.634		0.424
negative	-0.74 (-1.04, -0.43)		-0.82 (-1.14, -0.51)		-0.74 (-1.04, -0.44)	
positive	-0.94 (-1.73, -0.16)		-1.17 (-1.96, -0.38)		-0.98 (-1.73, -0.23)	

The model was adjusted for the maternal age, prepregnancy BMI, annual household income, ethnicity, educational levels, smoking status, alcohol consumption, gravidity, seasons of enrollment, and weeks of gestation, unless the one used as a modifier. PM$_{2.5}$, particulate matter with an aerodynamic diameter less than or equal to 2.5 μm; BMI, body mass index; CNY, Chinese Yuan; and TPOAb, thyroid peroxidase antibodies. The reference of PM$_{2.5}$ exposure is 9.64 μg/m^3. The 50th, 75th and 95th percentile of PM$_{2.5}$ exposure is 45.04 μg/m^3, 52.75 μg/m^3 and 58.31 μg/m^3.

115   Table S9. Association between PM_1 exposure and TSH, stratified by potential modifiers.

air pollution	50th		75th		95th	
	β (95% CI)	$P_{interaction}$	β (95% CI)	$P_{interaction}$	β (95% CI)	$P_{interaction}$
age		0.815		0.939		0.878
≥ 35 years	0.15 (-0.41, 0.70)		0.15 (-0.39, 0.70)		0.16 (-0.37, 0.68)	
< 35 years	0.17 (-0.10, 0.44)		0.20 (-0.07, 0.46)		0.23 (-0.03, 0.48)	
prepregnancy BMI		0.347		0.386		0.393
≥ 25 kg/m²	0.44 (-0.21, 1.10)		0.46 (-0.19, 1.12)		0.50 (-0.13, 1.13)	
< 25 kg/m²	0.13 (-0.13, 0.39)		0.16 (-0.10, 0.41)		0.18 (-0.07, 0.43)	
education level		0.972		0.991		0.845
< 16 years	0.17 (-0.10, 0.43)		0.21 (-0.05, 0.47)		0.22 (-0.04, 0.47)	
≥ 16 years	0.16 (-0.41, 0.73)		0.15 (-0.42, 0.72)		0.23 (-0.32, 0.78)	
annual household income		0.190		0.146		0.152
< 200,000 CNY	-0.09 (-0.51, 0.34)		-0.06 (-0.48, 0.37)		-0.00 (-0.42, 0.41)	
≥ 200,000 CNY	0.29 (0.01, 0.58)		0.32 (0.03, 0.60)		0.33 (0.05, 0.60)	
gravidity		0.678		0.471		0.531
1	0.26 (-0.09, 0.62)		0.28 (-0.07, 0.62)		0.27 (-0.06, 0.61)	
≥2	0.09 (-0.24, 0.41)		0.12 (-0.20, 0.45)		0.18 (-0.13, 0.49)	
TPOAb status		0.283		0.077		0.116
negative	0.12 (-0.12, 0.36)		0.13 (-0.11, 0.36)		0.08 (-0.16, 0.32)	
positive	0.59 (-0.23, 1.41)		0.87 (0.08, 1.65)		0.77 (-0.06, 1.60)	

116   The model was adjusted for the maternal age, prepregnancy BMI, annual household income, ethnicity, educational levels, smoking status, alcohol consumption,
117   gravidity, seasons of enrollment, and weeks of gestation, unless the one used as a modifier. PM_1, particulate matter with an aerodynamic diameter less than or equal
118   to 1 μm; BMI, body mass index; CNY, Chinese Yuan; and TPOAb, thyroid peroxidase antibodies. The reference of PM_1 exposure is 6.92 μg/m³. The 50th, 75th and 95th
119   percentile of PM_1 exposure is 33.83 μg/m³, 38.55 μg/m³ and 42.53 μg/m³.

120   Table S10. Association between $PM_{1-2.5}$ and TSH, stratified by potential modifiers.

air pollution	50th		75th		95th	
	β(95% CI)	$P_{interaction}$	β(95% CI)	$P_{interaction}$	β(95% CI)	$P_{interaction}$
age		0.752		0.118		0.418
≥ 35 years	0.11 (-0.19, 0.41)		0.22 (-0.11, 0.55)		0.21 (-0.09, 0.54)	
< 35 years	0.16 (-0.15, 0.47)		0.13 (-0.18, 0.44)		0.12 (-0.21, 0.45)	
prepregnancy BMI		0.230		0.185		0.836
≥ 25 kg/m²	0.18 (-0.36, 0.72)		0.14 (-0.38, 0.66)		0.15 (-0.43, 0.73)	
< 25 kg/m²	0.13 (-0.23, 0.49)		0.21 (-0.16, 0.58)		0.19 (-0.20, 0.58)	
education level		0.246		0.665		0.134
< 16 years	0.17 (-0.27, 0.61)		0.18 (-0.26, 0.62)		0.23 (-0.22, 0.68)	
≥ 16 years	0.14 (-0.19, 0.47)		0.15 (-0.19, 0.49)		0.08 (-0.24, 0.40)	
annual household income		0.879		0.893		0.541
< 200,000 CNY	0.15 (-0.19, 0.49)		0.16 (-0.18, 0.51)		0.18 (-0.16, 0.52)	
≥ 200,000 CNY	0.16 (-0.12, 0.44)		0.17 (-0.11, 0.45)		0.14 (-0.18, 0.46)	
gravidity		0.218		0.267		0.166
1	0.21 (-0.16, 0.58)		0.21 (-0.17, 0.59)		0.26 (0.11, 0.60)	
≥2	0.13 (-0.24, 0.49)		0.11 (-0.25, 0.47)		0.14 (-0.22, 0.51)	
TPOAb status		0.173		0.121		0.104
negative	0.03 (-0.49, 0.55)		0.09 (-0.45, 0.63)		0.08 (-0.47, 0.62)	
positive	0.27 (-0.71, 1.25)		0.38 (-0.59, 1.35)		0.63 (-0.34, 1.60)	

121   The model was adjusted for the maternal age, prepregnancy BMI, annual household income, ethnicity, educational levels, smoking status, alcohol consumption,
122   gravidity, seasons of enrollment, and weeks of gestation, unless the one used as a modifier. $PM_{1-2.5}$, particulate matter with an aerodynamic diameter between 1 and 2.5
123   μm; BMI, body mass index; CNY, Chinese Yuan; and TPOAb, thyroid peroxidase antibodies. The reference of $PM_{1-2.5}$ exposure is 0.02 μg/m³. The 50th, 75th and 95th
124   percentile of $PM_{1-2.5}$ exposure is 13.26 μg/m³, 19.23 μg/m³ and 23.46 μg/m³.

125 Table S11. Association between PM$_{2.5}$ and TSH, stratified by potential modifiers.

air pollution	50th		75th		95th	
	β (95% CI)	$P_{interaction}$	β (95% CI)	$P_{interaction}$	β (95% CI)	$P_{interaction}$
age		0.476		0.562		0.545
≥ 35 years	0.27 (0.01, 0.60)		0.35 (0.08, 0.72)		0.35 (0.08, 0.73)	
< 35 years	0.19 (-0.13, 0.52)		0.25 (-0.03, 0.59)		0.26 (-0.06, 0.62)	
prepregnancy BMI		0.649		0.805		0.493
≥ 25 kg/m^2	0.24 (-0.33, 0.71)		0.24 (-0.28, 0.77)		0.10 (-0.40, 0.60)	
< 25 kg/m^2	0.19 (0.14, 0.51)		0.31 (0.13, 0.50)		0.29 (0.11, 0.47)	
education level		0.604		0.609		0.692
< 16 years	0.28 (0.07, 0.75)		0.37 (0.11, 0.75)		0.34 (0.09, 0.71)	
≥ 16 years	0.17 (0.01, 0.47)		0.28 (0.08, 0.48)		0.23 (0.04, 0.43)	
annual household income		0.934		0.955		0.960
< 200,000 CNY	0.27 (-0.00, 0.60)		0.31 (-0.00, 0.62)		0.25 (-0.05, 0.55)	
≥ 200,000 CNY	0.26 (0.08, 0.51)		0.30 (0.08, 0.51)		0.26 (0.06, 0.47)	
gravidity		0.908		0.961		0.289
1	0.28 (0.06, 0.57)		0.31 (0.06, 0.58)		0.36 (0.11, 0.60)	
≥2	0.24 (0.01, 0.53)		0.30 (0.06, 0.56)		0.17 (-0.06, 0.41)	
TPOAb status		0.252		0.284		0.335
negative	0.25 (0.10, 0.41)		0.23 (0.05, 0.40)		0.28 (0.10, 0.45)	
positive	0.60 (0.13, 1.11)		0.59 (0.01, 1.19)		0.63 (0.01, 1.26)	

126 The model was adjusted for the maternal age, prepregnancy BMI, annual household income, ethnicity, educational levels, smoking status, alcohol consumption,
127 gravidity, seasons of enrollment, and weeks of gestation, unless the one used as a modifier. PM$_{2.5}$, particulate matter with an aerodynamic diameter less than or equal
128 to 2.5 μm; BMI, body mass index; CNY, Chinese Yuan; and TPOAb, thyroid peroxidase antibodies. The reference of PM$_{2.5}$ exposure is 9.64 μg/m^3. The 50th, 75th and
129 95th percentile of PM$_{2.5}$ exposure is 45.04 μg/m^3, 52.75 μg/m^3 and 58.31 μg/m^3.

130   Table S12. The interaction between PM_1 and $PM_{1-2.5}$ in TPOAb positive.

	$PM_{1-2.5} < 50^{th}$ (n = 7832)	$PM_{1-2.5} \geq 50^{th}$ (n = 7832)	$P_{interaction}$
	OR (95%CI)	OR (95%CI)	
PM_1	1.05 (0.94, 1.16)	1.06 (0.94, 1.17)	0.969

131   The model was adjusted for the maternal age, prepregnancy BMI, annual household income,
132   ethnicity, educational levels, smoking status, alcohol consumption, gravidity, seasons of enrollment,
133   and weeks of gestation. PM_1, particulate matter with an aerodynamic diameter less than or equal
134   to 1 μm; $PM_{1-2.5}$, particulate matter with an aerodynamic diameter between 1 and 2.5 μm; and
135   BMI, body mass index. The 50th of $PM_{1-2.5}$ exposure is 13.26 μg/m³.

136   Table S13. The interaction between PM_1 and $PM_{1-2.5}$ in maternal FT4.

PM_1	$PM_{1-2.5} < 50^{th}$ (n = 7832)	$PM_{1-2.5} \geq 50^{th}$ (n = 7832)	$P_{interaction}$
	β (95%CI)	β (95%CI)	
50th	-0.36 (-0.92, 0.20)	-0.37 (-0.93, 0.19)	0.891
75th	-0.76 (-1.98, 0.46)	-0.79 (-1.35, -0.23)	0.773
95th	-	-0.81 (-1.36, -0.26)	-

137   The model was adjusted for the maternal age, prepregnancy BMI, annual household income,
138   ethnicity, educational levels, smoking status, alcohol consumption, gravidity, seasons of enrollment,
139   and weeks of gestation. PM_1, particulate matter with an aerodynamic diameter less than or equal to
140   1 μm; $PM_{1-2.5}$, particulate matter with an aerodynamic diameter between 1 and 2.5 μm; and BMI,
141   body mass index. The 50th of $PM_{1-2.5}$ exposure is 13.26 μg/m^3. The 50th, 75th and 95th percentile of
142   PM_1 exposure is 33.83 μg/m^3, 38.55 μg/m^3 and 42.53 μg/m^3.

143   Table S14. The interaction between PM_1 and $PM_{1-2.5}$ in maternal TSH.

PM_1	$PM_{1-2.5} < 50^{th}$ (n = 7832)	$PM_{1-2.5} \geq 50^{th}$ (n = 7832)	$P_{interaction}$
	β (95%CI)	β (95%CI)	
50th	0.13 (-0.11, 0.37)	0.13 (-0.13, 0.39)	0.912
75th	0.33 (-1.25, 1.91)	0.35(-0.06, 0.76)	0.852
95th	-	0.32 (-0.06, 0.81)	-

144   The model was adjusted for the maternal age, prepregnancy BMI, annual household income,
145   ethnicity, educational levels, smoking status, alcohol consumption, gravidity, seasons of enrollment,
146   and weeks of gestation. PM_1, particulate matter with an aerodynamic diameter less than or equal to
147   1 μm; $PM_{1-2.5}$, particulate matter with an aerodynamic diameter between 1 and 2.5 μm; and BMI,
148   body mass index. The 50th of $PM_{1-2.5}$ exposure is 13.26 μg/m^3. The 50th, 75th and 95th percentile of
149   PM_1 exposure is 33.83 μg/m^3, 38.55 μg/m^3 and 42.53 μg/m^3.
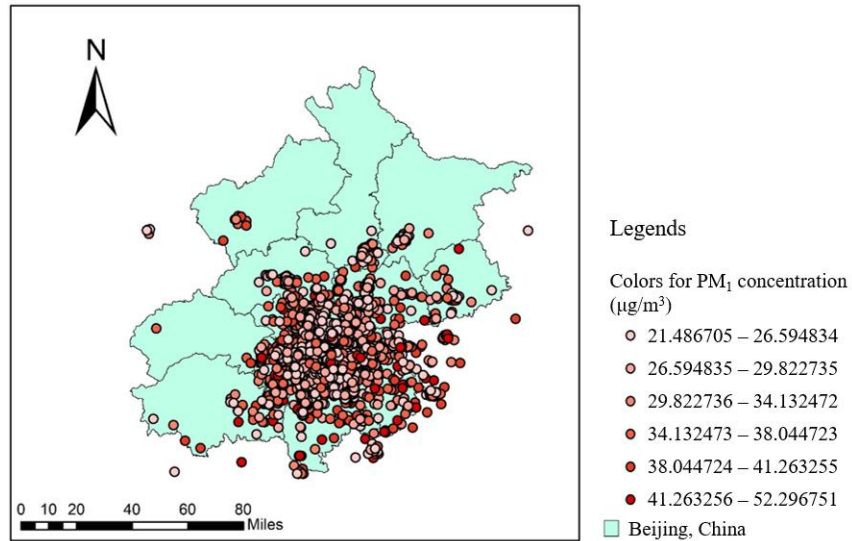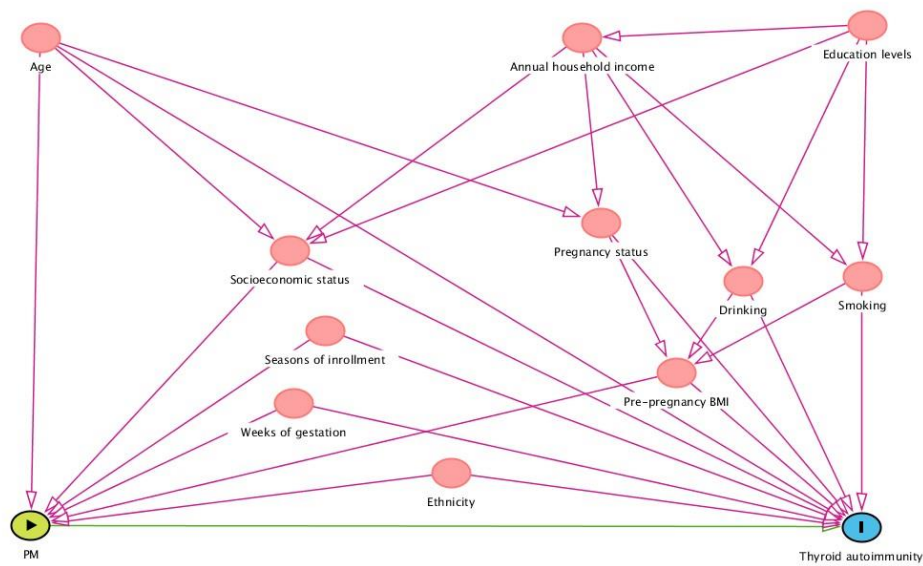
150

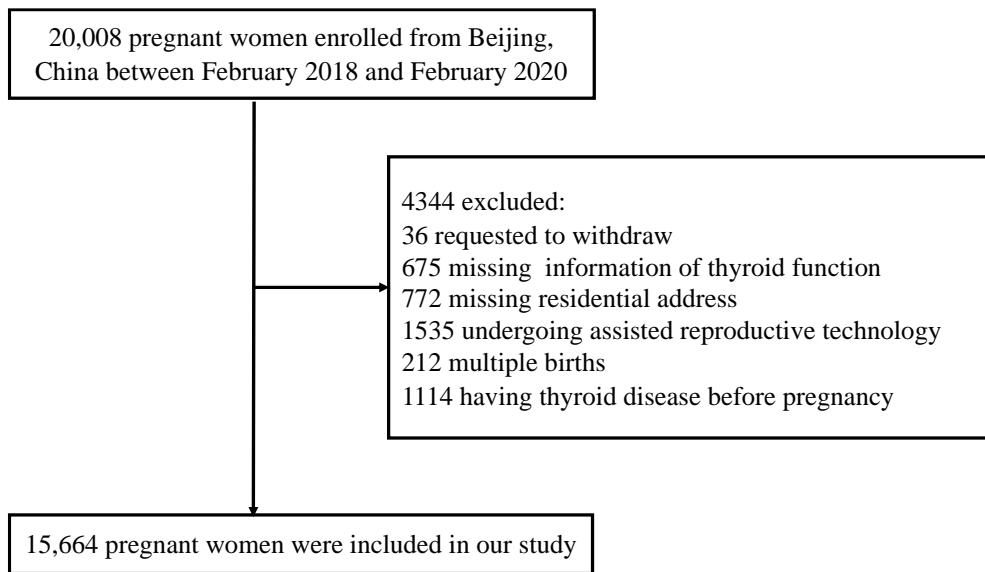151   Figure S1. Location of study populations and PM$_1$ concentrations, 2018-2020.
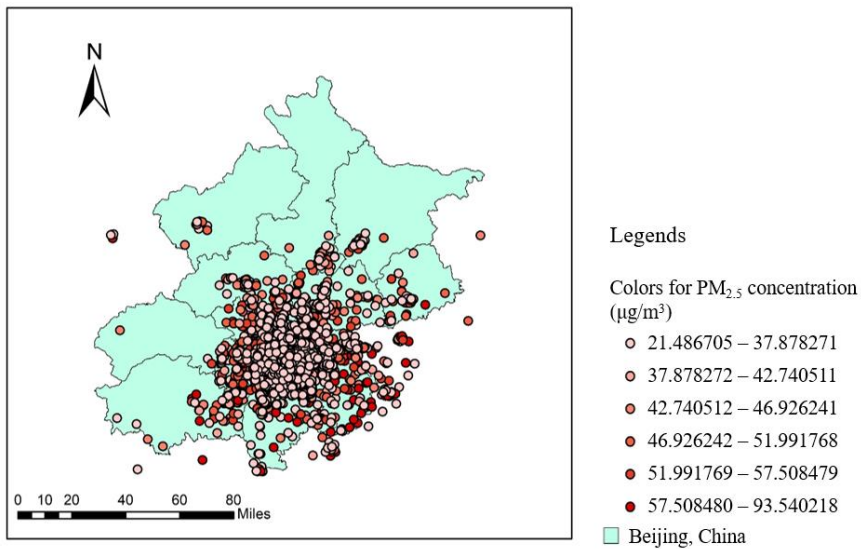
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153   Figure S2. Location of study populations and PM$_{2.5}$ concentrations, 2018-2020.

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Figure S3. Directed acyclic graph (DAG) for the association between PM exposure and thyroid autoimmunity during pregnancy using DAGitty (http://dagitty.net/).

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Figure S4. Flowchart of study enrolment, with the participants selected from Beijing Obstetrics and Gynecology Hospital during February 2018 and February 2020 (n = 15,664).

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