

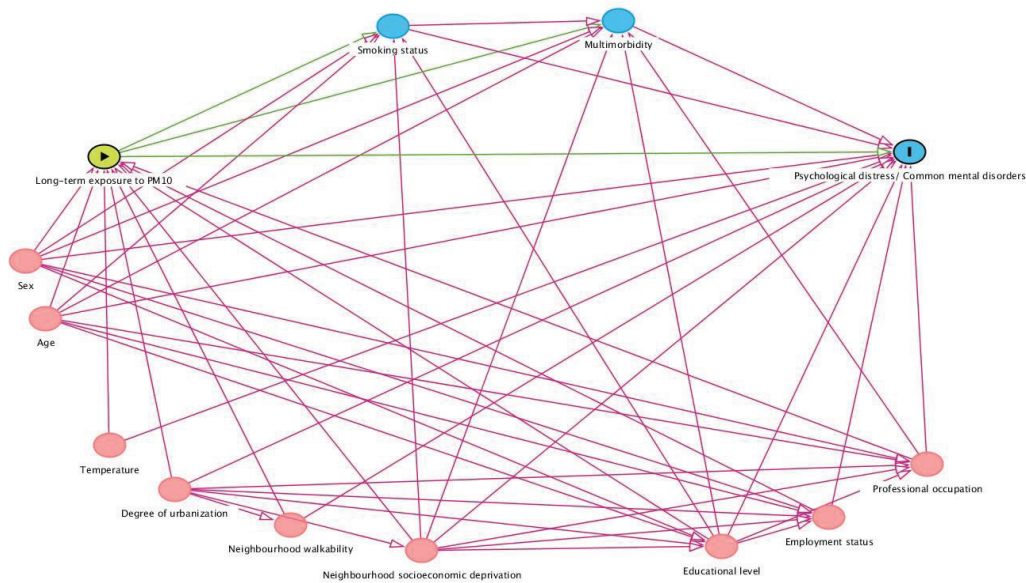
Appendix 1

MH-5 score is based on the following five questions:*

How much of the time in the previous 4 weeks:

- Have you been a very nervous person?
- Have you felt so down in the dumps that nothing could cheer you up?
- Have you felt calm and peaceful?
- Have you felt downhearted and blue?
- Have you been a happy person?

Supplementary Figure 1. Items of the 5-item Mental Health Inventory



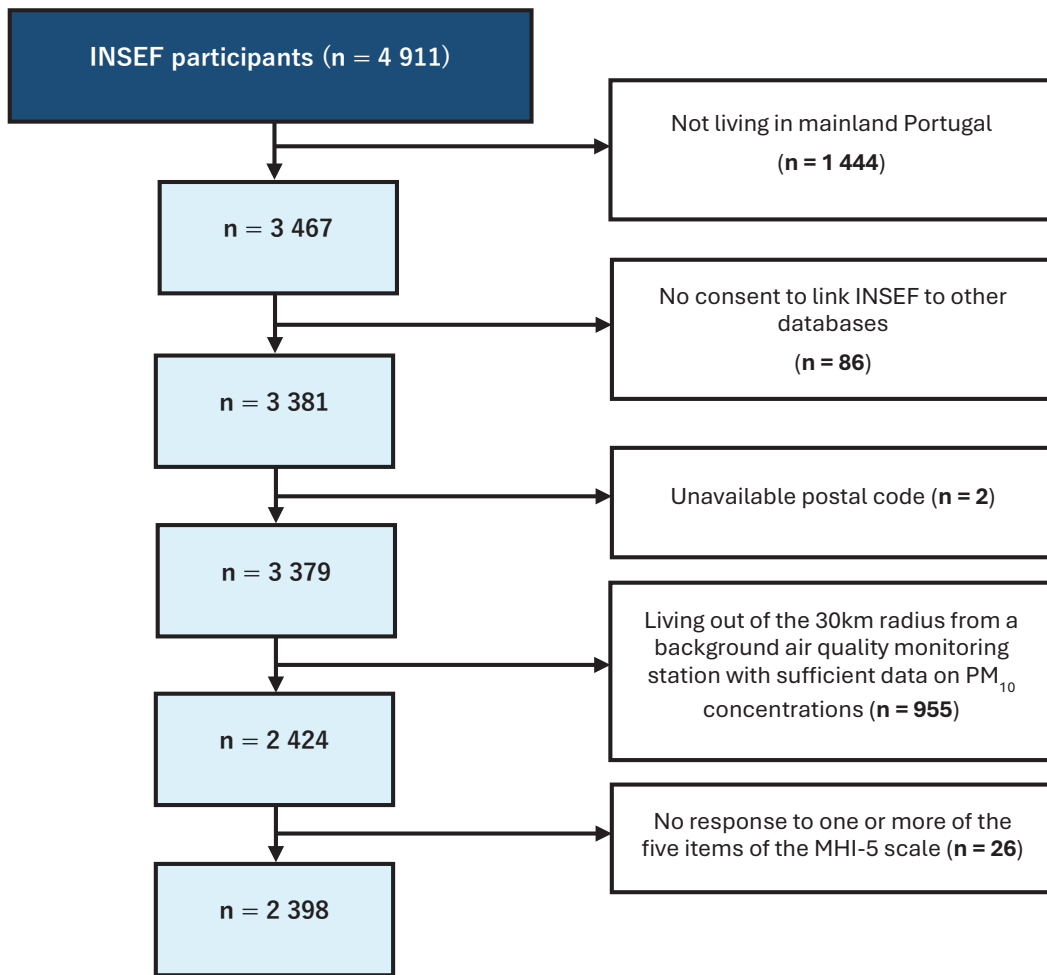
Supplementary Figure 2. Directed acyclic graph for the association between long-term exposure to PM₁₀ and psychological distress or common mental disorders

PM₁₀ - particulate matter with an aerodynamic diameter less than or equal to 10 micrometers.

“Long-term exposure to PM₁₀” represents the exposure, “Psychological distress/Common mental disorders” represents the outcomes. For the other covariates, blue colour (without an interior mark) indicates covariates that lie in the casual path between exposure and outcomes and thus not needed to adjust for in the analyses of this study, red colour represents covariates with confounding potential.

Previous studies were used to define the relationships between the variables presented. ^{19, 23, 29-31, 39}

(please, use colors)



Supplementary Figure 3 –Selection flow diagram for the individuals in study

PM10 - particulate matter with an aerodynamic diameter less than or equal to 10 micrometers. INSEF – First Portuguese National Health Survey with Physical Examination. MHI-5 - 5-item Mental Health Inventory.

Supplementary Table 1 – Comparison of the characteristics between the included and the excluded INSEF participants

	All (n=4 911)		Included (n=2 398)		Excluded (n=2 513)		p- value/95%C I [§]
Exposure							
Individual allocated 1-year average PM10* (µg/m³) – median (IQR)	18.5	(15.3,19.3)	18.6	(15.3,19.3)	18.5	(16.7,19.1)	(-0.345, 0.178)
Covariates							
Sex - %							0.805
Female	52.5		52.6		52.0		
Male	47.5		47.4		48.0		
Age group - %							0.245
25-34 years	18.3		18.9		16.3		
35-49 years	34.4		34.1		35.6		
50-64 years	31.4		31.5		30.7		
65-74 years	15.9		15.5		17.4		
Education level* - %							0.024
Low ^a	27.7		26.5		32.2		
Medium ^b	52.9		53.5		50.5		
High ^c	19.4		20.0		17.3		
Employment status* - %							0.441
Employed	61.9		62.3		60.7		
Unemployed	11.3		11.4		10.8		
Other ^d	26.8		26.3		28.5		
Professional occupation* - %							0.236
White-collar ^e	62.2		62.9		59.7		
Blue-collar ^f	37.8		37.1		40.3		
Area-level socioeconomic deprivation terciles* - %							0.512
Low deprivation (T1)	16.9		16.0		20.4		

Moderate deprivation (T2)	33.4	31.6	40.2	
High deprivation (T3)	49.7	52.4	39.4	
Individual allocated 1-year average temperature (°C) – median (IQR)	15.0 (14.5,16.7)	15.0 (14.8,16.7)	14.9 (14.5,16.2)	(-0.440, -0.326)
Area-level walkability terciles* - %				<0.001
Low walkability (T1)	5.3	1.3	20.8	
Moderate walkability (T2)	18.2	18.4	17.6	
High walkability (T3)	76.4	80.3	61.6	
Degree of urbanization- %				0.282
Rural	25.4	28.2	19.2	
Urban	73.6	71.8	80.8	
Outcome variables				
Mental well-being[§] - median (IQR)	72.0 (56.0,84.0)	72.0 (56.0,84.0)	72.0 (56.0,84.0)	(0, 0)
Probable diagnosis of common mental health disorders* - %				0.797
Yes	22.6	22.7	22.1	
No	77.4	77.3	77.9	

INSEF – First Portuguese National Health Survey with Physical Examination. 95%CI - 95% confidence interval. IQR - interquartile range. PM10 - particulate matter with an aerodynamic diameter less than or equal to 10 micrometers. T1 - first tercile. T2 - second tercile. T3 - third tercile. MHI-5 - 5-item Mental Health Inventory. * 2 339 missings in individual allocated 1-year average PM10 and PM10 exposure terciles, 2 missings in area-level socioeconomic deprivation, 2 missings in area-level walkability, 4 missings in education level, 3 missings in employment status, 476 missings in professional occupation, 53 missings in at least one of the 5 items composing the MHI-5 (instrument whose score was categorized in two to obtain the categorical variable "probable diagnosis of common mental health disorders", being a score ≤ 52 indicative of a probable diagnosis).

§ p-values or 95%CI were presented according to the test used to compare proportions (Chi-squared test) or medians (robust confidence intervals for generalized Hodges-Lehmann median differences), respectively. § Assessed through the score on MHI-5, being 0 the absence of mental well-being and 100 the complete mental well-being.

a: Low education: levels 0–2 of ISCED, 2011 (no education, basic 1st cycle).

b: Medium education: levels 3–4 of ISCED, 2011 (basic, secondary, post-secondary).

c: High education: levels 5–8 of ISCED, 2011 (higher education).

d: Other without professional activity: students, retired people, housewives, other.

e: White-collar: managers, professionals, technicians and associate professional, clerical support workers, and services and sales Workers.

f: Blue-collar: skilled agricultural workers, craft and related trades workers, plant and machine operators, and elementary occupations.

All the estimates were weighted to account for different selection probabilities and population distribution.

Supplementary Table 2. Estimates for the characteristics in study in the sensitivity analyses, in the included individuals (n=2 398)

	n	Sample estimates (median/%) [§]	Weighted estimates (95%CI) (median/%) [§]
Individual allocated 1-year average PM₁₀ for a 20-km radius* (µg/m³)	1 855	19.1	18.6 (18.5,18.7)
Self-report of diagnosed common mental health disorder or use of prescribed medication*			
Yes ^a	404	16.9	15.6 (13.4,18.2)
No ^b	1 990	83.1	84.4 (81.8,86.7)

PM10 - particulate matter with an aerodynamic diameter less than or equal to 10 micrometers. 95%CI - 95% confidence interval.

* 4 missings in self-report of diagnosed common mental health disorder or use of prescribed medication.

§ Medians or percentages were presented according to the type of variable being described (numerical or categorical, respectively).

a: Self-report of at least one of the following: medical diagnosis of depression, medical diagnosis of anxiety, use of prescribed medication for depression, use of prescribed medication for anxiety.

b: Without self-report of none of the following: medical diagnosis of depression, medical diagnosis of anxiety, use of prescribed medication for depression, use of prescribed medication for anxiety.

Supplementary Table 3. Sensitivity analysis for the exposure in a 20-km radius (n= 1 855) - estimation of percent changes

	n	% change* (95%CI)	
All included individuals			
Crude model	1 855	6	(-4,17)
Adjusted model 1 ^a	1 855	6	(-3,16)
Adjusted model 2 ^b	1 721	4	(-5,14)
Adjusted model 3 ^c	1 721	3	(-7,12)
Adjusted model 4 ^d	1 721	0	(-11,11)

95%CI - 95% confidence interval.

* Percent change was computed through the formula $100 \times (\exp(\text{regression coefficient}) - 1) \times 10$, per 10 $\mu\text{g}/\text{m}^3$ increment in annual average PM_{10} concentrations, having the coefficients been computed through linear regression models with the link function "log".

a: Adjusted for sex, and age group.

b: Adjusted for sex, age group, education level, employment status, and professional occupation.

c: Adjusted for sex, age group, education level, employment status, and professional occupation, and area-level socioeconomic deprivation terciles.

d: Adjusted for sex, age group, education level, employment status, professional occupation, area-level socioeconomic deprivation terciles, individual allocated 1-year average temperature, area-level walkability terciles, degree of urbanization.

ALL THE ESTIMATES WERE WEIGHTED TO ACCOUNT FOR DIFFERENT SELECTION PROBABILITIES AND POPULATION DISTRIBUTION.

Supplementary Table 4. Sensitivity analysis for the exposure in a 20-km radius (n= 1 855) - estimation of prevalence ratios

	n	PR (95%CI)	
All included individuals			
Crude model	1 855	0.966	(0.907,1.029)
Adjusted model 1 ^a	1 855	0.965	(0.910,1.023)
Adjusted model 2 ^b	1 721	0.976	(0.915,1.040)
Adjusted model 3 ^c	1 721	0.989	(0.926,1.058)
Adjusted model 4 ^d	1 721	1.008	(0.934,1.088)

PR - prevalence ratio. 95%CI - 95% confidence interval.

a: Adjusted for sex, and age group.

b: Adjusted for sex, age group, education level, employment status, and professional occupation.

c: Adjusted for sex, age group, education level, employment status, and professional occupation, and area-level socioeconomic deprivation terciles.

d: Adjusted for sex, age group, education level, employment status, professional occupation, area-level socioeconomic deprivation terciles, individual allocated 1-year average temperature, area-level walkability terciles, degree of urbanization.

All the estimates were weighted to account for different selection probabilities and population distribution.

Supplementary Table 5. Sensitivity analysis restricted to the individuals without self-reported common mental health disorder or use of prescribed medicine (n=1 990) - estimation of percent changes

	n	% change*	(95%CI)
All included individuals			
Crude model	1 990	6	(-3,15)
Adjusted model 1 ^a	1 990	6	(-2,14)
Adjusted model 2 ^b	1 841	4	(-3,12)
Adjusted model 3 ^c	1 841	3	(-4,10)
Adjusted model 4 ^d	1 841	0	(-5,5)

95%CI - 95% confidence interval.

* Percent change was computed through the formula $100 \times (\exp(\text{regression coefficient}) - 1) \times 10$, per 10 $\mu\text{g}/\text{m}^3$ increment in annual average PM_{10} concentrations, having the coefficients been computed through linear regression models with the link function "log".

a: Adjusted for sex, and age group.

b: Adjusted for sex, age group, education level, employment status, and professional occupation.

c: Adjusted for sex, age group, education level, employment status, and professional occupation, and area-level socioeconomic deprivation terciles.

d: Adjusted for sex, age group, education level, employment status, professional occupation, area-level socioeconomic deprivation terciles, individual allocated 1-year average temperature, area-level walkability terciles, degree of urbanization.

All the estimates were weighted to account for different selection probabilities and population distribution.

Supplementary Table 6. Sensitivity analysis restricted to the individuals without self-reported common mental health disorder or use of prescribed medicine (n=1 990) - estimation of prevalence ratios

	n	PR (95%CI)
All included individuals		
Crude model	1 990	0.963 (0.912,1.017)
Adjusted model 1 ^a	1 990	0.962 (0.914,1.013)
Adjusted model 2 ^b	1 841	0.974 (0.931,1.020)
Adjusted model 3 ^c	1 841	0.984 (0.951,1.018)
Adjusted model 4 ^d	1 841	0.995 (0.962,1.028)

PR - prevalence ratio. 95%CI - 95% confidence interval.

a: Adjusted for sex, and age group.

b: Adjusted for sex, age group, education level, employment status, and professional occupation.

c: Adjusted for sex, age group, education level, employment status, and professional occupation, and area-level socioeconomic deprivation terciles.

d: Adjusted for sex, age group, education level, employment status, professional occupation, area-level socioeconomic deprivation terciles, individual allocated 1-year average temperature, area-level walkability terciles, degree of urbanization.

All the estimates were weighted to account for different selection probabilities and population distribution.

Supplementary Table 7. Sensitivity analysis restricted to the individuals with self-reported common mental health disorder or use of prescribed medicine (n=404) - estimation of percent changes

	n	% change* (95%CI)	
All included individuals			
Crude model	404	-1	(-14,13)
Adjusted model 1 ^a	404	-2	(-17,13)
Adjusted model 2 ^b	365	-5	(-24,15)
Adjusted model 3 ^c	365	-3	(-20,15)
Adjusted model 4 ^d	365	-4	(-21,13)

95%CI - 95% confidence interval.

* Percent change was computed through the formula $100 \times (\exp(\text{regression coefficient}) - 1) \times 10$, per $10 \mu\text{g}/\text{m}^3$ increment in annual average PM_{10} concentrations, having the coefficients been computed through linear regression models with the link function "log".

a: Adjusted for sex, and age group.

b: Adjusted for sex, age group, education level, employment status, and professional occupation.

c: Adjusted for sex, age group, education level, employment status, and professional occupation, and area-level socioeconomic deprivation terciles.

d: Adjusted for sex, age group, education level, employment status, professional occupation, area-level socioeconomic deprivation terciles, individual allocated 1-year average temperature, area-level walkability terciles, degree of urbanization.

All the estimates were weighted to account for different selection probabilities and population distribution.

Supplementary Table 8. Sensitivity analysis restricted to the individuals with self-reported common mental health disorder or use of prescribed medicine (n=404) - estimation of prevalence ratios

	n	PR (95%CI)
All included individuals		
Crude model	404	0.994 (0.961,1.028)
Adjusted model 1 ^a	404	0.996 (0.956,1.034)
Adjusted model 2 ^b	365	1.004 (0.958,1.054)
Adjusted model 3 ^c	365	1.005 (0.955,1.058)
Adjusted model 4 ^d	365	1.029 (0.973,1.088)

PR - prevalence ratio. 95%CI - 95% confidence interval.

a: Adjusted for sex, and age group.

b: Adjusted for sex, age group, education level, employment status, and professional occupation.

c: Adjusted for sex, age group, education level, employment status, and professional occupation, and area-level socioeconomic deprivation terciles.

d: Adjusted for sex, age group, education level, employment status, professional occupation, area-level socioeconomic deprivation terciles, individual allocated 1-year average temperature, area-level walkability terciles, degree of urbanization.

All the estimates were weighted to account for different selection probabilities and population distribution.

Supplementary Table 9. Sensitivity analysis adjusting for individuals with self-reported common mental health disorder or use of prescribed medicine - estimation of percent changes

	n	% change* (95%CI)	
All included individuals			
Crude model	2 398	5	(-4,14)
Adjusted model 1 ^a	2 398	5	(-4,14)
Adjusted model 2 ^b	2 210	4	(-5,12)
Adjusted model 3 ^c	2 210	3	(-6,11)
Adjusted model 4 ^d	2 210	-2	(-8,4)
Adjusted model 5 ^e	2 206	0	(-6,6)

95%CI - 95% confidence interval.

* Percent change was computed through the formula $100 \times (\exp(\text{regression coefficient}) - 1) \times 10$, per 10 $\mu\text{g}/\text{m}^3$ increment in annual average particulate matter with an aerodynamic diameter less than or equal to 10 micrometers concentrations, having the coefficients been computed through linear regression models with the link function "log".

a: Adjusted for sex, and age group.

b: Adjusted for sex, age group, education level, employment status, and professional occupation.

c: Adjusted for sex, age group, education level, employment status, and professional occupation, and area-level socioeconomic deprivation terciles.

d: Adjusted for sex, age group, education level, employment status, professional occupation, area-level socioeconomic deprivation terciles, individual allocated 1-year average temperature, area-level walkability terciles, degree of urbanization.

e: Adjusted for sex, age group, education level, employment status, professional occupation, area-level socioeconomic deprivation terciles, individual allocated 1-year average temperature, area-level walkability terciles, degree of urbanization and self-report of common mental health disorder or use of prescribed medicine.

All the estimates were weighted to account for different selection probabilities and population distribution.

Supplementary Table 10. Sensitivity analysis adjusting for individuals with self-reported common mental health disorder or use of prescribed medicine - estimation of prevalence ratios

	n	PR (95%CI)
All included individuals		
Crude model	2 398	0.972 (0.927,1.019)
Adjusted model 1 ^a	2 398	0.973 (0.931,1.016)
Adjusted model 2 ^b	2 210	0.982 (0.939,1.028)
Adjusted model 3 ^c	2 210	0.990 (0.951,1.031)
Adjusted model 4 ^d	2 210	1.012 (0.979,1.045)
Adjusted model 5 ^e	2 206	1.003 (0.967,1.040)

PR - prevalence ratio. 95%CI - 95% confidence interval.

a: Adjusted for sex, and age group.

b: Adjusted for sex, age group, education level, employment status, and professional occupation.

c: Adjusted for sex, age group, education level, employment status, and professional occupation, and area-level socioeconomic deprivation terciles.

d: Adjusted for sex, age group, education level, employment status, professional occupation, area-level socioeconomic deprivation terciles, individual allocated 1-year average temperature, area-level walkability terciles, degree of urbanization.

e: Adjusted for sex, age group, education level, employment status, professional occupation, area-level socioeconomic deprivation terciles, individual allocated 1-year average temperature, area-level walkability terciles, degree of urbanization and self-report of common mental health disorder or use of prescribed medicine.

All the estimates were weighted to account for different selection probabilities and population distribution.