

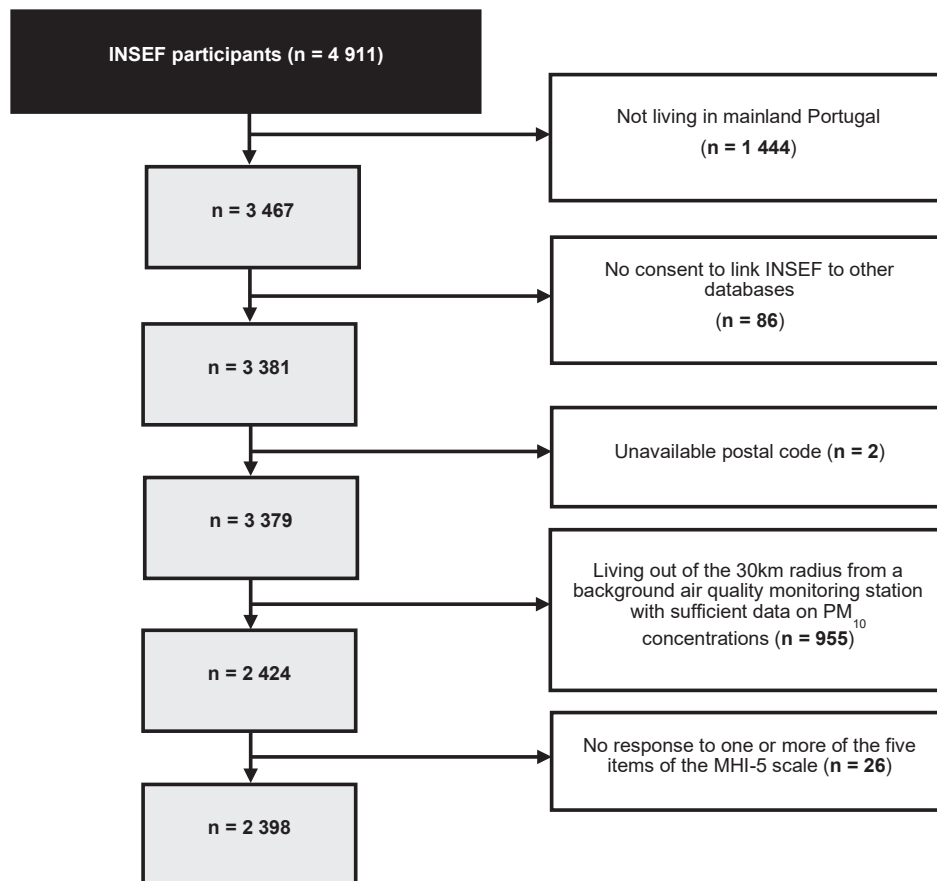
## Appendix 2

### Study 1 details

<b>The 5-item Mental Health Inventory</b>	
<b>How much of the time in the previous 4 weeks:</b>	
1.	Have you been a very nervous person?
2.	Have you felt so down in the dumps that nothing could cheer you up?
3.	Have you felt calm and peaceful?
4.	Have you felt downhearted and blue?
5.	Have you been a happy person?

**Figure 2.1.** Items of the 5-item Mental Health Inventory

Adapted from Theunissen MJ, Jansen M, van Gestel A. Are mental health and binge drinking associated in Dutch adolescents? Cross-sectional public health study. BMC Res Notes. Apr 4 2011;4:100. doi:10.1186/1756-0500-4-100.



**Figure 2.2.** Selection flow diagram for the individuals in study

SOURCE: prepared by the authors based on research data.

PM<sub>10</sub> - particulate matter with an aerodynamic diameter less than or equal to 10 micrometres, INSEF – First Portuguese National Health Survey with Physical Examination, MHI-5 - 5-item Mental Health Inventory.

**Table 2.1.** Study 1 models' specification

	Logistic	Log-binomial	Robust Poisson
<b>Hypothesis in study</b>	Long-term exposure to PM <sub>10</sub> is associated to an increased probable diagnosis of common mental disorders		
<b>Exposure</b>	Long-term exposure to PM <sub>10</sub> (individually allocated 1-year average measured concentrations of PM <sub>10</sub> , in µm/m <sup>3</sup> )		
<b>Other independent variables</b>	Sex (female/male, reference), age (25-34, reference/35-49/50-64/65-74 years), education level (low, reference/medium/high), employment status (employed, reference/unemployed/other), professional occupation (white, reference/blue-collar), area-level socioeconomic deprivation (terciles), individually allocated 1-year average temperature (continuous, in °C), degree of urbanization (urban/rural, reference), area-level walkability (terciles)		
<b>Outcome</b>	Probable diagnosis of common mental disorders (yes, if ≤ 52 in the MHI-5 score/no, if >52)		
<b>Fitted model equation</b>	$\ln\left(\frac{p}{1-p}\right) = b_0 + b_1 \times long - term\ exposure\ to\ PM_{10} + b_2 \times sex\ (female) + b_3 \times age\ (35 - 49) + b_4 \times age\ (50 - 64) + b_5 \times age\ (\geq 65) + b_6 \times education\ level\ (medium) + b_7 \times education\ level\ (high) + b_8 \times employment\ status\ (unemployed) + b_9 \times employment\ status\ (other) + b_{10} \times professional\ occupation\ (blue - collar) + b_{11} \times area - level\ socioeconomic\ deprivation\ (medium) + b_{12} \times area - level\ socioeconomic\ deprivation\ (high) + b_{13} \times temperature + b_{14} \times degree\ of\ urbanization\ (urban) + b_{15} \times area - level\ walkability\ (medium) + b_{16} \times area - level\ walkability\ (high),$ where <i>p</i> is the probability of having a probable diagnosis	Did not converge	$\log(p) = b_0 + b_1 \times long - term\ exposure\ to\ PM_{10} + b_2 \times sex\ (female) + b_3 \times age\ (35 - 49) + b_4 \times age\ (50 - 64) + b_5 \times age\ (\geq 65) + b_6 \times education\ level\ (medium) + b_7 \times education\ level\ (high) + b_8 \times employment\ status\ (unemployed) + b_9 \times employment\ status\ (other) + b_{10} \times professional\ occupation\ (blue - collar) + b_{11} \times area - level\ socioeconomic\ deprivation\ (medium) + b_{12} \times area - level\ socioeconomic\ deprivation\ (high) + b_{13} \times temperature + b_{14} \times degree\ of\ urbanization\ (urban) + b_{15} \times area - level\ walkability\ (medium) + b_{16} \times area - level\ walkability\ (high),$ where <i>p</i> is the probability of having a probable diagnosis

SOURCE: prepared by the authors based on research data.

PM<sub>10</sub> - PARTICULATE MATTER LOWER THAN 10 MICROMETRES, MHI-5 - MENTAL HEALTH INVENTORY 5.

**Table 2.2.** 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%CI <sup>§</sup>
<b>Exposure</b>				
<b>Individual allocated 1-year average PM<sub>10</sub>* (µg/m<sup>3</sup>) – median (IQR)</b>	18.5 (15.3-19.3)	18.6 (15.3-19.3)	18.5 (16.7-19.1)	(-0.345, 0.178)
<b>Independent variables</b>				
<b>Sex - %</b>				0.805

Female	52.5	52.6	52.0	
Male	47.5	47.4	48.0	
<b>Age group - %</b>				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	
<b>Education level* - %</b>				0.024
Low <sup>a</sup>	27.7	26.5	32.2	
Medium <sup>b</sup>	52.9	53.5	50.5	
High <sup>c</sup>	19.4	20.0	17.3	
<b>Employment status* - %</b>				0.441
Employed	61.9	62.3	60.7	
Unemployed	11.3	11.4	10.8	
Other <sup>d</sup>	26.8	26.3	28.5	
<b>Professional occupation* - %</b>				0.236
White-collar <sup>e</sup>	62.2	62.9	59.7	
Blue-collar <sup>f</sup>	37.8	37.1	40.3	
<b>Area-level socioeconomic deprivation terciles* - %</b>				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	
<b>Individual allocated 1-year average temperature (°C) – median (IQR)</b>	15.0 (14.5-16.7)	15.0 (14.8-16.7)	14.9 (14.5-16.2)	(-0.440, -0.326)
<b>Area-level walkability terciles* - %</b>				<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	
<b>Degree of urbanization- %</b>				0.282
Rural	25.4	28.2	19.2	
Urban	73.6	71.8	80.8	
<b>Outcome variables</b>				
<b>Probable diagnosis of common mental health disorders* - %</b>				0.797
Yes	22.6	22.7	22.1	
No	77.4	77.3	77.9	

SOURCE: prepared by the authors based on research data.

INSEF – First Portuguese National Health Survey with Physical Examination, 95%CI - 95% confidence interval. IQR - interquartile range, PM<sub>10</sub> - particulate matter with an aerodynamic diameter less than or equal to 10 micrometres, 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 PM<sub>10</sub> and PM<sub>10</sub> 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. Results in bold are those with statistically significant differences between individuals included and excluded of the study.

a: Less than secondary: levels 0–2 of the International Standard Classification of Education 2011 .

b: Secondary: levels 3–4 of the International Standard Classification of Education 2011 .

c: Professional or higher: levels 5–8 of the International Standard Classification of Education 2011.

d: Other: students, retired, stay-at-home parents, other.

e: White-collar: managers, professionals, technicians and associate professional, clerical support workers, and services and sales workers (according to the International Standard Classification of Occupations).

f: Blue-collar: skilled agricultural workers, craft and related trades workers, plant and machine operators, and elementary occupations (according to the International Standard Classification of Occupations).

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

**Table 2.3.** Estimates for the characteristics in study of the included individuals

	n	Sample estimates (%/median) <sup>§</sup>	Weighted estimates (95%CI) (%/median) <sup>§</sup>
<b>Exposure</b>			
<b>Individual allocated 1-year average PM<sub>10</sub> (µg/m<sup>3</sup>)</b>	2398	19.0	18.6 (18.4-18.7)
<b>Independent variables</b>			
<b>Sex</b>			
Female	1294	54.0	52.6 (50.2-55.1)
Male	1104	46.0	47.4 (44.9-49.9)
<b>Age group</b>			
25-34 years	353	14.7	18.9 (17.2-20.7)
35-49 years	826	34.4	34.1 (32.0-36.4)
50-64 years	827	34.5	31.5 (29.4-33.7)
65-74 years	392	16.4	15.5 (13.9-17.2)
<b>Education level*</b>			
Low <sup>a</sup>	679	28.3	26.5 (24.4-28.7)
Medium <sup>b</sup>	1279	53.4	53.5 (50.2-56.8)
High <sup>c</sup>	439	18.3	20.0 (16.7-23.7)
<b>Employment status*</b>			
Employed	1448	60.4	62.3 (59.4-65.0)
Unemployed	272	11.4	11.4 (9.7-13.4)
Other <sup>d</sup>	677	28.2	26.3 (24.1-28.7)
<b>Professional occupation*</b>			
White-collar <sup>e</sup>	1376	62.3	62.9 (58.5-67.1)
Blue-collar <sup>f</sup>	834	37.7	37.1 (32.9-41.5)
<b>Area-level socioeconomic deprivation terciles</b>			
Low deprivation (T1)	475	19.8	16.0 (10.5-24.5)
Moderate deprivation (T2)	609	25.4	31.6 (19.3-47.2)
High deprivation (T3)	1314	54.8	52.4 (37.8-66.6)
<b>Individual allocated 1-year average temperature (°C)</b>	2398	15.2	15.0 (14.8-15.3)
<b>Area-level walkability terciles</b>			
Low walkability (T1)	84	3.5	1.3 (0.6-2.9)
Moderate walkability (T2)	574	23.9	18.4 (13.5-24.6)
High walkability (T3)	1740	72.6	80.3 (73.2-85.9)

Degree of urbanization				
Rural	702	29.3	28.2	(22.7-34.5)
Urban	1696	70.7	71.8	(65.5-77.3)
Outcomes				
Probable diagnosis of common mental health disorders				
Yes	555	23.1	22.7	(20.0-25.6)
No	1843	76.9	77.3	(74.4-80.0)

SOURCE: prepared by the authors based on research data.

95%CI - 95% confidence intervals, PM<sub>10</sub> - particulate matter with an aerodynamic diameter less than or equal to 10 micrometres, T1 - first tercile, T2 - second tercile, T3 - third tercile.

\*1 missing in education level, 1 missing in employment status, 188 missings in professional occupation.

\$ percentages or medians were presented according to the type of variable being described (categorical or continuous, respectively).

a: Less than secondary: levels 0–2 of the International Standard Classification of Education 2011 .

b: Secondary: levels 3–4 of the International Standard Classification of Education 2011 .

c: Professional or higher: levels 5–8 of the International Standard Classification of Education 2011.

d: Other: students, retired, stay-at-home parents, other.

e: White-collar: managers, professionals, technicians and associate professional, clerical support workers, and services and sales workers (according to the International Standard Classification of Occupations).

f: Blue-collar: skilled agricultural workers, craft and related trades workers, plant and machine operators, and elementary occupations (according to the International Standard Classification of Occupations).

**Table 2.4.** Characteristics of the included individuals (n=2 398) and comparison between groups of probable diagnosis of common mental health disorders

	Total (n=2 398)	Probable diagnosis of CMD (n=555)	Without probable diagnosis of CMD (n=1 843)	p-value/ 95%CI <sup>s</sup>
<b>Individual allocated 1-year average PM<sub>10</sub> (µg/m<sup>3</sup>) – median (IQR)</b>	18.6 (15.3-19.3)	18. (15.2-19.2)	18. (15.3-19.3)	<b>(0.012, 0.423)</b>
<b>Sex - %</b>				<b>&lt;0.001</b>
Female	52.6	70.4	47.4	
Male	47.4	29.6	52.6	
<b>Age group - %</b>				0.072
25-34 years	18.9	14.3	20.2	
35-49 years	34.1	31.1	35.0	
50-64 years	31.5	37.3	29.9	
65-74 years	15.5	17.3	14.9	
<b>Education level* - %</b>				<b>&lt;0.001</b>
Low <sup>a</sup>	26.5	33.2	24.5	
Medium <sup>b</sup>	53.5	53.2	53.6	
High <sup>c</sup>	20.0	13.6	21.9	
<b>Employment status* - %</b>				<b>&lt;0.001</b>
Employed	62.3	51.5	65.4	
Unemployed	11.4	14.3	10.6	
Other <sup>d</sup>	26.3	34.2	24.0	
<b>Professional occupation* - %</b>				0.071

White-collar <sup>e</sup>	62.9	58.1	64.2		
Blue-collar <sup>f</sup>	37.1	41.9	35.8		
<b>Area-level socioeconomic deprivation terciles - %</b>				<b>0.087</b>	
Low deprivation (T1)	16.0	16.4	15.9		
Moderate deprivation (T2)	31.6	36.0	30.3		
High deprivation (T3)	52.4	47.6	53.8		
<b>Individual allocated 1-year average temperature (°C) – median (IQR)</b>	15.0	(14.8-16.7)	14.9	(14.6-16.7)	<b>15.2</b>
<b>Area-level walkability terciles - %</b>				<b>0.489</b>	
Low walkability (T1)	1.3	1.5	1.3		
Moderate walkability (T2)	18.4	20.6	17.7		
High walkability (T3)	80.3	77.9	81.0		
<b>Degree of urbanization - %</b>				<b>0.051</b>	
Rural	28.2	33.0	26.9		
Urban	71.8	67.0	73.1		

SOURCE: prepared by the authors based on research data.

CMD - common mental health disorders, 95%CI - 95% confidence interval, PM<sub>10</sub> - particulate matter with an aerodynamic diameter less than or equal to 10 micrometres, T1 - first tercile, T2 - second tercile, T3 - third tercile.

\*1 missing in education level, 1 missing in employment status, 188 missings in professional occupation.

\$ 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. Results in bold are those with statistically significant differences between individuals with and without probable diagnosis of CMD.

a: Less than secondary: levels 0–2 of the International Standard Classification of Education 2011 .

b: Secondary: levels 3–4 of the International Standard Classification of Education 2011 .

c: Professional or higher: levels 5–8 of the International Standard Classification of Education 2011 .

d: Other: students, retired, stay-at-home parents, other.

e: White-collar: managers, professionals, technicians and associate professional, clerical support workers, and services and sales workers (according to the International Standard Classification of Occupations).

f: Blue-collar: skilled agricultural workers, craft and related trades workers, plant and machine operators, and elementary occupations (according to the International Standard Classification of Occupations).

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