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Supplemental Material

Ambient Air Pollution in Relation to SARS-CoV-2 Infection, Antibody Response, and COVID-19 Disease: A Cohort Study in Catalonia, Spain (COVICAT Study)

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Table S1. Distribution of air pollution concentrations (2018-2019 average) at residence in participants (N=9,605) vs non-participants (N=7,295), CoviCat cohort members with valid residences in 2018-2019.

	Participants		
µg/m³	Mean (sd)	GM (95% CI)	p25-p75
NO_2	34.14 (9.16)	32.55 (32.33,32.77)	28.69-40.31
$PM_{2.5}$	16.25 (1.48)	16.18 (16.15,16.21)	15.43-17.29
BC	1.82 (0.39)	1.77 (1.76,1.78)	1.62-2.06
O_3	65.00 (6.95)	64.65 (64.52,64.79)	60.63-68.19
	Non-participants		
µg/m³	Mean (sd)	GM (95% CI)	p25-p75
NO2	33.82 (9.33)	32.14 (31.88,32.40)	27.43-40.41
PM2.5	16.17 (1.50)	16.09 (16.06,16.13)	15.25-17.26
BC	1.80 (0.38)	1.75 (1.74,1.76)	1.61-2.04
O3	65.56 (7.16)	65.19 (65.03,65.35)	60.90-69.70

Table S2. Characteristics of the COVICAT study population by COVID-19 case status (N=9605)

	COVID-19 Case No N(%)	COVID-19 Case Yes N(%)	P value
	N=9124	N=481	
Current age (years); mean (SD)	55.4 (7.9)	53.5 (6.9)	<0.001
Gender			
Male	3785 (41.5)	164 (34.1)	
Female	5339 (58.5)	317 (65.9)	0.001
Type of survey			
Online	8586 (94.1)	463 (96.3)	
Telephone	538 (5.9)	18 (3.7)	0.049
Quintiles of deprivation index			
1 Least deprived	1828 (20.0)	97 (20.2)	
2	1829 (20.0)	88 (18.3)	
3	1829 (20.0)	92 (19.1)	
4	1823 (20.0)	103 (21.4)	
5 Most deprived	1815 (19.9)	101 (21)	0.800
Educational level			
Less than primary	132 (1.4)	5 (1.0)	
Primary	975 (10.7)	38 (7.9)	
Secondary	3787 (41.5)	214 (44.5)	
University	4230 (46.4)	224 (46.6)	0.181
Baseline smoking status (before lockdown)			
Never smoker	3770 (41.4)	224 (46.6)	
Ex-smoker	3851 (42.3)	198 (41.2)	
Smoker	1489 (16.3)	59 (12.3)	0.020
n missing	*14*	*0*	
Physical Activity, according to IPAQ categories			
Low	1623 (18.8)	89 (20.0)	
Moderate	3903 (45.1)	207 (46.4)	
High	3130 (36.2)	150 (33.6)	0.537
n missing	*468*	*35*	
Any chronic disease			
No	6046 (66.3)	292 (60.7)	
Yes	3078 (33.7)	189 (39.3)	0.012
Respiratory, cardiometabolic, kidney and immune related chronic disease			
No	7508 (82.3)	372 (77.3)	
Yes	1616 (17.7)	109 (22.7)	0.006
BMI before lockdown; mean (SD)	26.2 (4.2)	26.9 (4.6)	0.001
n missing	*18*	*1*	
Obesity before lockdown			
BMI<30	7589 (83.3)	366 (76.3)	
BMI≥30	1517 (16.7)	114 (23.8)	<0.001
n missing	*18*	*1*	

Table S3. Percentage infected in the Covicat cohort among participants with serological analyses by BMI, previous diagnosis of NCDs, population density and degree of urbanization (n=4103)

	N	% infected
	N=4,103	
BMI		
<25	1.813	16.8
25-30	1.603	19.2
>30	681	19.1
n missing	*6*	
NCDs		
No	3.349	18.0
Yes	754	18.6
Population density		
Least dense	726	17.6
2	766	17.5
3	832	17.9
4	881	19.1
5 Most dense	898	18.3
Degree of urbanization		
City	3.742	18.1
Town or suburb	311	17.7
Rural area	50	20.0

Table S4. Descriptive characteristics of individuals who agreed to participate in COVICAT serology testing compared to those who did not.

	Participants NOT willing to participate in serology N(%)	Participants willing to participate in serology N(%)	P value
	N=699	N=8,906	
Current age (years); mean (SD)	57.3 (9.4)	55.2 (7.7)	<0.001
Gender			
Male	305 (43.6)	3644 (40.9)	
Female	394 (56.4)	5262 (59.1)	0.160
Air pollution levels			
NO_2; mean (SD)	34.9 (9.0)	34.1 (9.2)	0.016
$PM_{2.5}$; mean (SD)	16.3 (1.6)	16.2 (1.5)	0.135
BC; mean (SD)	1.9 (0.4)	1.8 (0.4)	0.006
O_3; mean (SD)	64.8 (7.0)	65 (6.9)	0.377
Type of survey	87 (12.4)	469 (5.3)	<0.001
Online	612 (87.6)	8437 (94.7)	
Telephone	87 (12.4)	469 (5.3)	<0.001
Quintiles of deprivation index			
1 Least deprived	141 (20.2)	1784 (20)	
2	123 (17.6)	1794 (20.1)	
3	132 (18.9)	1789 (20.1)	
4	133 (19)	1793 (20.1)	
5 Most deprived	170 (24.3)	1746 (19.6)	0.037
Educational level			
Less than primary	11 (1.6)	126 (1.4)	
Primary	115 (16.5)	898 (10.1)	
Secondary	292 (41.8)	3709 (41.6)	
University	281 (40.2)	4173 (46.9)	<0.001
Baseline smoking status (before lockdown)			
Never smoker	299 (42.8)	3695 (41.5)	
Ex-smoker	290 (41.5)	3759 (42.3)	
Smoker	109 (15.6)	1439 (16.2)	0.792
n missing	*1*	*13*	
Physical Activity, according to IPAQ categories			
Low	134 (20.5)	1578 (18.7)	
Moderate	327 (50)	3783 (44.8)	
High	193 (29.5)	3087 (36.5)	0.001
n missing	*45*	*458*	
Any chronic disease			
No	431 (61.7)	5907 (66.3)	

Yes	268 (38.3)	2999 (33.7)	0.012
Respiratory, cardiometabolic, kidney and immune related chronic disease			
No	546 (78.1)	7334 (82.3)	
Yes	153 (21.9)	1572 (17.7)	0.005
BMI before lockdown; mean (SD)	26.3 (4.4)	26.2 (4.3)	0.965
n missing	*2*	*17*	
Obesity before lockdown			
BMI<30	571 (81.9)	7384 (83.1)	
BMI≥30	126 (18.1)	1505 (16.9)	0.438
n missing	*2*	*17*	
COVID-19 disease			
No	678 (97)	8446 (94.8)	
Yes	21 (3)	460 (5.2)	0.012

Table S5. Risk Ratios and 95% confidence interval from log-binomial regression models, between air pollution at residence and SARS-CoV-2 infection determined through serology. Changes reported by IQR. Sensitivity analyses for participants without changes in residence municipality, those recruited prior to July 31, 2020, excluding those with indeterminate serological results and adjusting for green spaces

	RR (95% CI)[a]
Participants without municipality changes (n=3,920)	
NO_2	1.05 (0.95,1.16)
$PM_{2.5}$	1.03 (0.93,1.14)
BC	1.00 (0.92,1.09)
O_3	0.98 (0.90,1.07)
Participants recruited before 31th july (n=4,055)	
NO_2	1.07 (0.97,1.18)
$PM_{2.5}$	1.04 (0.95,1.15)
BC	1.01 (0.92,1.10)
O_3	0.97 (0.89,1.06)
Excluding indeterminated paricipants (n=3,360)	
NO_2	1.02 (0.90,1.16)
$PM_{2.5}$	0.95 (0.84,1.07)
BC	1.04 (0.93,1.17)
O_3	1.02 (0.92,1.14)
All participants adjusted for green spaces (n=4,103)	
NO_2	1.06 (0.96,1.18)
$PM_{2.5}$	1.03 (0.93,1.14)
BC	1.00 (0.91,1.09)
O_3	0.98 (0.89,1.06)

[a] Adjusted for age, sex, education (Less than primary/ Primary/ Secondary/ University), ip2011 (deprivation index, quintiles), population density and type of survey (online/telephone)

Table S6. Effect estimates corresponding to Figure 1. Association of air pollutants (NO2, PM2.5, BC, O3) with levels of IgG, IgM and IgA against five viral target antigens among participants those who were seropositive (n=743). Linear regression beta coefficients and 95% confidence intervals adjusted for potential confounders[a]. CoviCat study.

			β (95% CI)1
Participants with SARS-CoV-2 infection			*N=743*
IgM	NFL	NO_2	-0.03 (-0.07,0.02)
		$PM_{2.5}$	-0.01 (-0.06,0.03)
		BC	-0.02 (-0.06,0.02)
		O_3	0.02 (-0.02,0.06)
	NCt	NO_2	-0.01 (-0.04,0.03)
		$PM_{2.5}$	-0.01 (-0.05,0.03)
		BC	-0.01 (-0.04,0.02)
		O_3	0.01 (-0.02,0.04)
	RBD	NO_2	0.04 (-0.01,0.08)
		$PM_{2.5}$	0.03 (-0.02,0.08)
		BC	0.01 (-0.03,0.05)
		O_3	-0.04 (-0.08,0.00)
	S	NO_2	0.02 (-0.02,0.07)
		$PM_{2.5}$	0.02 (-0.03,0.06)
		BC	0.01 (-0.03,0.04)
		O_3	-0.03 (-0.07,0.01)
	S2	NO_2	0.04 (-0.01,0.08)
		$PM_{2.5}$	0.03 (-0.01,0.08)
		BC	0.00 (-0.04,0.04)
		O_3	-0.03 (-0.07,0.01)
IgA	NFL	NO_2	0.03 (-0.02,0.09)
		$PM_{2.5}$	0.01 (-0.04,0.07)
		BC	0.02 (-0.03,0.07)
		O_3	-0.02 (-0.07,0.03)
	NCt	NO_2	0.02 (-0.02,0.06)
		$PM_{2.5}$	0.01 (-0.03,0.04)
		BC	0.01 (-0.02,0.04)
		O_3	-0.01 (-0.05,0.02)
	RBD	NO_2	0.04 (0.00,0.08)
		$PM_{2.5}$	0.03 (-0.01,0.07)
		BC	0.01 (-0.02,0.04)
		O_3	-0.03 (-0.06,0.00)
	S	NO_2	0.04 (-0.01,0.08)
		$PM_{2.5}$	0.04 (-0.01,0.08)
		BC	0.01 (-0.03,0.05)

		O_3	-0.04 (-0.08,0.00)
	S2	NO_2	0.06 (-0.01,0.12)
		$PM_{2.5}$	0.04 (-0.03,0.10)
		BC	-0.01 (-0.06,0.05)
		O_3	-0.06 (-0.12,0.00)
IgG	NFL	NO_2	0.07 (0.01,0.12)
		$PM_{2.5}$	0.06 (0.00,0.12)
		BC	0.03 (-0.02,0.08)
		O_3	-0.06 (-0.12,-0.01)
	NCt	NO_2	0.05 (-0.01,0.11)
		$PM_{2.5}$	0.05 (-0.01,0.11)
		BC	0.03 (-0.02,0.08)
		O_3	-0.05 (-0.10,0.00)
	RBD	NO_2	0.11 (0.02,0.19)
		$PM_{2.5}$	0.10 (0.01,0.19)
		BC	0.03 (-0.04,0.11)
		O_3	-0.08 (-0.16,-0.01)
	S	NO_2	0.11 (0.02,0.20)
		$PM_{2.5}$	0.09 (0.00,0.18)
		BC	0.04 (-0.04,0.12)
		O_3	-0.08 (-0.16,0.00)
	S2	NO_2	0.09 (0.01,0.16)
		$PM_{2.5}$	0.07 (0.00,0.15)
		BC	0.02 (-0.04,0.08)
		O_3	-0.06 (-0.12,0.00)

[a] Adjusted for age, sex, education (less than primary/ primary/ secondary/ university), deprivation index (quintiles), population density, type of survey (online/telephone) and batch

Footnote:
IgG: immunoglobulin G; IgM: immunoglobulin M; IgA: immunoglobulin A
SARS-CoV-2 antigens: spike full protein (S); S2 fragment (S2); receptor-binding domain (RBD); nucleocapsid full protein (NFL); nucleocapsid C-terminal region (NCt)

Table S7. Association between air pollution and antibodies response for IgA and IgG by time since infection among participants with reported COVID-19 symptoms and serology (n=181). Linear regression beta coefficients and 95% confidence intervals adjusted for potential confounders[a]. CoviCat study.~~CoviCat study~~

			β (95% CI)[a]	β (95% CI)[a]	p value[b]
			Time since infection <120 days N=67	*Time since infection >120 days N=114*	
IgA	NFL	NO_2	-0.05 (-0.27,0.17)	-0.07 (-0.21,0.06)	0.823
		$PM_{2.5}$	0.03 (-0.17,0.22)	-0.08 (-0.24,0.08)	0.351
		BC	0.16 (0.02,0.31)	-0.02 (-0.13,0.10)	0.034
		O_3	0.17 (-0.02,0.36)	0.06 (-0.06,0.18)	0.261
	NCt	NO_2	0.00 (-0.12,0.12)	0.04 (-0.03,0.12)	0.531
		$PM_{2.5}$	0.00 (-0.11,0.11)	0.03 (-0.06,0.12)	0.584
		BC	0.04 (-0.04,0.13)	0.03 (-0.04,0.09)	0.726
		O_3	0.04 (-0.07,0.14)	-0.02 (-0.09,0.04)	0.270
	RBD	NO_2	0.06 (-0.12,0.24)	-0.03 (-0.14,0.08)	0.315
		$PM_{2.5}$	0.05 (-0.11,0.21)	-0.04 (-0.17,0.09)	0.344
		BC	0.10 (-0.02,0.22)	0.01 (-0.08,0.10)	0.184
		O_3	0.05 (-0.10,0.21)	0.06 (-0.04,0.16)	0.921
	S	NO_2	0.05 (-0.16,0.27)	-0.06 (-0.19,0.07)	0.333
		$PM_{2.5}$	0.04 (-0.15,0.24)	-0.07 (-0.23,0.09)	0.315
		BC	0.12 (-0.03,0.26)	0.01 (-0.10,0.12)	0.211
		O_3	0.10 (-0.08,0.28)	0.04 (-0.08,0.16)	0.557
	S2	NO_2	-0.05 (-0.34,0.24)	0.03 (-0.15,0.21)	0.603
		$PM_{2.5}$	-0.05 (-0.32,0.21)	0.00 (-0.21,0.21)	0.704
		BC	0.00 (-0.19,0.20)	0.08 (-0.07,0.23)	0.501
		O_3	0.21 (-0.03,0.46)	-0.02 (-0.18,0.14)	0.070
IgG	NFL	NO_2	-0.12 (-0.36,0.13)	0.00 (-0.15,0.14)	0.375
		$PM_{2.5}$	-0.01 (-0.23,0.21)	-0.02 (-0.20,0.16)	0.936
		BC	0.04 (-0.13,0.20)	0.07 (-0.06,0.20)	0.755
		O_3	0.21 (0.00,0.41)	0.02 (-0.12,0.15)	0.078
	NCt	NO_2	-0.10 (-0.36,0.15)	-0.02 (-0.18,0.13)	0.555
		$PM_{2.5}$	0.02 (-0.21,0.25)	-0.03 (-0.22,0.15)	0.681
		BC	0.05 (-0.12,0.22)	0.06 (-0.07,0.19)	0.931
		O_3	0.17 (-0.05,0.38)	0.00 (-0.14,0.14)	0.149
	RBD	NO_2	-0.10 (-0.48,0.29)	-0.03 (-0.26,0.20)	0.743
		$PM_{2.5}$	0.02 (-0.33,0.37)	-0.11 (-0.39,0.17)	0.506
		BC	0.10 (-0.16,0.36)	0.07 (-0.13,0.27)	0.833
		O_3	0.29 (-0.04,0.61)	0.07 (-0.14,0.28)	0.208
	S	NO_2	-0.16 (-0.55,0.23)	0.02 (-0.21,0.26)	0.365
		$PM_{2.5}$	-0.05 (-0.40,0.31)	-0.05 (-0.34,0.24)	0.983
		BC	0.04 (-0.23,0.30)	0.11 (-0.09,0.31)	0.612

	O_3	0.33 (0.00,0.66)	0.02 (-0.19,0.23)	0.074
S2	NO_2	-0.13 (-0.45,0.18)	0.14 (-0.06,0.33)	0.104
	$PM_{2.5}$	-0.02 (-0.31,0.27)	0.06 (-0.17,0.29)	0.607
	BC	0.01 (-0.20,0.23)	0.15 (-0.02,0.31)	0.277
	O_3	0.28 (0.01,0.55)	-0.07 (-0.24,0.10)	0.013

[a] Adjusted for age, sex, education (Less than primary/ Primary/ Secondary/ University), ip2011 (deprivation index, continuous), population density and type of survey (online/telephone)

[b] p-value for likelihood ratio test for interaction

Table S8. Risk Ratios and 95% confidence interval from log-binomial regression models, between air pollution at residence and COVID-19 disease among the total COVICAT population and subgroups with serological testing and positive antibodies for SARS-CoV-2 infection adjusting also for green spaces

	RR (95% CI)[a]	RR (95% CI)[b]
Total population	N=9,605	N=9,088
NO2 (per IQR)	1.18 (1.03,1.35)	1.21 (1.05,1.39)
PM2.5 (per IQR)	1.21 (1.06,1.37)	1.20 (1.05,1.38)
BC (per IQR)	1.00 (0.89,1.13)	1.01 (0.89,1.14)
O3 (per IQR)	0.91 (0.81,1.02)	0.90 (0.80,1.01)
Participants with serology	N=4,103	N=3,922
NO2 (per IQR)	1.29 (1.04,1.61)	1.35 (1.08,1.68)
PM2.5 (per IQR)	1.28 (1.03,1.59)	1.28 (1.02,1.59)
BC (per IQR)	0.95 (0.79,1.15)	0.97 (0.80,1.17)
O3 (per IQR)	0.83 (0.68,1.00)	0.81 (0.67,0.99)
Participants with SARS-CoV-2 infection	N=743	N=702
NO2 (per IQR)	1.18 (0.91,1.53)	1.21 (0.95,1.56)
PM2.5 (per IQR)	1.15 (0.89,1.48)	1.09 (0.85,1.39)
BC (per IQR)	1.03 (0.83,1.28)	1.03 (0.83,1.28)
O3 (per IQR)	0.92 (0.74,1.14)	0.90 (0.73,1.12)

[a] Adjusted for age, sex, education (Less than primary/ Primary/ Secondary/ University), ip2011 (deprivation index, quintiles), population density and type of survey (online/telephone) and green spaces

[b] Adjusted for age, sex, education (Less than primary/ Primary/ Secondary/ University), ip2011 (deprivation index, quintiles), population density, smoking (never/ex/smoker), physical activity (low/moderate/high) and type of survey (online/telephone) and green spaces

Table S9. Association of prepandemic air pollution on SARS-CoV-2 infection by age (<60 / >=60), previous NCDs, Socioeconomic status indicators, obesity, degree of urbanization and population density. Risk Ratios and 95% confidence interval fromlog-binomial regression models, CoviCat study.

	RR (95% CI)[a]	RR (95% CI)[a]	p value[b]
Age	*Age<60 (N=2,784)*	*Age≥60 (N=1,319)*	
NO_2	1.09 (0.98,1.22)	1.01 (0.86,1.19)	0,410
$PM_{2.5}$	1.06 (0.95,1.18)	0.99 (0.84,1.17)	0,509
BC	1.02 (0.92,1.13)	0.96 (0.84,1.11)	0,492
O_3	0.97 (0.88,1.06)	0.98 (0.85,1.13)	0,825
Gender	*Female (N=2,381)*	*Male (N=1,722)*	
NO_2	1.07 (0.95,1.20)	1.06 (0.92,1.23)	0,958
$PM_{2.5}$	1.02 (0.91,1.15)	1.06 (0.92,1.23)	0,686
BC	0.98 (0.88,1.09)	1.04 (0.92,1.18)	0,434
O_3	0.94 (0.85,1.05)	1.01 (0.90,1.14)	0,371
Educational level[c]	*High (N=1,953)*	*Low (N=2,150)*	
NO_2	0.99 (0.86,1.14)	1.13 (1.00,1.27)	0,158
$PM_{2.5}$	0.98 (0.86,1.12)	1.08 (0.96,1.22)	0,266
BC	0.95 (0.84,1.07)	1.05 (0.94,1.18)	0,163
O_3	1.00 (0.89,1.13)	0.95 (0.85,1.05)	0,426
Area-level deprivation[d]	*High (N=1,748)*	*Low (N=2,355)*	
NO_2	1.06 (0.92,1.23)	1.07 (0.95,1.20)	0,979
$PM_{2.5}$	0.98 (0.85,1.14)	1.07 (0.95,1.20)	0,372
BC	0.99 (0.88,1.12)	1.01 (0.90,1.13)	0,858
O_3	1.02 (0.90,1.16)	0.95 (0.86,1.05)	0,369
Previous diagnosis of chronic disease[e]	*No (N=3,349)*	*Yes (N=754)*	
NO_2	1.11 (1.00,1.24)	0.87 (0.71,1.07)	0,032
$PM_{2.5}$	1.09 (0.98,1.21)	0.83 (0.68,1.02)	0,020
BC	1.03 (0.94,1.13)	0.87 (0.73,1.05)	0,107
O_3	0.94 (0.85,1.03)	1.13 (0.96,1.32)	0,043
Obesity (BM≥30)	*No (N=3,416)*	*Yes (N=681)*	
NO_2	1.07 (0.97,1.19)	1.03 (0.84,1.27)	0,735
$PM_{2.5}$	1.04 (0.93,1.15)	1.04 (0.84,1.28)	0,995
BC	1.00 (0.91,1.09)	1.03 (0.85,1.24)	0,754
O_3	0.97 (0.89,1.06)	0.99 (0.83,1.19)	0,814
Degree of urbanization	*Suburb or rural (N=361)*	*City (N=3,742)*	
NO_2	1.20 (0.83,1.72)	1.09 (0.97,1.22)	0,608
$PM_{2.5}$	1.03 (0.77,1.39)	1.06 (0.94,1.18)	0,901
BC	1.09 (0.66,1.80)	1.00 (0.92,1.10)	0,740
O_3	0.95 (0.76,1.21)	0.96 (0.86,1.06)	0,984
Population density[f]	*Low (N=2,324)*	*High (N=1,779)*	

NO_2	1.12 (0.90,1.39)	1.05 (0.94,1.17)	0,596
$PM_{2.5}$	1.14 (0.93,1.40)	1.01 (0.90,1.12)	0,281
BC	1.15 (0.95,1.38)	0.96 (0.87,1.06)	0,083
O_3	0.89 (0.73,1.09)	0.99 (0.90,1.08)	0,344

a Adjusted for age, sex, education (Less than primary/ Primary/ Secondary/ University), ip2011 (deprivation index, continuous), population density and type of survey (online/telephone)

b p-value for likelihood ratio test for interaction

c University is considered as high educational level

d Low Deprivation: Q3-Q5 of deprivation score; High deprivation: Q1-Q2 of deprivation score

e Previous diagnosis of any of the following: respiratory, cardiometabolic, kidney or immune related diseases

f Low density: Q1-Q3 of population density; High density: Q4-Q5 of population density

Table S10. Association of prepandemic air pollution on IgG RBD levels in participants with SARS-CoV-2 infection by age (<60 / >=60), previous NCDs, Socioeconomic status indicators, obesity, degree of urbanization and population density. Linear regression beta coefficients and 95% Confidence Intervals. CoviCat study.

	β (95% CI)[a]	β (95% CI)[a]	p value[b]
Age	*Age<60 (N=496)*	*Age≥60 (N=247)*	
NO_2	0.14 (0.02,0.26)	0.14 (-0.04,0.33)	0,970
$PM_{2.5}$	0.16 (0.03,0.29)	0.05 (-0.13,0.22)	0,284
BC	0.07 (-0.04,0.17)	0.02 (-0.13,0.17)	0,572
O_3	-0.11 (-0.21,0.00)	-0.10 (-0.26,0.06)	0,956
Gender	*Female (N=433)*	*Male (N=310)*	
NO_2	0.17 (0.04,0.30)	0.09 (-0.07,0.25)	0,403
$PM_{2.5}$	0.17 (0.04,0.31)	0.05 (-0.11,0.20)	0,191
BC	0.07 (-0.04,0.18)	0.02 (-0.13,0.16)	0,516
O_3	-0.15 (-0.27,-0.04)	-0.03 (-0.17,0.10)	0,154
Educational level[c]	*High (N=344)*	*Low (N=399)*	
NO_2	0.14 (-0.01,0.29)	0.14 (0.00,0.28)	0,989
$PM_{2.5}$	0.10 (-0.05,0.25)	0.14 (0.00,0.28)	0,660
BC	0.03 (-0.09,0.16)	0.07 (-0.05,0.18)	0,702
O_3	-0.15 (-0.28,-0.02)	-0.06 (-0.18,0.06)	0,291
Area-level deprivation[d]	*High (N=377)*	*Low (N=406)*	
NO_2	0.08 (-0.09,0.25)	0.15 (0.03,0.28)	0,477
$PM_{2.5}$	0.02 (-0.14,0.18)	0.17 (0.04,0.31)	0,117
BC	-0.03 (-0.16,0.10)	0.10 (-0.02,0.22)	0,106
O_3	-0.06 (-0.20,0.09)	-0.12 (-0.23,-0.01)	0,482
Previous diagnosis of chronic disease[e]	*No (N=603)*	*Yes (N=140)*	
NO_2	0.17 (0.06,0.29)	-0.02 (-0.26,0.22)	0,123
$PM_{2.5}$	0.12 (0.00,0.24)	0.15 (-0.09,0.39)	0,823
BC	0.06 (-0.04,0.16)	-0.01 (-0.23,0.20)	0,511
O_3	-0.13 (-0.23,-0.03)	0.01 (-0.19,0.22)	0,179
Obesity (BM≥30)	*No (N=612)*	*Yes (N=130)*	
NO_2	0.15 (0.04,0.27)	0.07 (-0.15,0.30)	0,516
$PM_{2.5}$	0.13 (0.01,0.25)	0.10 (-0.12,0.31)	0,787
BC	0.04 (-0.06,0.14)	0.09 (-0.12,0.30)	0,675
O_3	-0.11 (-0.21,-0.01)	-0.07 (-0.27,0.14)	0,700
Degree of urbanization	*Suburb or rural (N=65)*	*City (N=678)*	
NO_2	0.38 (-0.03,0.80)	0.12 (0.00,0.25)	0,228
$PM_{2.5}$	0.05 (-0.26,0.37)	0.13 (0.00,0.26)	0,670
BC	-0.21 (-0.74,0.31)	0.05 (-0.05,0.15)	0,322
O_3	-0.08 (-0.36,0.19)	-0.10 (-0.22,0.01)	0,899
Population density[f]	*Low (N=411)*	*High (N=332)*	

NO_2	0.13 (0.01,0.25)	0.17 (-0.05,0.39)	0,774
$PM_{2.5}$	0.09 (-0.03,0.22)	0.23 (0.00,0.47)	0,285
BC	0.04 (-0.06,0.15)	0.07 (-0.13,0.28)	0,804
O_3	-0.10 (-0.20,0.00)	-0.14 (-0.35,0.08)	0,741

a Adjusted for age, sex, education (Less than primary/ Primary/ Secondary/ University), ip2011 (deprivation index, continuous), population density and type of survey (online/telephone)

b p-value for likelihood ratio test for interaction

c University is considered as high educational level

d Low Deprivation: Q3-Q5 of deprivation score; High deprivation: Q1-Q2 of deprivation score

e Previous diagnosis of any of the following: respiratory, cardiometabolic, kidney or immune related diseases

f Low density: Q1-Q3 of population density; High density: Q4-Q5 of population density

Table S11. Effect of prepandemic air pollution on IgG NFL levels in participants with SARS-CoV-2 infection by age (<60 / >=60), previous NCDs, Socioeconomic status indicators, obesity, degree of urbanization and population density. Linear regression beta coefficients and 95% Confidence Intervals. CoviCat study.

	β (95% CI)[a]	β (95% CI)	p value[b]
Age	*Age<60 (N=496)*	*Age≥60 (N=247)*	
NO_2	0.01 (-0.07,0.09)	0.06 (-0.06,0.17)	0,473
$PM_{2.5}$	0.03 (-0.05,0.11)	0.04 (-0.07,0.16)	0,842
BC	0.01 (-0.06,0.08)	0.03 (-0.07,0.12)	0,752
O_3	-0.02 (-0.09,0.05)	-0.06 (-0.16,0.04)	0,452
Gender	*Female (N=433)*	*Male (N=310)*	
NO_2	0.00 (-0.09,0.08)	0.06 (-0.04,0.17)	0,306
$PM_{2.5}$	0.01 (-0.07,0.10)	0.06 (-0.04,0.17)	0,433
BC	0.01 (-0.06,0.09)	0.02 (-0.08,0.11)	0,990
O_3	-0.01 (-0.09,0.06)	-0.06 (-0.15,0.02)	0,331
Educational level[c]	*High (N=344)*	*Low (N=399)*	
NO_2	0.00 (-0.10,0.09)	0.05 (-0.04,0.14)	0,386
$PM_{2.5}$	0.00 (-0.10,0.10)	0.06 (-0.03,0.15)	0,355
BC	0.01 (-0.08,0.09)	0.02 (-0.05,0.10)	0,736
O_3	-0.04 (-0.13,0.04)	-0.02 (-0.10,0.05)	0,679
Area-level deprivation[d]	*High (N=377)*	*Low (N=406)*	
NO_2	-0.01 (-0.12,0.10)	0.05 (-0.03,0.13)	0,426
$PM_{2.5}$	-0.03 (-0.13,0.07)	0.09 (0.00,0.17)	0,065
BC	0.00 (-0.08,0.08)	0.04 (-0.04,0.11)	0,495
O_3	0.00 (-0.09,0.10)	-0.06 (-0.13,0.01)	0,263
Previous diagnosis of chronic disease[e]	*No (N=603)*	*Yes (N=140)*	
NO_2	0.02 (-0.06,0.09)	0.06 (-0.09,0.22)	0,559
$PM_{2.5}$	0.01 (-0.07,0.08)	0.19 (0.03,0.34)	0,030
BC	0.01 (-0.06,0.07)	0.06 (-0.08,0.19)	0,489
O_3	-0.03 (-0.09,0.04)	-0.06 (-0.19,0.07)	0,613
Obesity (BM≥30)	*No (N=612)*	*Yes (N=130)*	
NO_2	0.01 (-0.07,0.08)	0.09 (-0.05,0.24)	0,284
$PM_{2.5}$	0.03 (-0.05,0.10)	0.05 (-0.09,0.19)	0,774
BC	0.00 (-0.07,0.06)	0.10 (-0.03,0.24)	0,140
O_3	-0.02 (-0.08,0.04)	-0.09 (-0.23,0.04)	0,291
Degree of urbanization	*Suburb or rural (N=65)*	*City (N=678)*	
NO_2	0.25 (-0.02,0.51)	-0.01 (-0.09,0.07)	0,063
$PM_{2.5}$	0.19 (0.00,0.39)	-0.01 (-0.09,0.08)	0,061
BC	-0.02 (-0.35,0.32)	0.01 (-0.05,0.07)	0,867
O_3	-0.20 (-0.37,-0.02)	0.01 (-0.07,0.08)	0,030
Population density[f]	*Low (N=411)*	*High (N=332)*	

NO_2	0.07 (-0.07,0.21)	0.01 (-0.07,0.09)	0,465
$PM_{2.5}$	0.08 (-0.07,0.23)	0.02 (-0.06,0.10)	0,485
BC	0.04 (-0.09,0.17)	0.01 (-0.06,0.08)	0,650
O_3	-0.02 (-0.15,0.12)	-0.04 (-0.10,0.03)	0,798

a Adjusted for age, sex, education (Less than primary/ Primary/ Secondary/ University), ip2011 (deprivation index, continuous), population density and type of survey (online/telephone)

b p-value for likelihood ratio test for interaction

c University is considered as high educational level

d Low Deprivation: Q3-Q5 of deprivation score; High deprivation: Q1-Q2 of deprivation score

e Previous diagnosis of any of the following: respiratory, cardiometabolic, kidney or immune related diseases

f Low density: Q1-Q3 of population density; High density: Q4-Q5 of population density

Figure S1. Flow diagram describing participation in the COVICAT cohort at each study stage

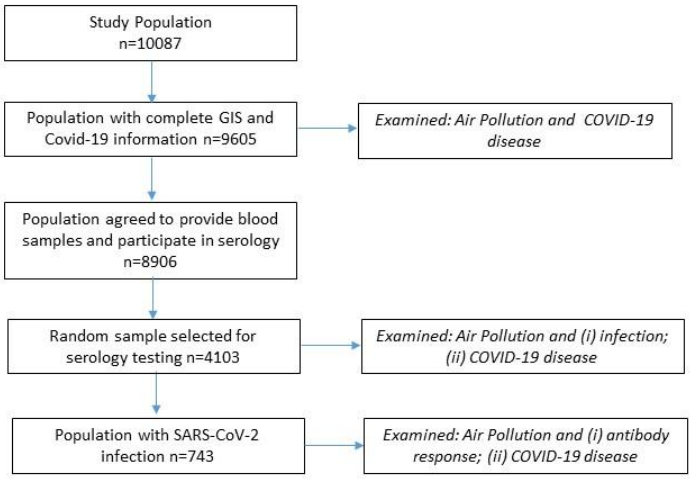


Figure S2. Epidemiological curves for SARS-CoV-2 positive tests over time by health region in Catalonia. The blue lines define the first period of sampling that includes approximately 75% of the CoviCat study population with serology. The green lines define the second sampling period with the remaining participants. Barcelona Ciutat, Catalunya Central, Girona, Lleida, Metropolita Nord, Metropolita Sud are the largest urban areas. The peak in Lleida was due to the influx of temporary agricultural workers after the end of lockdown and the lack of proventive measures for them

Data retrieved from website:
https://app.powerbi.com/view?r=eyJrIjoiOGIyNjgzYjctYjA0Ny00ZDRmLWIxNjctM2RkZWZhMDQ0ZjRiIiwidCI6IjNiOTQyN2RjLWQzMGUtNDNiYy04YzA2LWZmNzI1MzY3NmZlYyIsImMiOjh9

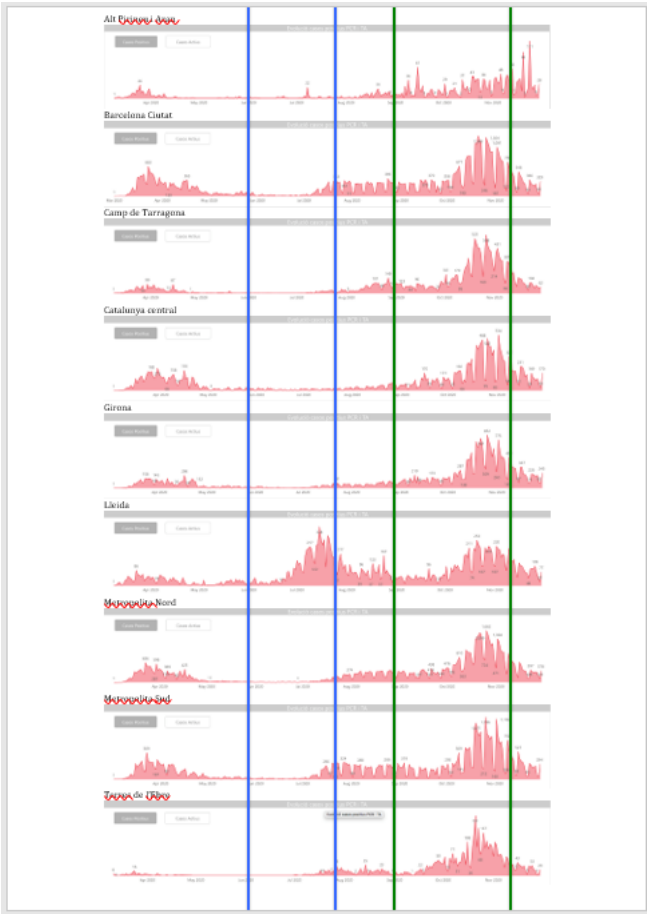


Figure S3. Directed acyclic graph for analysis of SARS-CoV-2 infection and COVID-19 disease in the Covicat cohort. Potential confounders include: Demographics (age and sex); SES (education and deprivation index); lifestyle (smoking and physical activity); survey type; green spaces; and population density.

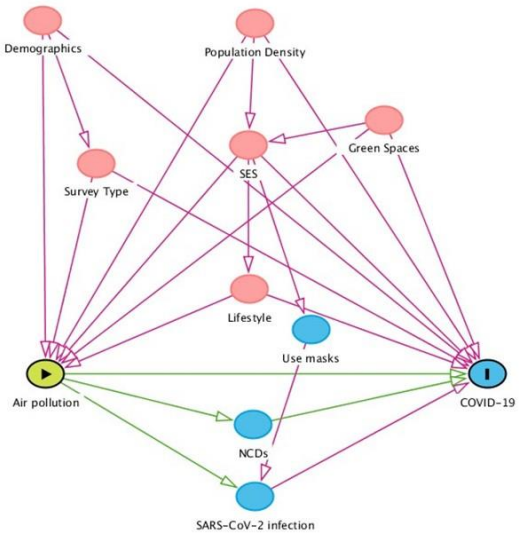


Figure S4. Map of residential location of total study population by COVID-19 disease status; participants with COVID-19 (blue triangles) and those non-diseased (yellow dots)

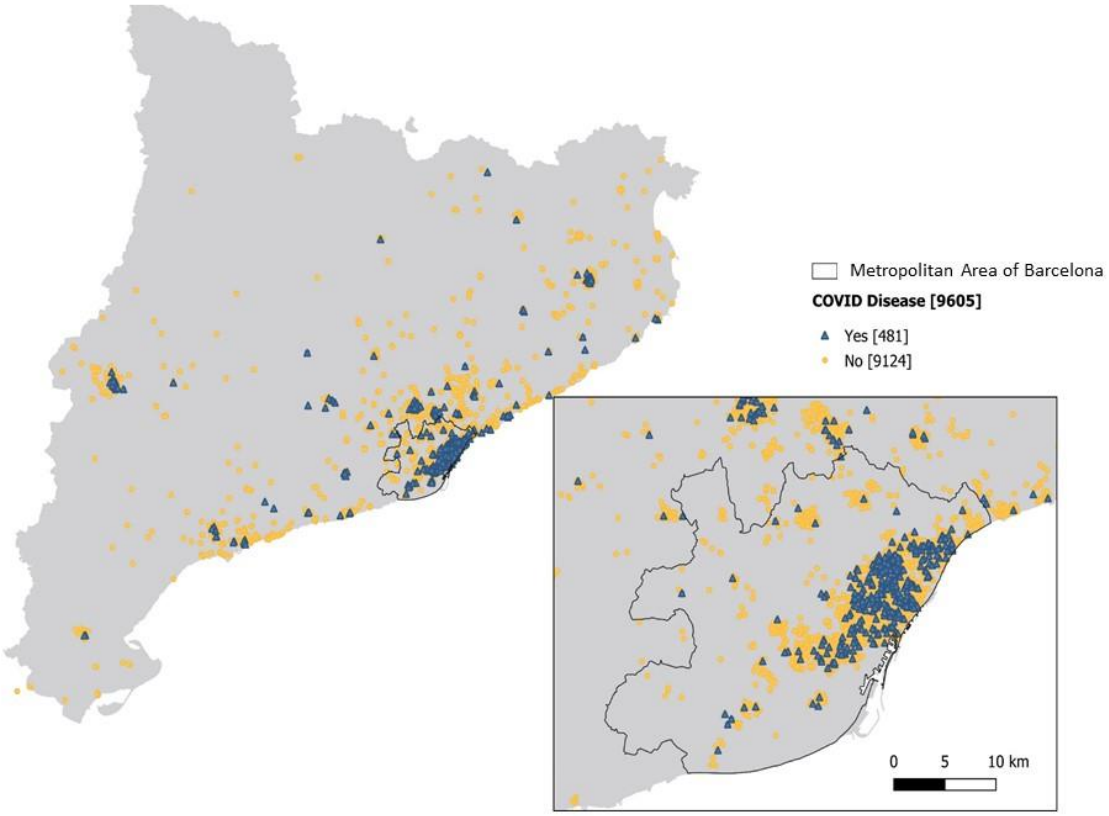


Figure S5. Map of residential location of study population with serology tested for infection to SARS-CoV-2 by COVID-19 disease status; participants with COVID-19 (blue triangles) and those non-diseased (yellow dots)

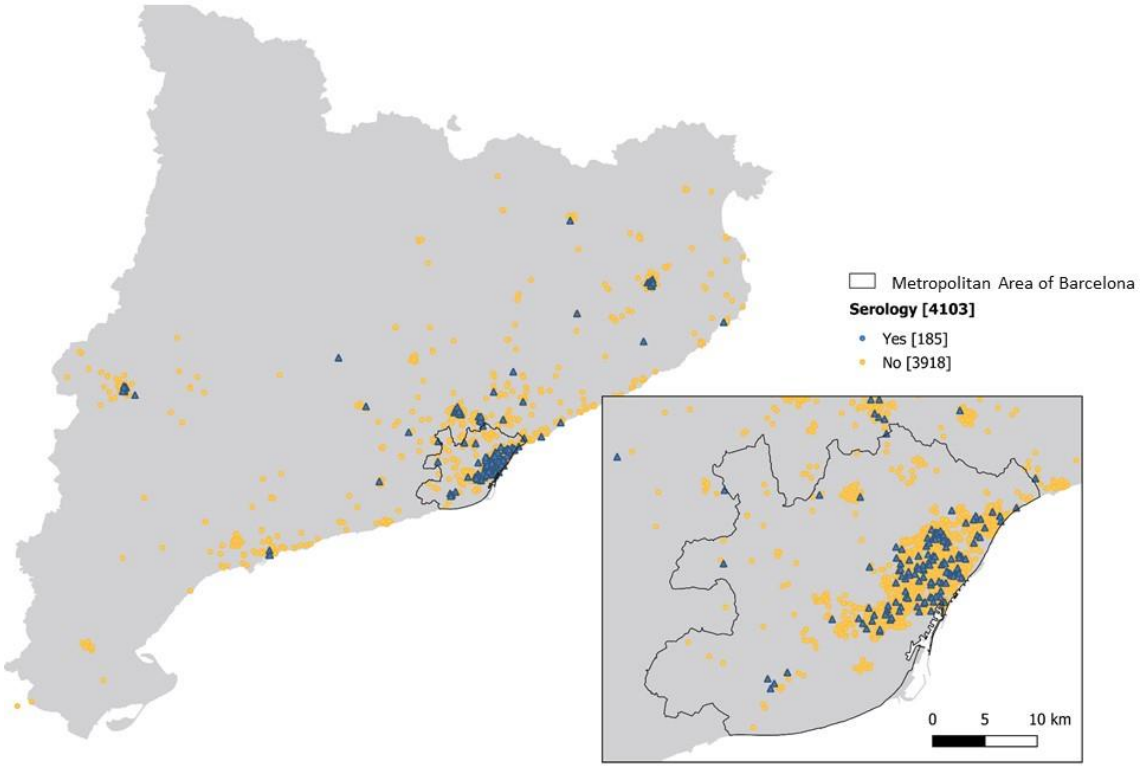
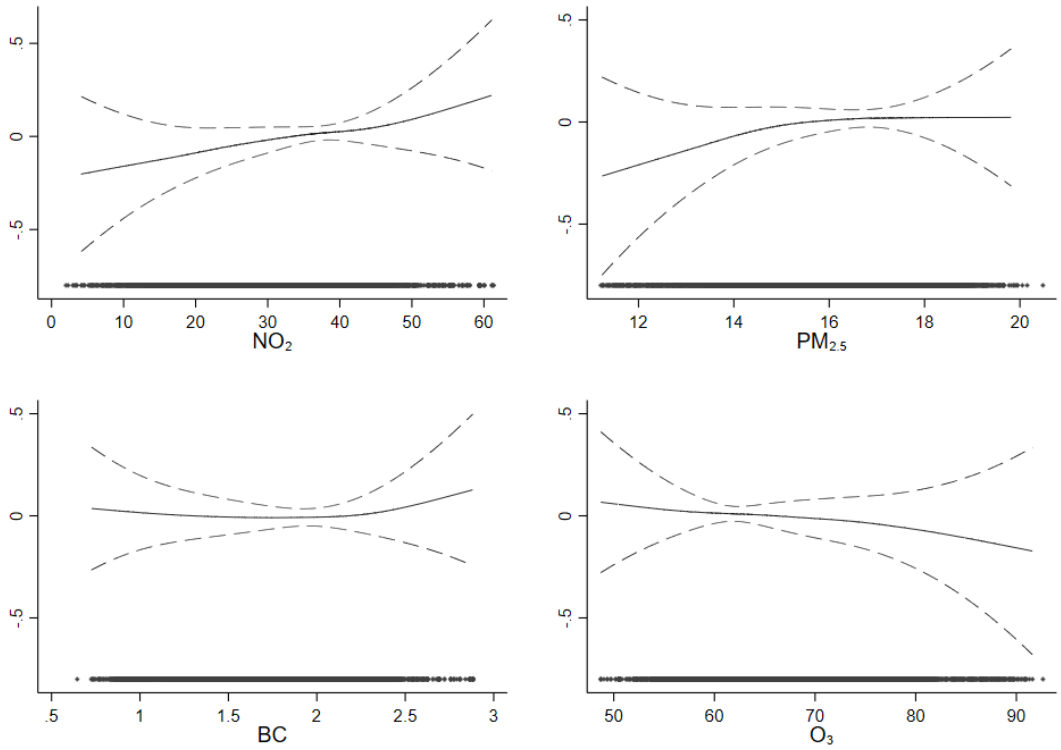
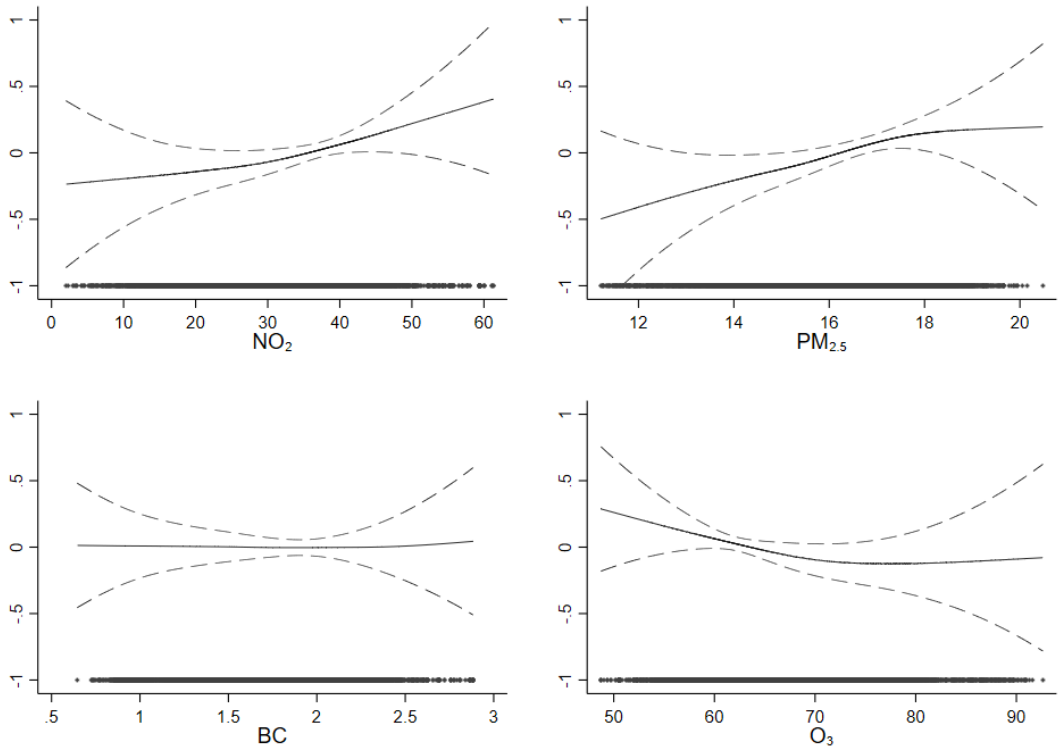


Figure S6. Generalized additive models (smoothed effects and 95% CI) for air pollution at residence (x-axis Interquartile Range) and prevalence of infection to SARS-CoV-2 measured through antibody response among the subpopulation serologically tested (N=4,103) [a]



[a] All models are with 2 degrees of freedom and there is no departure from linearity. All models adjusted for age, sex, education (Less than primary/ Primary/ Secondary/ University), ip2011 (deprivation index, quintiles), population density and type of survey (online/telephone)

Figure S7. Generalized additive models (smoothed effects and 95% CI) for air pollution at residence (x-axis Interquartile Range) and COVID-19 disease among the total COVICAT population (N=9,605) [a]



[a] All models are with 2 degrees of freedom and there is no departure from linearity. All models adjusted for age, sex, education (Less than primary/ Primary/ Secondary/ University), ip2011 (deprivation index, quintiles), population density and type of survey (online/telephone)