Supplementary materials

Ambient air pollution exposure and chronic bronchitis in the Lifelines cohort

Table S1: Lifelines chronic bronchitis questionnaire assessment items

Baseline assessment		
Phlegm in the mornings	*(Q1) Do you usually cough up phlegm in winter immediately after getting up?*	Yes, No
	(Q2) If you usually cough up phlegm in winter immediately after getting up, do you cough up phlegm like that almost daily, for at least three months a year?	Yes, No
Phlegm during the day	*(Q3) Do you usually cough up phlegm in winter during daytime or at night?*	Yes, No
	(Q4) If you usually cough up phlegm in winter during daytime or at night, do you cough up phlegm like that almost daily, for at least three months a year?	Yes, No
Cough in the mornings	*(Q5) Do you usually cough in winter when getting up?*	Yes, No
	(Q6) If you usually cough in winter when getting up, do you cough almost daily, for at least three months a year?	Yes, No
Cough during the day	*(Q7) Do you usually cough in winter during daytime or at night?*	Yes, No
	(Q8) If you usually cough in winter during daytime or at night, do you cough like that almost daily, for at least three months a year?	Yes, No
Second assessment		
Cough mucus, every day, three months a year	*(Q9) Do you cough up mucus every day for a period of three months a year?*	Yes, No
Cough, every day, three months a year	*(Q10) Do you cough almost every day for a period of three months a year?*	Yes, No

Recoding procedure for baseline outcomes:

Baseline *chronic bronchitis* defined as:

- Participants answering 'yes' to Q1 and Q2 *or* 'yes' to Q4 and Q5
- Participants with missing data in Q1 but 'yes' to Q2
- Participants with missing data to Q3 but yes to Q4

Baseline *chronic cough* defined as:

- Participants answering 'yes' to Q5 and Q6 *or* 'yes' to Q7 and Q8
- Participants with missing data in Q5 but 'yes' to Q6
- Participants with missing data to Q7 but yes to Q8

Baseline *usual sputum* defined as:

- Participants answering 'yes' to Q1 *or* 'yes' to Q3

Baseline *usual cough* defined as:

- Participants answering 'yes' to Q5 *or* 'yes' to Q7

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Table S2: Baseline characteristics of population included in baseline analyses and population excluded due to missing data

	Included in baseline analyse* (n = 132 595)	Excluded from baseline analyses due to missing data (n=19 546)	p-value for difference
Sex			
Male, n (%)	55 315 (41.7)	7 780 (39.8)	<0.001
Female, n (%)	77 280 (58.3)	11 766 (60.2)	
Age, mean ± SD	44.1 ± 12.6	48.1 ± 15.9	<0.001
Education †			<0.001
Low, n (%)	38 229 (28.8)	7 250 (44.7)	
Medium, n (%)	53 433 (40.3)	5 394 (33.3)	
High, n (%)	40 933 (30.9)	3 566 (22.0)	
Missing data		3 336	
Smoking status			<0.001
Never smoker, n (%)	62 895 (47.4)	4 554 (34.3)	
Former smoker, n (%)	43 079 (32.5)	5 156 (38.9)	
Current smoker, n (%)	26 621 (20.1)	3 548 (26.8)	
Missing data		6 288	
Pack-years smoking, mean ± SD ‡	11.8 ± 10.9	13.4 ± 12.9	<0.001
Missing data		11 597	
Asthma			0.001
Never diagnosed with asthma	120 783 (91.2)	17 655 (90.5)	
Ever diagnosed with asthma	11 612 (8.8)	1 849 (9.5)	
Missing data		42	
Chronic bronchitis, n (%)	8 128 (6.1)	1 167 (7.4)	<0.001
Missing data		3807	
"Usual sputum"	13 687 (10.3)	2 032 (12.8)	<0.001
Missing data		3 666	
Chronic cough (daily cough, 3 months a year), n (%)	9 754 (7.4)	1 508 (9.4)	<0.001
Missing data		3 569	
"Usual" cough"	19 564 (14.7)	2 893 (18.2)	<0.001
Missing data		3 693	

* For participants with complete data for chronic bronchitis, sex, age, educational attainment, BMI, smoking status, pack-years smoking, environmental tobacco smoke at home, and nitrogen dioxide.

† Educational attainment levels: low = junior secondary/lower vocation or less; medium = senior secondary/secondary vocation; high = higher vocational/university.

‡ Pack-years smoking are for current and former smokers (baseline: n= 69 700; participants excluded from baseline analyses: n= 3245)

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Table S3: Chronic bronchitis reporting at baseline and second assessment*

		Chronic bronchitis at baseline	
		No	*Yes*
Chronic bronchitis at second assessment	*No*	62 063 (92.6%)	1 096 (1.6%)
	Yes	2 946 (4.4%)	921 (1.4%)
	Missing	59 458	6 111

*For participants with complete data for sex, age, educational attainment, BMI, smoking status, pack-years smoking, environmental tobacco some at home, air pollution and chronic bronchitis

Table S4: Sensitivity analyses for incident chronic bronchitis and chronic cough at second assessment restricted to non-movers*

		Adjusted* OR (95%CI)		
	Cases/non-cases (n/n)	**$PM_{2.5}$**	**NO_2**	**Black carbon**
Chronic bronchitis	2 501/ 53 101	1.01 (0.95, 1.06)	**1.05 (0.99, 1.12)**	**1.06 (1.01, 1.13)**
Chronic cough	3 412 / 52 162	1.00 (0.96, 1.05)	1.04 (0.99, 1.10)	1.05 (1.00, 1.10)

* Model adjusted for sex, age, educational attainment (low: junior secondary/lower vocational or less, medium: senior secondary/secondary vocational, high: higher vocational/university), BMI (continuous), smoking status (never, ex, current), pack-years smoking and environmental tobacco smoke at home. IQR for PM2.5 = 1.30 µg/m^3, for NO2 = 6.92 µg/m^3 and for BC = 0.29 x 10^{-5} m^{-1}.

Table S5: Two-pollutant models for prevalent and incident chronic bronchitis and cough and sputum symptoms per interquartile range (IQR) increase in each pollutant

		Adjusted* OR (95%CI)	
	Cases/non-cases (n/n)	**$PM_{2.5}$**	**NO_2**
Prevalence analyses			
Chronic bronchitis	8 128 / 124 467	0.97 (0.94, 1.01)	**1.07 (1.03, 1.11)**
Usual sputum	13 687 / 118 704	1.00 (0.97, 1.03)	**1.07 (1.04, 1.11)**
Chronic cough	9 754 / 122 915	0.98 (0.95, 1.01)	**1.04 (1.01, 1.08)**
Usual cough	19 564 / 112 409	1.00 (0.97, 1.02)	**1.07 (1.04, 1.10)**
Incidence analyses			
Chronic bronchitis	2 946 / 62 063	0.97 (0.91, 1.03)	**1.09 (1.03, 1.17)**
Chronic cough	3 956 / 61 022	0.99 (0.94, 1.04)	1.04 (0.98, 1.10)

*Model adjusted for sex, age, educational attainment (low: junior secondary/lower vocational or less, medium: senior secondary/secondary vocational, high: higher vocational/university), BMI (continuous), smoking status (never, ex, current), pack-years smoking, environmental tobacco smoke at home and either NO_2 or $PM_{2.5}$. IQR for PM2.5 = 1.30 µg/m^3, and for NO2 = 6.92 µg/m^3