

## Supplementary materials

### Ambient air pollution exposure and chronic bronchitis in the Lifelines cohort

**Table S1:** Lifelines chronic bronchitis questionnaire assessment items

<b>Baseline assessment</b>		
<i>Phlegm in the mornings</i>	(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
<i>Phlegm during the day</i>	(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
<i>Cough in the mornings</i>	(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
<i>Cough during the day</i>	(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
<b>Second assessment</b>		
<i>Cough mucus, every day, three months a year</i>	(Q9) Do you cough up mucus every day for a period of three months a year?	Yes, No
<i>Cough, every day, three months a year</i>	(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

**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 $\pm$ SD	44.1 $\pm$ 12.6	48.1 $\pm$ 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 $\pm$ SD ‡	11.8 $\pm$ 10.9	13.4 $\pm$ 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 (%)			
			<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 (%)			
			<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)

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

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

\*For participants with complete data for sex, age, educational attainment, BMI, smoking status, pack-years smoking, environmental tobacco smoke 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\*

	Cases/non-cases (n/n)	<b>Adjusted* OR (95%CI)</b>		
		PM <sub>2.5</sub>	NO <sub>2</sub>	Black carbon
Chronic bronchitis	2 501/ 53 101	1.01 (0.95, 1.06)	<b>1.05</b> <b>(0.99, 1.12)</b>	<b>1.06</b> <b>(1.01, 1.13)</b>
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 PM<sub>2.5</sub> = 1.30 µg/m<sup>3</sup>, for NO<sub>2</sub> = 6.92 µg/m<sup>3</sup> and for BC = 0.29 x 10<sup>-5</sup> m<sup>-1</sup>.

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

	Cases/non-cases (n/n)	<b>Adjusted* OR (95%CI)</b>	
		PM <sub>2.5</sub>	NO <sub>2</sub>
<b>Prevalence analyses</b>			
Chronic bronchitis	8 128 / 124 467	0.97 (0.94, 1.01)	<b>1.07</b> <b>(1.03, 1.11)</b>
Usual sputum	13 687 / 118 704	1.00 (0.97, 1.03)	<b>1.07</b> <b>(1.04, 1.11)</b>
Chronic cough	9 754 / 122 915	0.98 (0.95, 1.01)	<b>1.04</b> <b>(1.01, 1.08)</b>
Usual cough	19 564 / 112 409	1.00 (0.97, 1.02)	<b>1.07</b> <b>(1.04, 1.10)</b>
<b>Incidence analyses</b>			
Chronic bronchitis	2 946 / 62 063	0.97 (0.91, 1.03)	<b>1.09</b> <b>(1.03, 1.17)</b>
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<sub>2</sub> or PM<sub>2.5</sub>. IQR for PM<sub>2.5</sub> = 1.30 µg/m<sup>3</sup>, and for NO<sub>2</sub> = 6.92 µg/m<sup>3</sup>