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Association between long-term exposure to low ambient PM_{2.5} and cardiovascular hospital admissions: a UK Biobank study

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Table S1: Hazard ratios (HRs, with 95% confidence intervals) of cardiovascular outcomes with ICD in primary position associated with an increase of 5 µg/m³ in PM_{2.5} in the UKB cohort, for combinations of length of exposure windows and confounding control.

Outcome	exposure window	Model 1	Model 2
5-point MACE	lag0	1.13 (1.03-1.24)	1.09 (0.98-1.22)
	lag02	1.14 (1.03-1.26)	1.10 (0.98-1.24)
	lag04	1.13 (1.01-1.25)	1.08 (0.95-1.22)
Myocardial Infarction (MI)			
Acute	lag0	0.93 (0.80-1.09)	0.99 (0.83-1.18)
	lag02	0.91 (0.77-1.07)	0.96 (0.79-1.16)
	lag04	0.91 (0.77-1.08)	0.97 (0.79-1.18)
STEMI	lag0	0.83 (0.65-1.05)	0.83 (0.64-1.09)
	lag02	0.86 (0.67-1.11)	0.88 (0.66-1.18)
	lag04	0.90 (0.69-1.17)	0.94 (0.69-1.27)
NSTEMI	lag0	1.12 (0.87-1.46)	1.39 (1.02-1.89)
	lag02	1.00 (0.76-1.32)	1.22 (0.87-1.70)
	lag04	0.98 (0.74-1.29)	1.17 (0.84-1.64)
Cerebrovascular disease and stroke			
Intracerebral stroke	lag0	1.64 (1.05-2.54)	1.63 (0.98-2.72)
	lag02	1.81 (1.14-2.88)	1.89 (1.09-3.29)
	lag04	1.79 (1.11-2.89)	1.87 (1.05-3.31)
Ischaemic stroke	lag0	1.22 (1.02-1.47)	1.14 (0.92-1.40)
	lag02	1.25 (1.03-1.52)	1.15 (0.92-1.45)
	lag04	1.20 (0.98-1.47)	1.08 (0.86-1.37)
Subarachnoid stroke	lag0	1.14 (0.71-1.84)	1.06 (0.62-1.81)

	lag02	1.15 (0.69-1.92)	1.05 (0.58-1.91)
	lag04	1.12 (0.65-1.92)	1.00 (0.53-1.88)
Other outcomes			
Heart failure	lag0	1.52 (1.14-2.03)	1.26 (0.91-1.74)
	lag02	1.59 (1.17-2.16)	1.28 (0.90-1.83)
	lag04	1.66 (1.21-2.28)	1.34 (0.93-1.93)
Atrial fibrillation and flutter	lag0	2.85 (1.32-6.16)	3.49 (1.46-8.38)
	lag02	3.70 (1.65-8.28)	5.17 (2.05-13.08)
	lag04	3.88 (1.67-9.01)	5.56 (2.10-14.72)
Cardiac arrest	lag0	1.12 (0.98-1.28)	1.15 (0.98-1.34)
	lag02	1.11 (0.96-1.28)	1.14 (0.96-1.35)
	lag04	1.12 (0.96-1.30)	1.15 (0.96-1.37)

Table S2: Hazard ratios (HRs, with 95% confidence intervals) of cardiovascular outcomes associated with an increase of 5 $\mu\text{g}/\text{m}^3$ in $\text{PM}_{2.5}$ in the UKB cohort with follow-up until 2019, for combinations of length of exposure windows and confounding control.

Outcome	exposure window	Model 1	Model 2
5-point MACE	lag0	1.15 (1.06-1.26)	1.11 (1.00-1.23)
	lag02	1.17 (1.06-1.28)	1.12 (1.00-1.24)
	lag04	1.16 (1.05-1.28)	1.10 (0.98-1.23)
Myocardial Infarction (MI)			
Acute	lag0	0.96 (0.83-1.11)	1.06 (0.89-1.26)
	lag02	0.94 (0.81-1.11)	1.04 (0.86-1.25)
	lag04	0.95 (0.80-1.12)	1.05 (0.86-1.28)
STEMI	lag0	0.93 (0.74-1.17)	1.04 (0.80-1.36)
	lag02	0.93 (0.73-1.19)	1.06 (0.80-1.42)
	lag04	0.95 (0.74-1.23)	1.11 (0.82-1.51)
NSTEMI	lag0	1.06 (0.83-1.36)	1.39 (1.02-1.88)
	lag02	1.00 (0.77-1.29)	1.27 (0.92-1.75)
	lag04	1.00 (0.77-1.31)	1.28 (0.92-1.77)
Cerebrovascular disease and stroke			
Intracerebral stroke	lag0	1.72 (1.16-2.57)	1.65 (1.03-2.64)
	lag02	1.89 (1.25-2.88)	1.88 (1.14-3.09)
	lag04	1.90 (1.23-2.94)	1.87 (1.11-3.15)
Ischaemic stroke	lag0	1.07 (0.90-1.29)	0.99 (0.80-1.22)
	lag02	1.11 (0.92-1.34)	1.02 (0.82-1.27)
	lag04	1.07 (0.88-1.31)	0.97 (0.77-1.22)
Subarachnoid stroke	lag0	1.01 (0.64-1.58)	0.91 (0.55-1.53)

	lag02	1.07 (0.66-1.73)	0.98 (0.56-1.71)
	lag04	1.12 (0.67-1.87)	1.03 (0.57-1.88)
Other outcomes			
Heart failure	lag0	1.37 (1.17-1.59)	1.22 (1.01-1.46)
	lag02	1.37 (1.17-1.61)	1.20 (0.99-1.45)
	lag04	1.41 (1.19-1.66)	1.22 (1.00-1.49)
Atrial fibrillation and flutter	lag0	1.11 (1.00-1.23)	1.10 (0.98-1.24)
	lag02	1.13 (1.02-1.27)	1.13 (0.99-1.28)
	lag04	1.12 (1.00-1.25)	1.10 (0.96-1.26)
Cardiac arrest	lag0	1.11 (1.00-1.23)	1.09 (0.97-1.22)
	lag02	1.13 (1.01-1.25)	1.11 (0.98-1.25)
	lag04	1.11 (0.99-1.24)	1.08 (0.95-1.23)

Table S3: Complete version of table 3 including all the length of the exposure window. Hazard ratios (HRs, with 95% confidence intervals) of cardiovascular outcomes in exposure subset analysis in the UKB cohort. Results are for an increase of 5 $\mu\text{g}/\text{m}^3$ in $\text{PM}_{2.5}$ using fully adjusted models (Model 2).

Outcome	exposure window	Exposure subset		
		≤ 10	≤ 12	Full analysis
5-point MACE	lag0	1.23 (1.03-1.46)	1.16 (1.03-1.31)	1.13 (1.02-1.24)
	lag02	1.21 (0.98-1.48)	1.20 (1.05-1.37)	1.15 (1.03-1.28)
	lag04	1.05 (0.84-1.32)	1.16 (1.01-1.34)	1.12 (1.00-1.26)
Myocardial Infarction (MI)				
Acute	lag0	1.45 (1.11-1.90)	1.04 (0.76-1.41)	1.07 (0.90-1.27)
	lag02	1.34 (0.97-1.84)	1.01 (0.71-1.45)	1.06 (0.87-1.28)
	lag04	1.27 (0.90-1.81)	0.78 (0.53-1.17)	1.06 (0.87-1.29)
STEMI	lag0	1.26 (1.01-1.56)	1.08 (0.84-1.38)	0.98 (0.75-1.28)
	lag02	1.19 (0.94-1.51)	1.01 (0.77-1.34)	1.03 (0.77-1.38)
	lag04	1.20 (0.94-1.53)	1.07 (0.81-1.43)	1.09 (0.80-1.49)
NSTEMI	lag0	1.19 (0.79-1.79)	0.88 (0.39-1.97)	1.52 (1.12-2.07)
	lag02	1.26 (0.77-2.08)	0.89 (0.33-2.36)	1.35 (0.97-1.88)
	lag04	1.19 (0.68-2.07)	0.75 (0.25-2.22)	1.32 (0.95-1.84)
Cerebrovascular disease and stroke				
Intracerebral stroke	lag0	1.94 (1.31-2.87)	1.14 (0.97-1.33)	1.74 (1.09-2.78)
	lag02	1.68 (1.06-2.66)	1.07 (0.88-1.30)	1.91 (1.15-3.17)
	lag04	1.70 (1.01-2.86)	1.10 (0.89-1.36)	1.94 (1.15-3.29)
Ischaemic stroke	lag0	1.63 (1.17-2.26)	1.08 (0.95-1.22)	1.07 (0.87-1.32)
	lag02	1.48 (1.03-2.12)	1.01 (0.88-1.16)	1.08 (0.86-1.36)

	lag04	1.45 (1.00-2.10)	0.98 (0.85-1.14)	1.01 (0.80-1.28)
Subarachnoid stroke	lag0	1.04 (0.85-1.29)	1.28 (1.00-1.65)	0.94 (0.56-1.56)
	lag02	1.11 (0.86-1.42)	1.32 (0.97-1.78)	0.98 (0.56-1.74)
	lag04	0.98 (0.74-1.29)	1.33 (0.95-1.87)	1.03 (0.56-1.89)
Other outcomes				
Heart failure	lag0	1.62 (0.80-3.30)	1.06 (0.93-1.21)	1.19 (1.00-1.42)
	lag02	2.06 (0.86-4.95)	1.07 (0.92-1.25)	1.21 (1.00-1.48)
	lag04	1.51 (0.58-3.93)	1.13 (0.95-1.35)	1.22 (1.00-1.50)
Atrial fibrillation and flutter	lag0	0.95 (0.53-1.69)	1.08 (0.92-1.27)	1.39 (0.94-2.05)
	lag02	0.85 (0.43-1.69)	1.09 (0.90-1.33)	1.38 (0.90-2.12)
	lag04	0.58 (0.27-1.22)	1.22 (0.98-1.52)	1.26 (0.81-1.95)
Cardiac arrest	lag0	1.38 (0.86-2.21)	1.06 (0.93-1.21)	1.09 (0.98-1.22)
	lag02	1.17 (0.69-1.98)	1.12 (0.97-1.30)	1.15 (1.02-1.29)
	lag04	0.95 (0.55-1.64)	1.08 (0.93-1.25)	1.16 (1.03-1.31)

Table S4: Hazard ratios (HRs, with 95% confidence intervals) of three MACE outcomes definitions associated with an increase of 5 $\mu\text{g}/\text{m}^3$ in $\text{PM}_{2.5}$ in the UKB cohort, for combinations of length of exposure windows and confounding control. *Results for 5-point MACE are the same as Table 2.

Outcome	exposure window	Model 1	Model 2
3-point MACE	lag0	1.11 (1.00-1.23)	1.10 (0.98-1.24)
	lag02	1.13 (1.02-1.27)	1.13 (0.99-1.28)
	lag04	1.12 (1.00-1.25)	1.10 (0.96-1.26)
4-point MACE	lag0	1.11 (1.00-1.23)	1.09 (0.97-1.22)
	lag02	1.13 (1.01-1.25)	1.11 (0.98-1.25)
	lag04	1.11 (0.99-1.24)	1.08 (0.95-1.23)
5-point MACE*	lag0	1.17 (1.08-1.28)	1.13 (1.02-1.24)
	lag02	1.20 (1.09-1.32)	1.15 (1.03-1.28)
	lag04	1.18 (1.07-1.31)	1.12 1.00-1.26)

Table S5: Hazard ratios (HRs, with 95% confidence intervals) of cardiovascular outcomes associated with an increase of the IQR ($3.7 \mu\text{g}/\text{m}^3$) in PM2.5 in the UKB cohort for combinations of length of exposure windows and confounding control.

Outcome	exposure window	Model 1	Model 2
5-point MACE	lag0	1.13 (1.06-1.20)	1.09 (1.01-1.18)
	lag02	1.14 (1.07-1.23)	1.11 (1.02-1.20)
	lag04	1.13 (1.05-1.22)	1.09 (1.00-1.18)
Myocardial Infarction (MI)			
Acute	lag0	0.98 (0.88-1.10)	1.05 (0.93-1.20)
	lag02	0.97 (0.86-1.09)	1.04 (0.91-1.20)
	lag04	0.97 (0.85-1.09)	1.04 (0.90-1.21)
STEMI	lag0	0.92 (0.77-1.09)	1.00 (0.82-1.21)
	lag02	0.93 (0.78-1.12)	1.04 (0.84-1.29)
	lag04	0.95 (0.79-1.16)	1.08 (0.86-1.36)
NSTEMI	lag0	1.12 (0.93-1.36)	1.37 (1.09-1.72)
	lag02	1.03 (0.85-1.26)	1.26 (0.99-1.60)
	lag04	1.02 (0.84-1.25)	1.24 (0.97-1.58)
Cerebrovascular disease and stroke			
Intracerebral stroke	lag0	1.54 (1.14-2.08)	1.49 (1.05-2.11)
	lag02	1.62 (1.18-2.22)	1.60 (1.09-2.33)
	lag04	1.63 (1.18-2.27)	1.62 (1.10-2.39)
Ischaemic stroke	lag0	1.10 (0.96-1.26)	1.06 (0.90-1.23)
	lag02	1.12 (0.97-1.29)	1.07 (0.90-1.26)
	lag04	1.09 (0.94-1.26)	1.02 (0.86-1.21)
Subarachnoid stroke	lag0	1.01 (0.72-1.42)	0.94 (0.65-1.38)
	lag02	1.05 (0.73-1.52)	0.98 (0.64-1.48)
	lag04	1.09 (0.74-1.59)	1.01 (0.64-1.58)
Other outcomes			
Heart failure	lag0	1.25 (1.11-1.40)	1.14 (1.00-1.30)
	lag02	1.28 (1.13-1.45)	1.16 (1.00-1.34)
	lag04	1.29 (1.14-1.47)	1.16 (1.00-1.35)
Atrial fibrillation and flutter	lag0	1.30 (1.01-1.68)	1.33 (0.99-1.78)
	lag02	1.31 (1.00-1.71)	1.34 (0.97-1.84)
	lag04	1.24 (0.94-1.64)	1.25 (0.90-1.73)
Cardiac arrest	lag0	1.10 (1.02-1.17)	1.07 (0.99-1.16)
	lag02	1.13 (1.05-1.22)	1.11 (1.02-1.21)
	lag04	1.14 (1.05-1.23)	1.11 (1.02-1.22)

Table S6: Hazard ratios (HRs, with 95% confidence intervals) of cardiovascular outcomes associated with an increase of 5 $\mu\text{g}/\text{m}^3$ in PM2.5 in the UKB cohort excluding the *wash-out* period from enrolment until 2013 for combinations of length of exposure windows and confounding control.

Outcome	exposure window	Model 1	Model 2
5-point MACE	lag0	1.24 (1.12-1.38)	1.20 (1.06-1.36)
	lag02	1.26 (1.13-1.41)	1.22 (1.07-1.38)
	lag04	1.25 (1.12-1.39)	1.20 (1.05-1.36)
Myocardial Infarction (MI)			
Acute	lag0	1.15 (0.95-1.39)	1.31 (1.05-1.63)
	lag02	1.12 (0.92-1.36)	1.29 (1.02-1.63)
	lag04	1.12 (0.93-1.37)	1.30 (1.03-1.64)
STEMI	lag0	1.13 (0.85-1.51)	1.28 (0.91-1.79)
	lag02	1.19 (0.88-1.61)	1.40 (0.97-2.00)
	lag04	1.22 (0.90-1.66)	1.45 (1.01-2.09)
NSTEMI	lag0	1.14 (0.87-1.49)	1.46 (1.06-2.02)
	lag02	1.03 (0.78-1.36)	1.31 (0.93-1.84)
	lag04	1.03 (0.78-1.35)	1.29 (0.92-1.80)
Cerebrovascular disease and stroke			
Intracerebral stroke	lag0	1.68 (1.05-2.68)	1.77 (1.03-3.06)
	lag02	1.76 (1.08-2.86)	1.92 (1.07-3.43)
	lag04	1.75 (1.07-2.84)	1.91 (1.06-3.42)
Ischaemic stroke	lag0	1.12 (0.90-1.40)	1.07 (0.83-1.37)
	lag02	1.11 (0.89-1.39)	1.04 (0.80-1.36)
	lag04	1.09 (0.87-1.36)	1.01 (0.77-1.31)
Subarachnoid stroke	lag0	0.89 (0.50-1.57)	0.84 (0.44-1.60)
	lag02	0.97 (0.53-1.77)	0.94 (0.47-1.89)
	lag04	1.02 (0.56-1.88)	1.00 (0.49-2.05)
Other outcomes			
Heart failure	lag0	1.41 (1.18-1.69)	1.23 (1.00-1.51)
	lag02	1.51 (1.25-1.81)	1.31 (1.05-1.64)
	lag04	1.50 (1.25-1.81)	1.30 (1.05-1.63)
Atrial fibrillation and flutter	lag0	1.51 (1.01-2.24)	1.55 (0.98-2.46)
	lag02	1.50 (0.99-2.27)	1.54 (0.94-2.51)
	lag04	1.40 (0.92-2.12)	1.40 (0.86-2.28)
Cardiac arrest	lag0	1.17 (1.05-1.31)	1.15 (1.01-1.30)
	lag02	1.22 (1.08-1.36)	1.20 (1.05-1.38)
	lag04	1.23 (1.09-1.38)	1.21 (1.06-1.39)

Table S7: Correlations between different exposure windows.

exposure windows	lag0	lag02	lag04
lag0	1		
lag02	0.93	1	
lag04	0.84	0.96	1

Figure S1: Distribution of annual average exposure to PM_{2.5} across participants of the UKB cohort in the period 2003-2021, with limits corresponding to air quality guidelines/directives (AQG and AQD) from the World Health Organization (WHO), European Union (EU), and the United Kingdom (UK).

