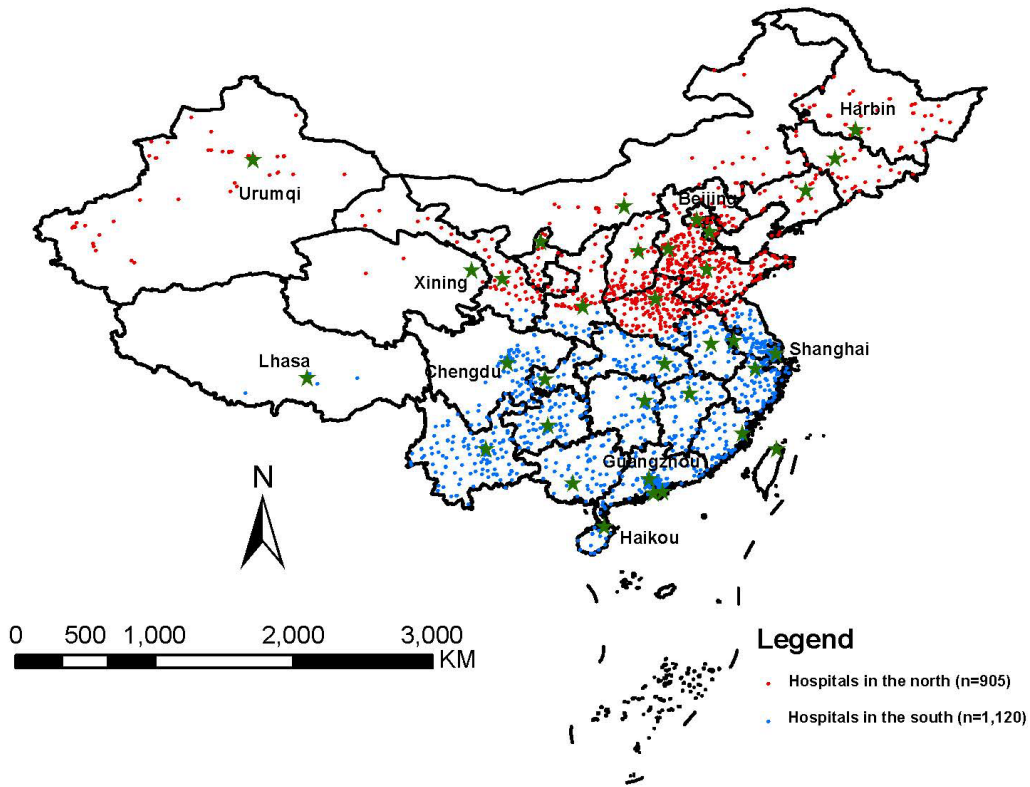
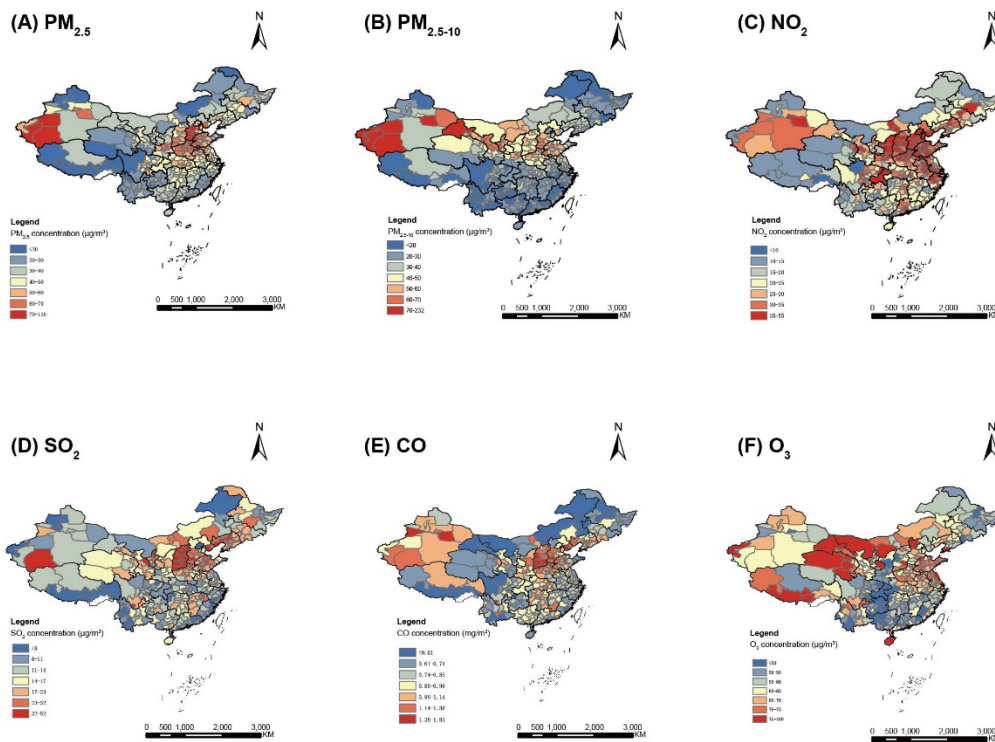


## Appendix 2

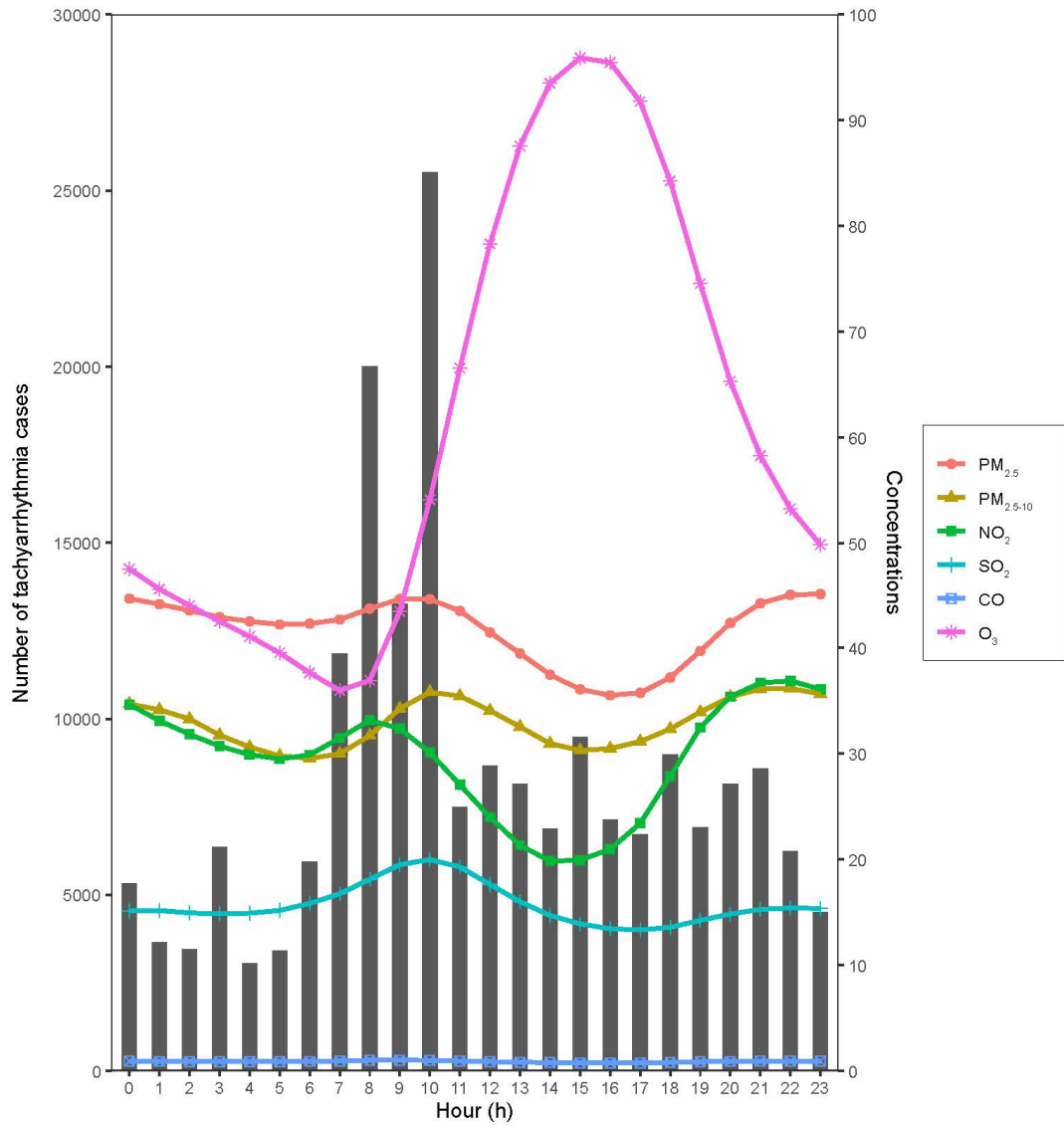


**Supplemental Figure S1. Geographic distribution of the 2025 hospitals.**



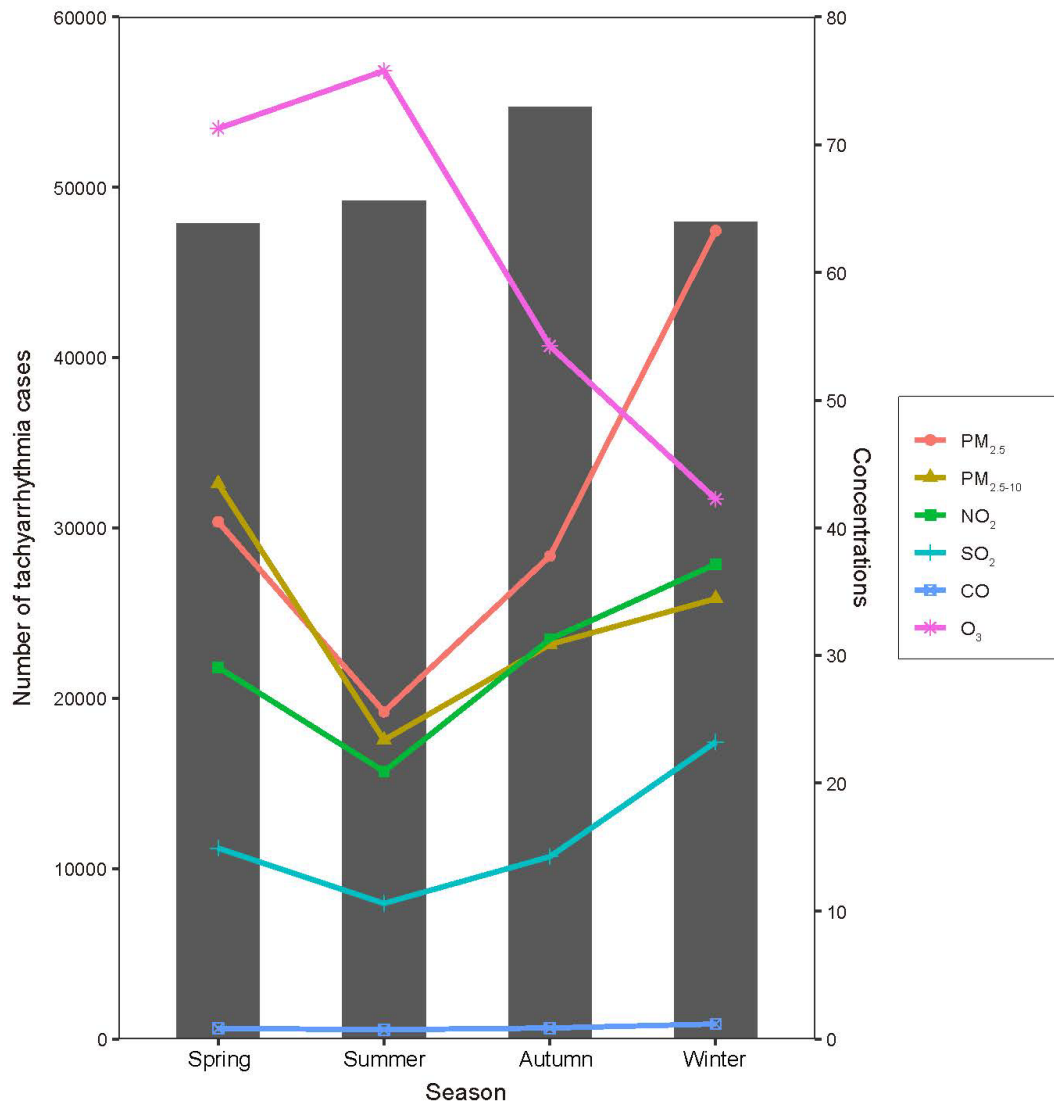
**Supplemental Figure S2. Annual mean concentrations of 6 air pollutants in cities across the China during the study period.**

Abbreviations: (A) PM<sub>2.5</sub>: particulate matter with an aerodynamic diameter less than or equal to 2.5  $\mu\text{m}$ ; (B) PM<sub>2.5-10</sub>: particulate matter with an aerodynamic diameter between 2.5 and 10  $\mu\text{m}$ ; (C) NO<sub>2</sub>: nitrogen dioxide; (D) SO<sub>2</sub>: sulfur dioxide; (E) CO: carbon monoxide; (F) O<sub>3</sub>: ozone



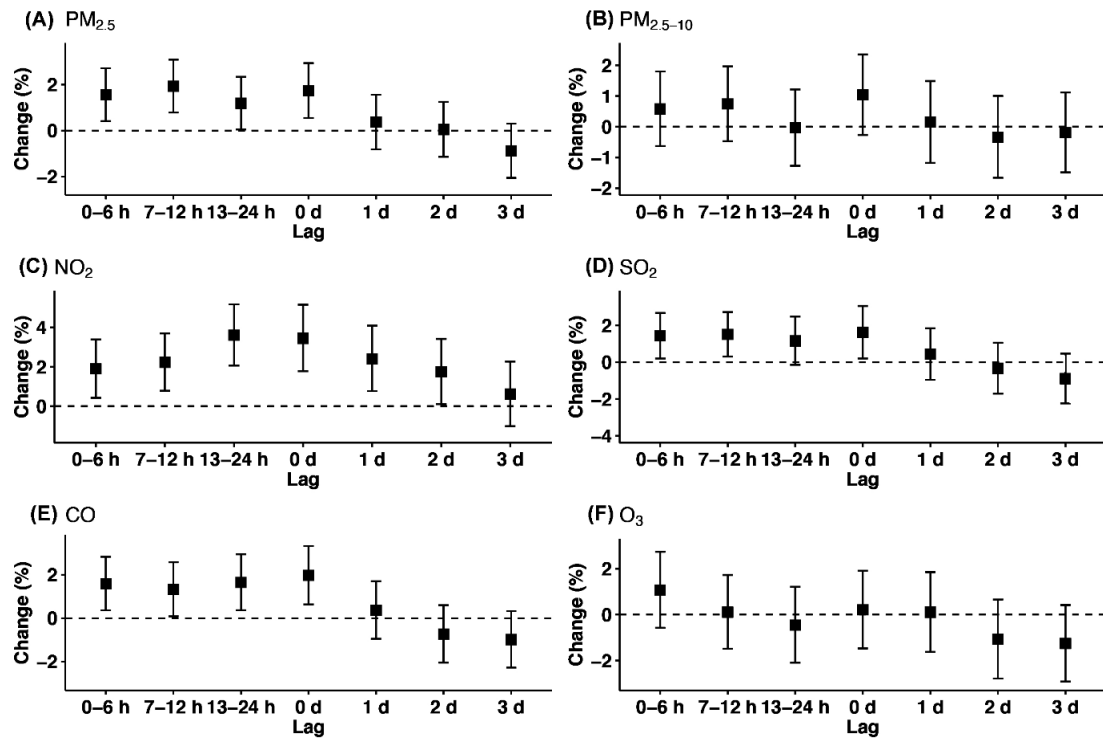
**Supplemental Figure S3. Diurnal distributions of air pollution levels and numbers of overall symptomatic arrhythmia cases.**

Abbreviations as Supplemental Figure S2.



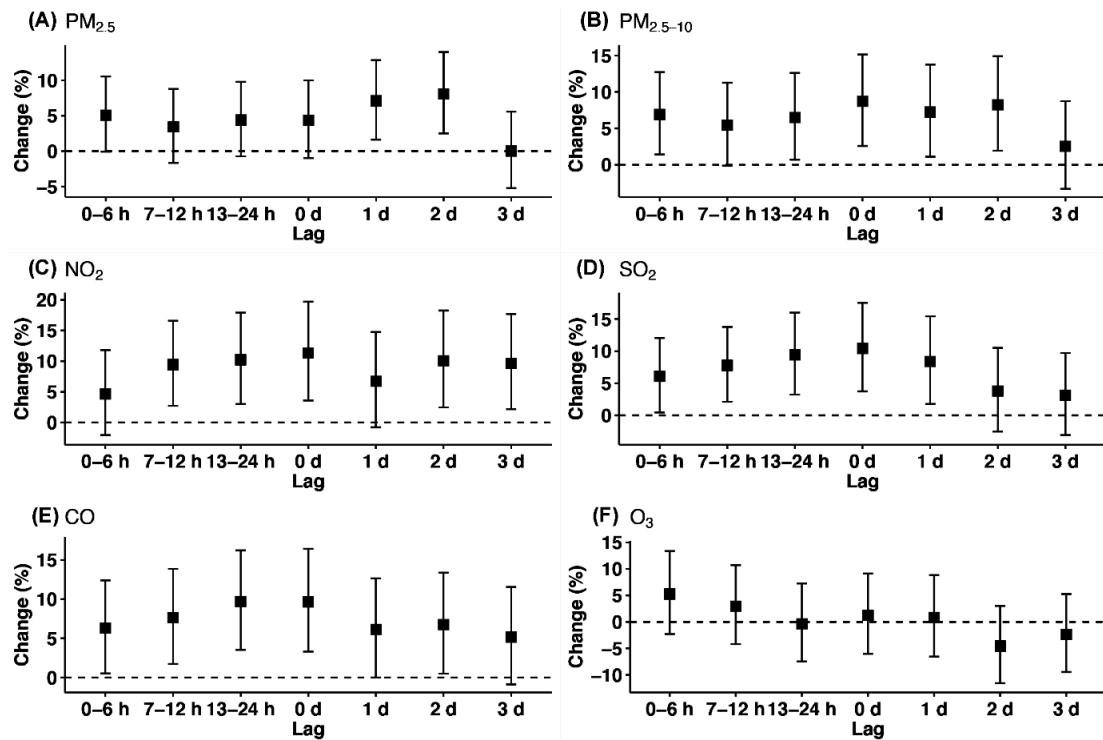
**Supplemental Figure S4. Air pollution levels and numbers of overall symptomatic arrhythmia cases classified by season.**

Abbreviations as Supplemental Figure S2.



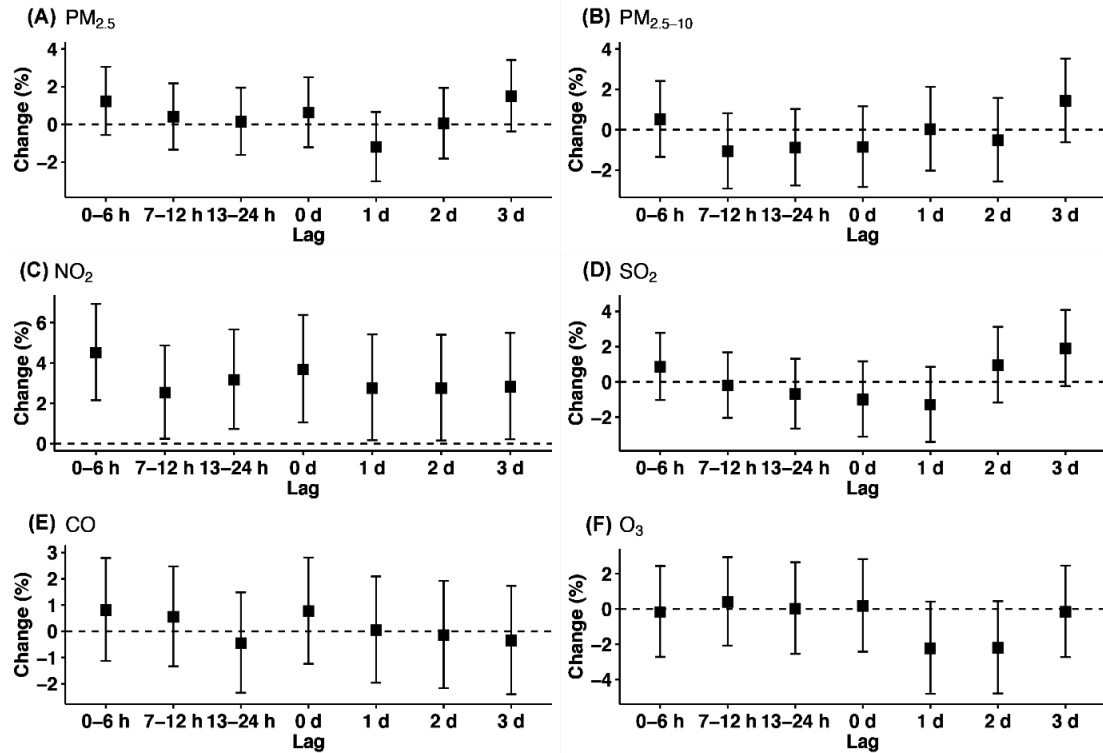
**Supplemental Figure S5. Percent changes and 95% confidence intervals in the odds of atrial fibrillation onset with an interquartile range increase of air pollutant concentrations at different lags.**

Abbreviations as Supplemental Figure S2.



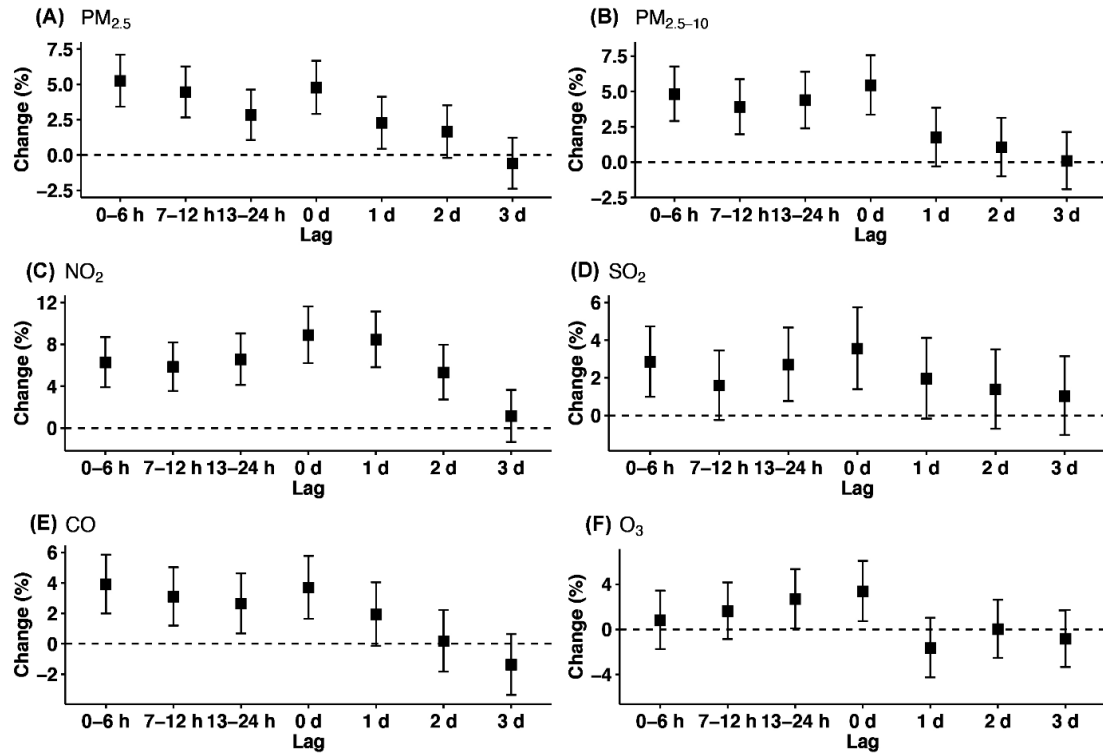
**Supplemental Figure S6. Percent changes and 95% confidence intervals in the odds of atrial flutter onset with an interquartile range increase of air pollutant concentrations at different lags.**

Abbreviations as Supplemental Figure S2.



**Supplemental Figure S7. Percent changes and 95% confidence intervals in the odds of premature beat onset with an interquartile range increase of air pollutant concentrations at different lags.**

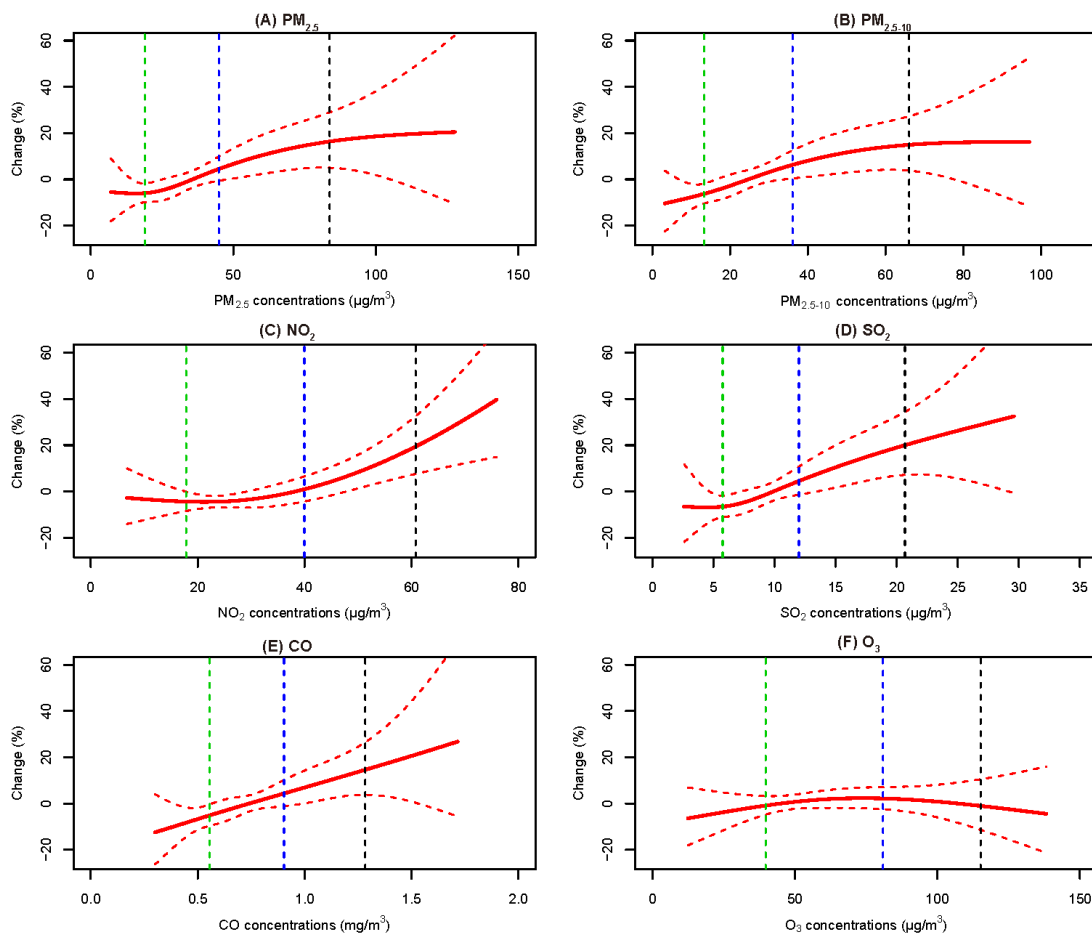
Abbreviations as Supplemental Figure S2.



**Supplemental Figure S8. Percent changes and 95% confidence intervals in the odds of supraventricular tachycardia onset with an interquartile range increase of air pollutant concentrations at different lags.**

Abbreviations as Supplemental Figure S2.



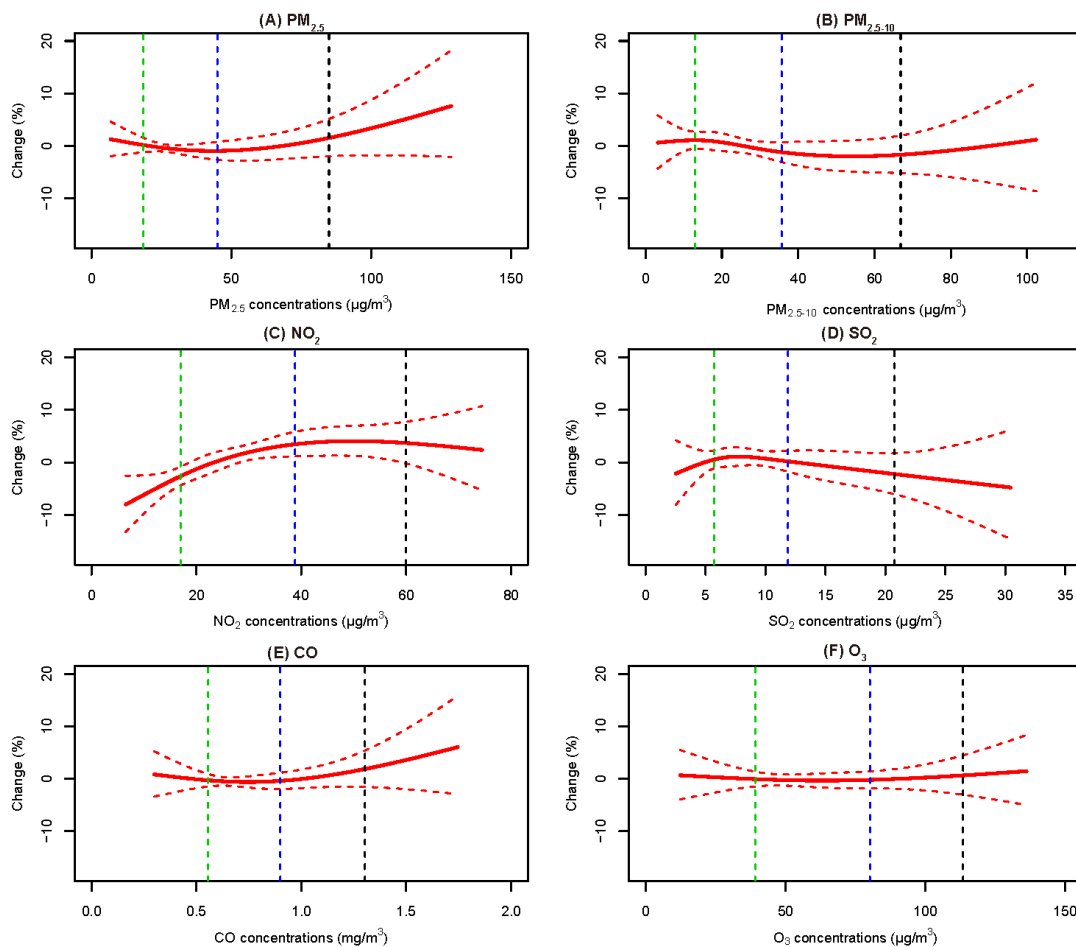


**Supplemental Figure S9. Exposure–response curves for concentrations of 6 air pollutants and atrial flutter onset.**

Note: The associations were presented as percentage change in the odds of the outcome in comparison to the odds at the median concentration at lag 0 to 24 hours (PM<sub>2.5</sub> at lag 2d, 49-72 h). The red solid lines represent the point estimates and the intervals between dashed lines represent 95% confidence intervals. The green dashed lines represent the 25th percentile of air pollutants concentration, The blue dashed lines represent the 75th percentile of air pollutants concentration, and the black dashed lines represent the 95th percentile of air pollutants concentration.

Abbreviations as Supplemental Figure S2.

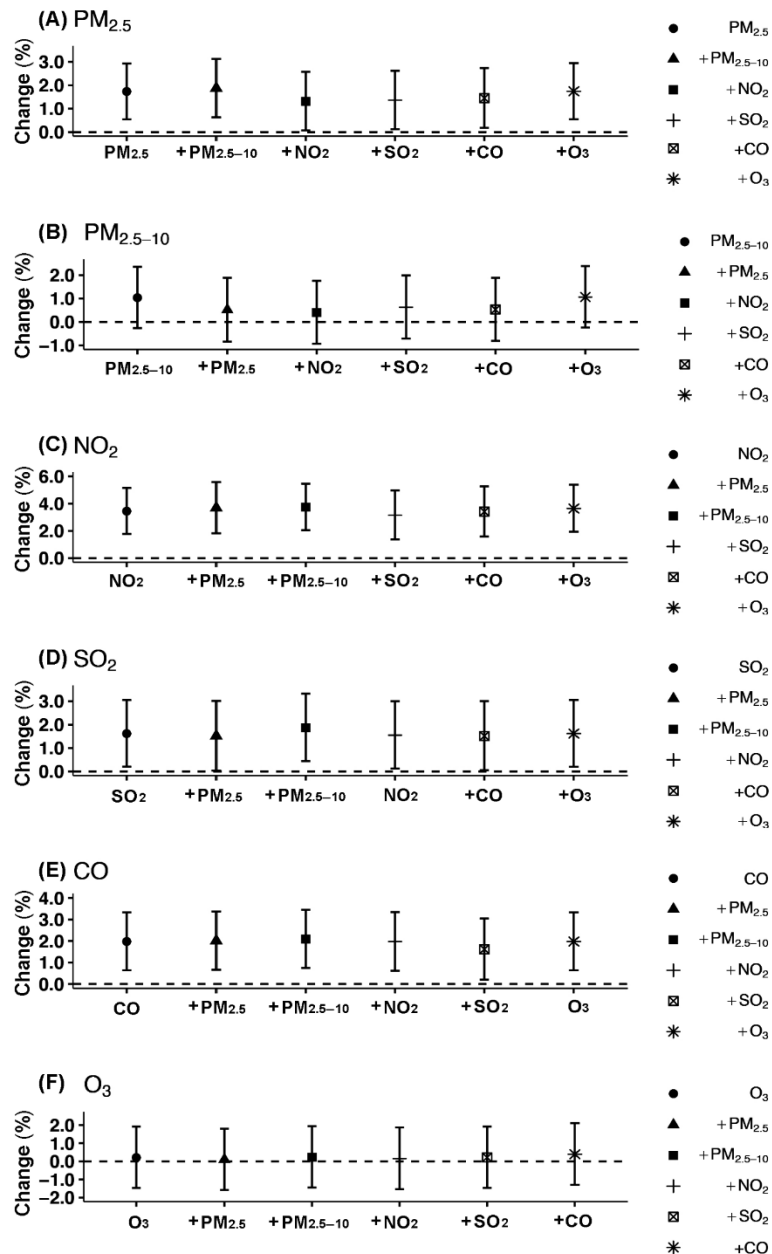




**Supplemental Figure S10. Exposure–response curves for concentrations of 6 air pollutants and premature beat onset.**

Note: The associations were presented as percentage change in the odds of the outcome in comparison to the odds at the median concentration at lag 0 to 24 hours. The red solid lines represent the point estimates and the intervals between dashed lines represent 95% confidence intervals. The green dashed lines represent the 25th percentile of air pollutants concentration, The blue dashed lines represent the 75th percentile of air pollutants concentration, and the black dashed lines represent the 95th percentile of air pollutants concentration.

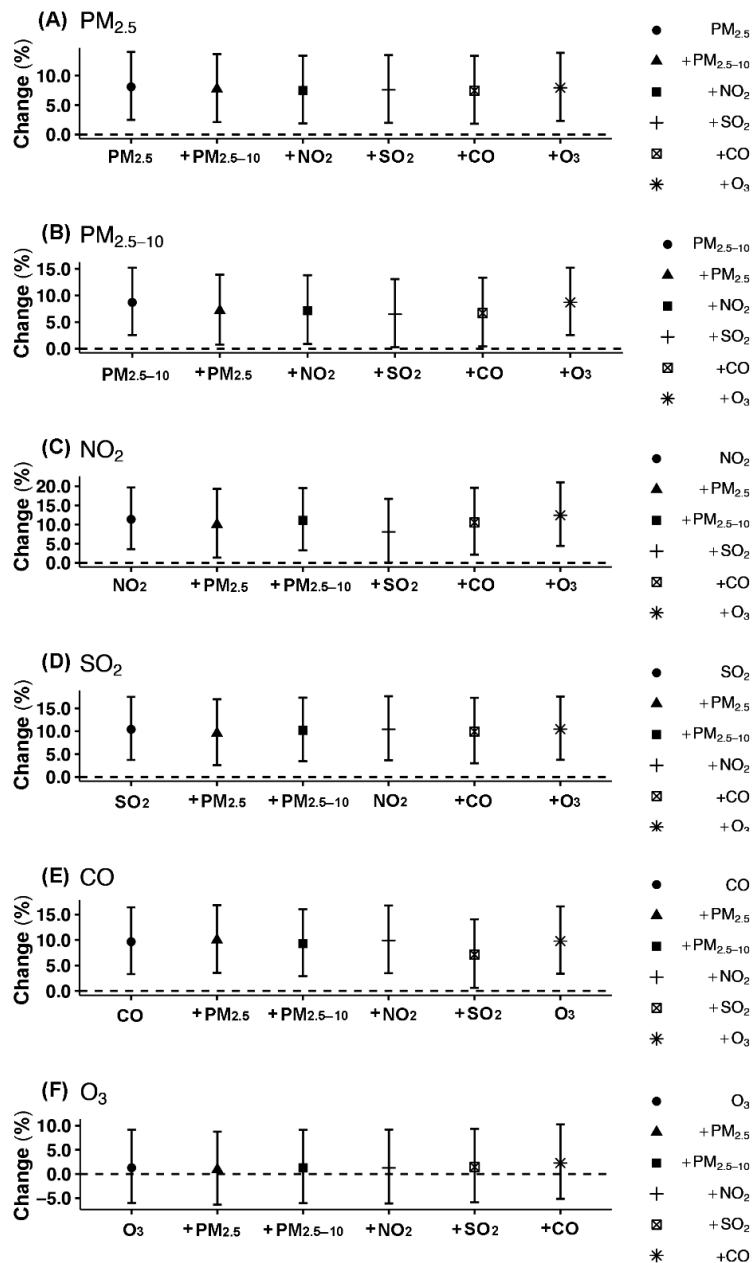
Abbreviations as Supplemental Figure S2.



**Supplemental Figure S11. Estimated percentage changes and 95% confidence intervals in the odds of atrial fibrillation onset associated with an interquartile range increase in air pollutant concentrations at lag 0 d in single- and two- pollutant models.**

Note: Legends showed co-pollutants were successively added into the single-pollutant models that formed a series of two-pollutant models

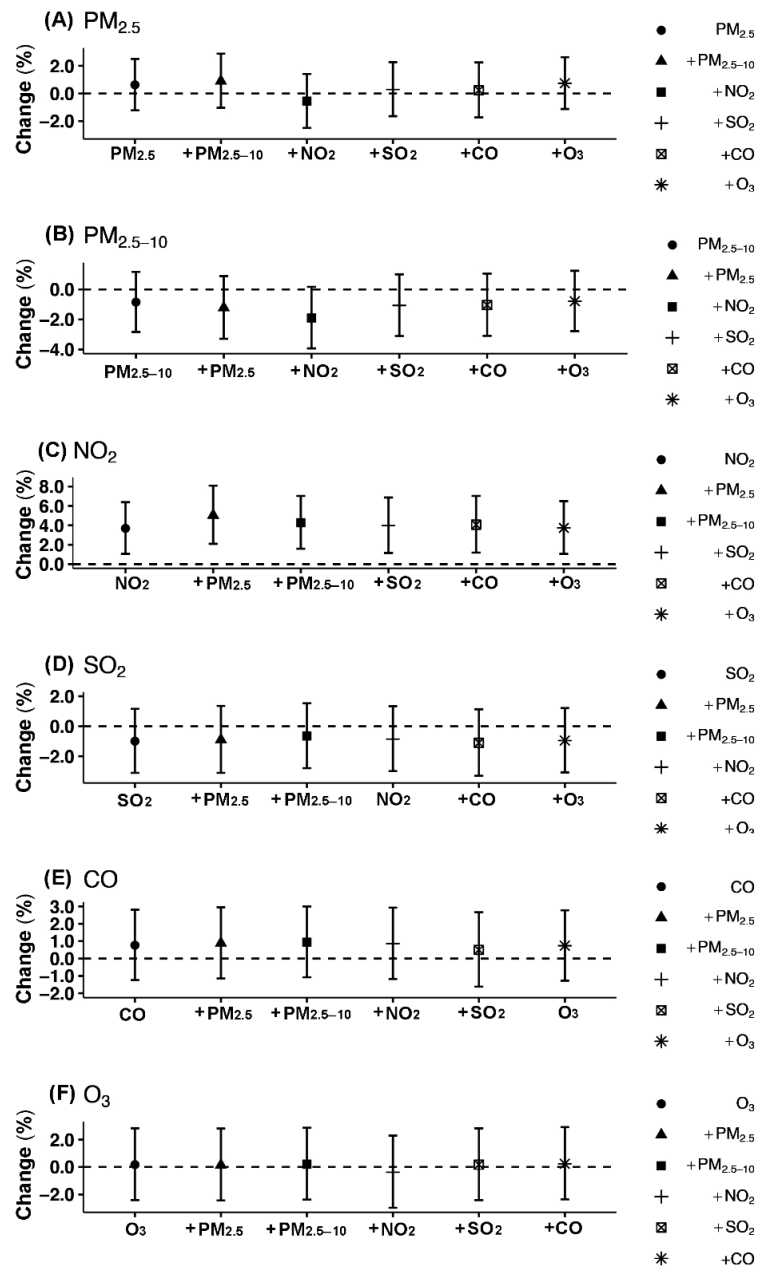
Abbreviations as Supplemental Figure S2.



**Supplemental Figure S12. Estimated percentage changes and 95% confidence intervals in the odds of atrial flutter onset associated with an interquartile range increase in air pollutant concentrations at lag 0 d (PM<sub>2.5</sub> at lag 2 d) in single- and two- pollutant models.**

Figure legend as in Supplemental Figure S11.

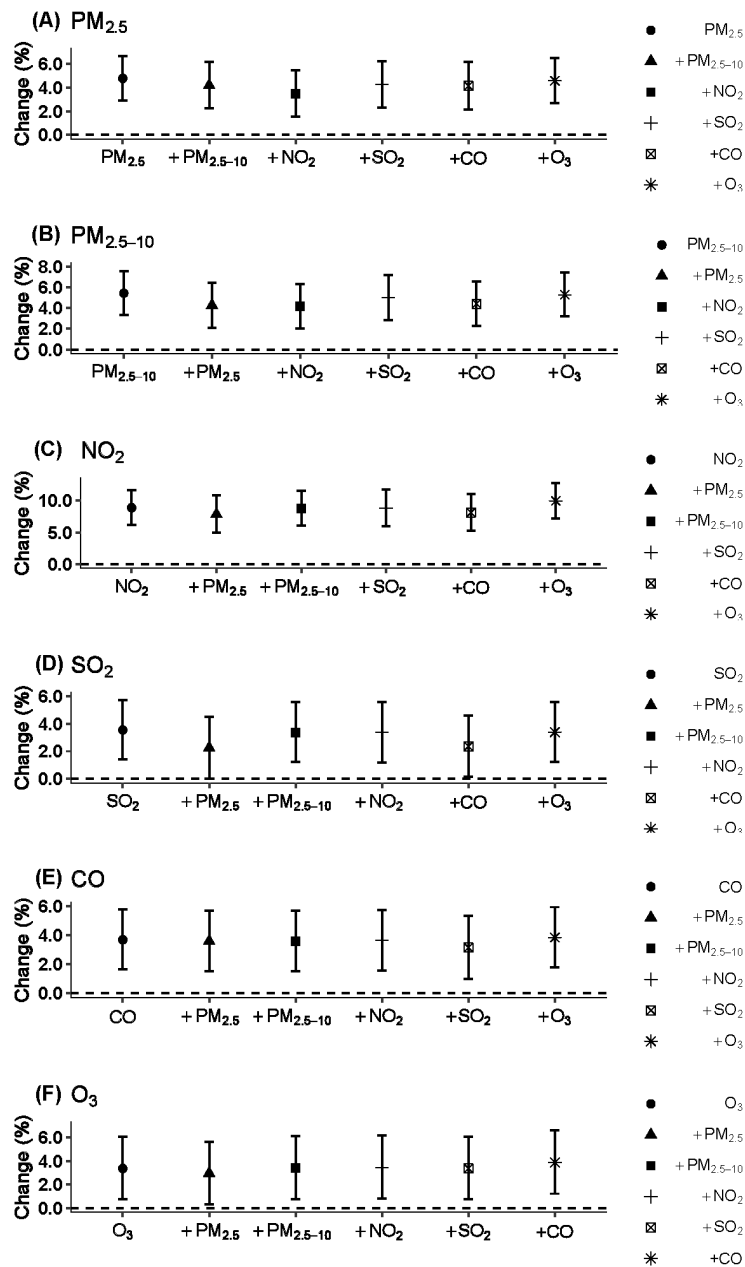
Abbreviations as Supplemental Figure S2.



**Supplemental Figure S13. Estimated percentage changes and 95% confidence intervals in the odds of premature beat onset associated with an interquartile range increase in air pollutant concentrations at lag 0 d in single- and two- pollutant models.**

Figure legend as in Supplemental Figure S11.

Abbreviations as Supplemental Figure S2.



**Supplemental Figure S14. Estimated percentage changes and 95% confidence intervals in the odds of supraventricular tachycardia onset associated with an interquartile range increase in air pollutant concentrations at lag 0 d in single- and two- pollutant models.**

Figure legend as in Supplemental Figure S11.

Abbreviations as Supplemental Figure S2.



**Supplemental Table S1. Spearman correlation coefficients of air pollutant concentrations and meteorological conditions over lags 0–24 h.**

	<b>PM<sub>2.5</sub></b>	<b>PM<sub>2.5–10</sub></b>	<b>NO<sub>2</sub></b>	<b>SO<sub>2</sub></b>	<b>CO</b>	<b>O<sub>3</sub></b>	<b>Temperature</b>
PM <sub>2.5–10</sub>	0.38						
NO <sub>2</sub>	0.55	0.24					
SO <sub>2</sub>	0.35	0.18	0.39				
CO	0.63	0.14	0.53	0.48			
O <sub>3</sub>	-0.16	0.04	-0.31	-0.07	-0.25		
Temperature	-0.45	-0.14	-0.35	-0.33	-0.36	0.42	
Relative humidity	-0.17	-0.32	-0.23	-0.31	-0.06	-0.22	0.25

Abbreviations as Supplemental Figure S2.

**Supplemental Table S2. Spearman correlation coefficients of the average concentrations of air pollutants and the numbers of overall arrhythmia cases at the diurnal or seasonal level.**

		<b>PM<sub>2.5</sub></b>	<b>PM<sub>2.5-10</sub></b>	<b>NO<sub>2</sub></b>	<b>SO<sub>2</sub></b>	<b>CO</b>	<b>O<sub>3</sub></b>
Diurnal	correlation coefficient	-0.10	0.12	-0.12	0.33	0.23	0.23
	P	0.7	0.6	0.6	0.1	0.3	0.3
Seasonal	correlation coefficient	-0.60	-0.80	0.00	-0.60	0.00	0.00
	P	0.4	0.2	1.0	0.4	1.0	1.0

Abbreviations as Supplemental Figure S2.

**Supplemental Table S3. P values for the statistical tests for the difference of model fit between linear models and nonlinear models.**

<b>Pollutants</b>	<b>Atrial fibrillation</b>	<b>Atrial flutter</b>	<b>Premature beat</b>	<b>Supraventricular tachycardia</b>
PM <sub>2.5</sub>	0.59	0.74	0.25	0.07
PM <sub>2.5-10</sub>	0.39	0.58	0.58	0.08
NO <sub>2</sub>	0.10	0.06	0.06	0.54
SO <sub>2</sub>	0.87	0.82	0.51	0.22
CO	0.40	0.98	0.37	0.38
O <sub>3</sub>	0.57	0.31	0.62	0.06

Abbreviations as Supplemental Figure S2.

**Supplemental Table S4. Estimated percent changes (and 95% confidence intervals, CIs) in odds of overall arrhythmia onset associated with an interquartile range (IQR) increase in air pollutant concentrations at lag 0–24 h, classified by subgroups.**

Subgroups	PM <sub>2.5</sub>	P	PM <sub>2.5–10</sub>	P	NO <sub>2</sub>	P	SO <sub>2</sub>	P	CO	P	O <sub>3</sub>	P
Sex												
Male	3.0 (1.8–4.2)	0.2	2.0 (0.7–3.4)	0.7	5.6 (3.9–7.4)	0.3	2.9 (1.5–4.4)	0.1	2.3 (1.0–3.7)	0.9	1.4 (-0.4–3.1)	0.4
Female	1.6 (0.4–2.9)		1.7 (0.3–3.1)		4.4 (2.6–6.2)		0.5 (-1.0–1.9)		2.3 (0.9–3.7)		0.4 (-1.3–2.2)	
Age												
≥65	1.4 (0.3–2.6)	0.1	0.9 (-0.4–2.2)	0.1	4.0 (2.3–5.7)	0.2	1.2 (-0.2–2.6)	0.3	1.9 (0.6–3.3)	0.4	-0.3 (-2.0–1.4)	0.1
<65	3.2 (1.9–4.6)		2.8 (1.4–4.3)		5.9 (4.1–7.8)		2.3 (0.8–3.8)		2.8 (1.4–4.3)		2.3 (0.5–4.2)	
Region												
North	3.3 (2.0–4.6)	0.047	1.4 (0.1–2.8)	0.7	6.2 (4.3–8.2)	0.3	4.7 (3.1–6.4)	0.045	3.2 (1.8–4.7)	0.6	2.3 (-0.01–4.6)	0.3
South	1.8 (0.5–3.1)		1.0 (-0.3–2.2)		4.2 (2.6–5.8)		0.5 (-0.9–1.8)		1.8 (0.5–3.2)		0.5 (-1.0–2.0)	
Season												
Warm	0.3 (-1.1–1.7)	0.2	-0.5 (-1.9–0.9)	0.03	0.5 (-1.1–2.1)	0.01	-0.3 (-1.7–1.2)	0.03	0.7 (-0.8–2.2)	0.2	-1.2 (-2.8–0.4)	0.047
Cold	3.2 (2.0–4.4)		2.9 (1.6–4.3)		8.0 (6.3–9.8)		3.9 (2.4–5.4)		2.9 (1.7–4.2)		2.1 (0.5–3.8)	

Note: P values for effect modification

Abbreviations as in Supplemental Figure S2.

**Supplemental Table S5. The coefficients and p-values for the interaction terms of grouping factors and air pollutants in the associations between air pollution (lag 0–24 h) and overall arrhythmia onset.**

<b>Grouping factors</b>		<b>PM<sub>2.5</sub></b>	<b>PM<sub>2.5-10</sub></b>	<b>NO<sub>2</sub></b>	<b>SO<sub>2</sub></b>	<b>CO</b>	<b>O<sub>3</sub></b>
Sex	$\beta$	-0.0005	-0.0004	-0.0007	-0.0045	-0.0025	-0.0003
	P	0.1	0.3	0.2	0.004*	0.9	0.3
Age	$\beta$	-0.0006	-0.0010	-0.0008	-0.0021	-0.0152	-0.0007
	P	0.1	0.012*	0.1	0.2	0.6	0.012*
Region	$\beta$	0.0005	0.0007	0.0007	0.0047	0.0373	0.0002
	P	0.1	0.1	0.2	0.003*	0.2	0.5
Season	$\beta$	0.0008	0.0008	0.0023	0.0037	0.0607	0.0008
	P	0.02*	0.04*	<0.001*	0.02*	0.04*	0.004*

\*: P<0.05

Note: A positive direction of interaction coefficients denotes higher risks of males, youngsters, the north region and the cold season

Abbreviations as in Supplemental Figure S2.

**Supplemental Table S6. The coefficients and p-values for the interaction of fine particulate matter and ozone in the associations between air pollution (lag 0–24 h) and each subtype of arrhythmias onset.**

	<b>Atrial fibrillation</b>	<b>Atrial flutter</b>	<b>Premature beat</b>	<b>Supraventricular tachycardia</b>
Coefficient	-0.00001	0.000002 †	-0.00003	0.00001
P	0.4	0.9	0.1	0.4

† The coefficient was estimated using PM<sub>2.5</sub> concentrations at lag 2 day (lag 49–72 h)

**Supplemental Table S7. Estimated percent changes and 95% confidence intervals (CIs) in odds of symptomatic arrhythmias onset associated with an interquartile range (IQR) increase in air pollutant concentrations at lag 0–24 h using exposure data assigned according to the onset address and the hospital address.**

<b>Pollutants</b>	<b>Atrial fibrillation</b>	<b>Atrial flutter</b>	<b>Premature beat</b>	<b>Supraventricular tachycardia</b>
Onset address				
PM <sub>2.5</sub>	2.1 (0.5–3.7)	8.2 (2.9–13.4) †	-0.3 (-3.0–2.4)	4.5 (1.9–7.2)
PM <sub>2.5–10</sub>	0.1 (-1.6–1.9)	15.6 (6.4–25.5)	0.3 (-2.5–3.2)	5.8 (2.9–8.7)
NO <sub>2</sub>	3.0 (0.6–5.4)	15.1 (3.2–28.5)	5.8 (2.0–9.8)	11.4 (7.5–15.5)
SO <sub>2</sub>	1.9 (0.1–3.8)	9.6 (0.3–19.7)	0.5 (-2.5–3.7)	3.0 (0.4–5.9)
CO	1.9 (0.2–3.5)	10.1 (0.9–20.1)	-0.1 (-2.9–3.0)	4.4 (1.5–7.4)
O <sub>3</sub>	-2.0 (-4.2–0.4)	7.6 (-3.5–20.0)	-2.0 (-5.5–1.7)	3.4 (1.5–5.3)
Hospital address				
PM <sub>2.5</sub>	1.3 (0.4–2.2)	7.3 (0.8–13.8)	-0.3 (-2.9–2.4)	4.7 (2.1–7.4)
PM <sub>2.5–10</sub>	0.7(-1.1–2.5)	14.5 (5.5–24.3)	-1.6 (-4.4–1.2)	6.8 (3.9–9.7)
NO <sub>2</sub>	4.1 (1.7–6.5)	15.3 (3.5–28.5)	4.4 (0.9–8.0)	10.3 (6.4–14.3)
SO <sub>2</sub>	2.0 (0.3–3.8)	11.2 (1.7–21.7)	0.2 (-2.8–3.2)	2.8 (0.3–5.3)
CO	1.5 (0.4–2.6)	14.9 (5.1–25.6)	-0.5 (-3.4–2.4)	3.8 (0.9–6.7)
O <sub>3</sub>	-1.0 (-3.3–1.3)	5.0 (-5.8–17.0)	-3.4 (-7.0–0.4)	2.9 (0.8–4.9)

† The percent change was estimated using PM<sub>2.5</sub> concentrations at lag 2 day (lag 49–72 h)

Abbreviations as in Supplemental Figure S2.

**Supplemental Table S8. Estimated percent changes and 95% confidence intervals (CIs) in odds of symptomatic arrhythmias onset associated with an interquartile range (IQR) increase in air pollutants concentration at lag 0–24 h according to the time of emergency–room visits and the time of symptom onset.**

<b>Pollutants</b>	<b>Time</b>	<b>Atrial fibrillation</b>	<b>Atrial flutter</b>	<b>Premature beat</b>	<b>Supraventricular tachycardia</b>
PM <sub>2.5</sub>	emergency–room visit	2.5 (1.3–3.7)	5.3 (0.2–10.3) †	2.7 (-0.8–6.2)	5.1 (3.2–7.0)
	symptom onset	1.7 (0.6–2.9)	8.1 (2.5–14.0) †	0.6 (-1.2–2.5)	4.8 (2.9–6.7)
PM <sub>2.5–10</sub>	emergency–room visit	1.9 (-0.6–4.3)	10.1 (4.0–16.6)	1.7 (-0.4–3.8)	4.6 (2.5–6.8)
	symptom onset	1.0 (-0.3–2.4)	8.7 (2.6–15.2)	-0.9 (-2.8–1.2)	5.4 (3.4–7.6)
NO <sub>2</sub>	emergency–room visit	5.8 (4.1–7.6)	14.2 (6.2–22.8)	7.0 (4.2–9.8)	10.2 (7.5–13.0)
	symptom onset	3.4 (1.8–5.1)	11.4 (3.6–19.7)	3.7 (1.1–6.4)	8.9 (6.2–11.6)
SO <sub>2</sub>	emergency–room visit	2.5 (1.0–4.0)	10.2 (3.3–17.4)	3.3 (-1.1–7.6)	4.2 (2.0–6.4)
	symptom onset	1.6 (0.2–3.1)	10.4 (3.7–17.5)	-1.0 (-3.1–1.2)	3.6 (1.4–5.7)
CO	emergency–room visit	2.5 (1.2–3.9)	10.4 (4.0–17.2)	2.7 (-0.6–6.0)	3.9 (1.8–6.0)
	symptom onset	2.0 (0.6–3.3)	9.7 (3.3–16.4)	0.8 (1.2–2.8)	3.7 (1.6–5.8)
O <sub>3</sub>	emergency–room visit	-0.4 (-2.1–1.3)	-3.2 (-10.3–4.5)	0.2 (-2.5–2.9)	2.9 (0.2–5.7)
	symptom onset	0.2 (-1.5–1.9)	1.3 (-6.0–9.2)	0.2 (-2.4–2.8)	3.4 (0.7–6.1)

† The percent change was estimated using PM<sub>2.5</sub> concentrations at lag 2 day (lag 49–72 h)

Abbreviations as in Supplemental Figure S2.



**Supplemental Table S9. The False Discovery Rates for the risk estimation between each air pollutant and each subtype of arrhythmias at lag 0–24 h.**

<b>Pollutants</b>	<b>Atrial fibrillation</b>	<b>Atrial flutter</b>	<b>Premature beat</b>	<b>Supraventricular tachycardia</b>
PM <sub>2.5</sub>	0.01	0.01 <sup>†</sup>	0.6	<0.001
PM <sub>2.5–10</sub>	0.2	0.01	0.5	<0.001
NO <sub>2</sub>	<0.001	0.01	0.01	<0.001
SO <sub>2</sub>	0.04	0.01	0.5	0.01
CO	0.01	0.01	0.6	0.002
O <sub>3</sub>	0.9	0.8	0.9	0.02

<sup>†</sup> The effect was estimated using PM<sub>2.5</sub> concentrations at lag 2 day (lag 49–72 h)

Abbreviations as in Supplemental Figure S2.

**Supplemental Table S10. The False Discovery Rates for the risk estimation between each air pollutant and overall arrhythmia in subgroup analyses at lag 0–24 h.**

<b>Subgroups</b>	<b>PM<sub>2.5</sub></b>	<b>PM<sub>2.5–10</sub></b>	<b>NO<sub>2</sub></b>	<b>SO<sub>2</sub></b>	<b>CO</b>	<b>O<sub>3</sub></b>
<b>Sex</b>						
Male	<0.001	0.01	<0.001	<0.001	0.002	0.2
Female	0.02	0.02	<0.001	0.6	0.003	0.7
<b>Age</b>						
≥65	0.03	0.2	<0.001	0.1	0.01	0.7
<65	<0.001	<0.001	<0.001	0.01	<0.001	0.02
<b>Region</b>						
North	<0.001	0.03	<0.001	<0.001	<0.001	0.1
South	0.01	0.2	<0.001	0.6	0.02	0.6
<b>Season</b>						
Warm	0.7	0.5	0.6	0.7	0.4	0.2
Cold	<0.001	<0.001	<0.001	<0.001	<0.001	0.02

Abbreviations as in Supplemental Figure S2.