PM_{10} increases mortality risk in rheumatoid arthritis–associated interstitial lung disease

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Supplemental materials

Appendix S1:

Material and methods

Individual-level exposure assessment for PM_{10} and NO_2

On the basis of the geo-coded residential addresses, the national-scale pointwise exposure prediction model was developed in a universal kriging framework to estimate the annual average concentrations of PM_{10} and NO_2 at any location in South Korea.[1,2] The model uses air pollution concentration data measured at approximately 300 regular air quality monitoring sites and includes 300 geographic variables that represent plausible air pollution sources.[1] The model performance was moderately good and revealed cross-validated R^2 values of 0.45 and 0.82 for PM_{10} and NO_2, respectively,[1] which were compatible with those of the previously reported national or regional models developed in Europe[3] and the United States.[4]

References

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2. Park Y, Song I, Yi J, Yi SJ, Kim SY. Web-Based Visualization of Scientific Research Findings: National-Scale Distribution of Air Pollution in South Korea. Int J Environ Res Public Health 2020;17.
3. de Hoogh K, Korek M, Vienneau D, Keuken M, Kukkonen J, Nieuwenhuijsen MJ, et al. Comparing land use regression and dispersion modelling to assess residential exposure to ambient air pollution for epidemiological studies. Environ Int 2014;73:382-92.
4. Hart JE, Yanosky JD, Puett RC, Ryan L, Dockery DW, Smith TJ, et al. Spatial modeling of PM10 and NO2 in the continental United States, 1985-2000. Environ Health Perspect 2009;117:1690-6.

Table S1. Comparison of the effect of high (top 25th percentile) air pollutant concentrations on mortality in patients with RA-ILD stratified by RF[*]

		Hazard Ratio (95% Confidence Interval)			
		Model 1	Model 2	Model 3	Model 4
Air pollutants					
PM_{10}, μg/m^3	RF (+)	1.16 (0.76, 1.77) p=0.495	1.35 (0.88, 2.09) p=0.172	1.46 (0.94, 2.27) p=0.091	1.54 (0.98, 2.42) p=0.060
	RF (-)	1.37 (0.52, 3.62) p=0.528	3.96 (1.07, 14.65) p=0.039	7.20 (1.63, 31.76) p=0.009	18.81 (2.91, 121.61) p=0.002
NO_2, ppb	RF (+)	1.04 (0.68, 1.61) p=0.845	0.86 (0.55, 1.34) p=0.512	0.89 (0.56, 1.41) p=0.610	0.98 (0.59, 1.62) p=0.939
	RF (-)	2.52 (1.02, 6.23) p=0.046	2.99 (0.79, 11.31) p=0.106	1.85 (0.43, 7.97) p=0.411	1.21 (0.14, 10.53) p=0.863

NO_2, nitrogen dioxide; PM_{10}, particulate matter < 10 μm; ppb, parts per billion; RA-ILD, rheumatoid arthritis–associated interstitial lung disease; RF, rheumatoid factor. * RF (+) (n=250) versus RF (-) (n=55)

Table S2. Comparison of the effect of high (top 25th percentile) air pollutant concentrations on mortality in patients with RA-ILD stratified by ACPA*

		Hazard Ratio (95% Confidence Interval)			
		Model 1	Model 2	Model 3	Model 4
Air pollutants					
PM_{10}, μg/m^3	ACPA (+)	1.33 (0.86, 2.08) p=0.203	1.43 (0.91, 2.24) p=0.124	1.51 (0.96, 2.37) p=0.076	1.58 (0.99, 2.51) p=0.054
	ACPA (-)	0.68 (0.24, 1.90) p=0.457	1.23 (0.36, 4.23) p=0.741	1.24 (0.35, 4.41) p=0.743	1.55 (0.40, 6.00) p=0.524
NO_2, ppb	ACPA (+)	1.17 (0.75, 1.82) p=0.486	0.93 (0.58, 1.46) p=0.738	1.03 (0.64, 1.66) p=0.897	1.15 (0.67, 1.96) p=0.620
	ACPA (-)	0.68 (0.22, 2.08) p=0.493	0.85 (0.25, 2.87) p=0.794	0.39 (0.10, 1.48) p=0.165	0.42 (0.08, 2.10) p=0.290

ACPA, Anti-citrullinated protein antibodies; NO_2, nitrogen dioxide; PM_{10}, particulate matter < 10 μm; ppb, parts per billion; RA-ILD, rheumatoid arthritis–associated interstitial lung disease. * ACPA (+) (n=237) vs. ACPA (-) (n=52)

Figure S1. The correlation between the annual average concentration of PM_{10} in 2006 and each year between 2001 and 2018 measured at regulatory monitoring sites in South Korea The X- and Y-axes present the measured PM_{10} in 2006 and each year during 2001–2018, respectively. The red and green lines indicate the best-fitted and identity lines, respectively. PM_{10}, particulate matter ≤ 10 μm; r, Pearson's correlation coefficient concentrations

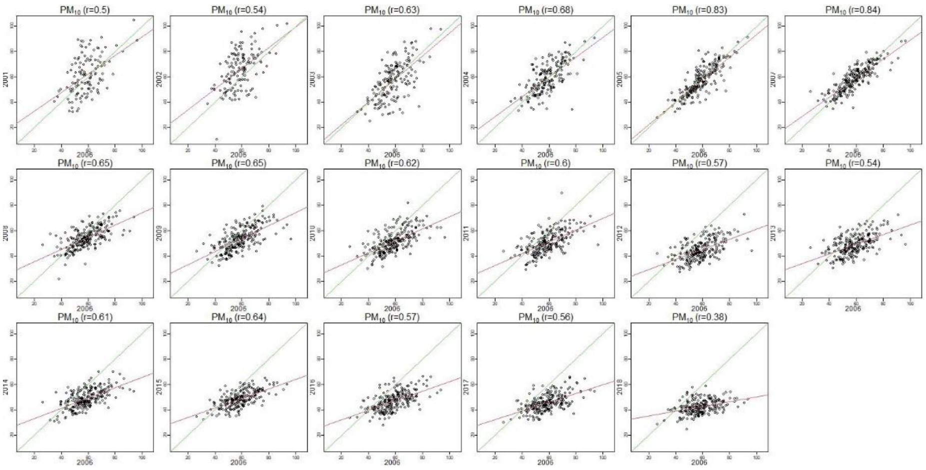

Figure S2. The correlation between the annual average concentration of NO_2 in 2006 and each year between 2001 and 2018 measured at regulatory monitoring sites in South Korea The X- and Y-axes present the measured NO_2 in 2006 and each year during 2001–2018, respectively. The red and green lines indicate the best-fitted and identity lines, respectively. NO_2, nitrogen dioxide; r, Pearson's correlation coefficient concentrations

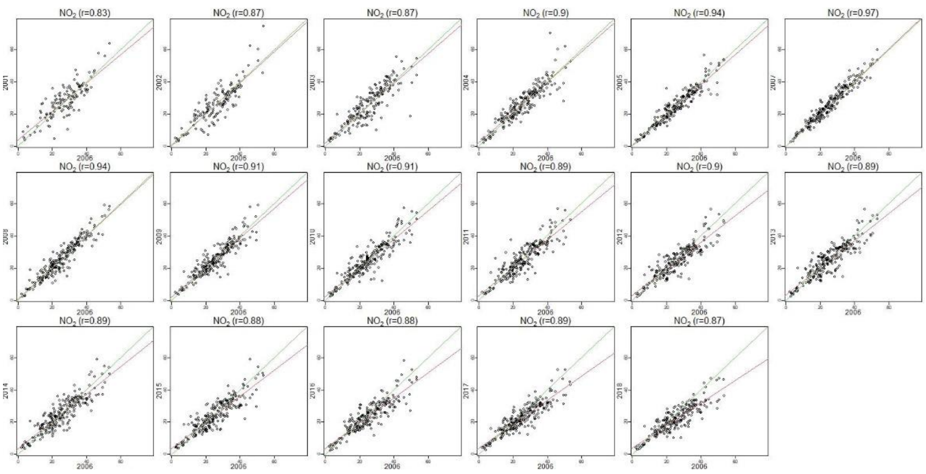

Figure S3. The survival probability over time in patients with RA-ILD

(a) The Kaplan–Meier survival curve for all the patients. (b) The Kaplan–Meier survival curve according to the quartiles of PM_{10} concentrations. (c) The Kaplan–Meier survival curve according to the quartiles of NO_2 concentrations.

RA-ILD, rheumatoid arthritis–associated interstitial lung disease; PM_{10}, particulate matter ≤ 10 μm; NO_2, nitrogen dioxide; Q1, first quartile (lowest 25% of the numbers); Q2, second quartile (next lowest 25% of the numbers up to the median); Q3, third quartile (second highest 25% of the numbers above the median); Q4, fourth quartile (highest 25% of the numbers)

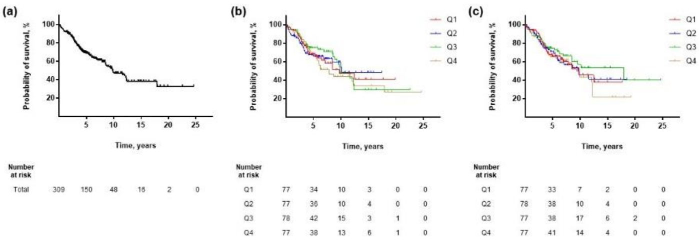

Figure S4. The effect of air pollutant concentrations on the mortality of patients with RA-ILD stratified by quartiles (Q1–Q4)

The forest plot of (a) PM_{10} and (b) NO_2. Symbols and error bars represent hazard ratios and 95% confidence intervals, respectively.

RA-ILD, rheumatoid arthritis–associated interstitial lung disease; PM_{10}, particulate matter ≤ 10 μm; NO_2, nitrogen dioxide; Q1, first quartile (lowest 25% of the numbers); Q2, second quartile (next lowest 25% of the numbers up to the median); Q3, third quartile (second highest 25% of the numbers above the median); Q4, fourth quartile (highest 25% of the numbers)

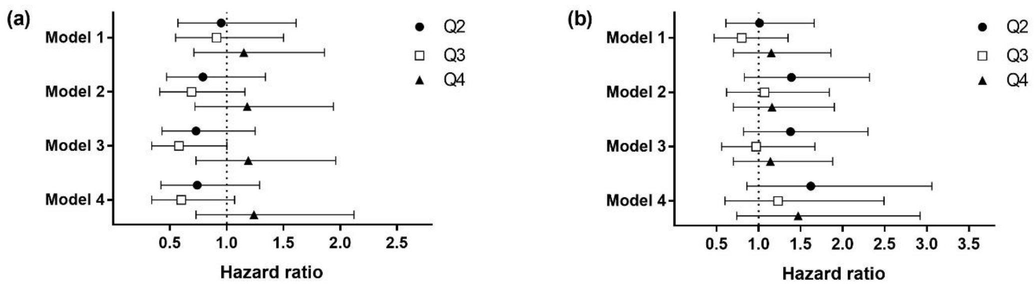

Figure S5. The effect of high (top 25th percentile) air pollutant concentrations on the mortality of patients with RA-ILD in a two-pollutant model

Symbols and error bars represent hazard ratios and 95% confidence intervals, respectively.

RA-ILD, rheumatoid arthritis–associated interstitial lung disease; PM_{10}, particulate matter ≤ 10 μm; NO_2, nitrogen dioxide

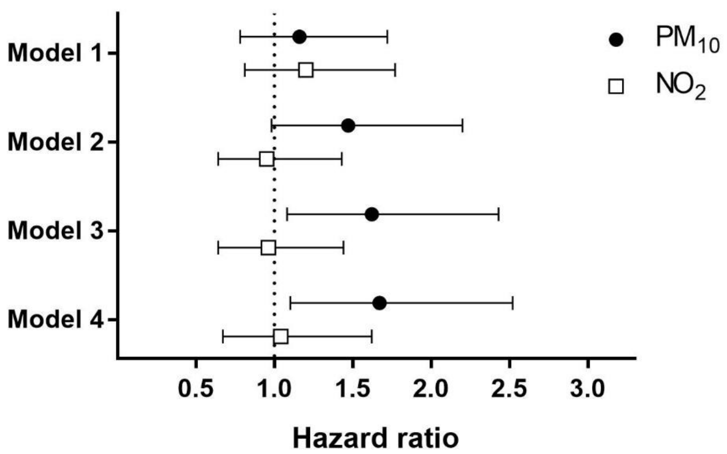

Figure S6. The effect of high (top 25th percentile) air pollutant concentrations on the mortality of patients with RA-ILD based on a single residential address (2006) for each patient

Symbols and error bars represent hazard ratios and 95% confidence intervals, respectively.

RA-ILD, rheumatoid arthritis–associated interstitial lung disease; PM_{10}, particulate matter ≤

10 μm; NO_2, nitrogen dioxide