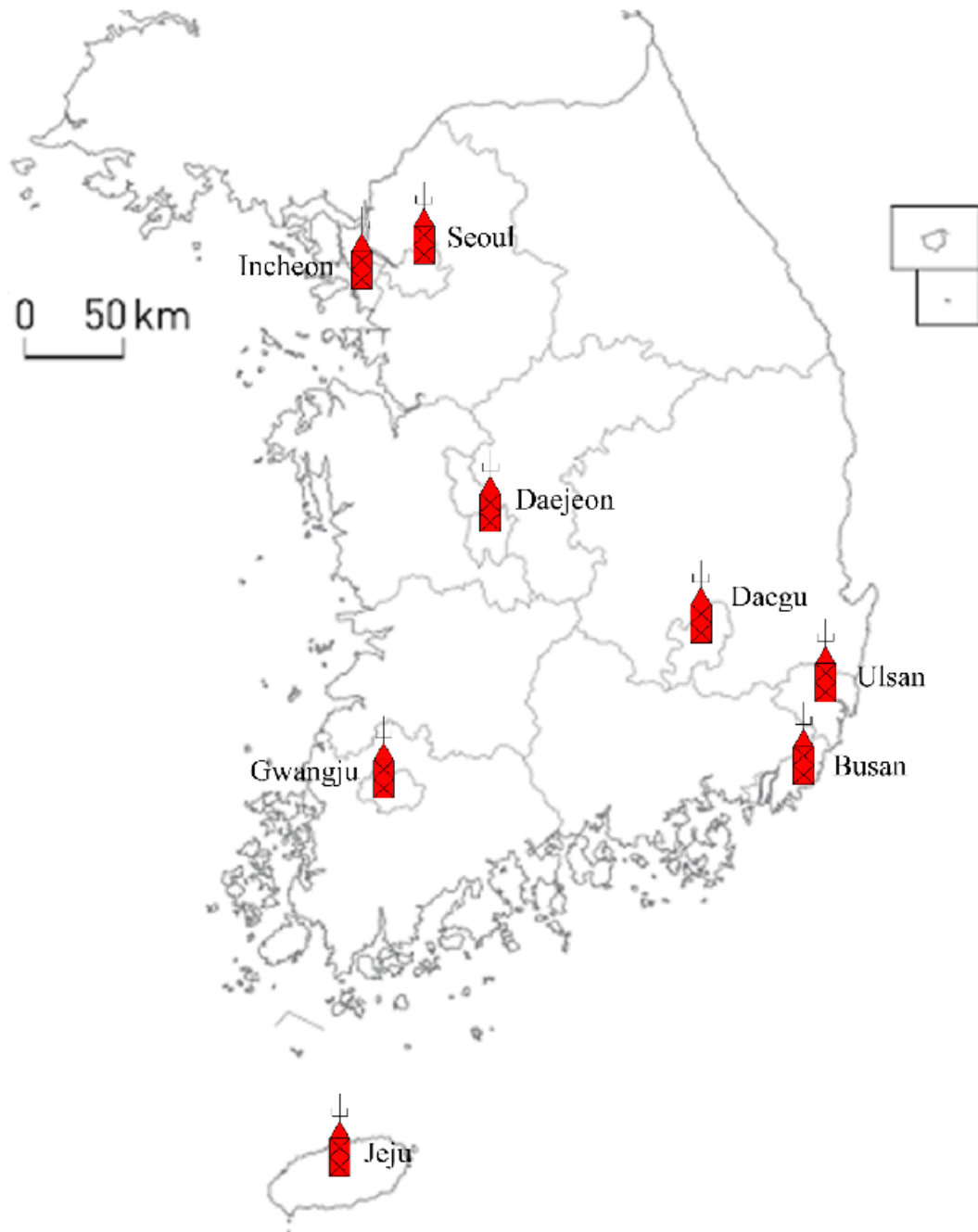
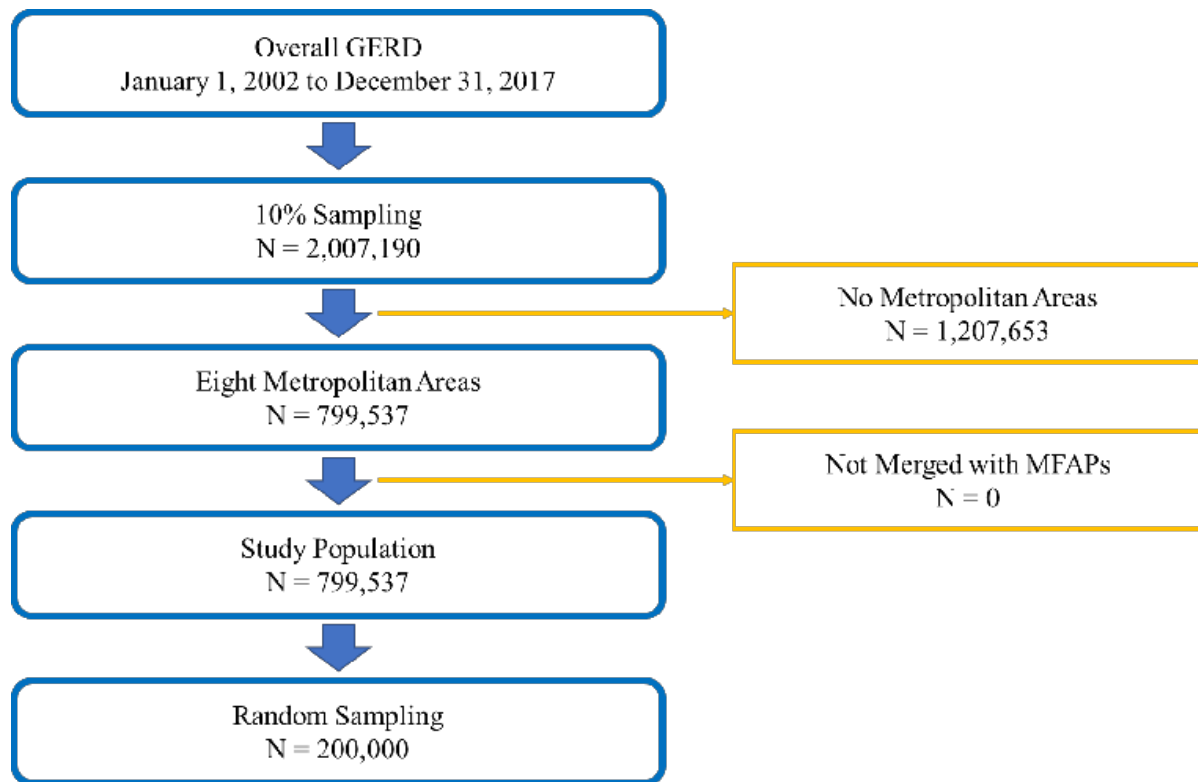


## Supplementary material



**Supplementary Figure 1.** MFAP collection center in the eight selected cities (Seoul, Incheon, Daejeon, Gwangju, Daegu, Ulsan, Busan, and Jeju).



**Supplementary Figure 2.** Flowchart showing participant selection

**Supplementary Table 1.** Validation of the selected meteorological factors and air pollutants (MFAPs)

Overdispersion test		Multicollinearity		Durbin-Watson test				
Criterion	Value/DF	Variable	Variance Inflation	Observations	Order	DW	Pr < DW	Pr > DW
Scaled Deviance	<b>0.0349</b>	Avg. Temp	<b>2.716</b>	200,000	1	0.252	<.0001	1.0000
		Wind Speed	<b>1.273</b>		2	0.432	<.0001	1.0000
Scaled Pearson $\chi^2$	<b>0.0255</b>	Sun. Duration	<b>2.540</b>		31	1.975	<.0001	1.0000
		PM <sub>2.5</sub>	<b>1.073</b>		32	1.991	0.0202	0.9798
		CO	<b>1.375</b>		<b>33</b>	<b>2.008</b>	<b>0.9612</b>	<b>0.0388</b>
				34	2.022	1.0000	<.0001	

MFAP, meteorological factors and air pollutants; DF, Degree of freedom; DW, Durbin-Watson test; Pr; Probability

**Supplementary Table 2.** Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC) of the relationship between the number of daily gastroesophageal reflux disease (GERD) related medical utilizations and meteorological factors and air pollutants (MFAPs)

Test	MFAP as effect	BIC	AIC
1	Average Temperature, Diurnal Temperature Range, Daily Rain, Wind Speed, Dew point Temperature, Humidity, Vapor Pressure, Sunshine Duration, Solar Radiation, Daily Snow, Cloud, PM <sub>10</sub> , PM <sub>2.5</sub> , CO, SO <sub>2</sub> , O <sub>3</sub> , NO <sub>2</sub>	16.02	451.6
2	Average Temperature, Diurnal Temperature Range, Daily Rain, Wind Speed, Dew point Temperature, Humidity, Vapor Pressure, Sunshine Duration, Solar Radiation, Daily Snow, Cloud, PM <sub>10</sub> , PM <sub>2.5</sub> , CO, SO <sub>2</sub> , O <sub>3</sub>	11.15	389.7
3	Average Temperature, Diurnal Temperature Range, Daily Rain, Wind Speed, Dew point Temperature, Humidity, Vapor Pressure, Sunshine Duration, Solar Radiation, Daily Snow, Cloud, PM <sub>10</sub> , PM <sub>2.5</sub> , CO, SO <sub>2</sub>	10.10	333.6
4	Average Temperature, Diurnal Temperature Range, Daily Rain, Wind Speed, Dew point Temperature, Humidity, Vapor Pressure, Sunshine Duration, Solar Radiation, Daily Snow, Cloud, PM <sub>10</sub> , PM <sub>2.5</sub> , CO	9.97	322.7
5	Average Temperature, Diurnal Temperature Range, Daily Rain, Wind Speed, Dew point Temperature, Humidity, Vapor Pressure, Sunshine Duration, Solar Radiation, Daily Snow, Cloud, PM <sub>10</sub> , PM <sub>2.5</sub>	10.13	423.6
6	Average Temperature, Diurnal Temperature Range, Daily Rain, Wind Speed, Dew point Temperature, Humidity, Vapor Pressure, Sunshine Duration, Solar Radiation, Daily Snow, Cloud, PM <sub>10</sub> , CO	9.01	244.5
7	Average Temperature, Diurnal Temperature Range, Daily Rain, Wind Speed, Dew point Temperature, Humidity, Vapor Pressure, Sunshine Duration, Solar Radiation, Daily Snow, Cloud, PM <sub>2.5</sub> , CO	8.78	227.4
8	Average Temperature, Diurnal Temperature Range, Daily Rain, Wind Speed, Dew point Temperature, Humidity, Vapor Pressure, Sunshine Duration, Solar Radiation, Daily Snow, PM <sub>2.5</sub> , CO	8.77	217.2
9	Average Temperature, Diurnal Temperature Range, Daily Rain, Wind Speed, Dew point Temperature, Humidity, Vapor Pressure, Sunshine Duration, Solar Radiation, PM <sub>2.5</sub> , CO	8.73	230.8
10	Average Temperature, Diurnal Temperature Range, Daily Rain, Wind Speed, Dew point Temperature, Humidity, Vapor Pressure, Sunshine Duration, PM <sub>2.5</sub> , CO	8.70	176.6
11	Average Temperature, Diurnal Temperature Range, Daily Rain, Wind Speed, Dew point Temperature, Humidity, Vapor Pressure, PM <sub>2.5</sub> , CO	8.73	221.8
12	Average Temperature, Diurnal Temperature Range, Daily Rain, Wind Speed, Dew point Temperature, Humidity, Sunshine Duration, PM <sub>2.5</sub> , CO	8.71	181.9

13	Average Temperature, Diurnal Temperature Range, Daily Rain, Wind Speed, Dew point Temperature, Sunshine Duration, PM <sub>2.5</sub> , CO	8.67	145.1
14	Average Temperature, Diurnal Temperature Range, Daily Rain, Wind Speed, Sunshine Duration, PM <sub>2.5</sub> , CO	8.35	121.6
15	Average Temperature, Diurnal Temperature Range, Daily Rain, Sunshine Duration, PM <sub>2.5</sub> , CO	8.45	139.7
16	Average Temperature, Diurnal Temperature Range, Wind Speed, Sunshine Duration, PM <sub>2.5</sub> , CO	8.35	37.8
<b>17</b>	<b>Average Temperature, Wind Speed, Sunshine Duration, PM<sub>2.5</sub>, CO</b>	<b>8.33</b>	<b>14.0</b>
18	Average Temperature, Wind Speed, Sunshine Duration, PM <sub>2.5</sub> , PM <sub>10</sub>	9.20	209.0
19	Average Temperature, Wind Speed, Sunshine Duration, PM <sub>2.5</sub> , SO <sub>2</sub>	8.64	127.3
20	Average Temperature, Wind Speed, Sunshine Duration, PM <sub>2.5</sub> , O <sub>3</sub>	8.59	166.8
21	Average Temperature, Wind Speed, Sunshine Duration, PM <sub>2.5</sub> , NO <sub>2</sub>	8.52	182.9

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**Supplementary Table 3.** Results of the generalized additive Poisson regression model (GAM) with cubic spline analysis for the number of daily gastroesophageal reflux disease (GERD)-related medical utilizations depending on lags from 2002 to 2017

Time	Variables	Univariate				Multivariate			
		RR	ER(%)	95% CI	P-value	RR	ER(%)	95% CI	P-value
Lag 0	Avg. Temp.	1.0001	0.01	[0.9999-1.0003]	0.4195	1.0007	0.07	[1.0003-1.0011]	0.0010
	Wind Speed	1.0336	3.36	[1.0314-1.0357]	<.0001	1.0166	1.66	[1.0140-1.0192]	<.0001
	Sun. Duration	1.0022	0.22	[1.0008-1.0036]	0.0017	1.0048	0.48	[1.0025-1.0071]	<.0001
	PM <sub>2.5</sub>	1.0040	0.40	[1.0038-1.0041]	<.0001	1.0008	0.08	[1.0006-1.0010]	<.0001
	CO	1.0080	0.80	[1.0066-1.0093]	<.0001	1.0118	1.18	[1.0099-1.0137]	<.0001
Lag 1	Avg. Temp.	1.0002	0.02	[0.9999-1.0004]	0.2122	1.0008	0.08	[1.0004-1.0012]	0.0001
	Wind Speed	1.0346	3.46	[1.0324-1.0367]	<.0001	1.0168	1.68	[1.0141-1.0194]	<.0001
	Sun. Duration	1.0022	0.22	[1.0008-1.0036]	0.0017	1.0051	0.51	[1.0028-1.0075]	<.0001
	PM <sub>2.5</sub>	1.0003	0.03	[1.0001-1.0005]	0.0016	1.0007	0.07	[1.0004-1.0009]	<.0001
	CO	1.0066	0.66	[1.0052-1.0079]	<.0001	1.0104	1.04	[1.0084-1.0123]	<.0001
Lag 2	Avg. Temp.	1.0001	0.01	[0.9999-1.0004]	0.2238	1.0007	0.07	[1.0003-1.0011]	0.0012
	Wind Speed	1.0347	3.47	[1.0325-1.0368]	<.0001	1.0180	1.80	[1.0153-1.0207]	<.0001
	Sun. Duration	1.0019	0.19	[1.0006-1.0033]	0.0057	1.0043	0.43	[1.0020-1.0067]	0.0002
	PM <sub>2.5</sub>	1.0001	0.01	[0.9999-1.0004]	0.4713	1.0009	0.09	[1.0007-1.0011]	<.0001
	CO	1.0072	0.72	[1.0059-1.0086]	<.0001	1.0092	0.92	[1.0073-1.0111]	<.0001
Lag 3	Avg. Temp.	1.0002	0.02	[1.0000-1.0004]	0.1140	1.0007	0.07	[1.0003-1.0011]	0.0004
	Wind Speed	1.0337	3.37	[1.0315-1.0358]	<.0001	1.0168	1.68	[1.0142-1.0195]	<.0001
	Sun. Duration	1.0017	0.17	[1.0004-1.0031]	0.0129	1.0044	0.44	[1.0021-1.0067]	0.0002
	PM <sub>2.5</sub>	1.0007	0.07	[1.0005-1.0009]	<.0001	1.0011	0.11	[1.0008-1.0013]	<.0001
	CO	1.0081	0.81	[1.0068-1.0095]	<.0001	1.0106	1.06	[1.0086-1.0125]	<.0001
Lag 4	Avg. Temp.	1.0002	0.02	[1.0000-1.0005]	0.0674	1.0007	0.07	[1.0003-1.0011]	0.0012
	Wind Speed	1.0334	3.34	[1.0312-1.0355]	<.0001	1.0162	1.62	[1.0135-1.0188]	<.0001
	Sun. Duration	1.0015	0.15	[1.0002-1.0029]	0.0296	1.0040	0.40	[1.0017-1.0063]	0.0008
	PM <sub>2.5</sub>	1.0007	0.07	[1.0005-1.0009]	<.0001	1.0011	0.11	[1.0009-1.0013]	<.0001
	CO	1.0089	0.89	[1.0076-1.0103]	<.0001	1.0119	1.19	[1.0099-1.0138]	<.0001
Lag 5	Avg. Temp.	1.0002	0.02	[1.0000-1.0005]	0.0615	1.0006	0.06	[1.0002-1.0010]	0.0022
	Wind Speed	1.0324	3.24	[1.0302-1.0346]	<.0001	1.0157	1.57	[1.0130-1.0184]	<.0001
	Sun. Duration	1.0013	0.13	[0.9999-1.0027]	0.0646	1.0037	0.37	[1.0014-1.0061]	0.0017

	PM <sub>2.5</sub>	1.0007	0.07	[1.0005-1.0009]	<.0001	1.0010	0.10	[1.0008-1.0012]	<.0001
	CO	1.0093	0.93	[1.0080-1.0107]	<.0001	1.0125	1.25	[1.0105-1.0144]	<.0001
	Avg. Temp.	1.0003	0.03	[1.0000-1.0005]	0.0217	1.0007	0.07	[1.0003-1.0011]	0.0002
	Wind Speed	1.0282	2.82	[1.0240-1.0323]	<.0001	1.0145	1.45	[1.0118-1.0172]	<.0001
Lag 6	Sun. Duration	1.0010	0.10	[0.9997-1.0024]	0.1372	1.0032	0.32	[1.0009-1.0056]	0.0004
	PM <sub>2.5</sub>	1.0005	0.05	[1.0003-1.0007]	<.0001	1.0008	0.08	[1.0006-1.0010]	<.0001
	CO	1.0091	0.91	[1.0078-1.0104]	<.0001	1.0121	1.21	[1.0102-1.0140]	<.0001
	Avg. Temp.	1.0003	0.03	[1.0001-1.0006]	0.0059	1.0005	0.05	[1.0001-1.0009]	<.0001
	Wind Speed	1.0209	2.09	[1.0168-1.0250]	<.0001	1.0120	1.20	[1.0094-1.0146]	<.0001
Lag 7	Sun. Duration	1.0008	0.08	[0.9995-1.0022]	0.2360	1.0021	0.21	[0.9998-1.0044]	0.1106
	PM <sub>2.5</sub>	1.0004	0.04	[1.0002-1.0006]	0.0002	1.0007	0.07	[1.0005-1.0009]	<.0001
	CO	1.0087	0.87	[1.0073-1.0100]	<.0001	1.0112	1.12	[1.0093-1.0131]	<.0001
	Avg. Temp.	1.0004	0.04	[1.0001-1.0006]	0.0019	1.0004	0.04	[1.0001-1.0007]	0.0051
	Wind Speed	1.0159	1.59	[1.0098-1.0220]	<.0001	1.0096	0.96	[1.0069-1.0122]	<.0001
Lag 8	Sun. Duration	1.0007	0.07	[0.9993-1.0021]	0.3222	1.0016	0.16	[0.9992-1.0040]	0.2523
	PM <sub>2.5</sub>	1.0004	0.04	[1.0002-1.0006]	0.0003	1.0006	0.06	[1.0004-1.0008]	<.0001
	CO	1.0073	0.73	[1.0060-1.0086]	<.0001	1.0102	1.02	[1.0083-1.0121]	<.0001
	Avg. Temp.	1.0004	0.04	[1.0002-1.0006]	0.0008	1.0002	0.02	[0.9998-1.0006]	0.0876
	Wind Speed	1.0080	0.80	[1.0011-1.0148]	<.0001	1.0064	0.64	[1.0034-1.0094]	<.0001
Lag 9	Sun. Duration	1.0004	0.04	[0.9991-1.0018]	0.5209	1.0016	0.16	[0.9993-1.0039]	0.3125
	PM <sub>2.5</sub>	1.0002	0.02	[0.9999-1.0004]	0.2764	1.0003	0.03	[1.0001-1.0005]	0.0005
	CO	1.0078	0.78	[1.0065-1.0092]	<.0001	1.0050	0.50	[1.0039-1.0062]	0.0142
	Avg. Temp.	1.0004	0.04	[1.0002-1.0007]	0.0004	1.0001	0.01	[0.9999-1.0003]	0.4378
	Wind Speed	1.0034	0.34	[0.9944-1.0125]	0.1732	1.0019	0.19	[0.9992-1.0045]	0.9630
Lag 10	Sun. Duration	1.0002	0.02	[0.9989-1.0016]	0.7462	1.0010	0.10	[0.9991-1.0030]	0.8741
	PM <sub>2.5</sub>	1.0000	0.00	[0.9998-1.0002]	0.4311	1.0002	0.02	[1.0000-1.0004]	0.0799
	CO	1.0020	0.20	[0.9999-1.0041]	0.4793	1.0019	0.19	[0.9999-1.0039]	0.0821

GAM, generalized additive Poisson regression model; GERD, gastroesophageal reflux disease; RR, relative risk; CI, confidence interval; ER, excess risk