

Online supporting information for the following article

Impact of climate and ambient air pollution on the epidemic growth during COVID-19 outbreak in Japan

Kenichi Azuma<sup>1</sup>, Naoki Kagi<sup>2</sup>, Hoon Kim<sup>3</sup>, Motoya Hanashi<sup>4</sup>

*1 Corresponding Author: Department of Environmental Medicine and Behavioral Science, Kindai University Faculty of Medicine, Osakasayama, Osaka, Japan*

*2 Department of Mechanical and Environmental Informatics, Graduate School of Information Science and Engineering, Tokyo Institute of Technology, Tokyo, Japan*

*3 Department of Environmental Health, National Institute of Public Health, Wako, Saitama, Japan*

*4 Laboratory of Environmental Space Design, Division of Architecture, Faculty of Engineering, Hokkaido University, Sapporo, Hokkaido, Japan*

Table S1. List of analysed 28 geographical areas

Area	Population	Total land area (km <sup>2</sup> )
Nagoya	2,295,638	326.45
Naha	319,435	39.98
Gifu	406,735	203.60
Sendai	1,082,159	786.30
Kyoto	1,475,183	827.83
Hiroshima	1,194,034	906.68
Saitama	1,263,979	217.43
Tokorozawa	340,386	72.11
Kawaguchi	578,112	61.95
Yokohama	3,724,844	437.56
Kawasaki	1,475,213	143.01
Sagamihara	720,780	328.91
Kanazawa	465,699	468.64
Ichikawa	481,732	57.45
Matsudo	483,480	61.38
Chiba	971,882	271.77
Funabashi	622,890	85.62
Sakai	839,310	149.82
Suita	374,468	36.09
Osaka	2,691,185	225.21
Tokyo	13,515,271	2,193.96
Toyama	418,686	1,241.77
Fukui	265,904	536.41
Fukuoka	1,538,681	343.39
Kitakyushu	961,286	491.95
Kobe	1,537,272	557.02
Nishinomiya	487,850	99.96
Sapporo	1,952,356	1,121.26

Table S2. Correlations between climate factors and ambient air pollutants

	Mean temperature	Mean daily minimum temperature	Mean daily maximum temperature	Precipitation	Sunshine hours	Mean wind speed	Mean relative humidity	Mean daily minimum relative humidity	Mean absolute humidity	NO	NO <sub>2</sub>	Ox	SPM	PM <sub>2.5</sub>
Mean temperature	1													
Mean daily minimum temperature	0.909**	1												
Mean daily maximum temperature	0.831**	0.566**	1											
Precipitation	-0.105	0.052	-0.330**	1										
Sunshine hours	0.108	-0.126	0.429**	-0.810**	1									
Mean wind speed	0.130	0.213*	-0.010	-0.082	0.001	1								
Mean relative humidity	-0.118	0.128	-0.425**	0.764**	-0.880**	-0.082	1							
Mean daily minimum relative humidity	0.026	0.265**	-0.321**	0.773**	-0.871**	-0.111	0.931**	1						
Mean absolute humidity	0.696**	0.844**	0.318**	0.345**	-0.446**	0.062	0.570**	0.653**	1					
NO	0.089	0.017	0.168*	-0.110	0.229*	-0.259**	-0.279**	-0.160	-0.093	1				
NO <sub>2</sub>	0.089	-0.034	0.224**	-0.027	0.232*	-0.427**	-0.258**	-0.108	-0.123	0.856**	1			
Ox	0.373**	0.283**	0.353**	-0.500**	0.402**	0.334**	-0.342**	-0.376**	0.060	-0.329**	-0.449**	1		
SPM	0.419**	0.282**	0.439**	-0.094	0.324**	-0.178*	-0.183*	-0.098	0.188*	0.337**	0.497**	0.113	1	
PM <sub>2.5</sub>	0.395**	0.230**	0.510**	-0.313**	0.487**	-0.319**	-0.354**	-0.269**	0.066	0.381**	0.532**	0.121	0.687**	1

Value is expressed as the Pearson product-moment correlation coefficient. \*  $p < 0.05$ , \*\*  $p < 0.01$ . Abbreviations: NO, nitrogen monoxide; NO<sub>2</sub>, nitrogen dioxide; Ox, photochemical oxidant; SPM, suspended particulate matter; PM<sub>2.5</sub>, fine particulate matter.

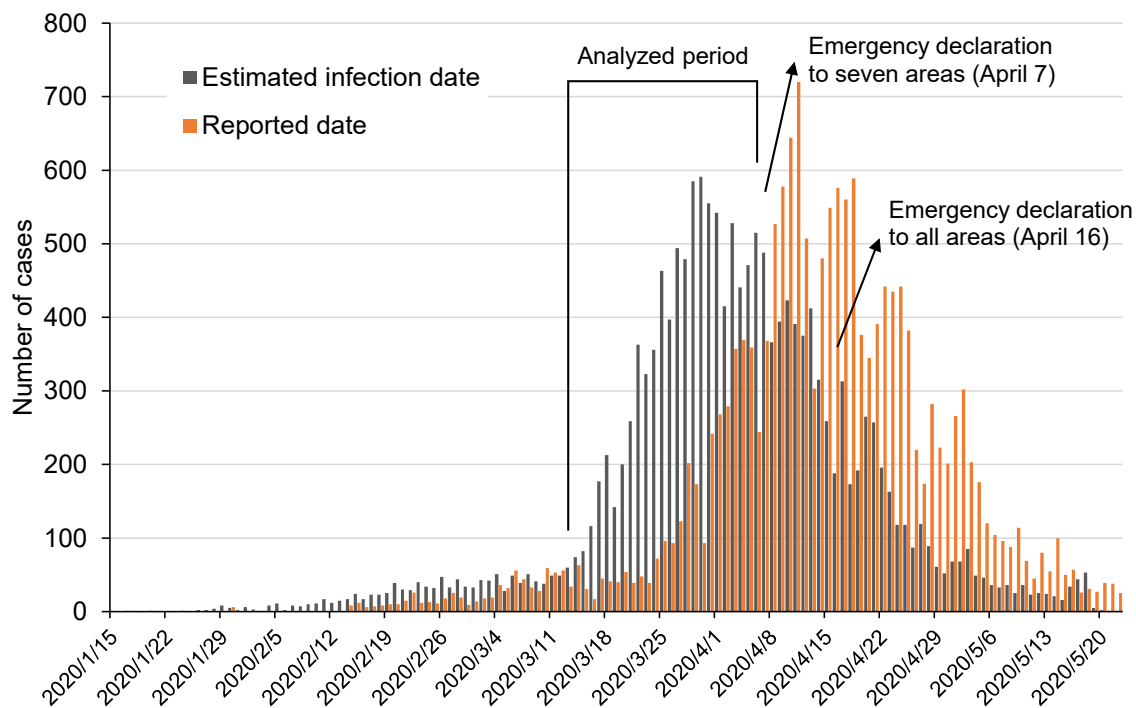


Figure S1. Number of COVID-19 cases in Japan as of May 22, 2020

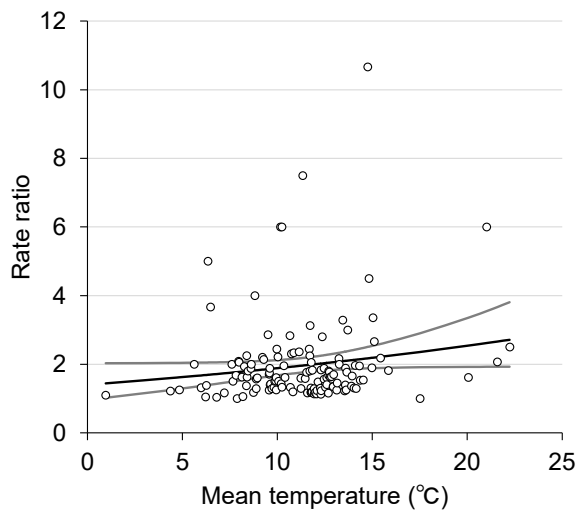
Data on the basis of the estimated date of the infection is shown as gray band. Data on the basis of the reported date is shown as orange band. Seven areas are Saitama, Chiba, Tokyo, Kanagawa, Osaka, Hyogo, and Fukuoka prefectures.

Reference of data on the basis of the reported date

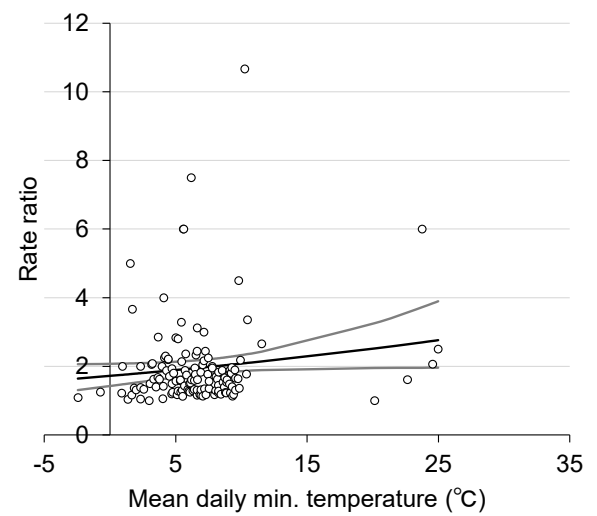
NHK (Japan Broadcasting Corporation), 2020. Reported number of COVID-19 cases in Japan, summary counts by the NHK. Available at: <https://www3.nhk.or.jp/news/special/coronavirus/data-all/>, accessed on June 22, 2020.

Bubble plots of the confirmed rate ratio of COVID-19 on the y-axis against exposure variables on the x-axis were constructed, and prediction lines and 95% confidence bands for the univariate association with epidemic growth for exposure variables were superimposed for showing the trend of the results of statistical analyses.

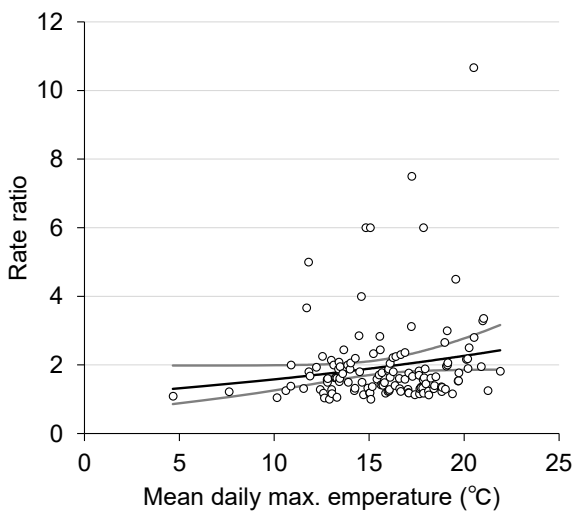
(a) Mean temperature



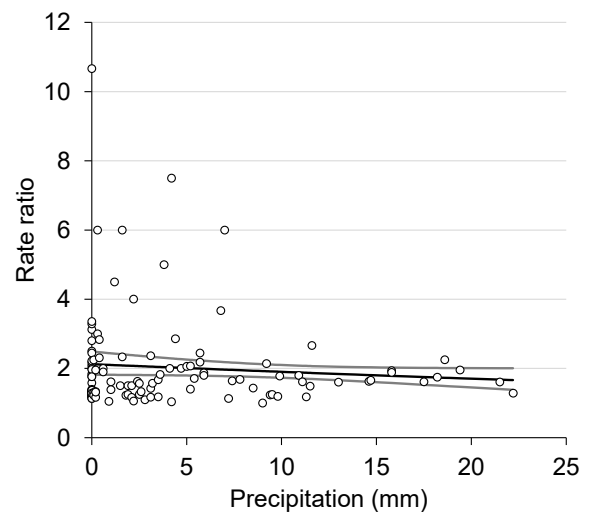
(b) Mean daily minimum temperature



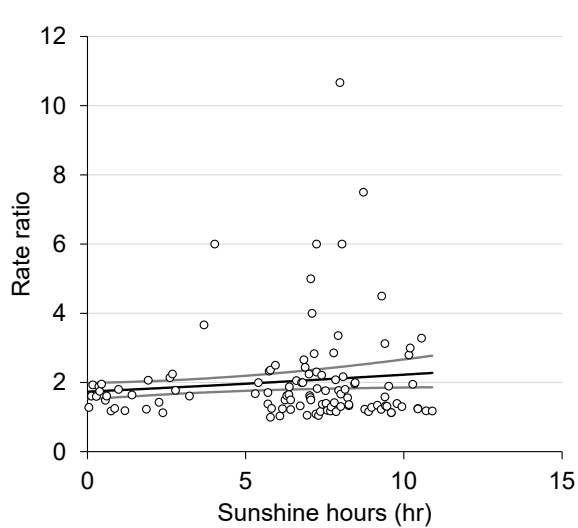
(c) Mean Daily maximum temperature



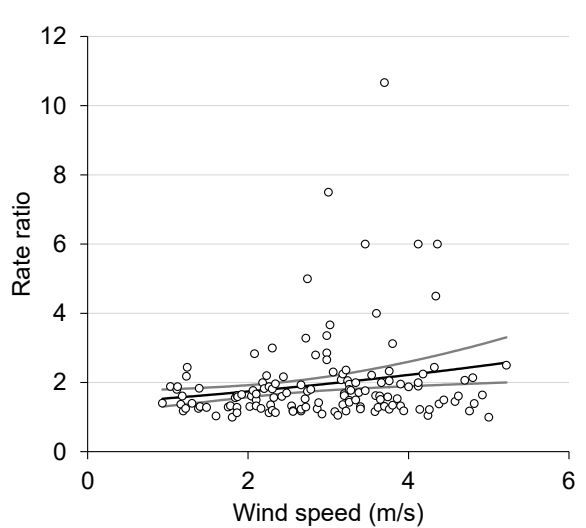
(d) Precipitation



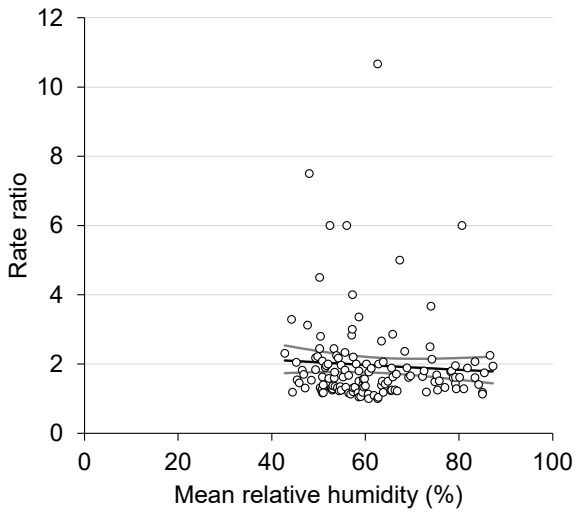
(e) Sunshine hours



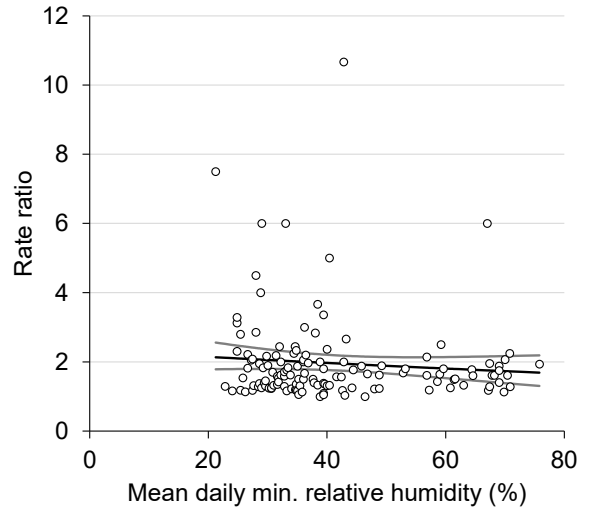
(f) Wind speed



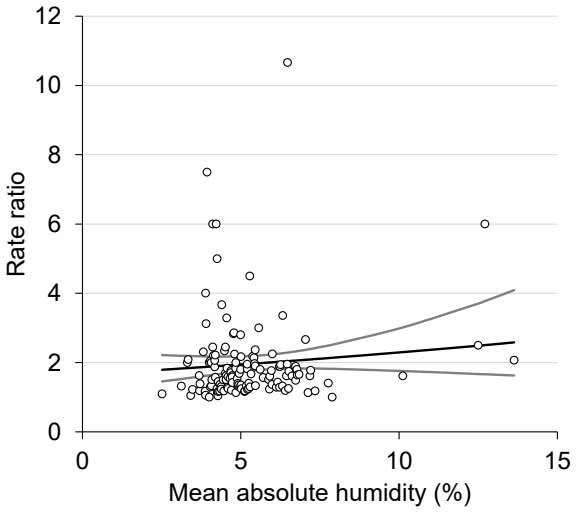
(g) Mean relative humidity



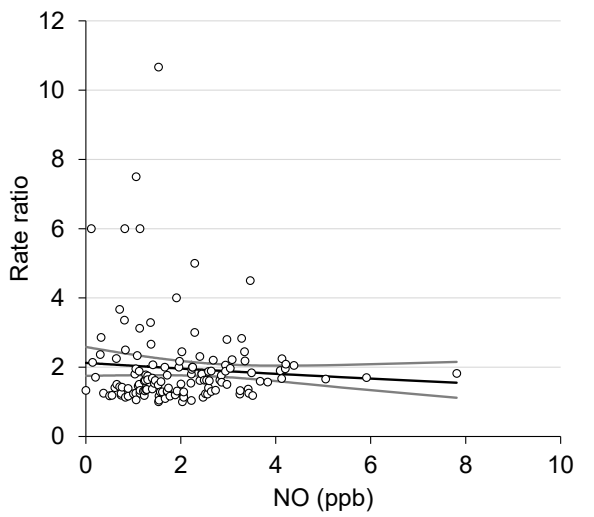
(h) Mean daily minimum relative humidity



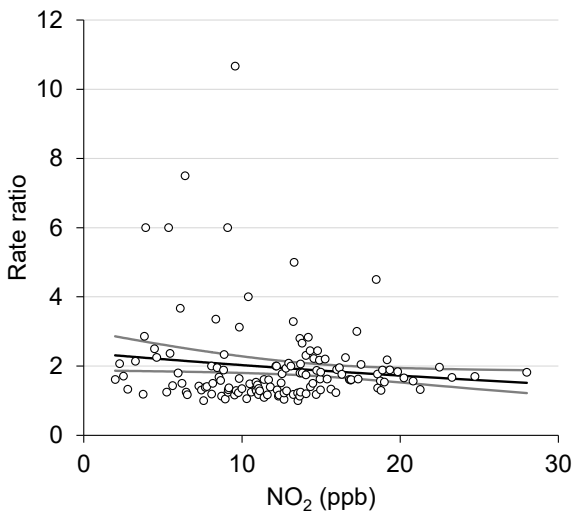
(i) Mean absolute humidity



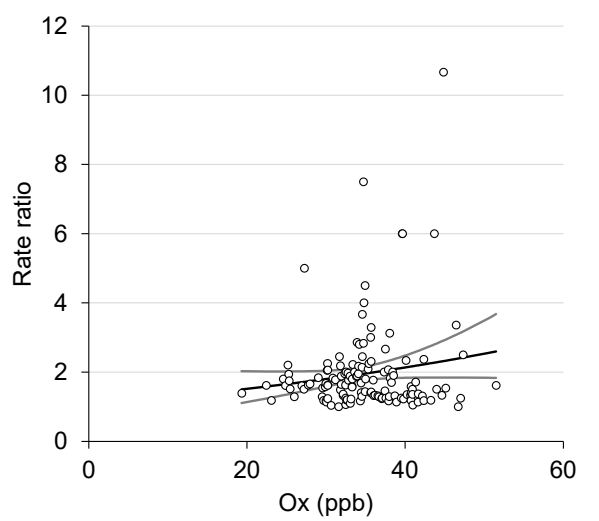
(j) NO



(k) NO<sub>2</sub>



(l) Ox



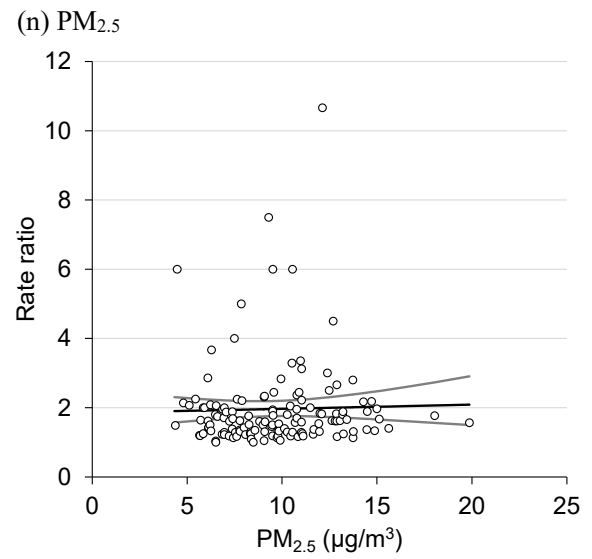
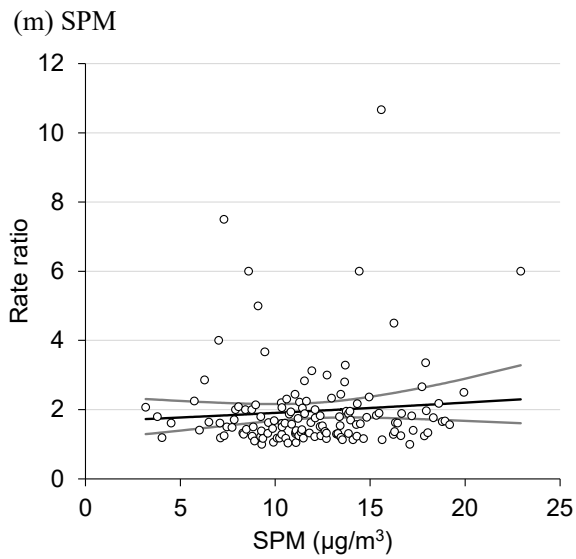


Figure S2. Bubble plot of epidemic growth against climate factors and ambient air pollutants

Each bubble represents a geographical area ( $n = 28$ ). Prediction line and 95% confidence band are for the univariate association of epidemic growth with climate factors and ambient air pollutants temperature from random-effects regression with inverse-variance weights. Abbreviations: NO, nitrogen monoxide; NO<sub>2</sub>, nitrogen dioxide; Ox, photochemical oxidant; SPM, suspended particulate matter; PM<sub>2.5</sub>, fine particulate matter.