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Letter to the Editor

Important factors affecting COVID-19 transmission and fatality in metropolises



The coronavirus disease 2019 (COVID-19) pandemic has resulted in more than 66 million cases and 1.5 million deaths as of December 6, 2020. Metropolises, such as Wuhan¹ and New York,² were the hardest-hit COVID-19 areas for their high population densities. Thus, an investigation of the COVID-19 epidemic in metropolises is meaningful. To explore the impact of essential factors on COVID-19 transmission and fatality in metropolises, we collected the data of cumulative confirmed COVID-19 cases and deaths, gross domestic product (GDP) per capita in 2019, latitude, longitude, temperature, humidity, wind speed, major sports events, and race in 360 cities or metropolitan areas holding more than one million people (Supplementary Tables S1 and 2). The numbers of cumulative COVID-19 cases and deaths were the reports on June 23, 2020, and the temperature, humidity, wind speed, and sports events were the records from January 1, 2020, to June 23, 2020.

We found that latitude, wind speed, the total number of participants in major sports events, and GDP per capita were positively correlated with the numbers of COVID-19 cases and deaths adjusted by the total population of cities (Spearman's correlation test, $p < 0.05$) (Fig. 1A). The positive association between latitude and COVID-19 risk could be because latitude is one of the main factors affecting temperature.³ The positive association between the number of participants in major sports events and COVID-19 risk confirmed that social distancing is crucial in mitigating COVID-19 spread.⁴ The positive association between GDP per capita and COVID-19 risk could be attributed to the more large-scale social activities and a higher proportion of the elderly population,^{4,5} in developed than in developing cities. In contrast, temperature and longitude were negatively correlated with COVID-19 cases and deaths. The negative association between temperature and COVID-19 risk was consistent with the reports from previous

studies.⁶ A potential explanation for the negative association between longitude and COVID-19 risk is that the large cities in America are located in west longitude, where the COVID-19 spread is serious. Humidity showed no significant correlation with the numbers of COVID-19 cases or deaths. However, high-humidity (>65%) cities had more COVID-19 cases than medium-humidity ([40, 65]) cities and that low-humidity (<40%) cities had more COVID-19 cases and deaths than high- and medium-humidity cities ($p < 0.05$) (Fig. 1B). We found that the majority-White cities had more COVID-19 cases and deaths than the other cities ($p < 0.001$) (Fig. 1C). In contrast, the majority-Yellow cities tended to have less COVID-19 cases and deaths than the other cities (Fig. 1C). These results indicate that the White race is associated with a higher risk of COVID-19 and that the Yellow race is associated with a lower risk.

We built logistic models to predict high- (>median) versus low-COVID-19-risk (<median) cities using eight predictors (Fig. 1D). Consistent with previous results, wind speed, major sports events, and White race were significant positive predictors for COVID-19 cases and deaths (β coefficients ≥ 0.8 , $p < 0.05$). The GDP per capita was a positive predictor for COVID-19 deaths ($\beta = 1.07$, $p = 0.04$). The positive association between wind speed and COVID-19 risk confirmed that airborne transmission is the main route of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) transmission.⁷ In contrast, Yellow race was a negative predictor for COVID-19 cases ($\beta = -1.76$, $p = 6.62 \times 10^{-6}$) and deaths ($\beta = -0.94$, $p = 0.01$).

In conclusion, social distancing, geographical location, temperature, humidity, wind speed, economic development level, and race are significant factors associated with COVID-19 transmission in metropolises.

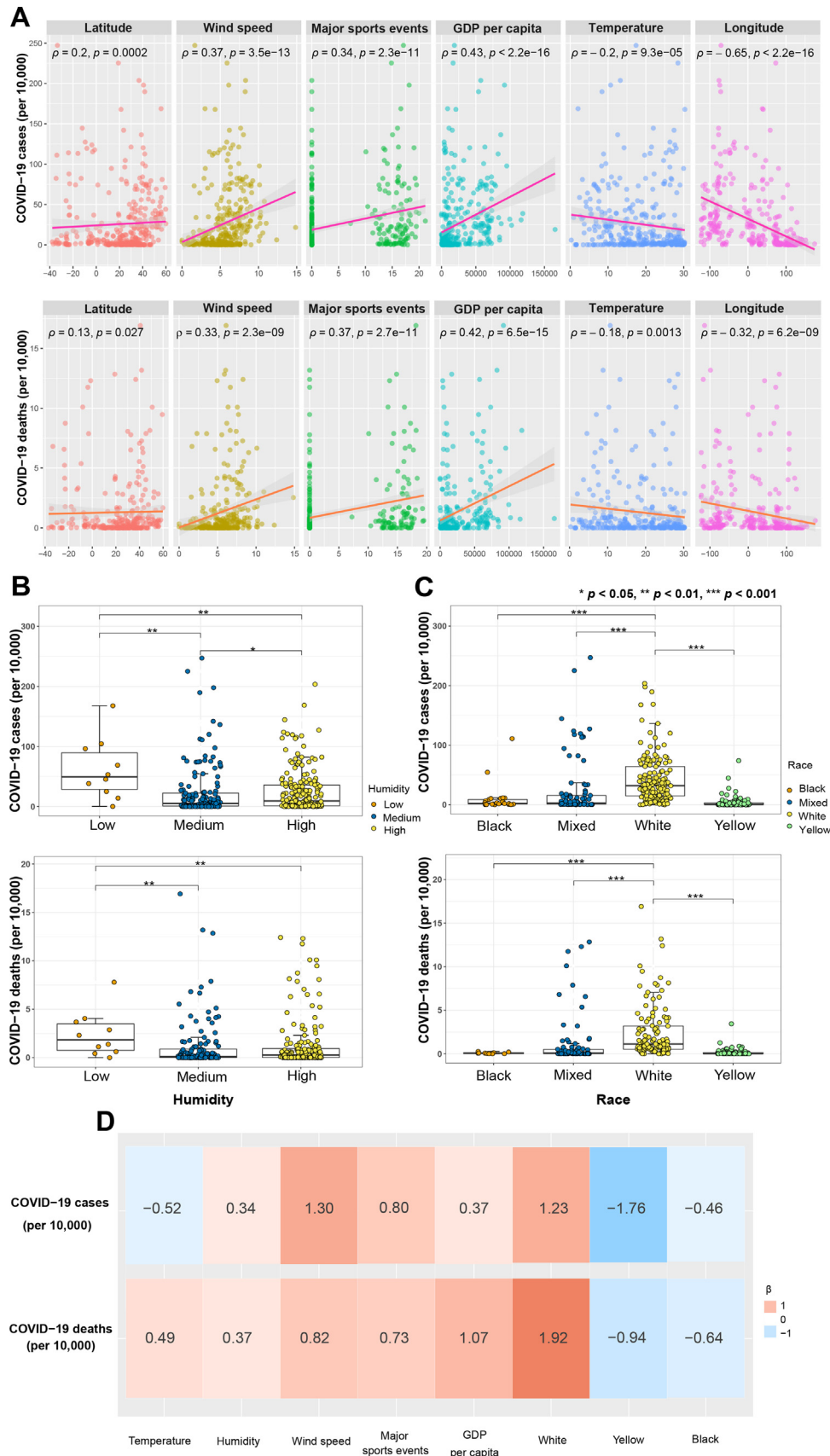


Fig. 1. Associations between various factors and COVID-19 transmission and fatality in metropolises. (A) Correlations between latitude, wind speed, numbers of participants in major sports events, and GDP per capita and numbers of COVID-19 cases and deaths per 10,000 in metropolises. Spearman's correlation test *P*-values and correlation coefficients (ρ) are shown. Comparisons of the numbers of COVID-19 cases and deaths per 10,000 between high- (>65%), medium- ([40, 65]), and low-humidity (<40%) cities (B) and between majority-Black, -White, -Yellow, and -Mixed cities (C). The one-sided Mann-Whitney U test *P*-values are indicated. (D) Contributions of different factors in predicting high- (>median) versus low-COVID-19-risk (<median) cities by logistic models. The β coefficients and *P*-values are indicated. COVID-19, coronavirus disease 2019.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.puhe.2020.11.008>.

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