Title: Ambient temperature and COVID-19 incidence rates: An opportunity for intervention?

Short title: Ambient temperature and COVID-19 incidence rates

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Brief description of the article

We hypothesized that there is a lower incidence of COVID-19 infection in regions with higher temperatures and present global data in favour of this hypothesis. However, controversy exists and this remains to be vigorously investigated.

Keywords: COVID-19; Pandemic; isothermal belt; Incidence rate; Infection; Air-conditioning

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Novel COVID-19 infection is one of the most serious medical crises the world is facing today, since the beginning of the year 2020. Though various
recommendations are emerging, including pharmacoprophylaxis, no sound treatment or vaccine to control the outbreak is available so far. Therefore, we must focus on non-pharmacological measures for controlling the spread of this viral infection at once. Although the COVID-19 infection has spread around the world, and the counts being reported could have methodological errors, a phenomenal difference in the incidence rates of reported cases among different countries could suggest an effect of ambient temperature on the spread of COVID-19.

To understand the relationship between environmental temperature and total cases/population for COVID-19, data on the total number of confirmed cases from 179 and 143 countries were collected from the “WHO- Coronavirus disease 2019 (COVID-19) Situation Report – 71 and 83” for the months, 31 March 2020 and 12 April 2020 respectively.1,2 The cumulative incidence rate of COVID-19 per 100,000 was calculated. Average temperature data for March and April 2020 were collected from Google search with search term of “Country name+ temperature March and April 2020.”

The scatter plot illustrating the correlation between COVID-19 incidence rates and mean temperatures for 179 countries in the WHO report of March showed a gradual decrease with increased temperature (Fig 1). Countries with highest case rate had a mean ambient temperature range between 5-25 °C. The Scatter plot best fit line curve for March month data starts at -10°C and end at 30.55°C (P<0.0001; R²=0.126), indicating the gradual reduction of incidence rate with increased ambient temperature. Remarkably, the liner regression analysis between the ambient temperature and Corona infection incidence rates on the data from WHO on 12th April 2020 for 143 countries are also consistent with the above pattern, at the ambient temperatures ranging from 0.478 °C to 28.00°C (P<0.0001; R²=0.163).
The average temperature on March 2020 and April 2020 in WPR was 20.43±11.61 and 23.06±6.56 of SD respectively. Interestingly, highest case report on March 2020 was observed in the Republic of Korea was 20.45 with correspondent average temperature of 3.5°C, whereas the lowest case rate was observed in Vietnam was 0.26 with correspondent average temperature of 28.8°C. On the other hand, recent 12 April 2020 data, the highest case rate was found in Guam, followed by Singapore and Brunei Darussalam with corresponding average temperature of 27.50, 27.33 and 12.30. Further, the warmest country in WPR in March and April 2020 with the reported temperature at an average of 30.55 and 32.22 °C respectively was Cambodia reported with the case rate of 0.64 and 0.73. Therefore, there is a clear evidence of role of ambient temperature on the outbreak of COVID-19.

The countries with the highest reported rates of COVID-19 infections come within 45±5° latitude, especially in the Northern hemisphere. In the Southern hemisphere too in the same latitude have now been showing rising infection rates.

From the analysis of global data, we observed the countries falling in the range of 30±10°N latitude are at high risk of COVID-19 outbreak. Interestingly, Magnolia identified as warmest country in the WPR is located 42-50°N of latitude has the very lowest case rate in WPR, yet another fact strongly supporting our hypothesis. A deviation being observed with Singapore case rates could be due to the excess use cooling devices like air-conditioners in public gathering places. However, controversy on enhanced risk from use of AC exists and this remains to be vigorously investigated.

**Conflict of Interest**

The Authors have no conflict of interest
Acknowledgement

Dr. Murugesan Arumugam was funded by Council of Scientific and Industrial Research (CSIR), Government of India through a Scientist's Pool Scheme. Authors would like to thank JIPMER e-library facility and national knowledge network, India for providing access to scientific journals and other relevant e-data.

References


Fig 1a and 1b: Scatter plots: Correlation of incidence rate of COVID-19 with average day time temperature in 41 countries for February 2020 (1a) and in 57 countries for March 2020 (1b). [Incidence rates resourced from WHO situation reports 41 & 65.]