

Effects of temperature on COVID-19 transmission in India

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ABSTRACT

This paper aims to study the correlation between COVID-19 and temperature in India. Secondary published data from different websites is employed by us. The climate indicators included within the study are maximum temperature, minimum temperature. Correlation tests were chosen for data analysis. We find that maximum temperature has significant relations related to the COVID-19 pandemic and the study will help health regulators to combat COVID-19 in India.

Key words : COVID -19, Maximum temperature, Correlation, India

Introduction

Novel Corona Virus (COVID-19), is related to the respiratory disease in humans which has been declared as a worldwide epidemic and pandemic within the half-moon of the year 2020 by the planet Health Organization (<https://www.who.int/novel-coronavirus-2019>). People with low immunity, old age, immunocompromised and medical problems specially associated with lungs, diabetes, cardiac related problems are more susceptible to Covid 19 disease. The symptoms are cough, cold, breathing problem very almost like flu. Exact transmission route of COVID-19 is yet to be identified; it had been transmitted mainly by respiratory droplets in humans (Ge *et al.*, 2013; Huang *et al.*, 2020). Climate factors includes wind speed, humidity, temperature (Yuan *et al.*, 2006; Dalziel *et al.*, 2018; Bashir *et al.*, 2020). Bull (1980) reported that

pneumonia's death rate is very much correlated with weather changes. Preventive measures are to guard oneself by washing hands frequently, avoiding touching the mouth, nose, and face, and by maintaining social distancing (1 meter or 3 feet) with people. It's reported that there are two important stages of Covid 19; stage-II and stage-III. In stage-II, there's person-to-person transmission and in stage-III, there's a community transmission. The primary case of Covid 19 was reported in India on 30 January 2020, originating from China. Almost after two months this disease spread in most parts of India. Majority of Nations of world have noticed an enormous number of Covid 19 cases from December 2019 onwards. WHO acknowledged Indian strategies to control the outbreak of this epidemic (Sharma, 2020). India accounts for nearly one-fifth of the world's population and is second leading country in terms of population within the world.

India contributes heavily to the world's GDP and is amongst the foremost prominent developing country within the world with fairly strong economic process percentages (Myers, 2020). India's good closeness with majority of the nations within the world and its helpful nature makes it a perfect for other countries. Therefore, the analysis of COVID-19 outbreak in Indian region is closely watched and monitored by the planet and there's a requirement of comprehensive analytical studies supported by different strategies taken by Indian administrators.

In this study, we aimed to determine the relation between maximum and minimum temperatures with COVID 19 disease rates over India.

Methods

India is considered as seventh largest country in the world and is situated between $8^{\circ}4'$ north to $37^{\circ}6'$ north latitude and $68^{\circ}7'$ to $97^{\circ}25'$ east longitude (India year Book, 2007) with a complete area of 3,287,263 square kilometre (1,269,219 sq mi) (India, 2012). In India there are 28 states and eight Union Territories (States and Union Territories, 2020) . India is the worlds second most populous country (1.2 billion, census, 2011) after Peoples Republic of China. In terms of inhabitant India has 614000 villages and 72.2 percent of the entire population reside in rural areas (Census, 2011, Provisional Population Totals). On the idea of net migrants by last record Maharashtra had most immigration with 2.3 million, followed by Delhi (1.7 million), Gujarat (0.68 million), Haryana (0.67 million). Uttar Pradesh and Bihar topped the list for interstate emigration. The States of Uttar Pradesh, Maharashtra, Bihar, West Bengal and Madhya Pradesh accounts for nearly half (48.89 percent) of the entire Indian Population (India Census, 2011). consistent with report of National Institution for Transforming India, Government of India the population density of State of West Bengal (1029 persons per sq km) is highest followed by Bihar (1102 persons per sq km) and among Union Territories the population density of Delhi (11297 persons per sq km) is highest followed by Chandigarh (9252 persons per sq km). Secondary published data from different websites is employed by us. Dataset for the climate indicators includes heat and coldness. because the data wasn't normally distributed therefore Kendall and Spearman rank correlation statistical tests were utilized to look at the correlation between variables

using, SPSS 20 and XLSTAT software (Addinsoft, 2010).

Dataset for COVID-19 is taken from January 30, 2020–May 10, 2020, from the https://en.wikipedia.org/wiki/Template:COVID19_pandemic_data/India_medical_cases_summary#cite_note-2 and therefore the data for climate indicators was taken from https://weather.com/en_IN/weather/monthly.

Results and Discussion

Sharp rise in daily infective also as active cases are noted along with the death rate. India is taken into account as warm country and temperature plays important role in spread of COVID-19. During the Year 2020, maximum temperature varies from 2 to 45 °C and minimum temperature varies from -5 to 31 °C. With rise of temperature the droplets which falls on the bottom immediately dries thanks to heat. The areas where the daily fluctuation rate of temperature is high suffers tons. In India from March onwards the COVID-19 is at its peak the temperature is additionally not such a lot high but from April onwards there's slight decline in number of cases (Figure 1). But spread of any pandemic diseases also depends upon personal contact. Government of India implemented strict rules of Lockdown as there's no other alternatives as there's no vaccine and no other medicines to regulate them. Less number of cases in dense country like India is additionally possible thanks to strong implementation of lockdown.

The temperature dependency of COVID-19 could also be almost like that of SARS-Cov which loses its

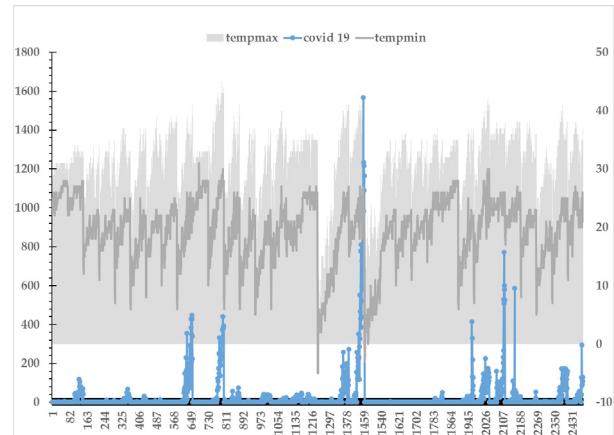


Fig. 1. Cases of Covid-19 in India with fluctuations in maximum and minimum temperature

ability to survive in higher temperatures (Chan *et al.*, 2011). According to Schoeman and Fielding, 2019 high temperature breakdown the lipid layer of the virus. With approaching summer, that is when the temperature rises upto 25 °C and above the population of virus gradually declines.

Table 1 and 2 present the empirical correlation coefficients with scatter plot on Figure 2 . From both Tables it's clear that tempmax has more positive correlation with distribution of COVID-19. It clearly suggests that max temperature has inhibitory effect on COVID-19 whereas minmtemp supports the spread of the disease. Previous studies of Tan *et al.* (2005) and Vandini *et al.* (2013); Shi *et al.* (2020) and Bashir *et al.* (2020) support our findings.

Despite strong evidence of temperature association with COVID-19, provides the subsequent limitations. First, more variables are needed to conduct a comprehensive study as COVID-19 is an communicable disease and it's suffering from many variables like humidity, rainfall, wind speed, social distancing, people's endurance and availability of health facilities. Second, data about personal hygiene indicators like hand wash must be explored in further studies.

Conclusion

Climate plays important role to fight against COVID-19 in country like India. This study finds that maximum temperature significant correlated with COVID-19 pandemic and can be useful in suppressing COVID-19. Current study is of preliminary in nature and further detailed study is required to overcome this situation.

Conflict of Interest Statement

We declare that we have no conflict of interest

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Credit Authorship contribution statement

IB- Data curation, Writing Original Draft, Statistical analysis, **BM-** Reviewing, Editing, **AD-** Data Curation, **PS-** Data Curation, **PPC-** Designing, Monitoring, Reviewing, Communication

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Table 1. Kendalls Correlation Coefficient

Variables	Place	Month	Date	Covid 19	Tempmax	Tempmin
place	1	0.000	0.000	0.091**	0.086**	-0.032*
month	0.000	1	-0.098*	0.359**	0.383**	0.370**
date	0.000	-0.098**	1	0.088*	0.073**	0.081**
covid 19	0.091**	0.359**	0.088**	1	0.411**	0.300**
tempmax	0.086**	0.383**	0.073**	0.411**	1	0.552**
tempmin	-0.032*	0.370**	0.081**	0.300**	0.552**	1

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Table 2. Spearmans Correlation Coefficient

Variables	Place	Month	Date	Covid 19	Tempmax	Tempmin
place	1	0.000	0.000	0.122**	0.121**	-0.046*
month	0.000	1	-0.117**	0.413**	0.473**	0.453**
date	0.000	-0.117**	1	0.116**	0.104**	0.113**
covid 19	0.122**	0.413**	0.116**	1	0.520**	0.384**
tempmax	0.121**	0.473**	0.104**	0.520**	1	0.703**
tempmin	-0.046*	0.453**	0.113**	0.384**	0.703**	1

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

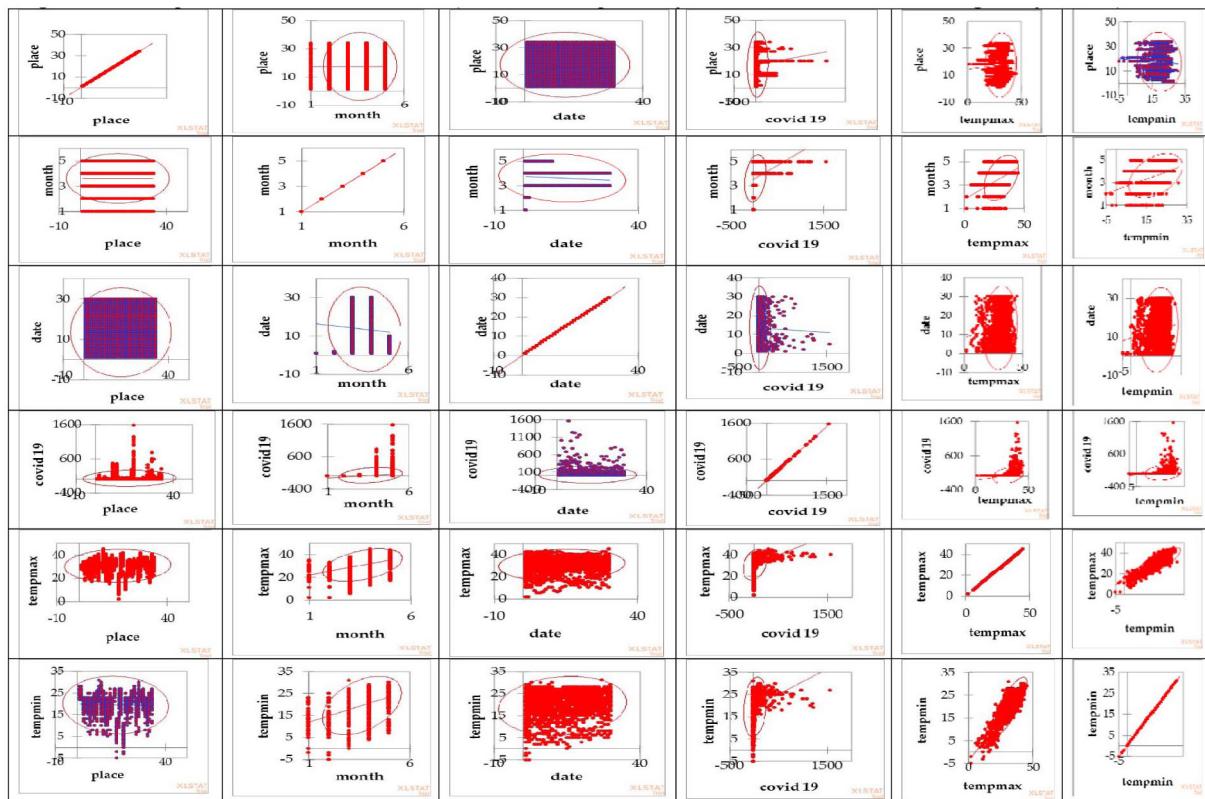


Fig. 2. Scatterplots of correlation coefficients (red marks are positively related and blue marks are negatively related)

Ethical Statement

No ethical approval was required because we used the secondary published data from different websites.

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