International Journal of Community Medicine and Public Health
Mahajan S et al. Int J Community Med Public Health. 2021 Sep;8(9):4307-4312
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20213529

Original Research Article

Impact of meteorological factors on number of new COVID-19 cases in Pune

Saurabh Mahajan[1], Ravi Devarakonda[1], Gautam Mukherjee[1], Nisha Verma[1], Kumar Pushkar[2]*

[1]Armed Forces Medical College, Pune, Maharashtra, India
[2]Command Hospital, Pune, Maharashtra, India

Received: 23 July 2021
Accepted: 21 August 2021

***Correspondence:**
Dr. Kumar Pushkar,
E-mail: kumarpushkar14817@gmail.com

ABSTRACT

Background: Coronaviruses are a family of viruses that can result in different types of illnesses, most commonly, as Severe acute respiratory syndrome (SARS). Researches have shown that the atmospheric variables and the density of population have affected the transmission of the disease. Meteorological variables like temperature, humidity among others have found to affect the rise of pandemic in positive or negative ways. Respiratory virus illnesses have shown seasonal variability since the time they have been discovered and managed. This study investigated the relationship between the meteorological variables of temperature, humidity and precipitation in the spread of COVID-19 disease in the city of Pune.
Methods: This record based descriptive study is conducted after secondary data analysis of number of new cases of COVID-19 per day from the period 01 May to 24 December 2020 in Pune. Meteorological data of maximum (T_{max}), minimum (T_{min}) and daily average temperature (T_{avg}), humidity and precipitation were daily noted from Indian meteorological department website. Trend was identified plotting the daily number of clinically diagnosed cases over time period. Pearson's correlation was used to estimate association between meteorological variables and daily detected fresh cases of COVID-19 disease.
Results: Analysis revealed significant negative correlation ($r=-0.3563$, $p<0.005$) between daily detected number of cases and maximum daily temperature. A strong positive correlation was seen between humidity and daily number of cases ($r=0.5541$, $p<0.005$).
Conclusions: The findings of this study will aid in forecasting epidemics and in preparing for the impact of climate change on the COVID epidemiology through the implementation of public health preventive measures.

Keywords: COVID epidemiology, Humidity, Preventive measures

INTRODUCTION

Coronaviruses are a family of viruses that can result in different types of illnesses, most commonly, as Severe acute respiratory syndrome (SARS). A novel coronavirus outbreak started Wuhan city of China in late 2019 in China and has since spread at a rapid pace throughout the world.

The causative virus has been named as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). And the disease as Coronavirus disease 2019 (COVID-19). Within a month of the first reported case in China, large numbers of infections and deaths followed in countries across the globe. On 30 January 2020, the WHO Director-General determined that the outbreak of COVID-19 constitutes a Public Health Emergency of International Concern and declared it as a pandemic on 11th March 2020.[1] The world has been facing, the pandemic, named as COVID-19, since then. Its impact has been showing upon all the countries and their economies. This pandemic reminds us of the last pandemic of the world, which was

the 1918 influenza pandemic, started in London, United Kingdom. The mortality associated with COVID-19 is much higher than previous coronaviruses (i.e.; SARS-CoV and MERS-CoV) so far and still goes up, impacting the economies of all countries, across the globe.

India recorded its first case on 30 January 2020 in the state of Kerala. The pandemic is still ongoing, and has till date recorded 85,509,038 cases world wise with 1,850,719 deaths and 60,476,700 recoveries worldwide as on 04 January 2020.[2] India has recorded 103 lakh cases and 1.5 lakh deaths.[2]

Corona virus in human beings was first identified in 1960s. Initially it was thought to be a respiratory tract infecting virus of the infant age group. Newer viruses of the corona family were recognized in 2003, some of them were SARS, MERS, Corona virus 2 (CoV-2), Human corona virus (HCoV), New Haven corona virus (NHC). All these viruses were acting upon the respiratory tract.[3] Researches have shown that the atmospheric variables and the density of population have affected the transmission of the disease.[4]

Meteorological variables like temperature, humidity among others have found to affect the rise of pandemic in positive or negative ways. At 40°C of temperature, it was found to that there is a viral inactivation when compared to relative humidity levels which play a minor role at lower temperatures.[5] Respiratory virus illness have shown seasonal variability since the time they have been discovered and managed.[6] The aim of the study was to investigate the relationship between the meteorological variables of temperature, humidity and precipitation in the spread of COVID-19 disease in the city of Pune.

METHODS

This record based descriptive study is conducted after secondary data analysis of number of new cases of COVID-19 per day from the period 01 May to 24 December 2020 in Pune. Crowdsourced line listing of COVID-19 cases in Pune was obtained from https://www.covid19india.org/ which is government portal of COVID data and freely accessible. Data triangulation was done and checks were made from Pune Municipal Corporation (PMC) and Pune Chinchwad Municipal Corporation (PCMC). Minor inconsistencies in the dataset were corrected upon tallying the data.

Meteorological data of maximum (T_{max}), minimum (T_{min}) and daily average temperature (T_{avg}), humidity and precipitation were daily noted from Indian Meteorological Department website.[7] Trend was identified for COVID-19 cases reported from May 2020 to December 2020 by plotting the daily number of clinically diagnosed cases over time period to identify pattern. A database was created and the data was checked for missing data, errors, outliers and duplicate reports. Epidemic curve was constructed using daily incidence data. The date column was converted in UTC (Coordinated universal time) format for time series processing. Cumulative number of cases were calculated from daily reported case data. Also, weekly incidence and cumulative incidence was calculated.

Pearson's correlation was used to estimate association between meteorological variables and daily detected fresh cases of COVID-19 disease. Data was analysed using IBM Corp. Released 2013. IBM SPSS Statistics for Windows, version 22.0 in Armonk, NY: IBM Corporation.

RESULTS

During the study period, September month had highest of cumulative daily confirmed new cases of COVID-19 disease, with total of 118001 new cases.

Month of June had minimum of cumulative daily confirmed new cases, with total of 14408 new cases.

The maximum mean temperature was in May 20 at 34.2±1.68ºC and minimum mean temperature was in month of December at 24.8±1.98ºC. The maximum mean humidity was found in month of August at 78.6±1.86% and minimum in month of May at 34.3%±4.32%. Month of August had highest precipitation at 228.6 mm and month of December receiving 0 mm precipitation.

The mean daily temperature (T_{avg}) maximum daily temperature (T_{max}) and daily minimum temperature (T_{min}), mean humidity and precipitation (in mm) with total daily confirmed new cases from May 2020 to December 2020 are as per Table 1.

Figure 1 depicts the trend of daily confirmed COVID-19 cases in Pune from May to December 20 with T_{max}, T_{min} and T_{avg}. It can be seen that there was increase in the number of cases from May onwards peaking in September and reaching low in November and December 2020.

Figure 2 shows the trend of the daily confirmed new cases to the changes in monthly average humidity. Similarly, precipitation and number of daily new cases were depicted on the graph as shown in Figure 3.

Pearson's correlation was used to find corelation between the meteorological factors and daily number of cases in Pune as given in Table 2. Analysis revealed significant negative correlation ($r = -0.3563$, $p<0.005$) between daily detected number of cases and maximum daily temperature.

A strong positive correlation was seen between humidity and daily number of cases ($r=0.5541$, $p<0.005$) implying that with increase in humidity the number of cases per day tend to increase. Correlation between number of cases per day and precipitation was weak although significant ($r=0.1598$, $p=0.0136$).

Table 1: Temperature, humidity, and precipitation along with monthly cumulative cases in Pune.

Months	T_{avg}	T_{max}	T_{min}	Humidity	Precipitation (mm)	Cumulative daily new cases detected for the month
May	34.2	37.6	24.2	34.3	73.4	6671
June	30.2	30.4	24.9	67.6	225.1	14408
July	30.1	31.1	24.7	72.4	126.4	66904
August	27.4	30.1	26.2	78.6	228.6	84079
September	29.3	31.1	27.4	72.3	173.2	118001
October	28.1	30.8	20.6	69.8	49.1	41072
November	26.6	29.7	16.3	49.2	0.5	18742
December	24.8	28.6	14.2	43.1	0	15978

Table 2: Pearson Corelation between daily number of cases and various meteorological factors values.

Parameters	Daily detected cases	P value
T_{max}	-0.3563	0.0001
T_{min}	0.2218	0.0006
T_{avg}	-0.0661	0.3099
Humidity	0.5541	0.0001
Precipitation	0.1598	0.0136

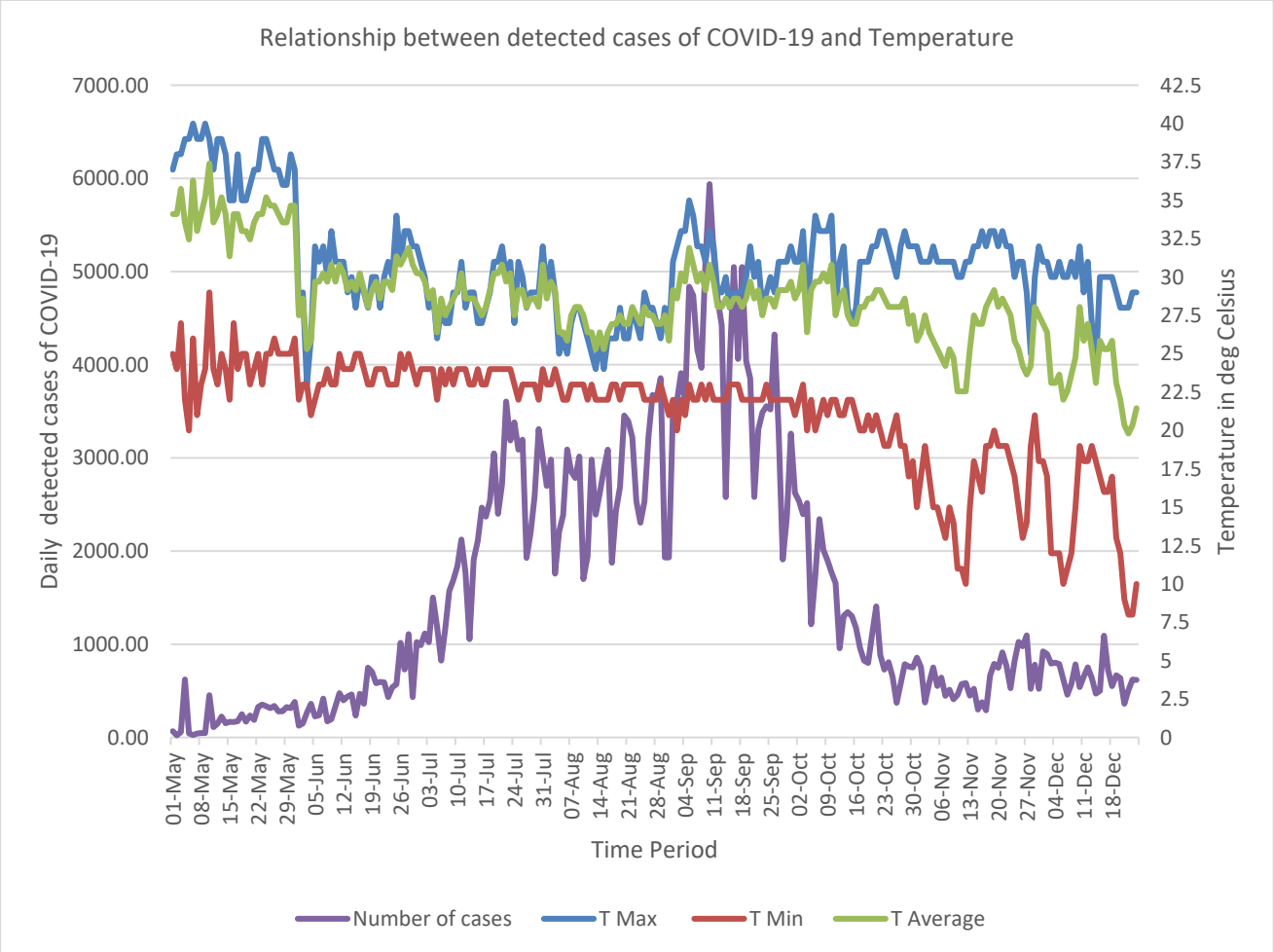

Figure 1: Relationship between detected cases of COVID-19 and temperature.

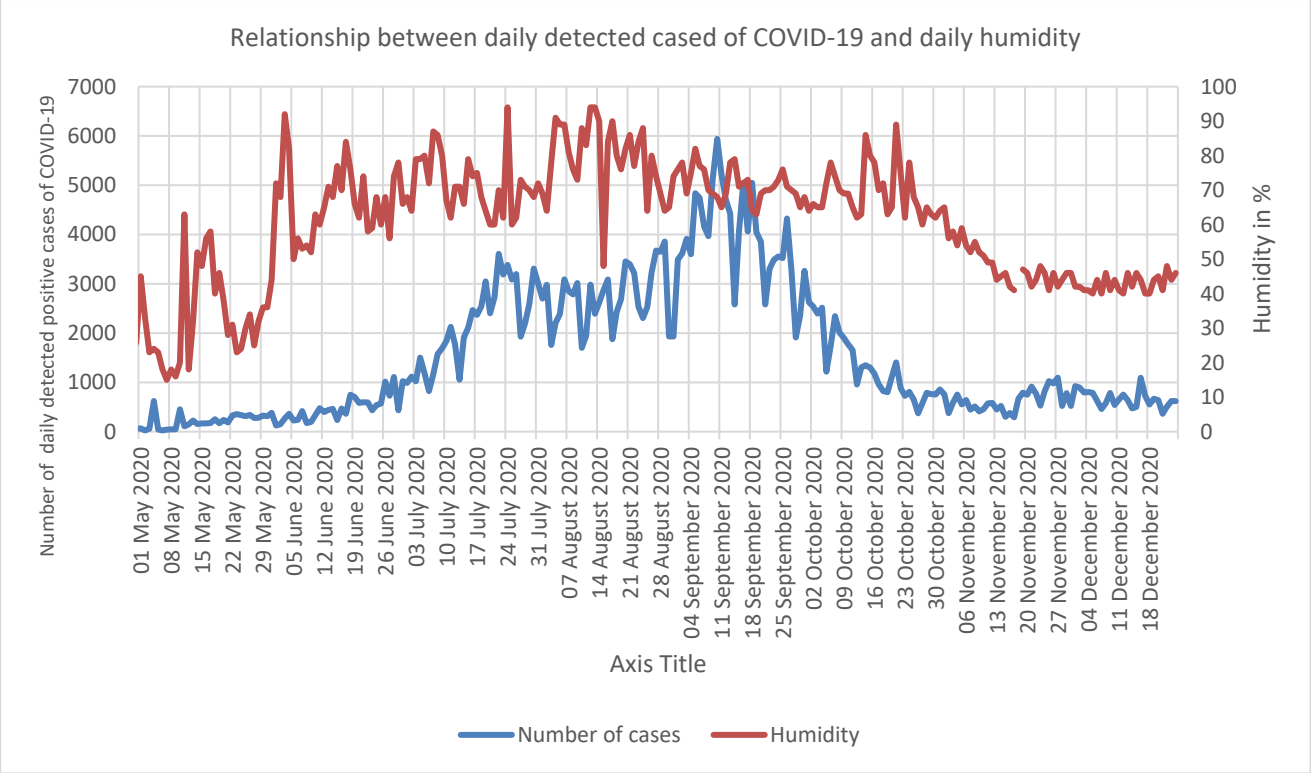

Figure 2: Relationship between daily detected cased of COVID-19 and daily humidity.

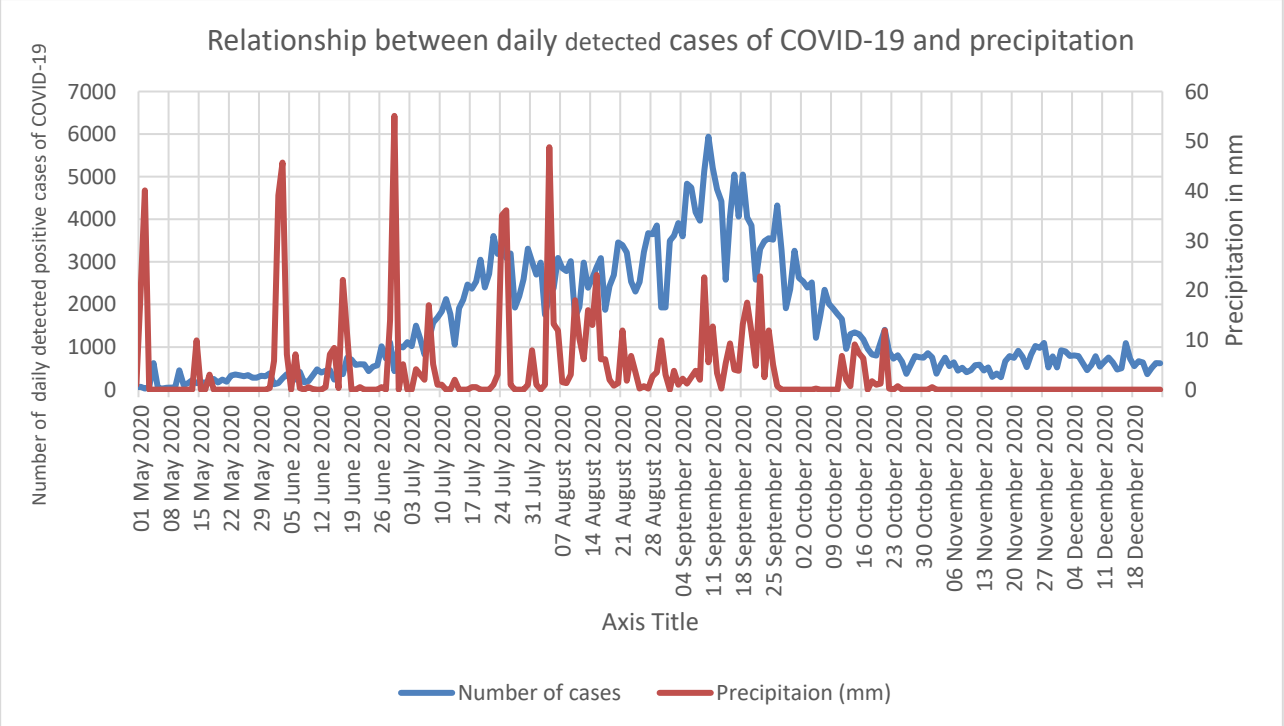

Figure 3: Relationship between daily detected cases of COVID-19 and precipitation.

DISCUSSION

As coronavirus can travel a certain distance through the air and can sustain in the air form a long time, there will be a sure influence of the meteorological factors over the transmission intensity of COVID-19.[8] There were many studies that have shown that there was relation between the temperature and transmission of the disease. Research done by Noghani and Noghanibehambari, in US counties show that an increase of one degree in temperature was

associated with a reduction of 0.041 cases per 100,000 population at the county-level.[9] Michael et al in their study "International study of temperature, heat and urban mortality: the 'ISOTHURM' project" 2008 have shown that effects of heat and cold vary depending on climate and non-climate factors such as the population disease profile and age structure. Such populations undergo some form of adaptions to the increasing temperatures and are more likely to have vulnerability to climate change in terms of disease profile.[10] Temperature is a key factor which can play a vital role in the human living system and their health regarding epidemic containment and control.[11] Along with temperature other factors that influence the transmission of the disease include population density, quality of medical care and ambient humidity. Our study showed similar findings of negative correlation between the temperature and daily detected cases of COVID-19 disease which is in conjunction with the findings of other studies.

Bu et al 2020 have found a meteorological condition with the temperature between 13 and 19°C and humidity between 50% and 80% was suitable for the survival and transmission of the coronavirus.[12] Bukhari and Jameel (2020) in their study on the spread of 2019-nCoV, have hypothesised there would be lower number of cases in tropical countries due to warm and humid conditions. They found the relation between the number of COVID-19 cases and temperature and absolute humidity observed is strong with unclear underlying relationship.[13] The potential factors for the spread of the disease, wind (speed and direction), national population age groupings, the density of population, and global indices (Global Health Security Index; GHSI, and human development index; HDI) should be considered the confounding factors for the COVID-19 transmission.[14] Meteorological factors (humidity, temperature, and rainfall) are critical drivers for controlling infectious diseases.[15]

Elevated temperatures via evaporation may prevent the spread of the infection. Humidity can enhance the survival time of the virus in the atmosphere and increase the transmission. Previous studies by Wu et al in 2020, have supported that humidity affects the infection rates of COVID-19 outbreak.[16] Auler et al in 2020 have in their study have hypothesised that in Brazil, high mean temperature and intermediate relative humidity may be responsible for the COVID-19 outbreak and with the increased death rates of the country.[17]

Sahin et al in 2020 in his study, stated that Spearman's correlation coefficients revealed that wind speed and temperature had a direct relationship with COVID-19 cases in Turkey.[15] Islam et al in 2020 have found that temperature and wind speed a strong relationship with the transmission and spread of the disease in their study based in Bangladesh.[18] Our study brought out similar findings of a positive correlation of precipitation and humidity with the daily increase in COVID-19 cases. Similar findings was brought out by Kumar et al, wherein he found a positive association between daily COVID-19 cases and temperature and a mixed association with relative and absolute humidity over India.[19]

Some methodological limitations were present in this study. The data was taken from publicly available datasets, however real-time use of National Surveillance Data should be used for public health decision making. The study did not take into account emigration, immigration and the effect of lockdown. However, in a study by Mahajan et al it was found that there was a miniscule effect of lockdown on Effective reproduction number and growth rate not sufficient enough to control the pandemic.[20]

CONCLUSION

Explication of the effects of weather variability on infectious disease epidemiology has become incredibly valuable to public health officials and practitioners in controlling diseases. The findings of this study will aid in forecasting epidemics and in preparing for the impact of climate change on the COVID epidemiology through the implementation of public health preventive measures such as promoting good hygiene practices, temporary closure of educational institutions, active vaccination and campaigns that include press releases and media events to encourage preventive activities.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. WHO. Pneumonia of unknown cause – China, 2020. Available at: http://www.who.int/csr/don/05-january-2020-pneumonia-of-unkowncausechina/en/. Accessed on 14 July 2021.
2. Worlometer. Coronavirus Update (Live): 85,509,038 Cases and 1,850,719 Deaths from COVID-19, 2021. Available at: https://www.worldometers.info/coronavi. Accessed on 14 July 2021.
3. Yuan J, Yun H, Lan W, Wang W, Sullivan SG, Jia S, et al. A climatologic investigation of the SARS-CoV outbreak in Beijing, China. Am J Infect Control. 2006;34(4):234-6.
4. Kahn JS, Intosh K. History and recent advances in coronavirus discovery. Pediatr Infect Dis J. 2005;24(11):223-7.
5. Roy I. Atmospheric Variables and Additional Urgent Solutions for Combating COVID-19. Int J Environ Sci Technol. 2020.
6. Moriyama M, Hugentobler WJ, Iwasaki A. Seasonality of Respiratory Viral Infections. Annu Rev Virol. 2020;7(1):83-101.
7. India Meteorological Department. All India Weather Forecast Bulletin, 2021. Available at: https://mausam.imd.gov.in/imd_latest/contents/all_india_forcast_bulletin.php. Accessed on 14 July 2021.

8. Lu J, Gu J, Li K, Xu C, Su W, Lai Z, et al. COVID-19 Outbreak Associated with Air Conditioning in Restaurant, Guangzhou, China, 2020. Emerg Infect Dis. 2020;26(7):1628-31.
9. Noghanibehambari H. The Effect of Temperature on Covid-19 Confirmed Cases: Evidence from US Counties. medRxiv. 2021.
10. Michael AJ, Wilkinson P, Kovats RS, Pattenden S, Hajat S, et al. International study of temperature, heat and urban mortality: the 'ISOTHURM' project. Int J Epidemiol. 2008;37(5):1121-31.
11. Tobias A, Molina T. Is temperature reducing the transmission of COVID-19 ?. Environ Res. 2020;186:109553.
12. Bu J, Peng DD, Xiao H, Yue Q, Han Y, Lin Y, et al. Analysis of meteorological conditions and prediction of epidemic trend of 2019-nCoV infection in 2020. medRxiv. 2020.
13. Bukhari Q, Jameel Y. Will Coronavirus Pandemic Diminish by Summer?. SSRN Electron J. 2020.
14. Islam ARMT, Hasanuzzaman M, Shammi M, Salam R, Doza B, Rahman M, et al. Are meteorological factors enhancing COVID-19 transmission in Bangladesh? Novel findings from a compound Poisson generalized linear modeling approach. Environ Sci Pollut Res. 2021;28:11245-58.
15. Şahin M. Impact of weather on COVID-19 pandemic in Turkey. Sci Total Environ. 2020;728:138810.
16. Wu Y, Jing W, Liu J, Ma Q, Yuan J, Wang Y, et al. Effects of temperature and humidity on the daily new cases and new deaths of COVID-19 in 166 countries. Sci Total Environ. 2020;729:139051.
17. Auler AC, Cássaro FAM, Silva VO, Pires LF. Evidence that high temperatures and intermediate relative humidity might favor the spread of COVID-19 in tropical climate: A case study for the most affected Brazilian cities. Sci Total Environ. 2020;729:139090.
18. Islam ARMT, Hasanuzzaman M, Azad MAK, Salam R, Toshi FZ, Khan MSI, et al. Effect of meteorological factors on COVID-19 cases in Bangladesh. Environ Dev Sustain. 2020;1-24.
19. Kumar S. Effect of meteorological parameters on spread of COVID-19 in India and air quality during lockdown. Sci Total Environ. 2020;745:141021.
20. Mahajan S, Kumar PV, Pushkar K. Estimating the impact of lockdown on COVID-19 cases in Pune, Maharashtra. Int J Community Med Public Health. 2020;8(1):379.

Cite this article as: Mahajan S, Devarakonda R, Mukherjee G, Verma N, Pushkar K. Impact of meteorological factors on number of new COVID-19 cases in Pune. Int J Community Med Public Health 2021;8:4307-12.