|| ISSN(online): 2589-8698 || ISSN(print): 2589-868X ||
International Journal of Medical and Biomedical Studies
Available Online at www.ijmbs.info
NLM (National Library of Medicine ID: 101738825)
Index Copernicus Value 2019: 79.34
Original Research Article
Volume 5, Issue 3; March: 2021; Page No. 137-142

COVID-19: CORRELATION OF AMBIENT TEMPERATURE AND COVID-19 INCIDENCE IN A DISTRICT OF RAJASTHAN AND PREDICTION

Dr. Pushpa Sharma[1], Proff. (Dr.) Anjli Gupta[2], Dr. Neha Kalra[3], Dr. Shahinda Quadri[4], Dr. Abdul Wahid[5], Dr. Bhavya Pareek[6], Dr. Dimpel Bishnoi[7], Dr. Shobhana Nat[8], Dr. Mohammad Salim[9], Dr. Kalim Ashraf[10], Dr. Abhishek Binnani[11], Dr. Nidhima Aggarwal[12], Rishi Kumar Sharma[13], Dr. L.K.Kapil[14]

[1]*VRDL - Department of Microbiology, SPMC, Bikaner*
[2] *VRDL - Department of Microbiology, SPMC, Bikaner*
[3] *Department of Repertory, Sri Guru Nanak Dev Homoeopathic Medical College & Hospital, Ludhiana.*
[4] *Department of Materia Medica, MNHMC & RI ,Bikaner*
[5] *MNHMC & RI, Bikaner.*
[6] *Govt. PBM Hospital, Bikaner.*
[7] *Department of Paedriatics, Sri Ganganagar Homoeopathic Medical College, Tantia University.*
[8] *MN HMC & RI, Bikaner.*
[9] *MN HMC & RI, Bikaner.*
[10] *MN HMC & RI, Bikaner.*
[11] *VRDL - Department of Microbiology, SPMC, Bikaner*
[12] *VRDL - Department of Microbiology, SPMC, Bikaner*
[13] *RUHS, Jaipur*
[14]*Trauma Centre, Govt. PBM Hospital, Bikaner*

Article Info: Received 13 February 2021; Accepted 20 March 2021
DOI: https://doi.org/10.32553/ijmbs.v5i3.1840
Corresponding author: Dr. Pushpa Sharma
Conflict of interest: No conflict of interest.

Abstract

The SARS-CoV-2 is a novel corona virus identified as the cause of COVID-19 and, as the pandemic evolves, many have made parallels to previous epidemics such as SARS-CoV (the cause of an outbreak of severe acute respiratory syndrome [SARS]) in 2003. In India, the disease was first detected on 30 January 2020 in Kerala in a student who returned from Wuhan. The total (cumulative) number of confirmed infected people is 324101 in Rajasthan and 271282 till now across India (19 March 2021). Many have speculated that, like SARS, the activity of SARS-CoV-2 will subside when the climate becomes warmer. We sought to determine the relationship between ambient temperature and COVID-19 incidence in Bikaner district of Rajasthan state. In this article, we will focus the infected people in Bikaner district and build growth models to predict infected people for that state in the next 30 days. The impact of preventive measures on daily infected-rate is discussed. We analyzed over 272851 COVID-19 cases of Bikaner from February 2020 to March 15, 2021. We find a statistically significant association between total cases or effective reproductive number of COVID-19 and ambient temperature. Our findings do not support the hypothesis that higher temperatures will reduce transmission of COVID-19 and warns the public not to lose vigilance and to continue practicing safety measures such as hand washing, social distancing, and use of facial masks despite the warming climates.

Introduction

The outbreak of Corona virus Disease-2019 (COVID-19) caused by Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) has threatened health worldwide. The year 2020 is begins with a huge challenge called COVID 19 in India too. The first case of COVID 19 in India was reported on 30 January 2020, originating from China. After four months this disease spread in almost all parts of the country. Coronavirus disease (COVID-19) is an infectious disease caused by corona virus. Affects of COVID-19 seen in different people in different ways. The total (cumulative) number of confirmed infected people is 324101 in Rajasthan and 271282 till now across India (19 March 2021).

Corona viruses belong to the Coronaviridae family in the Nidovirales order [1]. Corona represents crown-like spikes on the outer surface of the virus; thus, it was named as a corona virus. Corona viruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was identified as the cause of a disease outbreak that originated in China.

The virus is now known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The disease it causes is called coronavirus disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the seventh member of the family of coronaviruses that infect humans [2] and induces coronavirus disease 2019 (COVID-19).

The virus that causes COVID-19 is mainly transmitted through droplets generated when an infected person coughs, sneezes, or exhales. These droplets are too heavy to hang in the air, and quickly fall on floors or surfaces. Early research suggests that person-to-person infectious transmission from COVID-19 requires up to two weeks of incubation time [3]. Most infected people will develop mild to moderate illness and recover without hospitalization. Old age people and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness [4]. The World Health Organization (WHO) declared the outbreak of the novel corona virus COVID-19 as a global pandemic on March 11, 2020, as it became a global health threat (Organization 2020). The prevailing COVID-19 pandemic is spreading at a continuous pace with 12,507,849 confirmed cases as of July 12, 2020, worldwide. WHO declared Corona virus disease 2019 (COVID-19) as a global pandemic on 11 March 2020 [5]. The disease has spread across 210 countries and territories around the world, with a total of more than two million confirmed cases [6, 7]. In India, the disease was first detected on 30 January 2020 in Kerala in a student who returned from Wuhan [8, 9]. The total (cumulative) number of confirmed infected people is 17615 till now (19 April 2020) across India [10]. There are few states with cumulative infected peoples are low in number. Depending on how those states strictly follow the preventive measures, we may see a rise in the confirmed cases.

Preventive Measures

Table1: List of major preventive measures taken by the Indian Govt.

Date	Measure
25/1/2020-13/3/2020	Health screenings at airports and border crossings
26/2/2020-20/3/2020	Introduction of quarantine policies: gradually for passengers coming
26/2/2020-13/3/2020	Visa restrictions: gradually for different countries
5/3/2020	Limit public gatherings
11/3/2020	Border checks
13/3/2020-15/3/2020	Border closure
16/3/2020	Limit public gatherings
18/3/2020	Travel restrictions
20/3/2020	Testing for COVID-19
22/3/2020	Flights suspension
22/3/2020	Cancellation of Passenger Train Services
24/3/2020	Suspension of Domestic Airplane Operation
25/3/2020	21 days Lockdown of entire Country
25/3/2020	Cancellation of Passenger Train Services
30/3/2020	Increase of quarantine/isolation facilities
14/4/2020	Extension of Lockdown till 3 May 2020
June 2020	All preventive measures were hand-over to state govt.

Method

We conducted a one year district wide retrospective survey on the impact of COVID-19 on the cases of acute coronary syndrome (ACS) from February 2020 to March 15, 2021.

The major aim of this article is to collect, process, analyzed and visualize the result into its geographical form for the easy understating and for further usages. The primary data of COVID19 is collected from Ministry of Health and Family Welfare (https://mohfw.gov.in), COVID19 INDIA (https://covid19india.org), and local administrative. The collected data is cleaned and processed into spreadsheets and arranged in the required manner.

Study area

Rajasthan is a state in northern India. The state covers an area of 342,239 square kilometers or 10.4 percent of the total geographical area of India. It is the largest Indian state by area and the seventh largest by population. Rajasthan is among the states of the country which have conducted highest number of tests and have per capita ratio of tests higher than national average.[11**]** Bikaner is a city in the northwest of the state of Rajasthan, India. It is located 330 kilometers (205 mi) northwest of the state capital, Jaipur. Bikaner recorded their first laboratory-confirmed COVID-19 cases on 5 March. Under-ascertainment of cases during March and early April was likely due to limited testing availability and testing algorithms.

The present study examines the impact of weather indicators on the COVID-19 outbreak in the Bikaner district of Rajasthan state of India. The coronavirus disease 2019 (COVID-19) outbreak has had a major impact on medical and surgical activities.

We will focus on the infected people of Bikaner district and build growth models to predict infected people for Bikaner in the next 30 days.

Patient Cohort

Consecutive patients with COVID-19 infection from Feb. 2, 2020, to March 15, 2021, in 7 major Bikaner public hospital centres were studied. Research criteria were (a) diagnosis of COVID-19 based on possible exposure history or symptoms that were clinically compatible with the disease, validated with detection of SARS-CoV-2 via reverse transcriptase polymerase chain reaction assays on the nasopharyngeal, throat, or lower respiratory tract swabs; (b) severe COVID-19 infection defined as requirement for hospitalization and oxygen therapy.

Virologic Assessment

Quantitative real-time reverse transcriptase polymerase chain reaction tests for SARS-CoV-2 nucleic acid were performed on nasopharyngeal or lower respiratory tract swabs. Primer and probe sequences target two regions on the RNA dependent RNA polymerase (RdRp) gene and are specific to SARS-CoV-2. Assay sensitivity is around 10 copies per reaction.

Statistical Models

In this article, we consider the exponential model and the logistic model, for COVID-19 pandemic prediction at the district level. These models have already been used to predict epidemics like COVID-19 around the world, including China, Ebola outbreak in Bomi, Liberia (2014) [12, 13, 14].

Exponential Model

A pandemic can show exponential growth at the initial stage. For example, at the early stage, the 2014-15 Ebola epidemics in West Africa had shown a seemingly exponential spread [15].

We can write the exponential model as-

$$y = y_0 \times exp(\mu_{max} \times time)$$

Logistic Model

Some pandemics follow an S-shaped curve (sigmoid curve). In other words, the pandemic may start slowly; then, it will increase the growth-rate (infection-rate), and finally, it will flatten the growth-rate over time. The following logistic model can capture that [16].

$$y = \frac{K \times y_0}{y_0 + (K - y_0) \times exp(-\mu_{max} \times time)},$$

Results

The percentage of tests yielding positive results peaked at 1.09% on April 2020, when the daily number of tests performed was low in state (range, 2169 tests; Fig. 1). Throughout early May, there was increases in the number of tests performed daily coincided with a reduction in the proportion of tests yielding positive results. Our analyses include data collected through 2 February, at this time Bikaner had started to diagnose the cases through RT-PCR test (table 2).

The first case of COVID19 in Bikaner was reported on 30 April 2020. The COVID-19 cases appeared from 2 March 2020 onwards. These cases were related to people who have been evacuated or have arrived from COVID19 affected countries. From 20 March 2020, there is an exponential growth in the daily number of COVID19 cases at district level.

The earliest clusters of locally acquired cases emerged in April in Bikaner district of Rajasthan. On April 3 Bikaner district reported their first case due to the Tablighi Jamaat members.[17]

On April 4, first death of the state was reported in Bikaner, as a 60-year-old woman died due to the virus.[18] Till April 7, three died due to the virus.[19]

By 17 April, Bikaner districts emerged as the new hotspots of the virus as these saw a surge in cases in April.[20] Bikaner ultimately experienced the highest cumulative incidence of COVID-19, totaling 58835 cases (204.6 per 10,000 population) by August 2020. An outbreak beginning on 28 April caused 8464 cases by May. Thereafter, few cases were identified in this district until early June (fig. 1). On 1 June, one death in Bikaner was recorded, On 18 May, Rajasthan government issued guidelines and relaxations regarding lockdown 4.0 in the state and classified the zones under Urban and Panchayat samiti categories in each district. On 16 June, the state government said that no passes or NOC would be required to enter or leave the state from now on.[21] In a subsequent manner, several restrictions were eased. In November, the increasing cases amid festive season and cold weather conditions prompted the government to impose night curfew in selected cities and urban areas.[22] After this, number of positive cases start increasing due to the end of lockdown period, which increases rush on the roads and public gathering. Gradual increase in positive cases were seen after lockdown period with highest incidence in October 11652 out of 35961 i.e. 32.40%. This was the festival season. But after this increase, gradual decrease was seen in positive cases with decrease in temperature as shown in fig.1 and table 1. The educational institutions were allowed to open from 18 January 2021 with necessary guidelines.[23] On 18 January 2021, the night curfew was withdrawn in view of significant reduction in coronavirus cases and few more relaxations were given.[24]

In view of gradual increase in cases in February, negative RT-PCR report was made mandatory for travellers from Maharashtra and Kerala.[25]

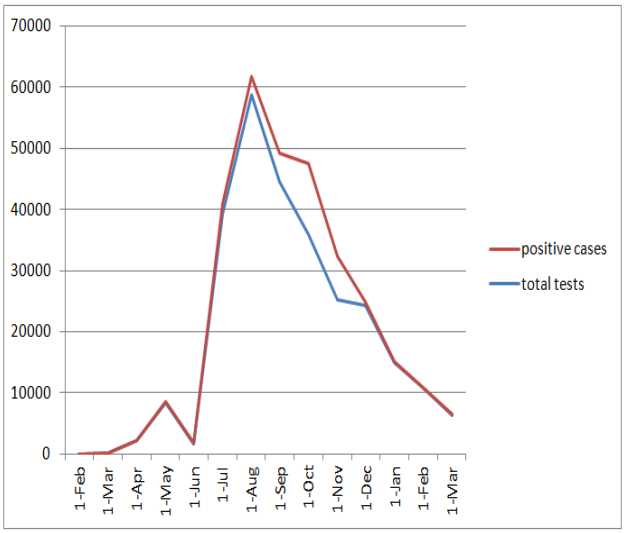

Figure 1: Graph representing the Incidence overtime and across district. Diagnostic tests conducted each month (top) and the proportion of tests yielding positive results (bottom) for the period Feb. 2, 2020 to March 15, 2021, when districts reported comprehensive testing information to the state governments.

These data show that there was a quiet an increase in the number of positive cases in mid of March, 2021 in comparison to January and February. This is the second wave of COVID 19. This decline in the number of positive cases up to February may be due to low atmospheric temperature. This may also show that there could be a many

of people who are in the community without knowing that they are carrying the virus.

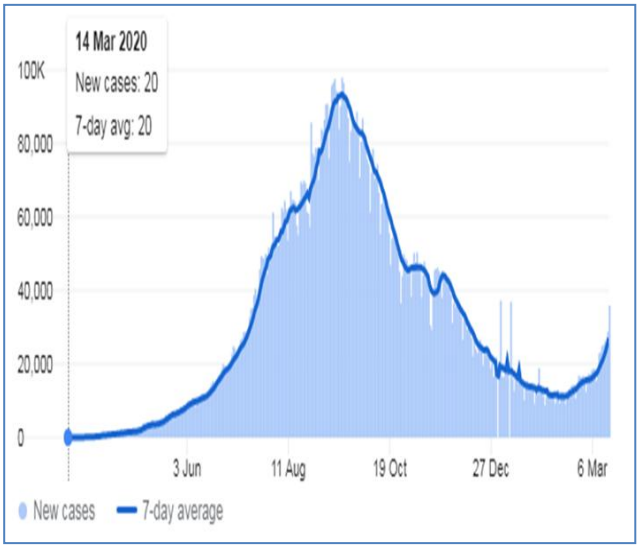

Fig 2: graph representing the COVID cases in Rajasthan

But as when environmental temperature increases, COVID positive cases are going to rise again. In mid March total positive cases were 42 in Bikaner, which was half of total positive cases of January and February which were 88. This is the period when COVID vaccination also started. While in the entire Rajasthan state the number of positive cases was 323774 out of 6556622 i.e. 4.9% on March 15, 2021. The high growth of active cases in the latter part of the lockdown is a major concern for this state. It could be a signal of a community spread of the COVID-19.

Table 2: Positive and negative cases during 12 months of covid19 pandemic

Month	Maximum samples	Positive samples	Negative samples	Percentage
February	4	0	0	0%
March	101	0	0	0%
April	2169	39	2130	1.79%
May	8464	69	8395	0.81%
June	1681	229	16585	1.36%
July	39290	1707	37583	4.34%
August	58835	2879	55956	4.89%
September	44556	4691	39865	10.52%
October	35961	11652	24309	32.40%
November	25285	7139	18146	28.23%
December	24255	597	23658	2.46%
January	15001	67	14934	0.4%
February	10858	21	10837	0.19%
March,15	**6391**	**42**	**6349**	**0.65%**
Total	272851	29132	258747	10.67%

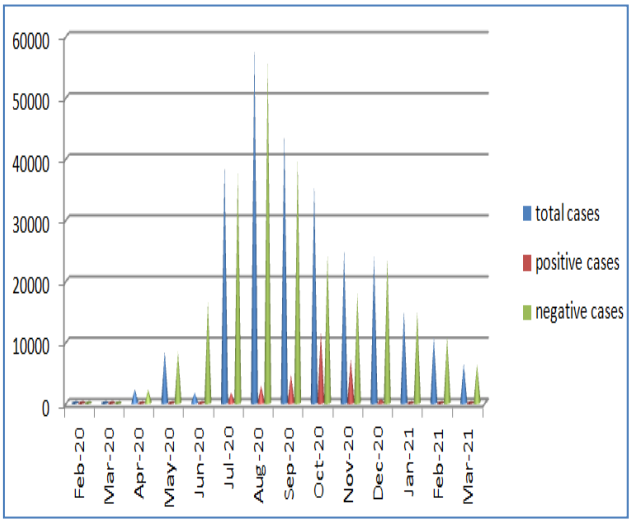

Figure 3: The bar chart shows the daily growth of the COVID-19 cases in Bikaner. The western state district reported 42 cumulative infected COVID-19 cases. The logistic model indicates that in another 30 days from now, the state can see around more than 100 cumulative infected cases. This district has not observed a specific trend in the daily infected rates during the lockdown. The current infection-rates for Rajasthan are still on the higher side. This state needs immediate intervention to make all the preventive measures already taken by the Government strictly. It may show that absence of any preventive measure, the numbers could have increased manifold.

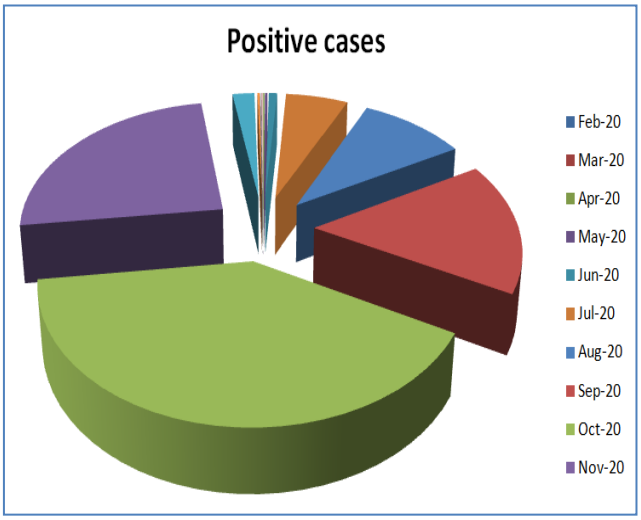

Figure 4: Pie chart showing the positive cases of COVID 19 in Bikaner district

Discussion

India, a country of 1.3 billion people, has reported 17615 confirmed COVID-19 cases after 80 days (19 April 2020) from the first reported case in Kerala [7]. India has taken many preventive measures to combat COVID-19 in much earlier stages compared to other countries, including nationwide lockdown from 25 March 2020. Apart from lockdown, people have certain conjectures about possible reasons behind India's relative success, e.g., measures like the travel ban relatively early, use of BCG vaccination to

combat tuberculosis in the population that may have secondary effects against COVID-19 [33,34], exposure to malaria and antimalarial drugs [35], hot and humid weather slowing the transmission, and so on [36,37].

However, as of now, there is no concrete evidence to support these conjectures.

Note that India may have seen fewer COVID-19 cases till now, but the war is not over yet. There are many states like Maharashtra, Delhi, Madhya Pradesh, Rajasthan, Gujarat, Uttar Pradesh, and West Bengal, who are still at high risk. These states may see a huge jump in confirmed COVID-19 cases in the coming days if preventive measures are not implemented properly. We hope India can be free of COVID-19 with a strong determination as already shown by the central and respective state Governments.

Acknowledgements

As an author of this paper, I am grateful to VRDL, Deptt of Microbiology, SPMC, Bikaner, to provide COVID 19 data. I am also thankful to the ministry of health and family welfare (Govt.of India), Govt. of Rajasthan, covid19 India.org administrative for providing updated COVID19 data for this study.

Reference

1. Coronavirus infections-more than just the common cold. Paules CI, Marston HD, Fauci AS. JAMA. 2020;323:707–708. [PubMed] [Google Scholar]
2. A novel coronavirus associated with severe acute respiratory syndrome. Ksiazek TG, Erdman D, Goldsmith CS, et al. N Engl J Med. 2003;348:1953–1966. [PubMed] [Google Scholar]
3. Dutheil, F., Baker, J.S. & Navel, V. COVID-19 and air pollution: the worst is yet to come. Environ Sci Pollut Res 27, 44647–44649 (2020). https://doi.org/10.1007/s11356-020-11075-6.
4. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. Wang D, Hu B, Hu C, et al. JAMA. 2020;323:1061–1069. [Google Scholar]
5. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Huang C, Wang Y, Li X, et al. Lancet. 2020;395:497–506. [PMC free article] [PubMed] [Google Scholar]
6. Coronavirus disease (COVID-19) pandemic. [Mar;2020]; https://www.who.int/emergencies/diseases/novel-coronavirus-2019 202.
7. Kerala reports first confirmed coronavirus case in India - India News. https://www.indiatoday.in/india/story/kerala-reports-first-confirmed-novel-coronavirus-case-in-india-1641593-2020-01-30. Accessed March 28, 2020.
8. Bhatnagar T, Murhekar M V, Soneja M, et al. Lopinavir/ritonavir combination therapy amongst symptomatic coronavirus disease 2019 patients in India: Protocol for restricted public health emergency use. Indian J Med Res. 2020;(PG-). doi:10.4103/ijmr.IJMR_502_20
9. No Title https://icmr.nic.in/sites/default/files/whats_new/ICMR_testing_update_19April_9PM_IST.pdf. Accessed April 21, 2020.
10. "Rajasthan records 46 new COVID-19 cases; total up to 179". outlookindia. Retrieved 14 April 2020.
11. Dubey, Jyotindra (13 April 2020). "Covid-19: How Indian states have fared in testing for coronavirus". Business Standard India. Retrieved 28 April 2020.
12. Roosa K, Lee Y, Luo R, et al. Short-term Forecasts of the COVID-19 Epidemic in Guangdong and Zhejiang, China: February 13–23, 2020. J Clin Med. 2020;9(2):596. doi:10.3390/jcm9020596
13. Viboud C, Simonsen L, Chowell G. A generalized-growth model to characterize the early ascending phase of infectious disease outbreaks. Epidemics. 2016;15:27-37. doi:10.1016/j.epidem.2016.01.002
14. Nakamura GM, Martinez AS. Hamiltonian dynamics of the SIS epidemic model with stochastic fluctuations. Sci Rep. 2019;9(1):1-9. doi:10.1038/s41598-019-52351-x
15. Growthrates package | R Documentation. https://www.rdocumentation.org/packages/growthrates/versions/0.8.1. Accessed April 5, 2020.
16. "Rajasthan records 46 new COVID-19 cases; total up to 179". outlookindia. Retrieved 14 April 2020.
17. "COVID-19: India Crosses 3,000 Cases, Death Toll Reaches 75". The Quint. 4 April 2020. Retrieved 25 May 2020.
18. PTI (7 April 2020). "Coronavirus death toll nears 124, total confirmed cases reach 4,789 in Indi". ThePrint. Retrieved 14 April 2020.
19. "Coronavirus: Complete list of 170 COVID-19 hotspots in India | What are Red, Orange and Green zones". Jagran English. 16 April 2020. Retrieved 19 April2020.
20. "Rajasthan: Pass, NOC not needed for entry/exit in or from state". BW Businessworld. ANI. Retrieved 17 June 2020. Iqbal, Mohammed (22 November 2020). "Night curfew in Rajasthan". The Hindu.
21. "Rajasthan: Schools, colleges & coaching centres to reopen from January 18". The Times of India. 6 January 2021.
22. "Rajasthan govt ends night curfew after decline in COVID-19 cases". The Economic Times. Press Trust Of India. 18 January 2021.
23. "Covid-19: Rajasthan makes negative RT-PCR report mandatory for travellers from Maharashtra, Kerala". Scroll.in. 25 February 2021.
24. PTI (7 April 2020). "Coronavirus death toll nears 124, total confirmed cases reach 4,789 in India". ThePrint. Retrieved 14 April 2020.
25. "Coronavirus: Complete list of 170 COVID-19 hotspots in India | What are Red, Orange and Green zones". Jagran English. 16 April 2020. Retrieved 19 April 2020.

26. Coronavirus latest: pandemic could have killed 40 million without any action. https://www.nature.com /articles/d41586-020-00154-w. Accessed March 27, 2020.
27. Countries where Coronavirus has spread - Worldometer. https://www.worldometers.info/ coronavirus/countries-where-coronavirus-has-spread/. Accessed March 27, 2020.
28. https://www.who.int/docs/default-source/ coronaviruse/situation-reports/20200121-sitrep-1-2019-ncov.pdf. Accessed April 5, 2020.
29. https://www.who.int/docs/default-source/sri-lanka-documents/what-is-coronavirus english.pdf?sfvrsn=a6b21ac_2. Accessed April 5, 2020.
30. Zhu W, Xie K, Lu H, Xu L, Zhou S, Fang S. Initial clinical features of suspected Coronavirus Disease 2019 in two emergency departments outside of Hubei, China. J Med Virol. 2020;(PG 10.1002/jmv.2576310.1002/jmv.25763):10.1002/jmv .25763-10.1002/jmv.25763. doi:10.1002/jmv.25763
31. (No Title). https://www.ecdc.europa.eu/sites/default/ files/documents/RRA-sixth-update-Outbreak-of-novel-coronavirus-disease-2019-COVID-19.pdf. Accessed April 5, 2020.
32. Coronavirus latest: pandemic could have killed 40 million without any action. https://www.nature.com /articles/d41586-020-00154-w. Accessed March 27, 2020.
33. Hegarty PK, Service NH, Kamat AM, Dinardo A. BCG vaccination may be protective against Covid-19. 2020;(March). doi:10.13140/RG.2.2.35948.10880
34. Bacille Calmette-Guérin (BCG) vaccination and COVID-19. https://www.who.int/news-room/ commentaries/detail/bacille-calmette-guérin-(bcg)-vaccination-and-covid-19. Accessed April 21, 2020.
35. Mayo Clinic is studying antimalarial drug for COVID-19 treatment | Healthcare Finance Newshttps://www.healthcarefinancenews.com/node/ 139936. Accessed April 21, 2020.
36. Why India has the upper hand against COVID-19 | World Economic Forum. https://www.weforum.org/agenda/2020/04/india-covid19-coronavirus-response-kerala-uttar-pradesh/. Accessed April 20, 2020.
37. To T, Zhang K, Maguire B, Terebessy E, Fong I, Parikh S, Zhu J. Correlation of ambient temperature and COVID-19 incidence in Canada. Sci Total Environ. 2021 Jan 1;750:141484. doi: 10.1016/ j.scitotenv.2020.141484. Epub 2020 Aug 4. PMID: 32829260; PMCID: PMC7402211.
38. Ghosh P, Ghosh R, Chakraborty B. COVID-19 in India: Statewise Analysis and Prediction. JMIR Public Health Surveill. 2020;6(3):e20341. Published 2020 Aug 12. doi:10.2196/20341
39. Bukhari Q, Jameel Y. Will Coronavirus Pandemic Diminish by Summer? SSRN ElectronJ.March2020. doi:10.2139/ssrn.3556998.
40. Viboud C, Simonsen L, Chowell G. A generalized-growth model to characterize the early ascending phase of infectious disease outbreaks. Epidemics. 2016;15:27-37. doi:10.1016/j.epidem.2016.01.002.