

SARS-CoV-2 disease in Northwestern Himalayan region, India: evolution, forecast and impact of preventive measures

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Research Article

Keywords: Covid-19, coronavirus, 2019n-CoV, pandemic, transmissibility, infectious disease

Posted Date: July 10th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-40825/v1>

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Abstract

Aim: The outbreak of the new coronavirus pandemic (SARS-CoV-2) was initiated in December 2019, and within couple of months it has turned out to be a global health emergency. Given the importance to assess the evolution and transmissibility of SARS-CoV-2 and to forecast the next scenario of the pandemic in the future, mainly in countries with limited health care system, we estimated the reproductive number (R_0) of SARS-CoV-2 in Jammu and Kashmir (J&K), India, and a possible scenario for this pandemic in the region.

Subject and Methods: We estimated the reproductive number (R_0) of SARS-CoV-2 in its first outbreak stage in the North western region of Himalaya, India, and we also predicted new daily cases for the next 90 days using different R_0 , testing a plausible end of SARS-CoV-2 outbreak;

Results: Our results showed a considerable increase in the number of cases, but with a tendency to asymptote. Anantnag, Bandipora, Baramulla, Shopian, and Srinagar districts showed more than 100 cases and Kulgam and Kathua districts showed strong growth of the number of cases from the beginning of May, without a tendency to normalization. The estimated R_0 for J&K region was 1.041; but by decreasing 10, 25 and 50% the R_0 , we observed a great decrease in the daily number of new cases, specially by decreasing 50%;

Conclusion: Here, we indicate positive effects of the preventive measures, as lockdown and social distance, taken in J&K region, showing a stabilization of the growth curves of new cases of SARS-CoV-2, which tends to a strong decrease over time as the R_0 decreases.

Introduction

Currently, the whole world is dealing with one of the most severe epidemic viral disease, firstly reported in Wuhan province, China, in December 2019. This disease was named by the world health organization (WHO) as coronavirus disease 19 (Covid-19), caused by a novel coronavirus, primarily named as 2019n-CoV, and later as "Severe Acute Respiratory Syndrome Coronavirus-2" (SARS-CoV-2) (Gorbalenya et al. 2020). Phylogenetic studies have shown that SARS-CoV-2 is directly linked to two bat-related SARS-like coronaviruses bat-SL-CoVZXC21 (GenBank accession no. *MG772934.1*) and bat-SL-CoVZC45 (GenBank accession no. *MG772933.1*) with about 88- 89% similarity (Jiang et al. 2020; Lu et al. 2020; Ren et al. 2020). Further, it was also found that this new virus is associated with horseshoe bats (*Rhinolophus* genus), with about 98.7% sequence similarity to the *RdRp* (RNA- dependent RNA polymerase) gene of BtCoV/4991 strain of bats (GenBank KP876546) and about 87.9% sequence with bat-SL-CoVZXC21 and bat-SL-CoVZC45 strains of bats (Chen et al. 2020a).

Evolutionary studies based on S and N genes and ORF1a/1b have predicted that SARS-CoV-2 is a new strain of coronavirus independently transmitted from animals to humans (Chen et al. 2020a). On the

basis of these investigations and the incidence of some species of bats and other animals in the seafood market in the Wuhan province of China, it was speculated that SARS-CoV-2 may have been transmitted from bats into the humans (Zhou et al. 2020), presuming animal to human spread (Chen et al. 2020b). However, studies have also indicated human to human transmission through direct contact or droplet transmission (Huang et al. 2020).

This virus is tentatively presumed to have an average incubation period of 6.4 days and R_0 (basic reproductive number) of 2.24–3.58 (Zhao et al. 2020). The clinical manifestations of the disease can vary from asymptomatic to severe cases, leading to individuals death (Jin et al. 2020). Among the patients with SARS-CoV-2, fever was the most common symptom (92.8%), but others can be included as cough, myalgia, headache, dyspnea and diarrhea (Chen et al. 2020b). Rhinorrhea was also reported in about 4.0 % of cases, pharyngalgia in 17.4%, and sore throat in 5.1% of SARS-COV-2 cases whose clinical data was available (Chen et al. 2020b). Moreover, ground- glass opacity of lungs observed by computed tomography images of the lungs was the most common clinical symptom found in cases (Chung et al. 2020).

Although different medications have been used as treatment (Chen et al. 2020b; Huang et al. 2020; Wang et al. 2020), the scientific community has not been able to develop effective treatment for SARS-CoV-2. Then, several countries have taken measures of social isolation/distancing and total lockdown, as a way to decrease the transmission of the disease and avoid overcrowding in treatment centers (e.g. hospitals). Until May 12, 2020, the WHO reported more than 4.1 million confirmed cases and 287,000 deaths of this deadly viral epidemic in more than 190 countries (<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>).. Specifically in India, WHO has reported more than 74,281 confirmed cases of SARS-CoV-2, and 2,415 deaths by May 12, 2020 (<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>)..

It is extremely important to assess the evolution and transmissibility of SARS-CoV-2, and to forecast the next scenario of the pandemic in the future. Assessing these factors, government agencies will be able to act more accurately, investing in preventive and treatment measures in the most affected regions, especially in third world countries like India. Here we estimated the reproductive number (R_0) of SARS-CoV-2 in its first outbreak stage in the North western region of Himalaya, India, and we also predicted new daily cases for the next 90 days using different R_0 , testing a plausible end of SARS-CoV-2 outbreak. Using different R_0 values allow us to predict how preventive measures (e.g. lockdown and social distancing) are important for decreasing SARS-CoV-2 transmissibility. This is the first study conducted in this region evaluating the current situation and proposing future outcomes of SARS CoV-2, and will have positive implication in planning current and future measures.

Methodology

Studied region

Our study focused on a region of India, Jammu and Kashmir (J&K), located at the northern-most part of the country. It covers an area of 42,241 km² which extends between 33.7782N and 76.5762E (Fig. 1). The region is separated by the line of control from the Pakistan-administered territories of Azad Kashmir and Gilgit-Baltistan in the west and north respectively. It lies on the north of the Indian states of Himachal Pradesh and Punjab and the west of Ladakh. The Himalayas divide the Kashmir valley from the Tibetan plateau while the PirPanjal range, which encloses the valley from the west to the south, separates it from the Great Plains of northern India. The Union Territory is divided into two bio-geographic provinces, Jammu and Kashmir, which differ in terms of climate, culture and physiographic. As per the 2011 census, the population of Jammu and Kashmir is about 12.5 million.

Data source

We monitored and analyzed the cases of all districts (20) in Jammu and Kashmir (Fig. 1), India, namely: Anantnag, Bandipora, Budgam, Baramulla, Doda, Ganderbal, Jammu, Kupwara, Kulgam, Kathua, Kishtwar, Poonch, Pulwama, Rajouri, Ramban, Reasi, Srinagar, Shopian, Samba and Udhampur. We gathered the data from various sources, such as official twitter handle of “Principal secretary planning & information” of the government of J&K (Mr. Rohit Kansal) (<https://twitter.com/kansalrohit69?>), Official twitter handle of Department of Information & Public Relations of the government of J&K (<https://twitter.com/diprjk/status/>), as well as other sources the “E” newspapers of J&K which included “Greater Kashmir (<http://epaper.greaterkashmir.com/>)”, and Rising Kashmir (<http://epaper.risingkashmir.com/>). We also followed the website (<https://covidkashmir.org/>) which is the unique website in J&K providing the updated information of SARS-CoV-2 patients. To verify our data, we cross-checked it with the information on the website of the ministry of health and family welfare government of J&K (<https://www.mohfw.gov.in/>). We divided the cases based on active, recovered, and deaths. All these were monitored every day in every district of J&K from the first reported case (March 9, 2020) until May 12, 2020 (two months).

Analyses

All plots and analyses were performed using R 4.0.0 with 5% probability. Firstly, we used bar plots to visualize the current circumstances of SARS-CoV-2 in these districts, assessing the number of active cases, recovered, and deaths. In addition, we constructed accumulation curves to observe the trend of active cases and deaths in 18 districts of J&K, and in J&K region as a whole. We used only 18 districts because Doda and Poonch did not present any reported case. In these curves, we chose to transform and plot the data in log₂ to facilitate visualization and comparison of the data among each district, and these with the total.

For other analyses, we used the serial interval and the R₀ (reproductive number). Serial interval is the duration between symptom onset of the first and second case given a transmission chain; and R₀ is the

expected number of secondary cases that one primary case may generate in a susceptible population (Li et al. 2020; Zhang et al. 2020).

To assess the transmissibility of SARS-CoV-2 in J&K region, we estimated the R_0 in early stage of SARS-CoV-2 outbreak in the region using the package “early R” (Jombart et al. 2017). First we obtained the serial interval, which is required to estimate R_0 , using the mean (7.5 days) and standard deviation (3.4 days) values from SARS-CoV-2 in Wuhan, China (Li et al. 2020). Then, we fit the serial interval value with gamma distribution and Maximum-Likelihood (ML) estimate of R_0 . We also used a bootstrap analysis (1000 randomizations) to obtain a sample of plausible R_0 values and derive other statistics for this distribution (Jombart et al. 2017).

To predict plausible disease trajectories simulation and future daily incidence prediction, we used the package “projections” (Jombart and Nouvellet 2020). A model based on past incidence data, selection of plausible R_0 , and the distribution of the serial interval with Poisson distribution (determined by daily infectiousness) was fit to observe the simulation and prediction. Our observed R_0 was equal to 1.041 (see results), and our randomized R_0 was equal to 1.038; then we used $R_0 = 1.041$ in our analysis for being relatively the same value of R_0 provided by the null model. As our data has a range of 60 days, we predict future incidence for the next 90 days. We used a bootstrap resampling method with 1000 randomizations.

Finally, we decreased R_0 value in 10% ($R_0 = 0.9$), 25% ($R_0 = 0.75$), and 50% ($R_0 = 0.5$) to predict plausible disease trajectories simulation and future daily incidence prediction in the next 90 days. This analysis will show us how the future daily incidence evolves with a decrease in expected number of secondary cases that one primary case may generate in a susceptible population. In other words, we are evaluating how social distancing and lockdown are important for the evolution of SARS-CoV-2 cases in J&K region.

Results

Our results showed that the total number of cases (active, recovered, and deaths) in these 18 districts in J&K was 934 (Table 1). Of this total, 469 (50.2%) are active, 455 (48.7%) are recovered, and only 10 (1.1 %) died (Table 1, Fig. 2). The first case of SARS-CoV-2 was reported from Jammu district on March 9, 2020, and first death was reported from Srinagar district on March 24, 2020. In general, as of March 22, there has been a considerable increase in the number of cases, but with a tendency to asymptote. Considering these 18 districts, it is still not clear that there is a decrease in the number of cases and deaths; however, our accumulation curves show that there is a slow increase with a tendency to normalization (Fig. 3). Anantnag, Bandipora, Baramulla, Shopian, and Srinagar districts have more than 100 cases of SARS-CoV-2, nine other districts have between 10 and 100 cases, and only four have less than 10 cases (Table 1, Fig. 1). The district with the highest number of cases was Srinagar and Bandipora with 136 and 134 cases, respectively. In Bandipora, 107 people have already recovered and only one person has died. In Srinagar, 81 people have already recovered, and four died, making up the district with the highest number of deaths among these 18 evaluated districts.

Most of the districts with the highest number of cases appear to show a tendency to normalize the number of cases, i.e., a tendency to asymptote (Fig. 3). On the other hand, Kulgam and Kathua showed strong growth of the number of cases from the beginning of May. Samba, Kathua, Reasi, Kishtwar, and Ramban presented cases only from the second half of April, with minimal growth so far, except for Kathua (Fig. 3). Due to the high recovery rate, approximately 50% of all reported cases (Table 1), there has been a low number of deaths so far. The only districts with death cases were Bandipora (1), Anantnag (1), Srinagar (4), Baramulla (3) and Udampur (1).

Using our serial interval distribution of SARS-CoV-2 (Fig. 4a), we found a ML estimation of R_0 value equals to 1.041 for the outbreak at the early stage in the J&K region (Fig. 4b). Based on the bootstrap resampling method, we estimated a R_0 average of 1.038 and 95% confidence interval (CI) of 0.98–1.09 (Fig. 4c).

Then, we evaluated the future daily incidence number (Fig. 5a-d) and cumulative number (Fig. 5e-h), and the plausible disease trajectories (Fig. 5i-l) for the next three months (starting on May 12, 2020) considering different values of R_0 ($R_0 = 1.041$, $R_0 = 0.9$, $R_0 = 0.75$, $R_0 = 0.5$). For $R_0 = 1.041$, the monthly mean number with 95% CI of new cases would be 21.193 (21.191–21.195), 25.052 (25.050–25.055), and 29.674 (29.670–29.677) respectively (Fig. 5a, i). For $R_0 = 0.9$, the monthly mean number with 95% CI of new cases would be 14.393 (14.392–14.395), 9.290 (9.289–9.292), and 5.955 (5.953–5.956) respectively (Fig. 5b, j). For $R_0 = 0.75$, the monthly mean number with 95% CI of new cases would be 9.226 (9.225–9.228), 2.803 (2.802–2.804), and 0.866 (0.865–0.866) respectively (Fig. 5c, k). And finally, for $R_0 = 0.5$, the monthly mean number with 95% CI of new cases would be 4.113 (4.112–4.115), 0.2903 (0.2901–0.2905), and 0.0185 (0.0184–0.0185) respectively (Fig. 5d, l).

The monthly mean of the cumulative number of cases with 95% CI for $R_0 = 1.041$ would be 320.40 (320.33–320.47), 1013.5 (1013.40–1013.59), and 1834.5 (1834.3–1834.6) respectively (Fig. 4e). For $R_0 = 0.9$, the monthly mean number with 95% CI of new cases would be 238.37 (238.32–238.41), 585.99 (585.94–586.03), and 809.52 (809.46–809.57) respectively (Fig. 4f). For $R_0 = 0.75$, the monthly mean number with 95% CI of new cases would be 168.89 (168.86–168.92), 328.49 (328.47–328.51), and 376.77 (376.75–376.80) respectively (Fig. 4g). And finally, for $R_0 = 0.5$, the monthly mean number with 95% CI of new cases would be 88.57 (88.56–88.59), 130.93 (130.93–130.94), and 133.80 (133.79–133.81) respectively (Fig. 4h).

Discussion

We are facing one of the biggest virus pandemics ever witnessed by man. SARS-CoV-2 spread quickly to more than 190 countries in few months, killing approximately 290,000 people. Since no vaccine or effective treatment has been developed so far, preventive measures are the main ways to decrease the transmission of this disease. Therefore, for a better understanding and allocation of investments and resources, it is necessary to observe the present scenario of each location, to then propose mitigating and preventive measures in a more accurate way. In this study, we estimated the reproductive number (R_0) of

SARS-CoV-2 in its first outbreak stage in the Jammu & Kashmir region, India, and we also predicted new daily cases for the next 90 days using different R_0 , testing a plausible end of SARS-CoV-2 outbreak. In general, we found that there has been a considerable increase in the number of cases, but with a tendency to asymptote. Anantnag, Bandipora, Baramulla, Shopian, and Srinagar districts have more than 100 cases of SARS-CoV-2 and therefore government measures need to be taken immediately in those locations. Greater attention should also be paid to the districts of Kulgam and Kathua, which showed strong growth of the number of cases from the beginning of May, without a tendency to normalization. The estimated R_0 for J&K region was 1.041, and by decreasing 10–50% the R_0 (i.e., R_0 values equal to 0.9, 0.75 and 0.5) we observe a great decrease in the daily number of new cases of SARS-CoV-2, specially by decreasing 50% of R_0 , which cumulative curves reached the asymptote in about 40 days (Fig. 5d,h,l) with almost no case increase between the second and third month.

Jammu and Kashmir witnessed its first case of SARS-CoV-2 on March 9, 2020. Like other parts of the world, this region is also affected by the pandemic; however, the rate of spread of the virus is not the same as the rate found in western Europe and USA. This situation of lower cases in J&K is similar to the other parts of India and the south Asian countries as Pakistan, Bangladesh, Sri Lanka and Nepal. In India, the first person was tested positive on January 30 while in USA on January 21. However roughly after three and half months (May 12), the two countries show vast differences: in USA there were 1.3 million cases and in India 74,281 cases, accounting respectively for 31.63% and 1.7%

(<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>) of the total cases in the world. There are many explanations for this lower number of SARS-CoV-2 infection. First, the south Asian countries like India, imposed a strict lockdown similar to curfews imposed under Law and Order situation on right time, which had clearly made difference in preventing community transmission of the viruses as compared to the countries in western Europe and USA (Vaidyanathan 2020). This applies to the Himalaya region countries including J&K where strict lockdown was imposed. Second is that these south Asian countries have mandatory BCG vaccination against tuberculosis, which has been found to decrease susceptibility to the virus (Miller et al. 2020; Redelman-Sidi 2020). Supporting this idea, Portugal that has BCG vaccination program also has lower numbers of SARS-CoV-2 infection if compared with Spain, which does not have this vaccination program and has witnessed catastrophic spread of virus (Hegarty et al. 2020). However, the positive relation between the vaccination and low SARS-CoV-2 infection rates needs more statistical investigation to be proved. Another reason for the low number of cases in this area could be explained by an underestimation of SARS-CoV-2 infection in South Asia countries, due to the lack of test kits and the size of the population. All of these together difficult reaching the actual number of infected population.

In J&K, out of all identified cases 50.2% are active, 48.7% have recovered and 1.1% has died (Fig. 2). This clearly reveals that morbidity rate is very low, however active and recovered cases are almost close to each other, which predicts that recovery rate is same as infection rate. When studying the inter-district cases/infections, we found that Srinagar have majority of cases, which could be because this is the only city in the valley of “Kashmir” with aerial connectivity and is also the most densely populated area in J&K. It is also the main Healthcare hub where most of patients of the valley are treated for serious diseases. In

contrast, Jammu, which is also connected by train, controlled SARS-CoV-2 at the initial stage, maybe because it prohibited trains and travels to Vaishnav Devi at the right time. Both Jammu and Srinagar cities also controlled the infection soon, probably due to the strict lockdown. After Srinagar, Bandipora was the next hit area, and the reason for infection was that some people (Tableegi Jamaat) were on holy travel and got the virus; as asymptomatic while returning home, it was probably spread to their contacts especially locals and neighbors. In mean time, we analyzed the obtained data by plotting number of cases against time and successfully plotted accumulative curve (Fig. 3), which on interpretation gave information that there is slow increase in number of cases/infections with proclivity towards normalization. This is a very exciting data, suggesting that soon Jammu and Kashmir might be free itself from the highly contagious virus. But this only can be achieved by adopting the protocols suggested by Government, which include lockdown, social distancing, wearing masks, avoiding ceremonies, preventing holy gatherings, taking immunity boosting foods, along with sharing information with illiterate folks (Singh and Adhikari 2020).

On the basis of our existing data and using the accumulation curves to provide the estimation of R_0 to check the rate of spread of the SARS-CoV-2, our prediction showed that the R_0 is around 1.041 in Jammu and Kashmir. This R_0 value is much below to the previously calculated values ranging from 2.2 (95% CI, 1.4–3.9) to 3.58 (95% CI: 2.89–4.39) in other studies (Li et al. 2020; Wu et al. 2020; Zhao et al. 2020). The R_0 of 1.041 is low mainly because Jammu and Kashmir, especially in capital city of Srinagar took measures as strict lockdown ever before the reporting of any positive case and this has played a positive sole in human to human transmission of the virus. This is in agreement with what happened with Wuhan in China, as they imposed strict lockdown shortly after the occurrence of the infection, the number of cases of the disease was low and consequently there was low number of deaths. In this study we also predicted the incidence and spread of this virus in coming quarters. It is estimated by our prediction curves that the R_0 will decrease from 1.041 to 0.5 in August. This decrease is mainly because of strict lockdown and tracing of positive cases and their contacts effectively. Thus, according to our study, we suggest that by August SARS-CoV-2 cases should progressively taper off and finally disappear to large extent. We can predict this, because recent studies indicate that viral infections with R_0 less than 1 stop human to human transmission and finally disappear (Zhang et al. 2020).

Further, the cumulative incidence curves predict that with 95% CI for $R_0 = 1.041$ will result in increase in number of cases to 320.40, 1013.5, and 1834.6 in the next three months respectively. However, if the R_0 decreases at least in 10%, then the number of cases will also decrease gradually, and the cumulative number will stabilize. As the likelihood of an infected person to transmit the infection to another person decreases, we observe a significant decrease in the number of cases. Studying the probable outbreak size on the Diamond Princess cruise ship, Zhang et al. (2020) showed that decreasing the R_0 value in 25% and 50% there was a significant reduction of cumulative cases in following days. Indeed, these results from Zhang et al. (2020) along with ours clearly show the importance of preventive measures to curb the transmissibility of SARS-CoV-2. R_0 can be considered a daily transmission rate, and if there is a decrease in this rate, the number of people infected will decrease. Therefore, our results clearly state the importance of the lockdown and social distancing to end this pandemic. Although we showed important

results for understanding the current situation and plausible prediction of SARS CoV-2 for the next three months in the J&K region, India, our study presents a limitation, the precision with which R_0 is calculated depends on whether all the SARS-CoV-2 cases have been confirmed or there are some asymptomatic cases which have become a bottleneck in predicting R_0 accurately. However, this limitation does not alter the conclusions of this study in showing that the preventive measures taken can decrease R_0 , translating into a decrease in transmissibility and the appearance of new cases of SARS-CoV-2.

Final Remarks

Although there are cases of SARS-CoV-2 in J&K region of India with a relative increase in the number of cases since March, most districts and the region as a whole tend to asymptote (considered the actual estimated R_0 equals to 1.041). We observe that the growth curve does not follow an exponential distribution as we have seen for many countries, but rather a platykurtic curve. Perhaps this type of curve is the ideal one. Cases of SARS-CoV-2 will appear, but will be dispersed over time with a low growth rate, which provides time for health centers to treat infected patients and received new ones. This becomes clearer when assessing countries that do not have an adequate or limited health system such as India. If the number of infected patients increases exponentially, health centers do not support the number of cases and the number of people treated will be low. Therefore, our results show that the measures that have been taken by the Indian government have been effective in stabilizing the increase in the number of cases in most J&K districts. However, these measures need to be kept, and greater attention needs to be given to districts with a high number of cases (e.g. Anantnag, Bandipora, Baramulla, Shopian, and Srinagar), where the transmission rate may be high, and to districts that appear to show strong growth in the number of cases in the past weeks (e.g. Kulgam and Kathua).

By decreasing the R_0 value by 10%, 25%, and 50%, we observed a clear decrease in the number of new cases of SARS-CoV-2, especially considering a R_0 of 0.5. Maintaining social isolation/distancing and lockdown are the best way to decrease R_0 . Our predictions suggest that if these preventive measures are maintained and the R_0 reaches 0.5 in the J&K region, the probability of a new case arising after one month (June 12) is practically zero. Finally, with this study we indicate positive effects of the preventive measures taken in J&K region, showing a stabilization of the growth curves of new cases of SARS-CoV-2, but which tends to a strong decrease over time as the R_0 decreases.

Declarations

Acknowledgments

We thank the Government of India for making SARS-CoV-2 data available; and all the people and professionals who are in some way fighting this pandemic. This study was financed in part by the Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG; RJS).

Conflict of interest

The authors declare that there is no conflict of interest.

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Tables

Table 1. Number of reported Covid-19 cases (active, recovered, and deaths) for the 20 districts in Jammu and Kashmir region, India, between March 9, 2020 and May 12, 2020.

District	Active	Recovered	Deaths	Total
Srinagar	51 (10.87%)	81(17.80%)	4 (40%)	136(14.56%)
Bandipora	26 (5.54%)	107(23.51%)	1 (10%)	134 (14.34%)
Anantnag	114 (24.3%)	12 (2.6%)	1 (10%)	127(13.6%)
Baramulla	49 (10.44%)	57 (12.52%)	3 (30%)	109 (11.67%)
Shopian	44 (9.38%)	60 (13.18)	0 (0%)	104(11.13%)
Kupwara	38 (8.10%)	45(9.89%)	0 (0%)	83 (8.88%)
Kulgam	63 (13.43%)	6 (1.31%)	0 (0%)	69(7.38%)
Budgam	3 (6.82%)	14 (3.07%)	0 (0%)	46 (4.92%)
Jammu	9 (1.91%)	26 (5.71%)	0 (0%)	35 (3.74%)
Ganderbal	9(1.91%)	14 (3.07%)	0 (0%)	23(2.46%)
Udampur	2(0.42%)	19 (4.17%)	1(10%)	22(2.35%)
Kathua	12(2.55%)	1 (0.21%)	0 (0%)	13(1.39%)
Pulwama	9(1.91%)	4 (0.87%)	0 (0%)	13 (1.39%)
Samba	7(1.49%)	4 (0.87%)	0 (0%)	11(1.17%)
Rajouri	0 (0%)	4 (0.87%)	0 (0%)	4 (0.42%)
Reasi	3 (0.63%)	0 (0%)	0 (0%)	3(0.32%)
Kishtwar	0 (0%)	1 (0.21%)	0 (0%)	1(0.10%)
Ramban	1(0.21%)	0 (0%)	0 (0%)	1(0.10%)
Doda	0 (0%)	0 (0%)	0(0%)	0 (0%)
Poonch	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Total	469	455	10	934

Figures

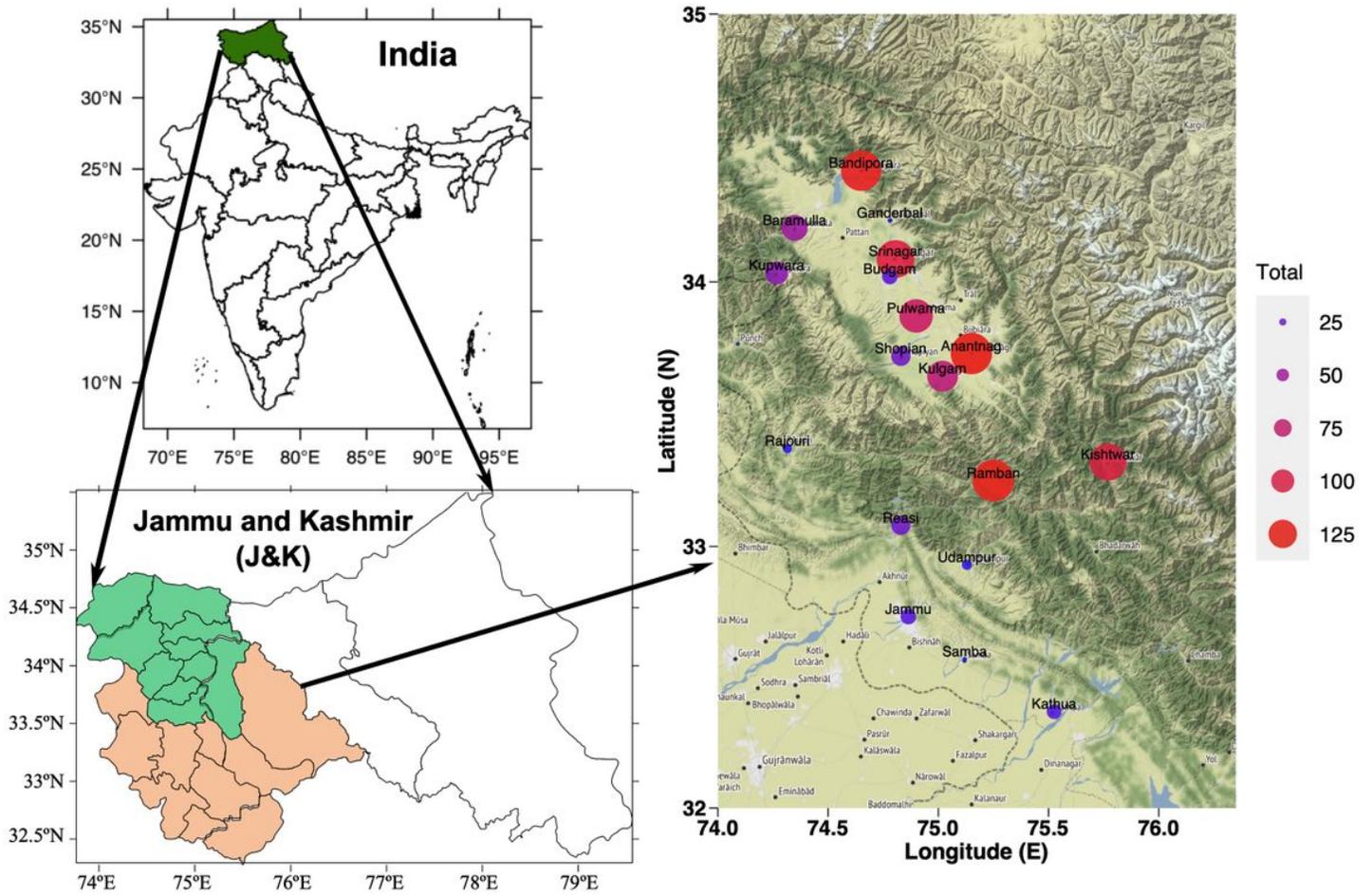


Figure 1

Map of the study area showing the Jammu & Kashmir region, India (left), and the 18 districts evaluated with proportional number of cases reported

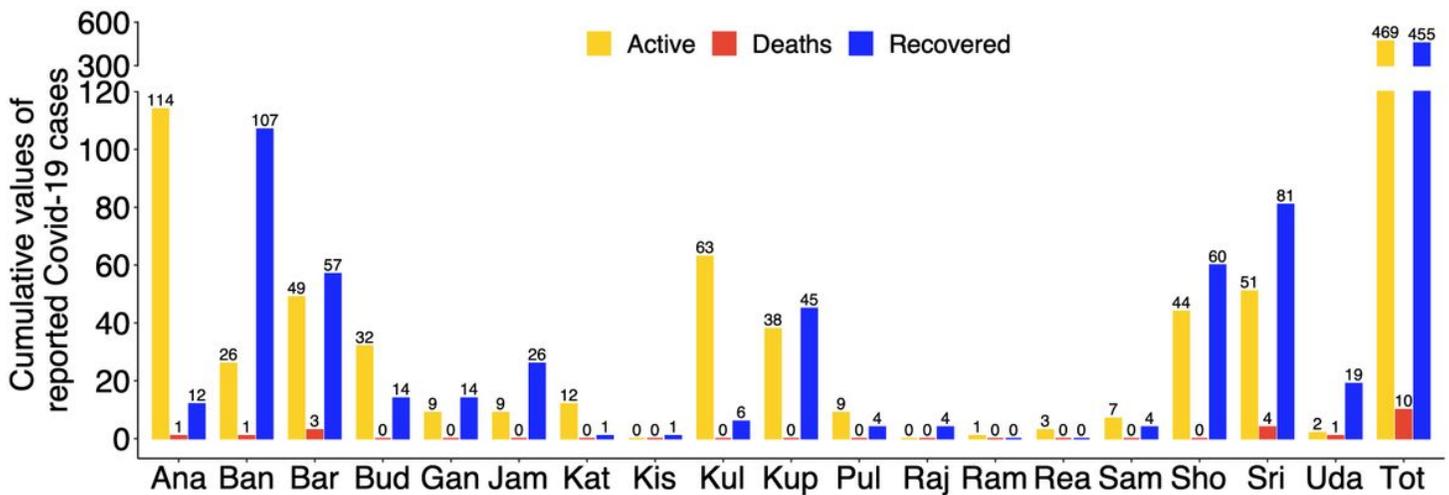


Figure 2

Cumulative values of reported SARS-CoV-2 cases (active, deaths, recovered) for 18 districts in J&K, India, between March 9, 2020 and May 12, 2020. Full districts name is depicted in Table 1. Tot – Total

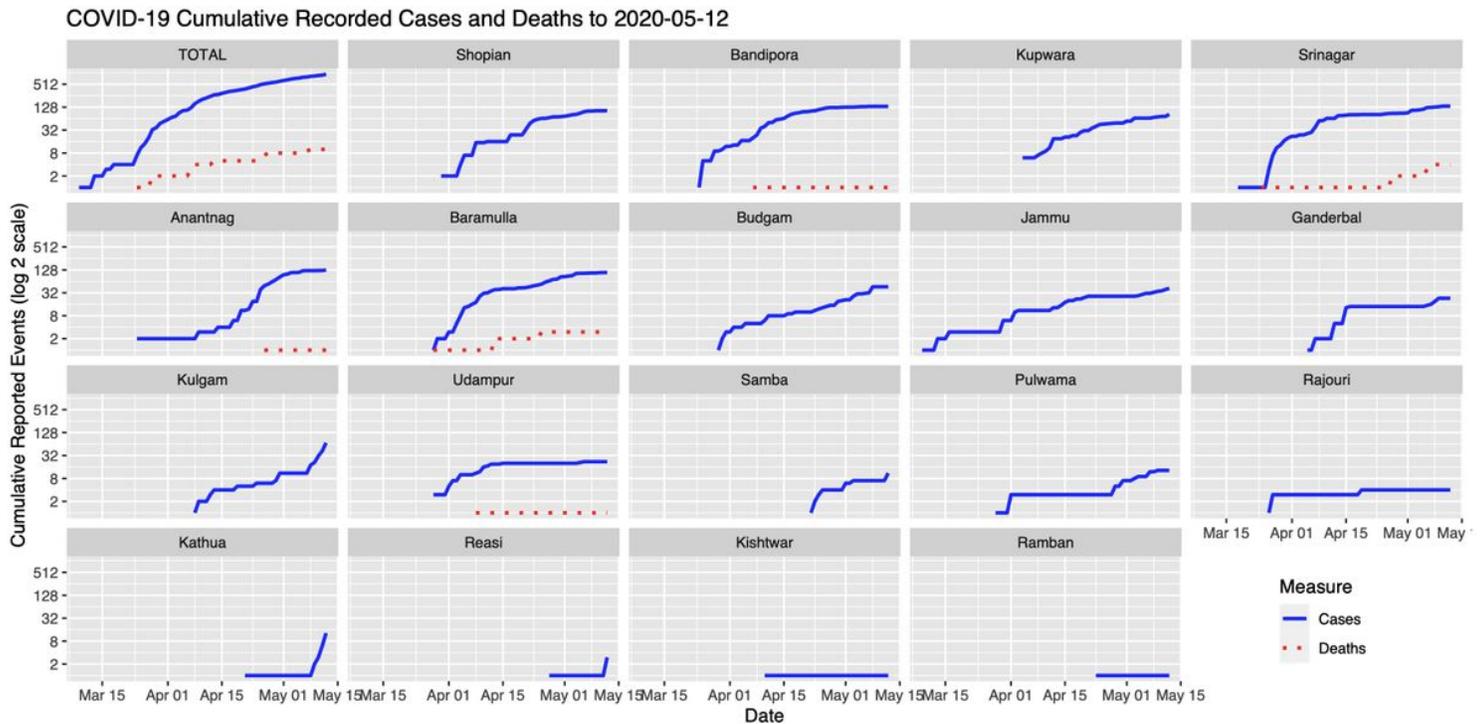


Figure 3

Cumulative reported events of SARS-CoV-2 (active cases and death) for 18 districts in Anantnag, Bandipora, Baramulla, Budgam, Ganderbal, Jammu, Kathua, Kishtwar, Kulgam, Kupwara, Pulwama, Rajouri, Ramban, Reasi, Samba, Shopian, Srinagar, Udampur, India, between March 9, 2020 and May 12, 2020. Data was transformed in log 2 to better represent the data

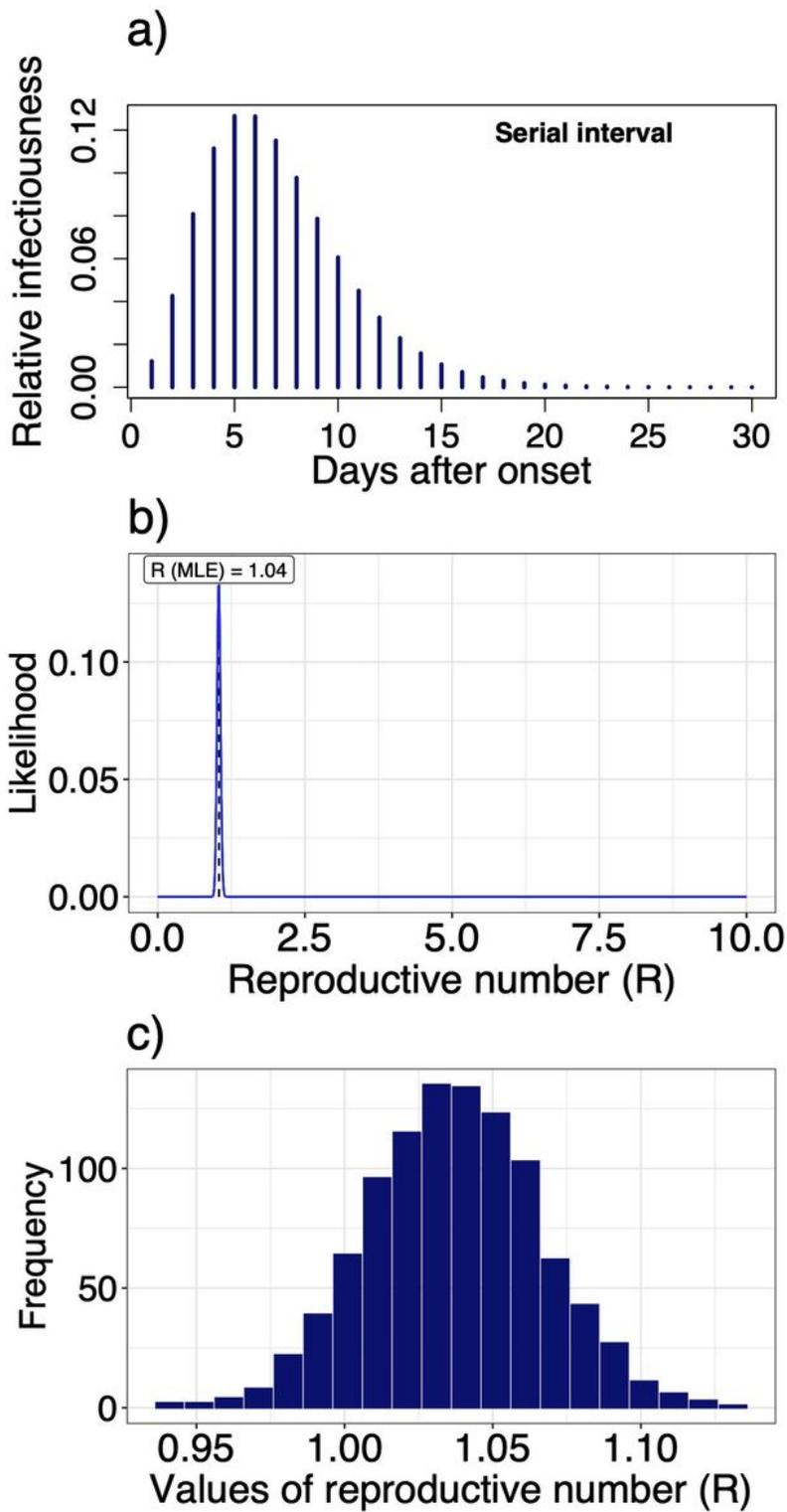


Figure 4

The distribution of serial interval (a), likely value of reproductive number (R_0) with the Maximum-Likelihood (ML) estimation (b), and a histogram of the 1000 randomized likely R_0 values using bootstrap resampling analysis (c) for SARS-CoV-2 in Jammu & Kashmir region, India

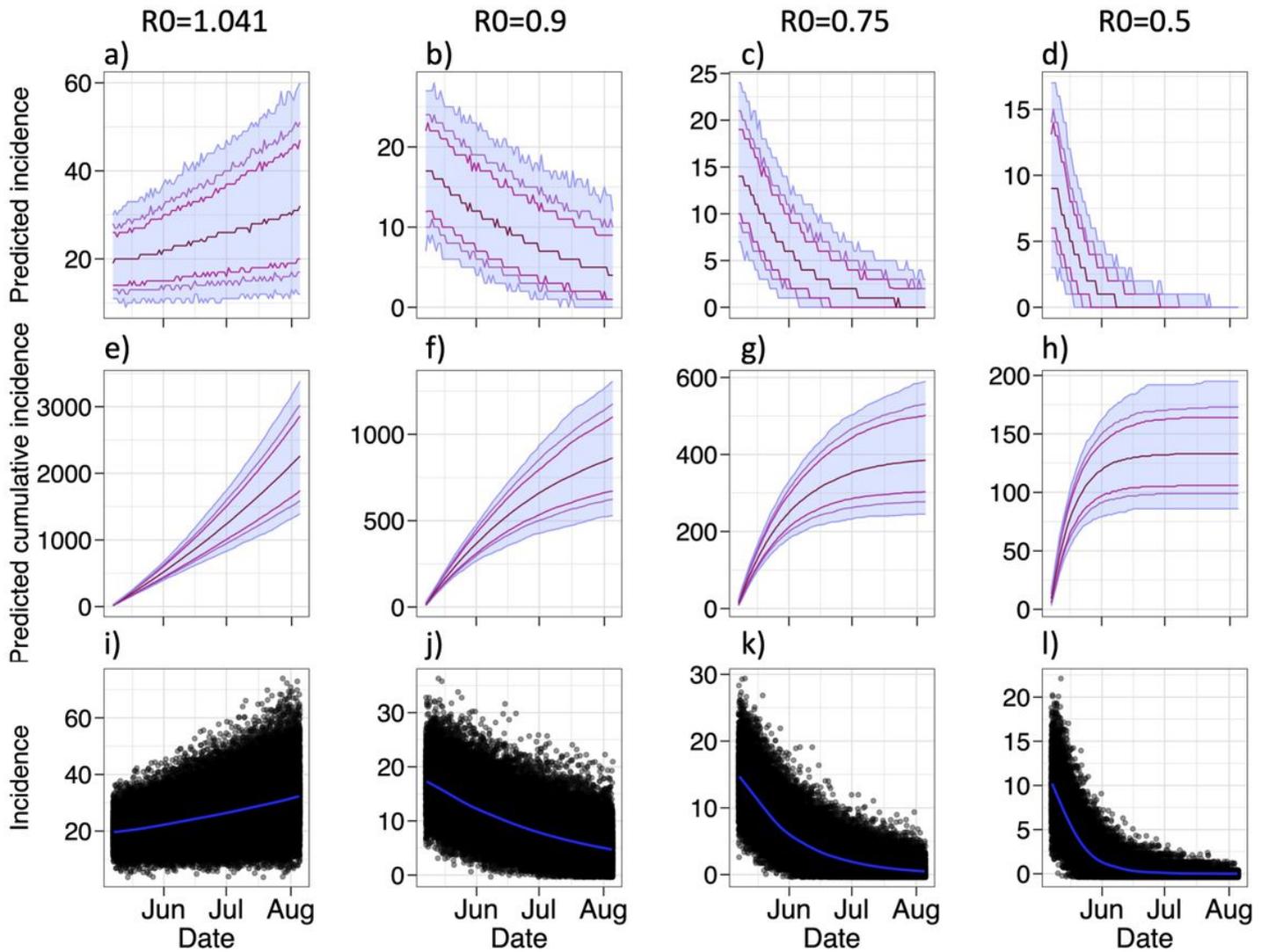


Figure 5

Epidemic trajectories of probable daily and cumulative cases for SARS-CoV-2 in the Jammu & Kashmir region, India, from March 9, 2020 to May 12, 2020. Panels show the probable number and cumulative incidence for the next 90 days from May 12, 2020, whether the reproductive number (R_0) value is unchanged (equal to 1.041; a, e, i), decreased by 10% (equal to 0.9; b, f, j), decreased by 25% (equal to 0.75; c, g, k), and decreased by 50% (equal to 0.5; d, h, l)