

Conducting Mass Gathering Events during the COVID-19 pandemic: A Case study of Kumbh Mela 2021 as a potential ‘Super Spreader Event’

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Abstract

Background: With the emergence of novel pathogens, there is a debate worldwide on the cancellation or conduction of mass gathering events.

Methods: In the current COVID-19 pandemic, this study assesses the challenges in the conduction of the recently held Kumbh Mela mass gathering (MG) which took place from 14th January 2021- 29th April 2021 at Haridwar, the capital city of the state of Uttarakhand, India. The correlation between increased cases of COVID-19 and the Kumbh Mela MG has been highlighted through statistical analysis and growth curves using the available data.

Results: The Kumbh Mela-2021 emerged as a potential super spreader event with an increase from 37 cases per day to 144 cases per day (276%) in the COVID-19 cases in Haridwar. An increase from 138 to 480 cases per day (236%) and from 45600 to 92754 cases per day (92%) was noted in Uttarakhand and India respectively during this MG. A very strong correlation of 'more than 0.99' was seen between the number of cumulative cases of COVID-19 in Uttarakhand and Haridwar, and Haridwar and India during the Kumbh Mela in the third wave of the pandemic.

Conclusions: The direct influence of Kumbh Mela on the increase in the number of COVID-19 cases is documented. Although, the socio-cultural, psychological, and economical advantages of MGs are considerable, in a developing nation like India organization of such events can be a huge health hazard. The lack of efficient implementation and observance of COVID-19 guidelines increase the necessity of cancellation of such MGs to prevent the outbreak of diseases. Thus, a well conducted risk assessment prior to the hosting of a MG event during a pandemic is required with strict application of precautionary measures during the event to prevent any superspreading events.

Keywords- Transmission, Risk Assessment, Epidemiology, Prevention, India, WHO

1. Introduction

Mass gatherings (MGs) refer to the accumulation of people at a particular place with defined purpose in a specific framework of time, potentially affecting the resources of the organizing community. MGs of various categories including religious, sports, festival, and fairs have been globally witnessed in huge numbers. The organization and need to cancel MGs in the current scenario of novel coronavirus disease-2019 (COVID-19), which has already claimed millions of lives, has gathered mixed views from the scientific community. Thus, this study was undertaken to assess hazards and benefits associated with the conduct of MGs in the COVID-19 pandemic, with emphasis on the recently held Kumbh Mela MG in the city of Haridwar, Uttarakhand State, India.

1.1 Risk Assessment for Mass Gatherings

Concerns about the hazards associated with MGs highlighting the need of proper risk assessment and maintenance of non-pharmaceutical interventions (NPIs) have been raised in previous studies.^{1,2} The MGs associated with religious belief systems have always attracted people across the globe, creating challenges for assuring safety and sanitation to prevent the outbreak of any unwanted hazardous event.³ The communicable mode of disease transmission through respiratory, blood-borne, faecal-oral, food and water borne, and vector-borne vehicles have been previously recognized and illustrated in Fig. 1.¹⁻⁶ The potential threat of spread of communicable diseases associated with rituals based on religious traditions and belief systems have been described.^{3,7} The spread of upper respiratory tract infections (URTI) at the Kumbh Mela in the year 2013 and the rapid occurrence of respiratory issues have been reported two days after the ritual of mass holy bathing (Snan).⁸ The potential contamination of water through mucus from nose and mouth, and intestinal mucus are noteworthy. The increase in the bacterial load of the river Godavari, Nasik, consequent to the mass bathing ritual at the Kumbh Mela in 2015, and the outbreak of cholera have been highlighted in the Kumbh Mela in the 19th century.⁹ The Kumbh Mela MG witnesses Hindu pilgrims from across the globe, and can potentially act as a 'super spreader event'. The first reported case of COVID-19 in India was from the state of Kerala, and higher transmission rates were reported with the return of migrant workers in large numbers.¹⁰ The hazard of increase in the transmission at religious MGs was highlighted in a study about the Sabarimala pilgrimage in Kerala.¹¹ The spread of tuberculosis, pertussis, rhinovirus, parainfluenza, and coronavirus 229E has been witnessed in the Hajj pilgrimage.⁴ The hazard

of global transmission of such diseases are highlighted due to global participation.^{3,7} A risk assessment study by Jokhdar et al. in 2020, highlighted the hazard of transmission of coronavirus among the pilgrimage of Umrah, and Hajj in the city of Makkah in Kingdom of Saudi Arabia (KSA).⁷ Consequently, the Umrah pilgrimage was put on hold and the Hajj pilgrimage in 2020 was performed by a limited number of pilgrims from within KSA with strict implementation of NPIs and public health guidelines to prevent transmission of the COVID-19.⁶ Similarly, the spread of travellers' diarrhoea, gastrointestinal and respiratory diseases in the Olympics and Para-Olympics games in London (2012), and Athens (2004) has been reported.⁸ The 11th festival of Pacific Arts in the Solomon Islands witnessed prolonged fever, non-watery diarrhoea, and influenza (H1N1) in the second musical event.⁸ Apart from communicable threats, non-communicable risks at MGs include stampedes, alcohol and drug abuse, casual sex encounters, management of crowds, accidents, terrorist attacks etc.⁸ Communicable and non-communicable diseases and other hazards associated with mass gathering events are summarized in Fig. S1. A word cloud (Fig. S1) has been compiled using titles and abstracts of published research and review articles.

1.2 Positive Impacts of Mass Gatherings

A recent study highlighted the positive impacts of MGs on social, cultural, and psychological upliftment. This includes the potentially positive and motivating benefits of religious beliefs and spirituality on health and wellbeing in addition to the development of optimistic and supportive social relations amongst humans.⁹ The employment associated with MGs in the form of local businesses, food stalls, hoteliers, cinema halls, tour guides play a vital role in the economy of the hosting locality specially in low- and middle-income countries. The imposition of lockdowns towards prevention of COVID-19 led to a major shrink of economy across the globe of around 4.4% in the pandemic year 2020.¹⁰ The cancellation of MGs affects the social, and economic well-being.¹¹ The workers associated with small scale units, and all other enterprises struggled with their means for sustenance. But the novelty of the virus, its rapid national and international spread, and unavailability of any approved medicines meant that imposing the lockdown was one of the most important measures towards saving human lives.^{12,13} Hence, to resume the economic resurgence, some governments decided to lift the restrictions. However, several guidelines for maintaining preventive measures issued by the WHO, including maintenance of social distancing, use of masks, frequent washing of hands, and avoiding public gatherings, were ignored.

1.3 Kumbh Mela

The Kumbh Mela, is one of the largest assemblage of pilgrims and mystics across the world, along the banks of sacred rivers in accordance with the Hindu calendar. The attainment of ‘moksha’ or cleansing of all sins is associated with ‘tirtha’ or visits to pilgrimage sites including various rivers. Kumbh Mela, often known as the ‘festival of pitcher’ denotes the spillage of some droplets of a ‘concoction’ of life during the struggle between the good and the evil. The locations of spillage of this sacred potion are venues for Kumbh Mela (Haridwar, Prayagraj, Nasik, and Ujjain)⁴. In 2021, the venue for Ardh (held at an interval of six years) Kumbh Mela was ‘Haridwar’. The mela was from 14th January 2021 to 29th April 2021 and was attended by ~10-20 million people between 1st April 2021- 30th April 2021.¹⁵ The mela area was equipped with 11,700 toilets, 6,674 urinals, 157.65 kilometres of roads, and a hospital with 159 beds acquainted with medical facilities.^{13,14}

This study attempts to critically assesses the Kumbh Mela-2021 with respect to its impact on COVID-19 cases in India. It aims to highlight the various challenges associated with future and upcoming MGs in the face of an ongoing pandemic and suggest recommendations, especially with the availability of effective vaccines and much more known public health preventative measures.

2. Materials and Methods

2.1 Data Sources

Major databases such as ScienceDirect, PubMed and Google Scholar, were explored with the keywords ‘mass gatherings’, ‘COVID-19’, ‘Kumbh Mela’, ‘infections’, ‘communicable diseases’, ‘non-communicable diseases’, and ‘religious gatherings’ for this study. Only peer reviewed articles were considered to gather information about the possible impacts of mass gatherings, its associated hazards, and strategies of risk assessment/management.

Further, various news articles, reports by the World Health Organization (WHO), and data on government web portals were searched to accumulate information about the Kumbha Mela. The data regarding the number of Covid-cases, cumulative cases, and deaths caused by the Covid-19 were collected from online portals.^{15,16}

2.2 Incubation Period

With respect to cumulative number of COVID-19 cases, the assessment period of this study was divided into three phases, viz., phase-I (11th March-31st March 2021), phase-II (1st April-05th April 2021), and phase-III (06th April-29th April 2021), where 11th March 2021 marked the first 'Shahi Snans' (SS) or 'bathing'.

Further, phase-wise correlation plots and graphs were prepared through Originpro software package, using the online data.

3. Results

3.1 Rise in Covid-19 cases

The number of COVID-19 cases in India, Uttarakhand, and Haridwar are represented in Fig. 2 with the dates (as per Zodiac) of all 'Shahi Snans' (SS) (bathing). The average daily increase in the number of cases in phase-I was found to be 0.39%, i.e., a daily increase of ~45600 cases (India), 0.14%, a daily increase of 138 cases (Uttarakhand), and 0.25%, i.e., an increase of ~37 cases per day (Haridwar), respectively. The corresponding numbers in the phase-II increased to 0.75% (92754 cases per day), 0.47% (480 cases per day), and 0.94% (~144 cases per day), in India, Uttarakhand and Haridwar respectively. This represented a steep increase in the number of cases in Haridwar of 276% from phase-I. Similarly, the cases in Uttarakhand increased by 236% from phase I, and the corresponding increase for India was 92%. This steep rise in number of Covid-19 cases for Haridwar coincided with a greater number of people that came to Haridwar as there were three SS in the month of April. In the third phase of the assessment period, the average daily increase was reported to be ~250000 cases per day, i.e., 1.63% (India), ~3000 cases per day, i.e., 2.24% (Uttarakhand), and ~658 cases per day, i.e., 2.94% (Haridwar), respectively. During the first five days of phase-III, the average daily increase in the number of cases was 1.51%, however, as the SS was on 12th April, the number of cases started to increase sharply and the average daily increase from 11th April-29th April was found to be 3.30%, resulting in a 252% increase compared to phase-II.

3.2 Correlation Analysis

The increasing number of pilgrims in Haridwar and subsequent rise in number of COVID-19 cases in Haridwar, Uttarakhand and India, indicates the possibility of these events being interrelated. Various correlation plots were prepared to analyse the correlation between the

daily cases of COVID-19 (Fig. 3) and the resulting coefficients of correlation (r^2) was found to be greater than 0.99.

The increase in number of COVID-19 cases in Haridwar was strongly correlated with the increasing cases in Uttarakhand with $r^2 > 0.99$ in all the three phases (Fig. 3a). The correlation plot also suggest that the best correlation was found between Haridwar and Uttarakhand indicating that attendees returning from Kumbh Mela 2021 might have caused the increase in COVID-19 cases in Uttarakhand as well. The coefficient of correlation between Haridwar-India, and Uttarakhand-India was found to be less than that of Haridwar-Uttarakhand (Fig. 3a, b, c), suggesting that increase in number of cases in India had contributions from other sources as well. Additionally, in all the correlation plots i.e., Haridwar-Uttarakhand, Haridwar-India, and Uttarakhand-India, the highest correlation was observed in phase-III ($r^2 = 0.998$), when the mela was attended by the maximum number of pilgrims.

4. Discussion

The findings suggest that the pilgrims doing holy bathing without strictly following the guidelines regarding the spread of COVID-19 had a huge impact on the total number of COVID-19 cases reported in Haridwar, and subsequently in Uttarakhand and India making the Kumbh Mela 2021 a potential 'Super Spreader Event'. The violation of COVID-19 guidelines including non-use of masks, social distancing, and self-isolation was reportedly witnessed during on 14th April 2021 (a major bathing date of 'Baisakhi Snan) when millions of people gathered, as opposed to a few thousands on other days, with 637 positive cases reported. Nearly 1700 people tested positive for COVID-19 within a duration of five days in the Kumbh Mela and considered as a potential 'super spreader' event with surged cases of COVID-19²⁰. The violation of COVID-19 guidelines in the MG of ~4.9 million people was reportedly seen during the two SS on 12th April 2021 (Somwati Amawasya) and 14th April 2021 (Mesh Sankranti). The lack of implementation of SOPs on the augurs of 13 akharas considering the limited time span to take auspicious bath at the Har ki Pauri ghat was also highlighted.¹⁷ Increased COVID-19 cases from across the nation were noted with people returning from Kumbh Mela.. According to various reports^{17,21,22}, ~11% of the returnees from Kumbh Mela to the state of Gujarat tested positive for COVID-19 on RT-PCR tests. The Sabarmati railway station could have probably played a transmission zone, with at least 10-15% of asymptomatic passengers.^{17,22} In a recent report²¹, it was stated that there is a possibility that one out of 10 COVID-19 positive case, may have been caused by people

returning from 'Kumbh Mela' to the state of Gujarat. The Kumbh Mela probably acted as an amplifier to the number of COVID-19 cases across the country. The state of Gujarat experienced the highest surge in the number of COVID-19 positive cases, and fatalities after the returnee's movement. Another 24 positive COVID-19 cases were found in Odisha state returning from the Kumbh Mela. The surge in the number of positive COVID-19 cases across the nation in coherence with the return of pilgrims from the Kumbh Mela is a huge matter of concern, considering the spike in mortality rate as well. In a developing nation like India, where the sanitation index ranking stands low, lack of vaccines, lack of emergency services including oxygen supplies, COVID specialized hospitals, the conduction of such a MG can be considered a major risk.

4.1 Probability of Disease Transmission at Kumbh Mela

The planning of environmental security and public health during mass gatherings includes the assurance of the welfare of visitors, working staff from all types of diseases, and injuries.¹⁸ The severity of the spread of infection, particularly in the rural population, was highlighted in a report.¹⁸ The pilgrims included religious and holy men and women from different sects or 'akahras' and their vast numbers of followers, who have a pre-determined order for entering the river for the ritual baths. They are trailed by other devotees making the entire process complex, set to a pattern that can result in long lines of devotees waiting their turn to enter the river. The pilgrims were found to be violating public health preventative guidelines including non-pharmaceutical interventions according to many reports.

Various activities are performed by millions of people in restricted spaces with overwhelming zeal, making the prevention of communicable and non-communicable hazards critical. The practise of Snan (bathing) is a particular risk in comparison to any other MGs. The spread of cholera at Kumbh Mela has been previously reported in the 19th century, considering the increased bacterial load due to the bathing of millions of people within a short span of time. The restrained spaces and close contact between pilgrims are a considerate cause of such diseases.

4.2 Challenges at various Mass Gatherings across the Globe

One of the major challenges and hazards associated with overseeing MGs are the implementation of already set policies and procedures with resultant transmission of

communicable diseases and non-communicable diseases, which have claimed life's and caused injury to pilgrims and visitors.

Conducting MG events in any country regardless of an ongoing pandemic poses a great risk for straining public health services. Careful risk assessment needs to be conducted by local and international experts prior to the event to decide what measures and interventions to take and whether the MG event could be held or needs to be modified or delayed. Any decision to restrict, modify, postpone, cancel, or proceed with holding a MG should be based on a rigorous risk assessment exercise, tailored to the event.²¹ Cancellation of all such events cannot be the ultimate solution or preventive measure as economic and other implications are at stake. Local vendors, businessman, hoteliers, guides have already suffered due to the previous lockdown and suspended tourism. The state of Uttarakhand gains a major portion of its income through tourists from across the globe, which was very severely affected due to lockdown. A proper risk assessment oriented at targeted implementation of the event could save the ill-effects of the ceremony.

The interpretation through development of a correlation amongst the rise of COVID-19 cases and Kumbh Mela in India was directly dependent on the availability of limited secondary data. Hence, in future a real time or primary data analysis should be attempted to support the findings of this study.

5. Recommendations for Management of Mass Gatherings

Any mass gathering event provides tremendous socio-economic opportunities for a country. It also presents an opportunity to conduct multidisciplinary collaborative research works related to public health. However, since these events have a potential to amplify the risk of outbreak of infectious diseases like COVID-19, it is imperative that planning and organizing committees make special arrangements and follow the WHO recommended risk assessment beforehand including:

1. The host country's existing regulations on public health and social measures to control spread of COVID-19, reflecting the intensity of transmission in the area.

2. Evaluation of risk factors associated with the event– appraisal of the likelihood that the event may contribute to the spread of COVID-19 and that the health services capacity may be exceeded by such spread.

3. Capacity to apply prevention and control measures- the ability to implement actions that can reduce the risks associated with the event.

It is hoped that the above risk assessment will lead to an evidence-based decision to proceeding with the MG event with the following key recommendations kept in mind:

- a) Provision of an efficient system for surveillance, outbreak detection, and alert management (monitoring through drones, spider cams etc.).
- b) Facilities associated with food management, water and wastewater management, and enough sanitation should be provided.
- c) Introducing a pre-registration system (online) and ensuring that only the pre-registered attendees attend such an event especially in the time of a disease outbreak.
- d) Sufficient display of infographics and videos to make the attendees aware about the safety guidelines, dos, and don'ts for the event.
- e) Limiting the number of participants with special attention to the elders, females and children, and those with chronic health conditions considering their susceptibility to serious infectious diseases.
- f) Consider the requirement for vaccination of attendees if an effective and approved vaccine is available and affordable.
- g) Emphasis on research about the possible emergence of new variants of viruses and promote genome surveillance.
- h) The adaptation of social network analysis can be viable tool towards quantification of the social structure of an occurrence.¹⁹

6. Conclusion

The MGs are an unavoidable part of human civilization. The current COVID-19, or any other such pandemic situation should not necessarily be a barrier in holding MGs which can be fruitful for economic, social, cultural, and psychological development of society. The lack of maintenance of SOPs in MGs during the COVID-19 pandemic can lead to 'super spreader' and transmitter events like that due to the 'Kumbh Mela 2021 in India. A relative leniency in

making the people follow the COVID-19 SOPs and guidelines contributed towards increasing the active cases of COVID-19 in Haridwar and India. The responsibility of following the necessary guidelines and precautionary measures lies on everyone. Hence, a coherent balance between policy makers through suitable decisions (lockdowns, cancellation of MGs, etc.) and successful implementation through citizen cooperation can bring a positive change in future MGs. Countries worldwide are well versed to their potential resources to manage the welfare of their citizens and should take suitable measures of revoking the balance of between 'human survival and sustenance'. This present study will act as a guideline for future MG event and help in creating awareness among the participants to strictly adhere to the guidelines issued by the governing authorities.

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Author Contributions

SS and RK visualized and designed the study, analysed the data, and wrote the original draft. ZAM gave important suggestions on improving the quality of the analysis. ZAM and YY monitored the study progress as well as contributed to revising the manuscript. All authors contributed to the checking and final processing. All authors reviewed the final version of the manuscript. All authors read and approved the final manuscript.

Competing Interest

The authors declare that they have no competing interests.

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Figure Captions:

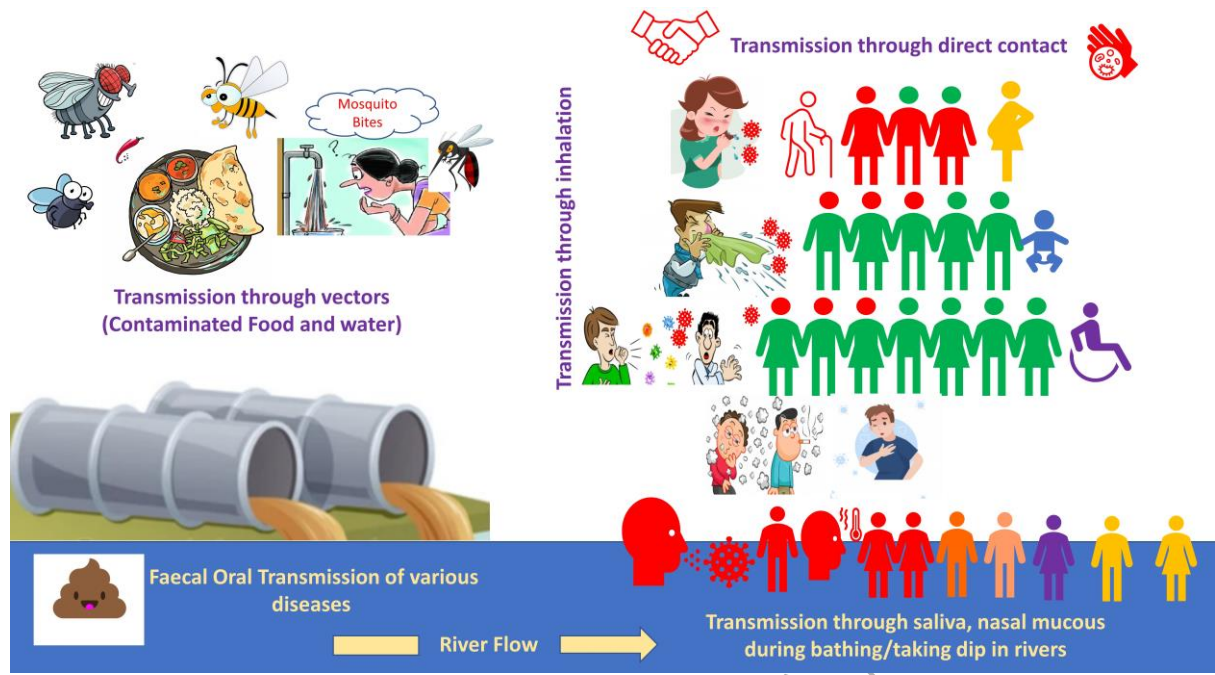


Fig. 1: Various possible pathways of disease transmission at Public Mass Gathering events

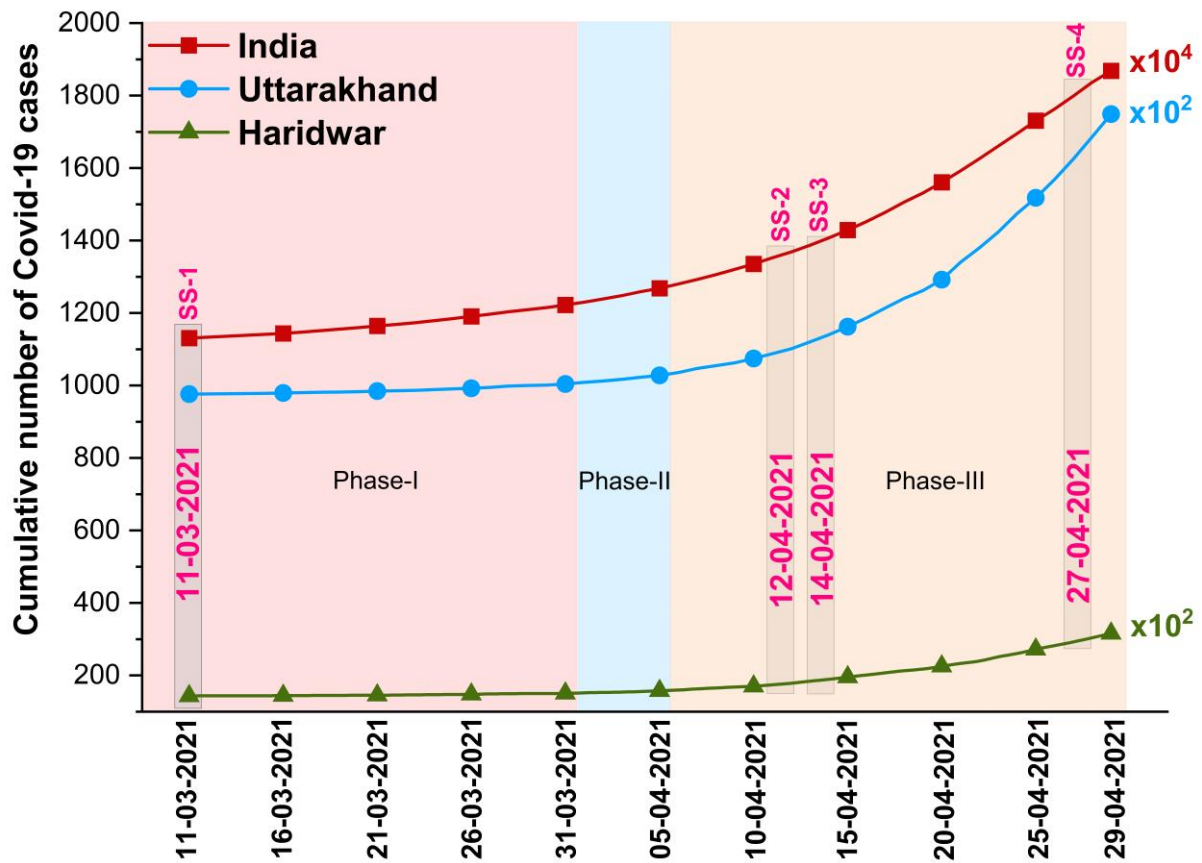


Fig. 2: Cumulative number of COVID-19 cases reported in Haridwar, Uttarakhand and India. SS represents the Shahi Snan.

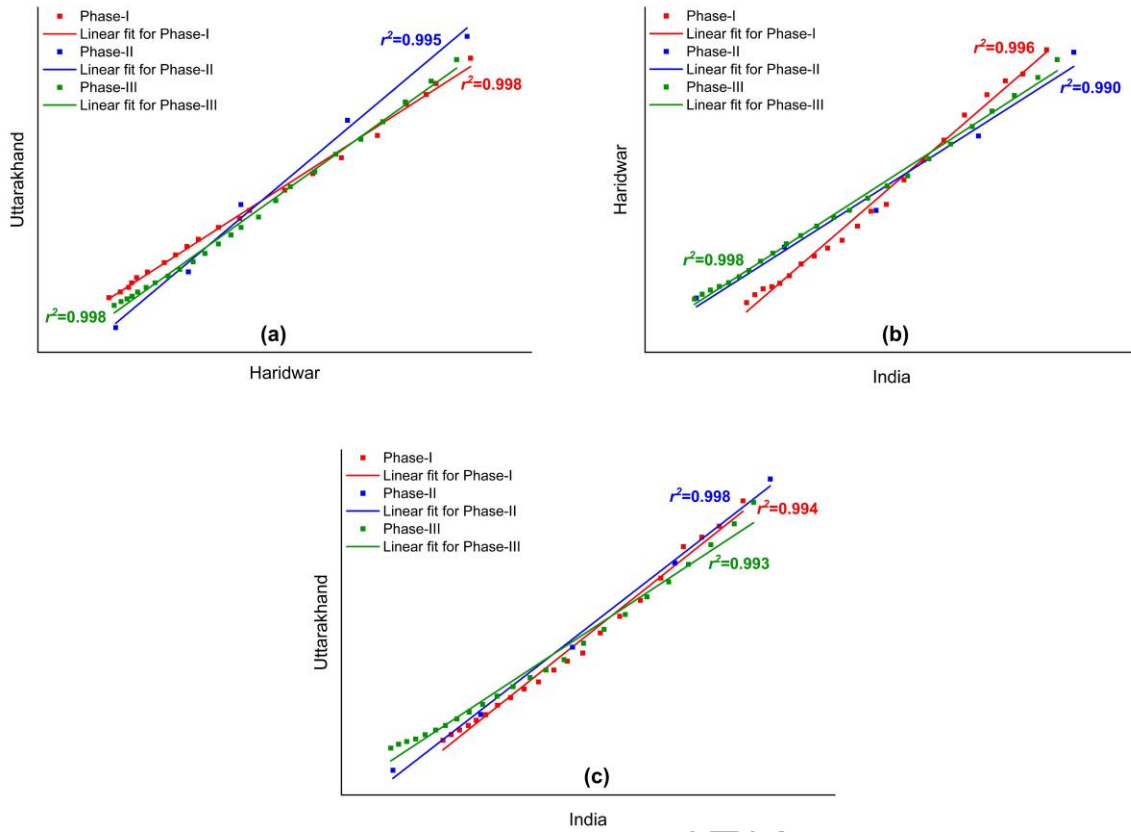


Fig. 3: Phase-wise correlation of cumulative number of COVID-19 cases between, (a) Haridwar and Uttarakhand, (b) Haridwar and India, and (c) Uttarakhand and India