

Disaster Management Strategies for Coping with COVID-19 Pandemic in India

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ABSTRACT The global pandemic COVID-19 has turned into a serious transmissible disease from human to human within a short period. India being a developing nation with second largest populated country of the world that houses about 17.7 percent of the world population, is expected to suffer from the adverse impacts of COVID-19 much higher than the developed nations with low population size and density. The present study indicates that only 0.012 percent of India's population was infected by May 30, 2020, which was quite lower than the expected one. The percentage of lethality rate was also low in India in comparison to the developed nations. It was anticipated in the beginning that the COVID-19 will be weakened with rising temperature in the summer or in the warm climate. In India, the COVID-19 spread was noticed all over the country from warm (southern) to cold regions (northern), and no relationship was observed between the warm climate and the low occurrence of COVID-19. The study discusses various strategies as taken up by the Government of India to reduce the risks and the adverse impacts of the pandemic.

INTRODUCTION

Worldwide, the year 2020 has become the year of coping with SARS-CoV-2/Novel Coronavirus-19 (COVID-19), which has declared as a global pandemic by the World Health Organization (Sohrabi et al. 2020). It is a highly transmittable disease from human to human through respiratory secretions, aerosols, and physical contacting of contaminated environmental surfaces (Del Rio and Malani 2020; Soetikno et al. 2020). The planet earth had suffered from infectious diseases in the past like the influenza in 1918, which spread across the world within 6 months and killed tens of millions of people (Patterson and Pyle 1991). However, the world has seldom suffered from the pandemic like COVID-19 in the era when the medical science has accomplished high standards and advanced technologies. In comparison to past, at present the world has connected well and reaching from one corner to other is quite easy and fast, which subsequently makes COVID-19 to spread fast.

In view of enhancing the capacity of nations to reduce risks and adverse impacts of

pandemics the Sendai Framework for Disaster Risk Reduction, which was adopted at the Third UN World Conference in Sendai, Japan, on March 18, 2015, has categorized pandemics as a biological hazard (UNDRR 2015). Accordingly, the governments across the world, including India, have been dealing with pandemics under the domain of disaster risk reduction and management (IFRC 2020; UNDRR 2020). Nonetheless, there are many factors, including prosperity, poverty and other inequalities across the countries determine the impacts of a disaster (Fothergill and Peek 2004; Kala 2014). It is hypothesized that the developed countries would be less affected by any disaster in comparison to developing countries. Besides, COVID-19 being a contagious disease, the population density, size and age structure of the respective countries may also determine the severity of consequences.

India being a developing nation with second largest populated country of the world, the adverse impacts of COVID-19 spread hence are expected to be quite high here in scale and intensity in comparison to developed nations with low population size and density. The world has the close eyes on India, as it houses about 17.7% of the world population (Gupta et al. 2020). However, the scale and severity of ad-

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verse impacts of any disaster can be diminished and managed depending on the disaster management skills, policies, and governance of the concerned countries (Berke et al. 2012; Zaré and Afrouz 2012; Kala 2015). The present study, therefore, attempts to understand and analyse the strategies of India to deal with the most uncertain and devastating pandemic of this century. The COVID-19 pandemic is the most unpredictable and devastating because there is yet no vaccine and standard medicine for its treatment. There were also uncertainties of COVID-19 spread with respect to climatic conditions, as in the beginning it was anticipated that the COVID-19 may not survive well in the warm climatic conditions (Sajadi et al. 2020). India has a range of climatic conditions from warm tropical climate to the alpine region in the Himalayas. Therefore, India is one of the best countries to study and understand the relationship of COVID-19 spread with the climate, if there is any such relationship exists.

METHODOLOGY

An extensive literature survey was carried out for compilation of information on various aspects of COVID-19, including its origin, spread, medication and management of such a highly infectious disease. The literature searched from different sources includes scientific journals, technical reports, websites, newspaper reports, magazines, and online databases. The Situation Reports on COVID-19 of the World Health Organization, information on the My GOV web site of the Government of India, and different Orders and Guidelines issued by the National Disaster Management Authority, Ministry of Home Affairs, Ministry of Health and Family Welfare, and the Ministry of Ayush of the Government of India were compiled, studied and analysed thoroughly. The different Acts, Legislations, Schemes and international conventions related to the epidemics and disaster management within India and abroad were also studied.

The spread and lethality rate of this highly infectious disease were calculated. Its spread was determined based on the number of confirmed cases reported within the country, which was further compared with the total human

population of the respective countries. The lethality rate (or the fatality rate) was calculated based on the number of deaths divided by the total number of confirmed COVID-19 cases multiplied by hundred. The recovery rate was calculated based on the total number of recovered patients divided by the total number of confirmed cases of COVID-19 multiplied by hundred.

RESULTS AND DISCUSSION

The Origin and Spread of Pandemic

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) as named by Coronavirus Study Group and COVID-19 by the World Health Organization was broken out first in the Wuhan city of China during second week of December 2019 (Guo et al. 2020). There are still uncertainties on the natural host of COVID-19 as one group of researcher suspects bats (Guo et al. 2020) whereas others suspect pangolins, as well (Zhang et al. 2020a). But there is no uncertainty on the severe spread of this disease infecting humans throughout the world, at present. By 1st March 2020, a total of 79,968 confirmed cases of COVID-19 with 2873 deaths were reported within China (WHO 2020a). It extended quite fast all across the countries, and as on April 1st 2020, the World Health Organization reported a total of 823626 cases of COVID-19 with the death toll of 40598 confirmed cases. Within a month on 1st May 2020, the COVID-19 confirmed cases increased to 3145407 with 221823 confirmed death tolls across 214 countries (WHO 2020a). By May 30, 2020, there were 5817385 confirmed cases of COVID-19, with 362705 deaths (WHO 2020a).

In India, the first case of COVID-19 was reported on January 30, 2020 in the southern state of Kerala when a student returned home from Wuhan was tested positive (Chandar, 2020). The first case of COVID-19 death, a 76-year-old person who returned from Saudi Arabia, was reported on 12th March 2020 from Bengaluru (Dwarakanath 2020) indicates that first human casualty took 42 days from the entry of COVID-19 in India. As on April 1st 2020, the Government of India reported a total of 35364 confirmed cases of COVID-19, which include

1152 deaths and 9064 cases of discharged from various hospitals on account of their recovery (My Gov. 2020a). Within two months by May 30, 2020, the number of confirmed cases in India had surged to 173763 (4.9 times higher than 1st of April), which included 4971 deaths and 82369 cases of discharged from the hospitals (My Gov. 2020a). Though, COVID-19 had spread all across the country, as per its contagious nature it had relatively high number of confirmed cases in the concentrated pockets within the States and Union Territories. The highest number of confirmed cases was reported in Maharashtra (62228), followed by Tamil Nadu (20246), Delhi (17386), and Gujarat (15934) by May 30, 2020.

Management of COVID-19 in India

Acts, Legislations, Policy and Government Interventions

In view of dealing with the dangerous epidemic diseases, historically, there is an Act in India, which is named as Epidemic Diseases Act, 1897. The section 2 of this Act empowers the Government of India to take extraordinary steps in order to prevent the outbreak and spread of dangerous diseases (Epidemic Diseases Act 1897). Besides, India has enacted the Disaster Management Act (DM Act) in 2005 in order to deal with any catastrophe or calamity in any area, arising from natural or manmade causes, which results in substantial loss of life or human suffering (DM Act 2005). In view of minimum loss of life, livelihood and property, the DM Act confirms to execute the proactive practices such as prevention, mitigation and preparedness along with the strategies after the disaster such as relief, rescue, recovery, rehabilitation and reconstruction. For the effective execution of the DM Act, and the further management of disaster, a three tier system is on place, which includes the National Disaster Management Authority (NDMA), State Disaster Management Authority and the District Disaster Management Authority. The NDMA is chaired by the Prime Minister and it is an apex body to lay down policies, plans and guidelines for management of disaster (DM Act 2005). Accordingly, the NDMA has made a na-

tional policy on disaster management in 2009 (National Policy on Disaster Management 2009).

In order to deal with and mitigate the impacts of present worldwide disaster in the form of COVID-19 pandemic, the Government of India issued an order on 24th March 2020 to impose lockdown in the entire country for 21 days with effect from 25 March 2020 while exercising its power under the DM Act, 2005 (MHA Order 2020a). Accordingly, the guidelines were issued on the same day for containment of COVID-19. With some necessary exceptions, all the central, state and union territory offices, commercial, private and industrial establishments, hospitality and transport services, education institutions and places of worship were closed down in all parts of the country. The hospitals and related medical establishments were directed to remain functional during the period of lockdown to deal with COVID-19 pandemic (MHA Guidelines 2020). On 24 March 2020, in a separate order the NDMA issued directions to all the state and central government establishments for taking necessary measures for ensuring social distancing so as to prevent the spread of COVID-19 (NDMA Order 2020). Thereafter, a series of instructions and guidelines were issued time to time by the Government of India to fight against the COVID-19 (Circulars for COVID-19 2020). However, the initiatives to combat with COVID-19 was started much earlier on January 18th, 2020 when the Government of India commenced thermal screening of passengers, especially coming to India from China and Hong Kong. Anticipating the severity of COVID-19 pandemic, on March 25, 2020, the first phase of Census 2021 and or updation of National Population Register were declared to be postponed until further orders.

On 29th March 2020, the Government of India constituted 11 empowered groups of officers to identify problem areas and provide effective solutions. Suddenly within a week of first phase of lockdown, movements of a large number of migrants were noticed in different parts of the country. The majority of these migrants belonged to the most marginalized sections of the society who mainly depended on daily wages for their living. Many migrants had marooned at state and district borders due to

lockdown (Abi-Habib and Yasir 2020). To deal with this problem of migrants, the Government of India issued directives to the State and Union Territory governments and authorities to take necessary actions and measures, which include to provide temporary shelters and food to the needy people. Further the employers were directed to pay the wages of their employees at their work place and the landlords were suggested not to take one month rent from the labours. On 2nd April, 2020, the Government of India issued a press note against the people spreading fake news on COVID-19 and subsequent panic in the migrants and society (Circulars for COVID-19 2020).

The lockdown period that was in the first phase imposed for 21 days with effect from 25 March 2020 was extended to 3rd May 2020 in the second phase and further upto 17 May 2020 in third phase by NDMA. Accordingly, new guidelines were issued on 1st May 2020 that were in effect from 4th May 2020 for next 2 weeks. The districts all across the country were categorized into 3 zones viz., red, orange and green based on their risk profile. The district, where there was no report of any confirmed case of COVID-19 in past 21 days or there was no case of COVID-19 till date was categorized as green zone. The districts, which have considerable active number of COVID-19 cases, doubling number of confirmed cases, and based on extent of testing and feedback from the Ministry of Health and Family Welfare, Government of India, were defined as red zone. The district, which did not fall any of these two important categories was placed in the orange zone (My Gov. 2020b; India Today 2020).

Accordingly, a total of 733 districts were positioned into these 3 zones, of which 130 were placed in red zone, 284 in orange zone and 319 in green zone by May 1st, 2020 (India Today 2020). Depending on the red and orange zones, the containment areas were defined and intensive surveillance mechanism were enforced, which include to ensure that every resident must be covered under an app called as Arogya Setu. This app was developed by the Ministry of Electronics and Information Technology, Government of India to provide essential services to the people and proactively reaching out and updating the users regarding risks,

and relevant advisories related to the containment of COVID-19 pandemic in the country (Arogya Setu App 2020). Besides, the new guidelines ensured to institutional and home quarantine of individuals, testing of cases having signs of COVID-19, and counselling of people. In orange zones, inter district and intra district plying of buses were not permitted and four wheeler vehicle was permitted with 2 passengers only. In green zones, most of the activities were permitted (My Gov. 2020b). The status of various zones was revised based on the available information.

As a precautionary measure, the Ministry of Health and Family Welfare, Government of India issued the revised guidelines on May 10, 2020 for home isolation of very mild or pre-symptomatic COVID-19 cases. Besides the strict guidelines to patients, the caregivers were also advised to wear triple layer medical masks and disposable gloves, avoid touching own face, practice hand hygiene, avoid direct contact with body fluid of the patient, and self-monitor their own health including temperature (MoHFW 2020a). The patients kept in home isolation were discharged after 17 days of onset of COVID-19 symptoms such as fever, tiredness, and dry cough and sometime pains, nasal congestion, runny nose, sore throat or diarrhoea. There were psychological and emotional issues associated with the pandemic hence counselling was arranged for people suffering from such disorders.

The Government of India gradually began to take initiative for normalizing the situation even before the end of 3rd phase of lockdown. Besides making some government and private institutions functional with restrictions in 3rd phase of lockdown, a limited railway services were made operational from May 12, 2020 onwards. In view of restoring economic growth and making the country self-reliant, the Prime Minister of India announced a package of 20 lakh crores that was about 10 percent of the Gross Domestic Products (Financial Express 2020). Accordingly, the Government of India announced 16 measures on May 13, 2020, of which 6 were related to micro, small and medium enterprises under the Prime Minister's Atmanirbhar Bharat Abhiyan (Self-reliant India Mission), a plan for post-pandemic financial package.

Despite imposition of lockdown till May 17, 2020, the confirmed cases of COVID-19 continued to be reported in various parts of the country. Therefore, the fourth phase of lockdown was imposed for 14 days. Accordingly, the lockdown was extended upto May 31, 2020 by NDMA (MHA Order 2020b). Many activities remained prohibited, which include domestic and international air travel, metro services, hotel and hospitality services, and large gatherings to any religious, academic, social, cultural and political functions. Except in the containment areas, some of the activities were allowed provided that the concerned States and Union Territories mutually agreed on such activities, which include movement of interstate passenger's vehicles. As delineated earlier, within red and orange zones the district authorities were asked to demarcate the containment and buffer zones so that the necessary restrictions may be extended or essential activities may be allowed in such areas (MHA Order 2020b). Being vulnerable, persons above 65 years and below 10 years of age were advised to stay at home apart from the pregnant women and persons with co-morbidities. Besides, the States were authorized to impose more restrictions, if required and necessary as per assessment, for the welfare of the people.

After 66 days of lockdown in the country, the Government of India initiated to unlock the lockdown in phases from June 1st, 2020. Accordingly, the first set of guidelines for phased re-opening of areas with unlock-one was issued by the Ministry of Home Affairs as per the directives of the NDMA by May 30, 2020 (MHA Order 2020c). The guidelines were categorized into three phases. In first phase, from June 8, 2020 the religious places, hotels, restaurant, hospitality services, and shopping malls will be allowed to open. In second phase (date yet to be decided), after consulting the concerned States and Union Territories the educational institutions will be opened, and in the final or third phase, international air travel, metro rails, and any other places which invite large congregations will be allowed to open. Further, the guidelines proclaim that the lockdown will continue till June 30, 2020 in the containment zones, which will be identified by the concerned district authorities. Besides, the

buffer zones may be identified around the containment zones to take necessary precautions (MHA Order 2020c).

While fighting with COVID-19, in the beginning, the Bhilwara model was remained in limelight in India. Bhilwara is a town and the headquarter of Bhilwara district, which is located in Mewar region of Rajasthan in India and is well-known for textile industry. It was seen as a major hotspot of COVID-19 during 3rd week of March when even doctors and other medical staff were tested positive by 19th March 2020 (Manish 2020). The State Government then chalked out a well-defined plan, which included 6 major steps such as complete isolation of district (sealing of its border with other districts), mapping of COVID-19 hotspots, aggressive door-to-door screening, contact tracing, increase in quarantine and isolation wards, and establishing a monitoring mechanism for the people living in far flung rural areas. Accordingly, no movement sectors were identified, traffic was stopped and daily disinfection was carried out, besides delivering essential food items and medicines to the doorstep of the people in need of such services (Vij-Aurora 2020). The number of infected cases reached 27 in Bhilwara by March 30, 2020. The situation was largely remained under control after execution of this plan (Manish 2020), and a total of 43 persons were tested positive in the district, of which 2 were died and 38 were recovered. Subsequently, Bhilwara was declared as an orange zone and ban on most of the activities was lifted by May 14, 2020 (Khan 2020).

Since the COVID-19 has spread all across the neighbouring countries of India, the Government of India initiated discussions with the South Asian Association for Regional Cooperation (SAARC) countries to work collectively to fight against the spread of the pandemic in the region. In this regard, on March 15, 2020 the SAARC leaders held a video conference to take necessary measures to contain the spread of COVID-19 in the region (Djalante et al., 2020; SAARC 2020). India advocated for the creation of a COVID-19 Emergency Fund, which is supposed to be generated and sustained by the voluntary contributions from Member States namely Afghanistan, Bhutan, Bangladesh, Nepal, India, Pakistan, Maldives, and Sri Lanka.

Use of Medicines

Since there was no vaccine and none of the acceptable medicine was yet discovered for treatment of COVID-19, there were reports on studying the existing antiviral, antibiotic, anti-retroviral and anti-malarial medicines to treat and prevent COVID-19. One of the antimalarial drugs called as hydroxychloroquine was anticipated as possible medicine to treat COVID-19 hence the president of USA requested India to procure this medicine when COVID-19 cases suddenly began to shoot up in America during 1st week of March 2020 (Chaudhury 2020). The caregivers at hospitals in India and the close contacts of patients suffering from COVID-19 were advised to take hydroxychloroquine prophylaxis (MoHFW, 2020a). Plasma therapy, in which the blood-component plasma of a cured coronavirus patient is injected into a COVID-19 patient, was also seen a possible solution to treat COVID-19. However, this method of treatment was also in the trial stage and the same had intimated by the Government of India that if it was not administered properly it might lead to life threatening complications (Hindustan Times 2020a). It was anticipated that the antibodies of a donor recovered from COVID-19 may work well in the patient of the same locality, as the donor might have developed locality-specific resistance for the COVID-19 (Jawhara 2020). During the end of the March 2020, one of the drugs called remdesivir, which was developed basically for treatment of Ebola fever caused by a virus, was brought into limelight as a possible medicine to treat corona by National Institute of Allergy and Infectious Diseases (NIAID 2020).

Traditionally, people in India use gargling of salt mixed hot water couple of times in a day to treat common cold, cough, throat-ache and throat related disorders. The same practice has been advised as a preventive measure from COVID-19. COVID-19 is known to remain in mouth, throat and nose for a few days (3-5 days) in the beginning. Therefore, drinking hot water or inhaling hot water vapours for 3 to 4 times in a day was also suggested, considering that it can drain the virus into the stomach where it may be neutralized due to presence of acid in gastric juices (True 2020). Adopting preven-

tive measures, which boost human immunity, may help to fight against the infectious diseases, including COVID-19. The regular yoga practice, which is an old tradition in India, is also known to strengthen the human immunity system, reduces stress and improves antioxidant levels of the body (Lim and Cheong 2015). Besides, yoga helps to maintain the healthy respiratory system, which is a cause of concern as this system is most vulnerable, highly infected and finally damaged by the COVID-19. One of the oldest therapeutic knowledge systems in India, the Ayurveda, has evolved on the bases of preventive care focussing the philosophy of adopting daily and seasonal regimes for maintaining healthy life (Ministry of Ayush 2020). The hot drink or decoction of some medicinal plants, including Indian basil (*Ocimum sanctum*) and ginger (*Zingiber officinale*) was also recommended to fight against the infections in the respiratory systems (Kala 2005; Ministry of Ayush 2020). The use of giloy (*Tinospora cordifolia*) and amla (*Phyllanthus emblica*) was also recommended to uphold immunity. Eating half spoon of Chawanprash (a general tonic made up of plants) once in the morning was recommended to increase the immunity. The Unani System of Medicine does prescribe the use of plants such as *Rheum australe*, *Tamarindus indica* and *Terminalia chebula* as a protective measure during epidemics (Nikhat and Fazil 2020). Maintaining personal hygiene, frequently washing hands with soap or sanitizer, covering mouth while coughing or sneezing, maintaining social distancing, avoiding close contacts with people who are unwell or showing symptoms of illness, and wearing mask are some of the preventive measures as suggested to fight against the COVID-19 (WHO 2020a; Ministry of Ayush 2020).

The health workers, however, need to take extra precautionary measures while dealing with patients as the infection is known to transmit through respiratory droplets, aerosols, body fluids including blood samples, apart from nearing in close contact with contaminated surroundings (Soetikno et al. 2020). Besides preventive measures, the Ministry of Ayush recommended to consume herbal decoction made up of basil, cinnamon, black pepper, dry ginger, and raisin once or twice a day to develop im-

munity. Further, the Ministry of Ayush has cautioned that this decoction should not be considered a medicine to cure COVID-19. Besides, some Ayurvedic medicines, including Samshamani Vati 500 mg containing aqueous extract of *Tinospora cordifolia*, have been recommended by the Ministry of Ayush with clear advisory that these medicines should not be taken without consulting the qualified physicians.

The preventive measures as prescribed, at present, to deal with COVID-19 remind some of the customary practices generally followed by majority of cultural groups, including Hindus, Buddhists, Jainism and Sikhs in India. It is a tradition to wash hands and feet before entering the home and also before sitting to eat meals. People used to keep their shoes outside the main door. The guests are welcomed with folded hands telling Namaste and also the same ritual is practiced while bidding adieu to them, which ensures social distancing and also avoid unnecessary contacts with others. As a last rite, Hindus cremate the dead body. Some of the ethnic groups in India like the tribal people in Baster also cremate the dead body of a person who dies due to infectious disease. But the same tribal group engraves the dead body of a person who dies naturally (Gupta, 2019). After attending the final ritual or cremation of the dead body, one has to take bath before entering house as per the customary norms (Kala, 2018). There are many customs in the society, which may not be demonstrated or standardized in the present scientific rigours and discourse but they had supported the society in the past. It appears that there is a need to make

a balance between the traditional knowledge occupied over the years of experimentation and the scientific knowledge, modern technology, economic conditions and global forces in view of developing an inclusive knowledge system (Gupta 2019). There is a need to thrive the valuable and time tested traditional knowledge that is based on the first hand information and understanding of nature.

Initial Effects of Initiatives

Low Lethality and Slow Spread of COVID-19

The COVID-19 spread in terms of the number of confirmed cases within 3 months when compared against the population of respective countries, the highest percentage of population was infected in Spain (0.496 %), followed by USA (0.446 %), Italy (0.374 %), United Kingdom (0.366 %) and France (0.215 %). In India, 0.007 % of its population was infected with COVID-19 within 3 months by May 20, 2020 (Table 1). As per one estimates, within 3 months about 5% of the population could be infected by COVID-19 (Emanuel et al. 2020). However, in actual, none of the countries across the world has reached to this guesstimate within 3 months. In the last 10 days from May 20 to May 30, 2020, there has been an increase in the confirmed COVID-19 cases against the population of the respective countries. India has witnessed this increase from 0.007 % to 0.012 % whereas it was increased from 0.496 % to 0.511 % in Spain, from 0.446 % to 0.512 % in USA,

Table 1: People infected against the population of the respective country. [(Source: Calculations based on the data with the World Health Organization (2020b), My Gov. of the Government of India (2020a), and the Worldometer (2020)]

Date	India	UK	USA	Italy	Spain	France
10-02-2020	2.17391E-07	5.89223E-06	3.62535E-06	4.96181E-06	4.27764E-06	1.68522E-05
20-02-2020	2.17391E-07	1.32575E-05	4.53169E-06	4.96181E-06	4.27764E-06	1.83842E-05
29-02-2020	2.17391E-07	2.94612E-05	1.8731E-05	0.001468695	6.84422E-05	8.73249E-05
10-03-2020	3.1884E-06	0.000475798	0.000142597	0.015169902	0.00219015	0.002147885
20-03-2020	1.41304E-05	0.005867188	0.004597848	0.077769732	0.0427336	0.019111888
30-03-2020	7.76084E-05	0.028762921	0.03705499	0.161571369	0.168532508	0.06073214
10-04-2020	0.000464636	0.095868057	0.128666341	0.237548234	0.326054377	0.130759015
20-04-2020	0.001251083	0.176871491	0.218610032	0.296008261	0.419088719	0.170762991
30-04-2020	0.00239492	0.243385931	0.303312979	0.336726516	0.455390891	0.194667022
10-05-2020	0.004560783	0.317096257	0.376364055	0.361001337	0.478192838	0.209898315
20-05-2020	0.007735483	0.366529122	0.446358661	0.374945672	0.496285107	0.215951307
30-05-2020	0.012591482	0.399531503	0.512039404	0.384123364	0.511040818	0.224680728

from 0.366 % to 0.399 % in UK, from 0.374 % to 0.384 % in Italy, and from 0.215 % to 0.224 % in France.

The lethality rate, which is determined based on the number of deaths due to COVID-19 divided by the total number of confirmed COVID-19 cases, was estimated highest for France (19.542 %), followed by Italy (14.307 %), UK (14.069 %), and Spain (12.153 %) by May 30, 2020. The lethality rate was comparatively low (2.860 %) in India, whereas in USA also it was relatively higher (5.918 %) than India by May 30, 2020 (Table 2). Among various States of India, the high percentage of recovery rate was found in Punjab (88.71), followed by Andhra Pradesh (64.78), Rajasthan (62.69), Uttar Pradesh (58.26), Telangana (56.95), Tamil Nadu (55.88) and Madhya Pradesh (55.85). Similarly, among the Union Territories of India, Andaman & Nicobar and Mizoram had 100% recovery rate, followed by Tripura (68.13), Chandigarh (65.40), and Ladakh (58.11). Whereas the percentage of lethality rate was highest in West Bengal (6.27), followed by Gujarat (6.15), Madhya Pradesh (4.37), Maharashtra (3.37), Telangana (2.93), Uttar Pradesh (2.72), Delhi (2.29) and Rajasthan (2.20). Meghalaya had encountered the highest lethality rate among the Union Territories (Table 3).

A joint study by the Ministry of Statistics and Programme Implementation, Government of India and the Indian Statistical Institute estimated that about 2 million COVID-19 cases

and 53773 deaths have been averted in the country till May 22, 2020 due to complete lockdown and related initiatives undertaken by the Government of India (MoHFW 2020b). There has been a surge in testing of COVID-19 cases and by May 22, 2020 with 103829 tests per day a total of 2755714 tests were conducted. Further, the clinical management of cases and number of initiatives as implemented by the Government of India including containment measures, have assisted in dropping the mortality rate from 3.13 % on May 19 to 3.02 % (MoHFW 2020b; The Economic Times 2020).

There are different reasons for high lethality rate in different countries. The high lethality rate in Italy is associated with existence of multiple disorders in COVID-19 infected person, higher number of asymptomatic infected individuals infecting others, frequent contact of elderly people with their children, and nature of occupation such as considerable amount of business travel and working in hospitals (Di Lorenzo and Di Trolio 2020). The high number of death toll in Italy was connected with the old age and history of other diseases such as diabetes, heart problems and cancer however this fact cannot be overlooked that they would have survived if not infected with COVID-19 (Remuzzi and Remuzzi 2020).

Though every person was possible host for COVID-19, however, the persons associated with some specific profession were more prone to this contagious disease, including health care

Table 2: Comparison of India with selected countries in terms of percentage of people died against the total number of confirmed infected cases (lethality rate) *

<i>Date</i>	<i>India</i>	<i>UK</i>	<i>USA</i>	<i>Italy</i>	<i>Spain</i>	<i>France</i>
10-02-2020	0	0	0	0	0	0
20-02-2020	0	0	0	0	0	8.333
29-02-2020	0	0	0	2.364	0	3.508
10-03-2020	0	0.928	4.025	5.047	2.734	2.139
20-03-2020	2.051	4.443	1.320	8.574	5.015	3.607
30-03-2020	2.707	6.289	1.721	11.036	8.284	6.563
10-04-2020	3.103	12.258	3.443	12.728	9.995	14.284
20-04-2020	3.145	13.375	4.726	13.219	10.438	17.664
30-04-2020	3.249	15.794	5.222	13.596	11.401	18.930
10-05-2020	3.350	14.673	6.049	13.925	11.842	19.172
20-05-2020	3.094	14.203	6.042	14.190	11.971	19.844
30-05-2020	2.860	14.069	5.918	14.307	12.135	19.542

*The number of confirmed covid-19 cases and confirmed death cases are based on the Situation Reports of the World Health Organization and the My Gov. website of the Government of India

Table 3: The percentage of recovery and lethality rate across the states and union territory in India by May 30, 2020*

State	Recovery rate	Lethality rate
Arunachal Pradesh	33.33	0
Andhra Pradesh	64.78	1.75
Andaman and Nicobar	100	0
Assam	12.21	0.39
Bihar	35.87	0.44
Chandigarh	65.40	1.38
Chhattisgarh	24.10	0.24
Dadra and Nagar Haveli [†]	0	0
Daman and Diu [§]	-	-
Delhi	45.13	2.29
Goa	59.42	0
Gujarat	54.04	6.15
Haryana	54.62	1.10
Himachal Pradesh	29.49	1.69
Jammu and Kashmir	40.43	1.29
Jharkhand	42.27	0.98
Karnataka	32.15	1.73
Kerala	49.13	0.70
Ladakh	58.11	0
Lakshadweep [§]	-	-
Madhya Pradesh	55.84	4.37
Maharashtra	43.38	3.37
Manipur	13.56	0
Meghalaya	44.44	3.70
Mizoram	100	0
Nagaland [†]	0	0
Odisa	51.48	0.41
Puducherry	27.45	0
Punjab	88.71	1.91
Rajasthan	62.69	2.20
Sikkim [†]	0	0
Tamil Nadu	55.88	0.76
Telangana	56.95	2.93
Tripura	68.13	0
Uttar Pradesh	58.26	2.72
Uttarakhand	14.25	0.70
West Bengal	36.88	6.27

* The calculations are based on the number of confirmed covid-19 cases, recovery cases and confirmed death cases as per My Gov. website of the Government of India on May 30, 2020.

[†] 1 confirmed covid-19 case in Sikkim, 2 in Dadra and Nagar Haveli and 25 in Nagaland were reported and they were active by May 30, 2020.

[§] No confirmed case of covid-19 has yet reported.

workers and police personnel, as they were engaged in providing services during the period of lockdown. An initial study in Wuhan reports 29% of patients (40 out of 138) were healthcare workers (Wang et al. 2020). The nature and stress of work in such distressed conditions where risk of infection was consider-

ably very high have shaken many of them psychologically. A study in medical staff members in China reports that more than one-third of the medical staffs have developed insomnia symptoms (difficulty falling asleep or staying asleep) during the COVID-19 outbreak (Zhang et al. 2020b). In Maharashtra, the state most infected in India with 67655 confirmed COVID-19 cases and 2286 deaths by June 01, 2020 (My Gov. 2020a), about 2,211 police personnel were tested positive for COVID-19 by May 29, 2020, of whom 25 have lost their lives (Hindustan Times 2020b). The Government of India, therefore, has repeatedly encouraged the medical staff and police personnel by honouring them for their extraordinary services during the present crisis.

India was in a better position than many other countries despite the fact that it is a developing nation with second highest populated country of the world. At the initial stage, the national address of the Prime Minister of India, which encouraged citizens to follow community vigilance and self-curfew, has slowed down the community spread in such a highly populated country (Djalante et al. 2020). The complete lockdown in the beginning and then the partial lockdown depending on the infected localities have controlled the spread of COVID-19 to some extent. Further, making the society to realize the urgency of maintaining social distancing, wearing masks and washing hands frequently to combat the COVID-19 has helped in upsetting the chain of COVID-19 spread to a greater extent. This social awareness will continue to help in future, as well, even when there is no lockdown and no restrictions on the movement of people.

Movement of Migrants

The reverse migration from urban to rural areas was one of the prime issues of concern during the period of lockdown in India. There are 1.77 million homeless people in India (Census 2011), and such homelessness is considered to be one of the by-products of rapid urbanization (Ballal 2011). The homeless people are those persons who are not living in census houses, but they live in the places such as roadsides, pavements, at railway platforms, at bus station, inside drainage pipes, in the open and

any other possible habitat (Goel et al. 2017). The homeless people were more prone to COVID-19 infection due to shortage of resources. The problem of homelessness is not only restricted to the developing countries like India. There are more than 500000 people in USA and 35000 people in Canada experiencing homelessness and they facilitate transmission of COVID-19 infection due to congregate living settings and limited access to basic hygienic supplies (Tsai and Wilson 2020). Besides, a large number of labours or migrants who had lost their jobs in the urban areas due to lockdown had also moved back home to the rural areas. By May 29, 2020, a total of 5200000 migrants were ferried back home within India (Nagpal 2020). The movement of such migrant population was considered to spread COVID-19 from urban to rural areas. In the hill districts of Uttarakhand in India, where there was none or a limited number of confirmed cases of COVID-19 till May 20, 2020 had experienced increasing number of COVID-19 cases after the arrival of such migrants from the cities.

In the democratic set up of India, village council is a basic unit to deal with any issue related to the respective villages. Managing sudden arrival of migrants at their own villages was a challenging task to the village councils, as there were enough reasons of fear and conflicts between migrants and residents. The village council of Sumari, a village in hills of Uttarakhand, in first phase of arrival of migrants ensured collectively for their home quarantine for two weeks. However, when the population of migrants have inflated, the villagers formed a task force comprising of five teams with 4-5 members in each team to arrange logistics, including food and medicine, for the migrants in a school outside of the village boundary. In view of dealing with the stress and sufferings of migrants in quarantine and isolation, the task force members used to stay overnight in a house close to the school and also entertained them with music and songs while maintaining proper social distancing. This helped in reducing the mental stress of the persons in quarantine. The school and its adjacent premises were sanitized repeatedly by the task force members. Through such a viable functional system and social activities, the village council ensured to

maintain the social fabric and better bonding in the different groups of people within the village that may have long-term impressions in the society.

Ecological and Environmental

The countrywide ban on traffic mobility due to lockdown greatly reduced transportation emissions. The reduction in movement of vehicles, and also close down of construction activities and industries have improved the Air Quality Index (AQI) in India, especially in the major cities and industrial areas. The AQI indicates the complex air quality data of various pollutants, including PM₁₀, PM_{2.5}, CO, NO₂, Ozone and SO₂ into a single number called as index value (SAFAR-India 2020). The environmental pollution, which is estimated in terms of AQI, reduced by 44, 33, 29, and 32 percent in north, south, east, and western parts of India, respectively (Sharma et al., 2020). Since the lockdown was implemented in various countries across the world, the environmental pollution was reduced up to 30 percent in such countries, which include China, Italy, France, Spain and USA (Muhammad et al. 2020).

Lessons Learnt and the Way Ahead

Every disaster, simultaneously, creates an environment for more advanced development depending on the learnings from impacts of hazards and vulnerability of systems (Kala 2014, 2017). In the beginning of its entry, India did not have resources and technology to fight against pandemics like COVID-19. Moreover, the worldwide lockdown has disrupted the supply chain of essential technology and resources to import. Therefore, the COVID-19 Task Force was set up by the Government of India, which immediately identified more than 500 entities to deal with various urgent issues, including arrangements of masks, testing kits, alcohol-based sanitizers, dress materials for frontline healthcare workers and protective equipment (Ministry of Science and Technology 2020). The 'Make in India' programme of the GOI was accelerated dynamically to deal with COVID-19 crisis by creating a network of skilled institutions and organizations. Shortly, the first

COVID-19 rapid testing kit with a capacity to provide results within 2.5 hours was developed in India by Mylab Discovery Solutions Pvt. Ltd. Further, the Mylab has improved its test capacity from 1,50,000 tests a week to 2 million tests a week (Ministry of Science and Technology 2020). A one-step curable anti-microbial coating, which does not allow COVID-19 to remain active on coated surfaces, was developed by the Jawaharlal Nehru Centre for Advanced Scientific Research. Besides, masks, sanitizers, anti COVID-19 solution reducing viral load upto 99.7% in a room, and protective equipment were developed within country (Ministry of Science and Technology 2020). COVID-19 has also created an environment to shift the traditional manual working to online technology hence the countries need to promote such remotely done work (Djalante et al. 2020).

COVID-19 has affected everyone but everyone might not have been affected equally. The poor and marginal sections of the society, ageing persons, and persons living with disabilities were found more vulnerable, albeit in the absence of proper medicines still prevention remains the only solution to save lives from COVID-19 (UNDRR 2020). In some in-vitro studies, chloroquine phosphate was found to block COVID-19 infection at low-micromolar concentration hence it is being projected to treat COVID-19 associated pneumonia in larger populations in days to come (Gao et al. 2020). However, one needs to be cautious enough while testing its use, as it has been assumed to create side effects, and so that the World Health Organization has put ban on its trial in last week of May 2020. The healthy lifestyles, which maintain the good hygienic condition and a healthy immune system, can help in fighting against the COVID-19.

A group of researchers hypothesized that higher mortality rates from COVID-19 might have linkages with vitamin D deficiency, because low serum vitamin D invites high risk and severity of viral respiratory infections (Braiman 2020; McCartney and Byrne 2020). Vitamin D is considered quite important for the health of bones and muscles and also for combating depression. Its deficiency may lead to compromise the immune system (McCartney and Byrne 2020). Therefore, all the vulnerable

groups including ageing persons, nursing home residents, hospital inpatients and health-care workers are advised to be supplemented with vitamin D to improve their resistance to COVID-19 (Grant et al. 2020; McCartney and Byrne 2020). In India, a sizeable population is malnourished hence they are highly susceptible to any infection, including COVID-19. Besides, reducing and degrading forest cover, air pollution, and expansion of urban areas are also linked to affect the respiratory system due to change in air quality in the environment (Kala 2020). There is a need to sort out these issues, as well, in order to improve the immunity for fighting against the COVID-19. A recent study in Madhya Pradesh state of India reports better immunity of citizens living in the areas having high forest availability (Outlook 2020).

Though, India possesses the largest pure vegetarian population in the world, consuming wildlife is not the sole reason of transmission of viruses to humans, as envisaged in transmission of COVID-19 to humans from bats and pangolins (Zhang et al. 2020a). It may be transferred to humans while coming into contact inadvertently with bat saliva (Li et. al. 2019), fruits infected by bats meant for human consumption, consuming livestock infected with viruses, and living in unhygienic conditions (Minhas 2020). Since India contributes 17.7% of global human population, any spread of such viruses to humans in India may become a catastrophe to the world population, as well. The present pandemic is a wakeup call to the nations to work together in dealing with any such catastrophe. An early warning system needs to be developed that can detect pathogens, including viruses and bacteria, and their possible transmission from wildlife and domestic livestock to humans (Kelly et al. 2017).

At the same time, the outburst of COVID-19 pandemic has cautioned the nations to be prepared for such catastrophes in future. It was noticed that mainly every country was engaged on its own resources while dealing with this global problem (Wang et al. 2020). Dealing with a pandemic like COVID-19, which is not restricted to a nation's boundary, requires continuous services and supports of international organizations, including the World Health Organization and United Nations Office for Disaster Risk

Reduction. Accordingly, every nation must be made to learn and work out on the public health preparedness, scaling up laboratory capacity, improving health communication system, and building up a strong synchronized system with other nations to detect, prevent, and control any such epidemic and pandemic (Jacobsen 2020). It is imperative in the present context when the world is working as a global village and the mobility of people across the world has become faster than ever before and so that the contagious diseases. The spread of COVID-19 from Wuhan to all across the nations within a short duration and its subsequent effects pass on some valuable lessons to the world to prepare a comprehensive plan which synchronizes the social, ecological, environmental, political, and institutional factors for combating any such pandemics and disasters.

Executing lockdown might have been a temporary short-term solution but it cannot continue indefinitely, and people have to learn how to live with COVID-19. Though, at present, applying temporary social distancing norms has been widely accepted by the countries across the globe, it has some demerits at the long run. Stringent temporary social distancing for longer time is not always the guarantee for higher decline in pandemic peak size. Further, when social distancing remains highly effective, it may lead to build up almost no population immunity rather it maintains a high proportion of susceptible individuals in the population that may escalate the pandemic (Kissler et al. 2020). Therefore, maintaining or growing immunity is one of the feasible solutions to fight against the present pandemic to a larger possible extent (Weitz et al. 2020). Apart from temporary intermittent social distancing, expanding critical care capacity and effective treatment system that rapidly helps in accumulating population immunity would improve the rate of success in long run (Kissler et al. 2020).

In the beginning of COVID-19 spread, some studies predicted that people living in the cold and temperate climate as compared to the warm and tropical climate will be affected more due to COVID-19 (Sajadi et al. 2020; Gupta et al. 2020). Accordingly, the effects of temperature, humidity, precipitation, and wind speed on the rate of COVID-19 spread were investigated (Oliveiros et al. 2020).

Though, understanding such interrelations and global trend is valuable, to date, no relationship has been confirmed precisely between weather and COVID-19 spread. India is one of the most diverse countries in terms of weather and climate, at the same time it has both cold and hot weather in two different eco-climatic zones due to its locality in the tropics and the mighty Himalaya in the north (Kala and Silori 2013). But, till date, there is no such sign of relation exists between weather and COVID-19 spread in India, which may be scientifically attested, as in past 4 months (from February to May 2020) it has spread all across the country irrespective of weathers from south to north and from east to west. There may be a possibility that after initial wave of infection it may circulate or fluctuate seasonally (Kissler et al. 2020). Though, the COVID-19 spread was noticed less in the Himalayan states of India, it was not related to weather and climate but it was more associated with isolated low populations in such States.

In India, the sudden movement of migrants was one of the prime issues during lockdown. At present, most of the labours and workers are hired on contract or on daily wages. Many of them either homeless or they do not have proper support system to live for longer period. Besides, there are short terms or seasonal or circular migrants, who arrive to work in cities or towns for a few weeks or months and then come back home (Kala 2012; Chandrasekhar and Sharma 2015). Such manpower being vulnerable is bound to return home in distress, as they do not have alternatives at their place of work. There are a few industrial models within India such as Modinagar in Uttar Pradesh and Tatanagar in Jharkhand where all necessary logistics have been provided to the workers within their workplace. Following Modinagar and Tatanagar models where necessary logistics are provided at their workplace may resolve the problems of migrant workers to a larger extent in the event of pandemics like COVID-19.

Since the term lockdown began to create panic and unease in the society, it was felt better to use the term that was more acceptable to the people. Therefore, the term unlock was brought into practice focussing on the activi-

ties those were allowed to use so that people perceptions might change. It was one of the good psychological strategies to make people feel good and also make them to convince with changing state of affairs, including policies. While following the stepwise unlocking activities, however people must be vigilant and informed themselves by authentic sources of information such as government websites, and avoid spreading unauthenticated information (Agrawal 2020). The awareness generation about COVID-19 should be continued through various means of communications. To build up and maintain the people's participation, which is highly required, collaborative actions and engagement of all stakeholders should be ensured (Trivedi 2020). The future impacts of COVID-19 and lockdown effects on the society, economy and environment may be disturbing and obviously they are the matter of grave concern in days to come. The core principles of risk assessment, including assessment of hazards, vulnerability, dose-response and risk characterization, may continue to be used to assess the risks from COVID-19. Further, the intends, inclusion, investment, infrastructure, and innovation of the Government of India through systematic, planned, integrated and interconnected reforms under the Self-reliant India Mission are expected to cope-up with the various impacts of the pandemic and subsequent development of the country.

CONCLUSION

India being the second largest populous country of the world, there were enormous challenges before the country to deal with COVID-19 pandemic, one of the most contagious diseases. The Government of India has accepted COVID-19 to be a serious problem and has taken numerous initiatives to save the people. It worked in a mission mode and immediately set up a Task Force, created network of skilled institutions, and identified a large number of entities to address urgent emergency issues, including arrangements of masks, testing kits, dress materials for frontline healthcare workers and protective equipment. The Disaster Management Act 2005 and the provisions as mandated in this Act have helped in implementing

the Government decisions. Besides the countrywide lockdown in the first four phases and establishing emergency management structures to address the COVID-19 spread, the containment zones were identified and rigorous management measures were implemented in such zones. The immediate initiatives as taken up by the Government of India have restricted the spread of COVID-19, and by May 30, 2020, only about 0.012% population was infected in the country. The percentage of lethality rate was also low in India in comparison to the developed nations. Further, these initiatives have resulted in averting a huge number of confirmed COVID-19 cases and human casualties within the country till May 30, 2020. With the process of unlocking the lockdown, there has been an attempt to make the country self-reliant by implementing systematic, planned, integrated and interconnected reforms.

RECOMMENDATIONS

In order to combat adverse effects of COVID-19 pandemic various guidelines are prepared and issued by the Government of India after several brainstorming sessions and interactions with the subject experts and knowledgeable people. The effective implementation of these strategic guidelines, as issued in the beginning, has slowed down the spread of COVID-19 pandemic in India to the possible extent. Based on the critical analysis of existing literatures and information, the present study recommends that the guidelines as prepared and issued by the Government of India need to be taken seriously as the lifesaving pills, when research is still going on to formulate a new drug for curing the ongoing pandemic. Maintaining social distancing, wearing masks and following hygienic life style are the need of hour and must be followed in true letter and spirit. In the absence of vaccine and proper medicine, people are required to maintain and enhance their immunity relying on the healthy foods, and natural immunity boosters, including medicinal plants and herbal formulations. The AYUSH system of medicine and the prescriptions for preventions as per the directives of the Ministry of AYUSH should continue to be followed for mitigating the adverse impacts of COVID-19 pandemic.

REFERENCES

- Abi-Habib M, Yasir S 2020. India's Coronavirus Lockdown Leaves Vast Numbers Stranded and Hungry. *The New York Times*, 29 March, 2020. From <<https://www.nytimes.com/2020/03/29/world/asia/coronavirus-india-migrants.html>> .
- Agrawal N 2020. COVID-19: A Perspective of a Disaster Management Professional. *eMediHealth*, 7 April, 2020. From <<https://www.emedihealth.com/covid-19-disaster-management.html>> .
- Arogya Setu App 2020. Ministry of Health and Family Welfare, Government of India. From <<https://www.mohfw.gov.in>> (Retrieved on 12 May 2020).
- Ballal A 2011. *The City Is Our Home: The Spatial Dimensions of Urban Homelessness*. Master Thesis. Trondheim, Norway: Department of Urban Design and Planning, Faculty of Architecture and Fine Art, Norwegian University of Science and Technology.
- Berke P, Smith G, Lyles W 2012. Planning for resiliency: Evaluation of state hazard mitigation plans under the disaster mitigation act. *Natural Hazards Review*, 13(2): 139-149.
- Braiman M 2020. Latitude dependence of the COVID-19 mortality rate-A possible relationship to Vitamin D deficiency? *SSRN*, 3561958. <http://dx.doi.org/10.2139/ssrn.3561958>.
- Census 2011. Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.
- Chandar S 2020. India's First Confirmed Case of Coronavirus Reported in Kerala. *Quartz India*, 30 January, 2020. From <<https://qz.com/india/1793841/indias-first-confirmed-case-of-coronavirus-reported-in-kerala/>> (Retrieved on 2 May 2020).
- Chandrasekhar S, Sharma A 2015. Urbanization and spatial patterns of internal migration in India. *Spatial Demography*, 3(2): 63-89.
- Chaudhury DR 2020. Trump Changes Course, Backs India's Position on Hydroxychloroquine. *The Economic Times*, 9 April, 2020.
- Circulars for COVID-19 2020. From <<https://www.mha.gov.in/notifications/circulars-covid-19>> (Retrieved on 6 May 2020).
- Del Rio C, Malani PN 2020. COVID-19—new insights on a rapidly changing epidemic. *JAMA*, 323(14): 1339-1340.
- Di Lorenzo G, Di Troilo R 2020. Coronavirus Disease (COVID-19) in Italy: Analysis of risk factors and proposed remedial measures. *Frontiers in Medicine*, 7: 140. doi: 10.3389/fmed.2020.00140.
- Djalante R, Shaw R, DeWit A 2020. Building resilience against biological hazards and pandemics: COVID-19 and its implications for the Sendai Framework. *Progress in Disaster Science*, 100080. <http://dx.doi.org/10.1016/j.pdisas.2020.100080>.
- DM Act 2005. From <<https://www.ndmindia.nic.in/images/The%20Disaster%20Management%20Act,%202005.pdf>>
- Dwarakanath N 2020. First Coronavirus Death In India: 76-Year-Old Who Died In Karnataka Had Covid-19, Says State Government. *India Today*, March 12, 2020. From <<https://www.indiatoday.in/india/story/first-coronavirus-death-in-india-karnatakaman-1654953-2020-03-12>> .
- Emanuel EJ, Persad G, Upshur R, Thome B, Parker M, Glickman A, Zhang C, Boyle C, Smith M, Phillips JP 2020. Fair allocation of scarce medical resources in the time of Covid-19. *The New England Journal of Medicine*. DOI: 10.1056/NEJMs200511.
- Epidemic Diseases Act 1897. From <https://indiacode.nic.in/bitstream/123456789/10469/1/the_epidemic_diseases_act%2C_1897.pdf> (Retrieved on 5 May 2020).
- Financial Express 2020. Covid-19 Crisis: India's Latest Stimulus Package among Largest in the World, 12 March, 2020. From <<https://www.financialexpress.com/economy/covid-19-crisis-indias-latest-stimulus-package-among-largest-in-the-world/1956924/>> (Retrieved on 14 March 2020).
- Fothergill A, Peek LA 2004. Poverty and disasters in the United States: A review of recent sociological findings. *Natural Hazards*, 32(1): 89-110.
- Gao J, Tian Z, Yang X 2020. Breakthrough: Chloroquine phosphate has shown apparent efficacy in treatment of COVID-19 associated pneumonia in clinical studies. *BioScience Trends*, 14(1): 72-73.
- Goel G, Ghosh P, Ojha MK, Shukla A 2017. Urban homeless shelters in India: Miseries untold and promises unmet. *Cities*, 71: 88–96. doi:10.1016/j.cities. 2017.07.006.
- Grant WB, Lahore H, McDonnell SL, Baggerly CA, French CB, Aliano JA, Bhatta HP 2020. Evidence that vitamin D supplementation could reduce risk of influenza and COVID-19 infections and deaths. *Nutrients*, 12: 988. <https://www.mdpi.com/2072-6643/12/4/988>.
- Guo Y, Cao Q, Hong Z, Tan Y, Chen S, Jin H, Tan K, Wang D, Yan Y 2020. The origin, transmission and clinical therapies on coronavirus disease 2019 (COVID-19) outbreak – an update on the status. *Military Medical Research*, 7: 11. <https://doi.org/10.1186/s40779-020-00240-0>.
- Gupta AK 2019. Creative Gadchiroli: Not Just a Land of Disquiet and Violence. *DNA*, Ahmedabad. From <<http://vslir.iima.ac.in:8080/xmlui/handle/11718/22260>> (Retrieved on 1 May 2020).
- Gupta S, Raghuvanshi GS, Chanda A 2020. Effect of weather on COVID-19 spread in the US: A prediction model for India in 2020. *Science of The Total Environment*, 728: 138860. <https://doi.org/10.1016/j.scitotenv.2020.138860>.
- Hindustan Times 2020a. Plasma Therapy Not Approved Treatment For Covid-19, Can Be Dangerous, says Centre. *Hindustan Times*, 28 April, 2020. From <<https://www.hindustantimes.com/india-news/plasma-therapy-not-approved-treatment-for-covid-19-can-be-dangerous-says-centre/story-vTeSdM43Q7ND3lUiThCAZK.html>> .
- Hindustan Times 2020b. 2,211 Maharashtra Police Personnel Found Covid-19 Positive; 25 Dead. *Hindustan Times*, 29 May, 2020. From <<https://www.hindustantimes.com/pune-news/2-211-maharashtra-police-personnel-found-covid-19-positive-25-dead/story-xNYw2wS6ER26SRsSc2EOtO.html>> (Retrieved on 1 June 2020).

- IFRC 2020. Legislation For Disaster Risk Reduction. International Federation of Red Cross and Red Crescent Societies, Geneva, Switzerland. From <<https://www.ifrc.org/en/what-we-do/disaster-law/about-disaster-law/legislation-for-disaster-risk-reduction/>>.
- India Today 2020. Full List of Red, Yellow, Green Zone Districts for Lockdown 3.0. From <<https://www.indiatoday.in/india/story/red-orange-green-zones-full-current-update-list-districts-states-india-coronavirus-1673358-2020-05-01>> (Retrieved on 12 May 2020).
- Jacobsen KH 2020. Will COVID-19 generate global preparedness? *The Lancet*, 395: 1013-1014. [https://doi.org/10.1016/S0140-6736\(20\)30559-6](https://doi.org/10.1016/S0140-6736(20)30559-6).
- Jawhara S 2020. Could intravenous immunoglobulin collected from recovered coronavirus patients protect against COVID-19 and strengthen the immune system of new patients? *International Journal of Molecular Sciences*, 21(7): 2272. <https://doi.org/10.3390/ijms21072272>.
- Kala CP 2005. Current status of medicinal plants used by traditional Vaidyas in Uttaranchal state of India. *Ethnobotany Research and Applications*, 3: 267-278.
- Kala CP 2012. *Traditional Ecological Knowledge and Conservation of Ethnobotanical Species in the Buffer Zone of Pachmarhi Biosphere Reserve, Madhya Pradesh*. Indian Institute of Forest Management, Bhopal, Madhya Pradesh, India.
- Kala CP 2014. Deluge, disaster and development in Uttarakhand Himalayan region of India: Challenges and lessons for disaster management. *International Journal of Disaster Risk Reduction*, 8: 143-152. <https://doi.org/10.1016/j.ijdr.2014.03.002>.
- Kala CP 2015. The tremor of tragedy. *Natural Hazards Observer*, 39(5): 4-8.
- Kala CP 2017. Environmental and socioeconomic impacts of drought in India: Lessons for drought management. *Applied Ecology and Environmental Sciences*, 5(2): 43-48.
- Kala CP 2018. Cultural significance and current conservation practices of the Ganga's ecosystem and environment. *Applied Ecology and Environmental Sciences*, 6(4): 128-136.
- Kala CP 2020. Medicinal plants used for the treatment of respiratory diseases in Uttarakhand state of India. *Studies on Ethno-medicine*, 14(1-2): 1-8. doi:10.31901/24566772.2020/14.1-2.597.
- Kala CP, Silori CS 2013. *Biodiversity, Communities and Climate Change*. The Energy and Resources Institute, New Delhi, India.
- Kelly TR, Karesh WB, Johnson CK, Gilardi KV, Anthony SJ, Goldstein T, Olson HS, Machalaba C, Consortium P, Mazet JAK 2017. One Health proof of concept: Bringing a transdisciplinary approach to surveillance for zoonotic viruses at the human-wild animal interface. *Preventive Veterinary Medicine*, 137: 112-118.
- Khan H 2020. Curfew Lifted in Bhilwara After 55 Days, But 'No Drastic Changes'. *The Indian Express*, May 14, 2020. From <<https://indianexpress.com/article/india/coronavirus-india-lockdown-curfew-lifted-in-bhilwara-after-55-days-but-no-drastic-changes-6408822/>> (Retrieved on 18 May 2020).
- Kissler SM, Tedijanto C, Goldstein E, Grad YH, Lipsitch M 2020. Projecting the transmission dynamics of SARS-CoV-2 through the postpandemic period. *Science*, 368 (6493): 860-868. doi:10.1126/science.abb5793.
- Li H, Mendelsohn E, Zong C, Zhang W, Hagan E, Wang N, Li S, Yan H, Huang H, Zhu G, Ross N, Chmura A, Terry P, Fielder M, Miller M, Shi Z, Daszak P 2019. Human-animal interactions and bat coronavirus spillover potential among rural residents in southern China. *Biosafety and Health*, 1(2): 84-90. <https://doi.org/10.1016/j.bsheal.2019.10.004>.
- Lim SA, Cheong KJ 2015. Regular yoga practice improves antioxidant status, immune function, and stress hormone releases in young healthy people: A randomized, double-blind, controlled pilot study. *The Journal of Alternative and Complementary Medicine*, 21(9): 530-538. <https://doi.org/10.1089/acm.2014.0044>.
- Manish S 2020. Bhilwara Model: How This Rajasthan District Brought Covid-19 Under Control. *Business Standard*, April 10, 2020. From <https://www.business-standard.com/article/current-affairs/bhilwara-model-how-this-rajasthan-district-brought-covid-19-under-control-120041000286_1.html>.
- McCartney DM, Byrne DG 2020. Optimisation of Vitamin D Status for Enhanced Immuno-protection Against Covid-19. *Irish Medical Journal*, 113(4): 58. From <http://www.indymedia.ie/attachments/may2020/covid-19_vit_d_irish_med_j_mccartney.pdf>.
- MHA Guidelines 2020. From <https://www.mha.gov.in/sites/default/files/Guidelines_0.pdf> (Retrieved on 6 May 2020).
- MHA Order 2020a. From <<https://www.mha.gov.in/sites/default/files/MHAorder%20copy.pdf>> (Retrieved on 6 May 2020).
- MHA Order 2020b. Order. Ministry of Home Affairs, Government of India. From <https://www.mha.gov.in/sites/default/files/MHAOrderextension_1752020.pdf> (Retrieved on 18 May 2020).
- MHA Order 2020c. Guidelines for Phased Reopening (Unlock-1), Ministry of Home Affairs, Government of India. From <https://www.mha.gov.in/sites/default/files/MHAOrderDt_30052020.pdf> (Retrieved on 31 May 2020).
- Minhas S 2020. Could India be the origin of next COVID-19 like epidemic? *Science of The Total Environment*, 728: 138918. <https://doi.org/10.1016/j.scitotenv.2020.138918>.
- Ministry of Ayush 2020. Ministry of Ayush, Government of India. From <<https://www.ayush.gov.in/>> (Retrieved on 1 May 2020).
- Ministry of Science and Technology 2020. India's S&T Institutions Raise their Game Against COVID-19. Ministry of Science & Technology, Government of India, 6 April 2020. From <<https://pib.gov.in/PressReleasePage.aspx?PRID=1611541>> (Retrieved on 30 May 2020).
- MoHFW 2020a. COVID 19 India. Ministry of Health and Family Welfare, Government of India. From <<https://www.mohfw.gov.in/>>.

- MoHFW 2020b. Press Release, Ministry of Health and Family Welfare, Government of India, May 22, 2020. From <<https://pib.gov.in/PressReleasePage.aspx?PRID=1626137>>.
- Muhammad S, Long X, Salman M 2020. Covid -19 pandemic and environmental pollution: a blessing in disguise? *Science of the Total Environment*, 728: 132820. doi.org/10.1016/j.scitotenv.2020.138820.
- My Gov. 2020a. Web Portal of the Government of India. From <<https://www.mygov.in/covid-19>> (Retrieved on 3 May 2020).
- My Gov. 2020b. From <https://static.mygov.in/rest/s3fs-public/mygov_15883406691.pdf> (Retrieved on 12 May 2020).
- Nagpal D 2020. 52 Lakh Migrants Ferried Back Home; Shramik Specials Will Run Till All Reach Their Destinations: Railways. Timesnownews.com, May 29, 2020. From <<https://www.timesnownews.com/india/article/52-lakh-migrants-ferried-back-home-shramik-specials-will-run-till-all-reach-their-destinations-railways/598785>> (Retrieved on 29 May 2020).
- National Policy on Disaster Management 2009. From <<https://ndma.gov.in/images/guidelines/national-dm-policy2009.pdf>> (Retrieved on 6 May 2020).
- NDMA Order 2020. From <https://www.mha.gov.in/sites/default/files/ndma%20order%20copy_0.pdf> (Retrieved on 6 May 2020).
- NIAID 2020. NIH Clinical Trial Shows Remdesivir Accelerates Recovery from Advanced COVID-19. From <<https://www.niaid.nih.gov/news-events/nih-clinical-trial-shows-remdesivir-accelerates-recovery-advanced-covid-19>>.
- Nikhat S, Fazil M 2020. Overview of COVID-19; its prevention and management in the light of Unani medicine. *Science of The Total Environment*, 138859. <https://doi.org/10.1016/j.scitotenv.2020.138859>.
- Oliveiros B, Caramelo L, Ferreira NC, Caramelo F 2020. Role of temperature and humidity in the modulation of the doubling time of COVID-19 cases. *medRxiv*. <https://doi.org/10.1101/2020.03.05.20031872>.
- Outlook 2020. Virus: MP Forest Dept Study Links Greenery With Immunity. Outlook, 13 May, 2020. From <<https://www.outlookindia.com/newscroll/virus-mp-forest-dept-study-links-greenery-with-immunity/1833590>>.
- Patterson D, Pyle GF 1991. The geography and mortality of the 1918 influenza pandemic. *Bulletin of the History of Medicine*, 65(1): 4-21.
- Remuzzi A, Remuzzi G 2020. COVID-19 and Italy: What next? *Lancet*, 395: 1225-1228.
- SAARC 2020. Press Release. From <http://saarc-sec.org/news/detail_front/pres-release-the-leaders-of-the-member-states-of-the-south-asian-association-for-regional-cooperation-saarc-held-a-video-conference-on-15-march-2020-to-discuss-measures-to-contain-the-spread-of-covid-19-in-the-region> (Retrieved on 28 May 2020).
- SAFAR-India 2020. System of Air Quality and Weather Forecasting and Research. Indian Institute of Tropical Meteorology, Pune. From <<http://safar.tropmet.res.in/AQI-47-12-Details>>.
- Sajadi MM, Habibzadeh P, Vintzileos A, Shokouhi S, Miralles-Wilhelm F, Amoroso A 2020. Temperature, Humidity and Latitude Analysis to Predict Potential Spread and Seasonality for COVID-19. SSRN. From <<https://doi.org/10.2139/ssrn.3550308>>.
- Sharma S, Zhang M, Gao J, Zhang H, Kota SH 2020. Effect of restricted emissions during COVID-19 on air quality in India. *Science of The Total Environment*, 728: 138878. doi.org/10.1016/j.scitotenv.2020.138878.
- Soetikno R, Teoh AY, Kaltenbach T, Lau JY, Asokkumar R, Cabral-Prodigalidad P, Shergill A 2020. Considerations in performing endoscopy during the COVID-19 pandemic. *Gastrointestinal Endoscopy*. https://library.umsu.ac.ir/uploads/25_1481_2_180.pdf.
- Sohrabi C, Alsafi Z, O'Neill N, Khan M, Kerwan A, Al-Jabir A, Losifidis C, Agha R 2020. World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19). *International Journal of Surgery*, 76: 71-76. <https://doi.org/10.1016/j.ijssu.2020.02.034>.
- The Economic Times 2020. 14-29 Lakh COVID-19 Cases Averted Due to Lockdown, 37,000-78,000 Lives Saved: Government. The Economic Times, May 22, 2020. From <<https://economictimes.indiatimes.com/news/politics-and-nation/14-29-lakh-covid-19-cases-averted-due-to-lockdown-37000-78000-lives-saved-government/articleshow/75901257.cms>>.
- Trivedi V 2020. Lessons from COVID-19 on Reducing India's Environmental Pollution. Down to Earth, 4 May, 2020. From <<https://www.downtoearth.org.in/blog/pollution/lessons-from-covid-19-on-reducing-india-s-environmental-pollution-70891>>.
- True R 2020. Coronavirus: Information to Help You. TrueMDWellness, 22 March, 2020. From <<https://www.truemd.com/author/truemduser/>> (Retrieved on 8 June 2020).
- Tsai J, Wilson M 2020. COVID-19: A potential public health problem for homeless populations. *The Lancet*, 5(5). [https://doi.org/10.1016/S2468-2667\(20\)30053-0](https://doi.org/10.1016/S2468-2667(20)30053-0).
- UNDRR 2015. Sendai Framework for Disaster Risk Reduction 2015-2030. United Nations Office for Disaster Risk Reduction, Geneva, Switzerland. From <<https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030>>.
- UNDRR 2020. United Nations Office for Disaster Risk Reduction, Geneva, Switzerland. From <<https://www.undrr.org/drr-and-covid-19>>.
- Vij-Aurora B 2020. From Worst to a Role Model, How Bhilwara Turned the Corner in War Against Coronavirus. Outlook, April 20, 2020. From <<https://www.outlookindia.com/magazine/story/india-news-from-worst-to-a-role-model-how-bhilwara-turned-the-corner-in-war-against-coronavirus/303065>>.
- Wang CJ, Ng CY, Brook RH 2020. Response to COVID-19 in Taiwan: Big data analytics, new technology, and proactive testing. *JAMA*, 323(14): 1341-1342.
- Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, Wang B, Xiang H, Cheng Z, Xiong Y, Zhao Y, Li Y, Wang X,

- Peng Z 2020. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *JAMA*, 323(11): 1061-1069. doi:10.1001/jama.2020.1585.
- Weitz JS, Beckett SJ, Coenen AR, Demory D, Dominguez-Mirazo M, Dushoff J, Leung C, Li G, Magalie A, Park SW, Rodriguez-Gonzalez R, Shivam S, Zhao CY 2020. Modeling shield immunity to reduce COVID-19 epidemic spread. *Nature Medicine*. <https://doi.org/10.1038/s41591-020-0895-3>.
- WHO 2020a. Coronavirus Disease (COVID-2019) Situation Reports. From <<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>> (Retrieved on 1 May 2020).
- WHO 2020b. *Considerations for Quarantine of Individuals in the Context of Containment for Coronavirus Disease (COVID-19): Interim Guidance*, 19 March 2020 (No. WHO/2019-nCoV/IHR Quarantine/2020.2). Geneva: World Health Organization.
- Worldometer 2020. Countries in the World by Population in 2020. From <<https://www.worldometers.info/world-population/population-by-country/>> (Retrieved on 31 May 2020).
- Zaré M, Afrouz SG 2012. Crisis management of Tohoku: Japan earthquake and tsunami, 11 March 2011. *Iranian Journal of Public Health*, 41(6): 12-20.
- Zhang C, Yang L, Liu S, Ma S, Wang Y, Cai Z, Du H, Li R, Kang L, Su M, Zhang J, Liu Z, Zhang B 2020b. Survey of insomnia and related social psychological factors among medical staff involved in the 2019 novel coronavirus disease outbreak. *Frontiers in Psychiatry*, 11: 306. doi: 10.3389/fpsy.2020.00306.
- Zhang T, Wu Q, Zhang Z 2020a. Probable pangolin origin of SARS-CoV-2 associated with the COVID-19 outbreak. *Current Biology*, 30(7): 1346-1351.e2. <https://doi.org/10.1016/j.cub.2020.03.022>.

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