Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

CHAPTER

18

Redefining vulnerability and resilience from COVID-19 lens: a case study of COVID-19 management in Bihar, India

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1. Introduction

The COVID-19 infection first erupted in China in 2019 is caused by severe acute respiratory syndrome coronavirus 2 (Wang et al., 2020). China informed the World Health Organization (WHO) on December 31, 2019, about outbreak of the disease. On January 7, 2020, virus was identified as coronavirus similar to the SARS-CoV (Singhal, 2020). The first fatal case due to the virus was reported on January 11, 2020, in Wuhan, China. The migration of people during the Chinese New Year led to the spread of the virus to other provinces and various parts of the world (Singhal, 2020). The virus overshadowed the world in unprecedented ways, forcing change and adaptability that was never witnessed before in any emergency (Kumar et al., 2022). Government, and people were caught unaware, and kept scrambling for solutions to arrest its impact (Kumar et al., 2022). At the beginning of the spread of the virus, much of the information related to coronavirus was unknown. There was no approved treatment for the infection, the treatment was essentially symptomatic and supportive. The genetic sequence of virus, infectivity, case morbidity, medicines for treatment, and vaccines were not available. In subsequent months, with the rapid spread of the virus in almost every country, the focus shifted quickly to the management and control of coronavirus (Kumar et al., 2022). By the

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time this chapter will get published a lot of information about the coronavirus will be available for the scientific community to understand and respond more effectively.

For the comprehensive and effective management of disease, digital technologies played an important role. Digital technologies helped in facilitating the pandemic strategy and management in ways that are hard to achieve manually (Whitelaw et al., 2020). Countries integrated digital technologies in surveillance, testing of cases, contact tracing, quarantine, and relief management which helped in the early flattening of the curve (Halpern & Tan, 2020). Since the initial days of the pandemic, several Indian states and the central government adopted technology-driven solutions for pandemic management. The Indian state of Bihar also adopted several tools for contact tracing, surveillance, monitoring, and management. Some of these digital tools were acclaimed and awarded by the President of India (National Informatics Centre, 2020). Some of the digital initiatives for management of COVID-19 and situation arising from the pandemic in the early phase of 2020 are discussed in the chapter.

2. An overview of COVID-19 in India

India registered its first case of COVID-19 on January 30, 2020, in the southern state of Kerala. In India, cases started to rise from March, when 29 cases were reported on March 5, 2020, mostly in Jaipur, Agra, and Delhi (Singhal, 2020). On March 12, the first fatality of coronavirus was registered in India to a person with a travel history of Saudi Arabia. Fig. 18.1 shows number of confirmed, active, cured/discharged, and death cases from March 2020 to January 2021 for India.

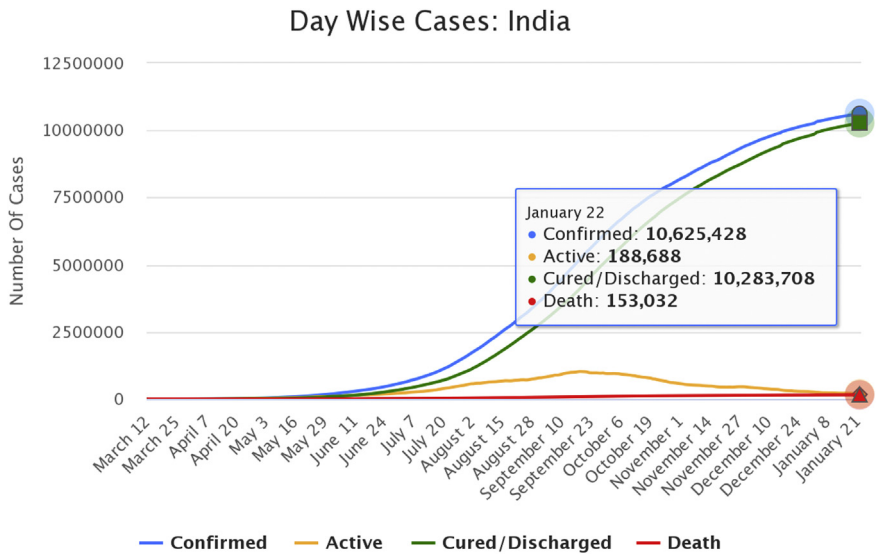

FIGURE 18.1 Details of COVID-19 cases in India. *Courtesy PRS Legislative Research.*

Table 18.1 shows COVID-19 situation from top 12 states of India. Maharashtra is on top of the list, whereas, Madhya Pradesh is a the bottom among these 12 states. India took swift actions in the initial phases of the pandemic to curtail viral spread. Surveillance at international entry points started on January 17, 2020, and travel restriction for foreign nationals was imposed on February 2020. As the cases continue to rise in the country, the Government of India announced suspension of all international flights on March 19, 2020 (Prabhu & Ghosh, 2020). The international flights remain suspended till August 31, 2021 (Upadhyay, 2021), except for the countries with whom India signed an air-bubble agreement. The Government of India also suspended all domestic flights on March 23, 2020; however, the domestic flights resumed service from May 25, 2020, onward (Dutta, 2020).

In the initial days of the pandemic, lockdown restriction was imposed to contain spread of virus in various parts of the world. India also witnessed its first lockdown (voluntary) on March 22, 2020, followed by a 21-day lockdown from 25 March to April 14, 2020. The Prime Minister of India announced a 14-hour of voluntary curfew followed by a 21-day nationwide lockdown announced by the Government of India on March 25, 2020 (Kanitkar, 2020). The first lockdown was subsequently extended till May 31, 2020, in four phases followed by gradual unlocking measures in phases. The details of lockdown and unlocking phases in 2020 and early 2021 are summarized in Table 18.2.

The lockdown was not only the beginning but the logical continuation of the strategic measures for management of the unprecedented situation in the country. Medical preparedness was enhanced to ramp-up the testing through production of testing kits, increasing testing facilities in the country. Hospital preparedness measures were taken to increase availability of isolation beds, critical care beds, and ventilators along with production of essential drugs. Series of guidelines are drawn by various departments of the government to overcome the challenges faced by societies in the country (Kumar et al., 2022).

TABLE 18.1 State-wise COVID-19 information (as of January 30, 2021).

State	Number of confirmed cases	Number of deceased cases	Number of tests conducted
Maharashtra	2,021,184	51,000	14,000,000
Karnataka	938,401	12,211	17,000,000
Kerala	923,913	3723	9,520,000
Andhra Pradesh	887,591	7152	13,000,000
Tamil Nadu	837,327	12,345	16,000,000
Delhi	634,773	10,841	11,000,000
Uttar Pradesh	599,837	8646	28,000,000
Odisha	334,850	1959	7,690,000
Rajasthan	317,292	2765	5,830,000
Gujarat	260,901	4385	11,000,000
Bihar	260,480	1495	21,000,000
Madhya Pradesh	254,667	3805	5,330,000

Based on data from Ministry of Health and Family Welfare, Government of India.

TABLE 18.2 Details of lockdown and unlocking in India.

	Lockdown		
	Date		
Phases	From	To	Number of days
Phase 1	March 25, 2020	April 14, 2020	21 days
Phase 2	April 15, 2020	May 3, 2020	19 days
Phase 3	May 4, 2020	May 17, 2020	14 days
Phase 4	May 18, 2020	May 31, 2020	14 days
Unlock			
Unlock 1.0	June 1, 2020	June 30, 2020	30 days
Unlock 2.0	July 1, 2020	July 31, 2020	31 days
Unlock 3.0	August 1, 2020	August 31, 2020	31 days
Unlock 4.0	September 1, 2020	September 30, 2020	30 days
Unlock 5.0	October 1, 2020	October 31, 2020	31 days
Unlock 6.0	November 1, 2020	November 30, 2020	30 days
Unlock 7.0	December 1, 2020	December 31, 2020	31 Days
Unlock 8.0	January 1, 2021	January 31, 2021	31 Days

Based on data from Ministry of Home Affairs, Government of India.

As the world was reeling under the pandemic, supply of essential medicines and personal protective equipment (PPE) was seen as a major challenge (Park, 2020). To secure domestic supply, and anticipated disruptions in the import of active pharmaceutical ingredients (APIs) required for manufacturing of major drugs, India placed restrictions on the export of certain medicines, PPEs, hand sanitizers, and ventilators in the early months of the pandemic (Ahmed et al., 2020). As the number of positive cases and the death toll started to increase, the demand for essential medicines and PPEs from North America and Western Europe started to grow. Based on the demand from western countries and requests on humanitarian grounds, India eased trade policies to allow export of hydroxychloroquine, paracetamol, and other medicines (Ahmed et al., 2020). India emerged as a major producer, supplier, and exporter of several key drugs, PPEs, and ventilators required for the treatment of COVID-19.

In subsequent months countries around the world started to grant permission for emergency use of COVID-19 vaccine. In early January 2021, India also approved emergency use of two local manufactured vaccines; Covaxin and Covishield (Kumar et al., 2021). Further, India started COVID-19 vaccination drive on January 16, 2021, to first vaccinate the high-risk group of people (Srivastava et al., 2021). In the first phase, four priority or high risk groups that included health-care workers, frontline workers, people over 50 years of age, and people with comorbidities, were vaccinated (Thiagarajan, 2021). At the same time, India

also dispatched millions of vaccine doses to South Asian neighbors, including Bhutan, Bangladesh, Maldives, Myanmar, Nepal, and Seychelles (Reuters, 2021). The government of India also cleared commercial export of the vaccines to Brazil, Morocco, South Africa, and Saudi Arabia (Mignali, 2021). India also provided training to the personnel involved in the vaccination rollout and setting the required infrastructure to administer the shots in several countries (Chaudhary, 2021). Consequently, India emerged as a valuable partner in supplying medicines and vaccines to the world.

3. Methodology

This chapter is divided mainly into two sections: the first section describes some of the key practices adopted through digital and e-governance means by the Indian state of Bihar in managing the COVID-19 situation, whereas the second section discusses the changing concepts of vulnerability and resilience in the context of COVID-19. This section put forth a comparison of key vulnerability indicators of two Indian states, namely Bihar and Maharashtra, and discusses the prevailing vulnerability discourse to the new vulnerability discourse discussed in this chapter. The first part of the chapter that provides information on the COVID-19 management in the state of Bihar was presented from the information available in the public domain. The information is gathered and compiled from secondary literature searches such as journal articles, reports, government orders, and newspaper articles. The second part of the chapter uses key vulnerability indicators from the demography, socioeconomic, and health domains. These indicators are selected from the existing scientific literature describing vulnerability parameters in the context of health emergency risk management. The analytical description is based on the secondary datasets obtained from government sources such as reports, journals, and websites.

4. Bihar and COVID-19 management

4.1 About Bihar

Bihar occupies a unique geographic position in the eastern part of India. As per the 2011 census, Bihar is the third most populous state in the country with a total population of 1,03,804,637 (Census of India, 2011a). Bihar is the 12th largest state in terms of geographical area and the third largest in the country by population. Like any other part of the world, Bihar was also impacted by the pandemic. The first case of COVID-19 was reported in Bihar when a 38-year-old Qatar returned person was found infected on March 22, 2020 (Srivastava, 2020). Since the beginning of the pandemic, Bihar took swift and stringent actions to prevent the state from entering into an acute stage for managing the pandemic. The state machinery responded to the outbreak by following the strategy of contact-tracing, testing, and home surveillance model. The Bihar government declared COVID-19 as an epidemic by invoking Sections 2, 3, and 4 of the Epidemic Diseases Act, 1897 (Kumar et al., 2022). Further, to aid the existing policies and framework in pandemic management, Bihar Government issued the Bihar Epidemic Diseases COVID-19 Regulation 2020 (Government of Bihar, 2020). A

statewide lockdown was announced from March 22−31, 2020, by the state government. The state lockdown also coincided with the nationwide lockdown timing. The nationwide lockdown was imposed under the Disaster Management (DM) Act, 2005, for containing the spread of the disease (Kumar et al., 2022). Bihar took several initiatives for effective management of the COVID-19 situation. It is difficult to highlight all the initiatives of the state in this chapter. Some of the digital initiatives adopted by the state government during the pandemic are described in the next section.

4.2 Pre-lockdown travelers tracking

As the coronavirus infections started to spread in the world, non-resident Indians returning home were found to be infected. In the initial days, as per the testing guideline of the Indian Council of Medical Research (ICMR)[1], COVID-19 testing was recommended mainly to international travelers, close contact with symptomatic patients, and health-care workers. A large number of Bihari diaspora living abroad returned to their native place for the famous festival of Holi scheduled on March 9, 2020. The chance of bringing infection with the returning Bihari was high. As per the guidelines issued by the Government of India, the Government of Bihar decided to track incoming foreign travelers in the state. A list of foreign returnees was provided to each state for contact tracing by the Government of India. Bihar also received the list of returnees and swung into action for their contact tracing. A detailed mechanism was set in place for tracking inbound travelers in the state. The State Emergency Operation Centre (SEOC) at Patna and District Emergency Operation Centres (DEOCs) in districts were activated and repurposed for effective coordination and management of COVID-19 in the state. A mobile application 'Garuda' was developed for traveler tracking. District administration mobilized field functionaries for the identification of travelers. The field functionaries were trained and directed to visit traveler's houses to collect their information in the 'Garuda' mobile application. The required vital information of each traveler was recorded and their health parameters were also observed twice a day to feed in the Garuda application. The data populated in the mobile application was further analyzed at the DEOC and SEOC regularly. Each traveler was monitored for 14 days by the field functionaries.

4.3 Mukhyamantri vishesh sahayata mobile app (chief Minister's special assistance mobile app)

To curb the spread of the virus, lockdown measures were enforced in the country. The lockdown led to the closure of factories, workplaces, and large workforce especially migrants who were left with no work. Bihar is the second-largest state in the country with the highest number of migrations. As per the last census held in 2011, 1.7 million population migrated out of the state for work or employment (Census of India, 2011a). Laborers were left stranded for several weeks in absence of a job and started moving to their native places. To support the workers left jobless due to lockdown, the Government of Bihar provided instant monetary support to the laborers with a digital solution (Bhaskar, 2020). Bihar became the first state

[1] ICMR is the apex body for formulation, coordination, and promotion of biomedical research in India.

to launch Direct Benefit Transfer (DBT) support to people of Bihar stranded outside the state. The "Aapda Sampoorti Portal"[2] of the state government facilitated beneficiary identification and registration, providing financial aid during the pandemic. The mobile application developed for the DBT purpose helped stranded migrant laborers to register themselves using Aadhaar (Unique Identification Number), bank account details, mobile number, and geotagged selfies. The financial aid was provided upon bank account verification and validation through Public Financial Management System (PFMS). Migrants stranded outside the state were only provided with financial aid using location-based service (LBS) and geofencing techniques. Each laborer was provided with a one-time amount of INR 1000 for their daily sustenance. The amount proved essential in providing necessary support at a time of grave impact on their livelihood sustenance. This digital innovation to support migrant laborers was presented with the President of India Award (National Informatics Centre, 2020).

4.4 Aapda sahyog (disaster assistance)

The Targeted Public Distribution System (TPDS) run by the Government of India is the largest food security scheme in the world for poor households. The system delivered 51.3 million tonnes of food grain (rice and wheat) at a subsidized to 0.53 billion people in 2011–12 (Kishore & Chakrabarti, 2015). The scheme proved helpful for the poor and destitute during the pandemic, as people left without any job or livelihood options were provided with food grains. Bihar not only provided food grain to the needy families but also provided financial aid through Direct Benefit Transfer (DBT) in the initial months to the PDS beneficiaries. 18 million people were provided assistance of INR 1000 using Aadhar Payment Bridge (APB) and PFMS. People without the PDS card were also surveyed by Jeevika[3] workers in the state and provided with one-time financial aid. A sum of INR 1000 per family was transferred to around 16.5 million ration card holding families plus specially surveyed families.

4.5 Role of emergency operation centre in COVID-19 management

An Emergency Operation Centre (EOC) provides a crucial support function during disaster situations. An effective response will rely on the EOC providing the key services of support, coordination, information management, and operational planning. Any shortfall in the provision of these services is likely to aggravate the disaster situation and adversely affect the effectiveness of critical response actions such as rescue and relief. In Bihar, EOC played a critical role in the management of COVID-19. The additional human resource was deployed in the EOC for better coordination purposes. Additional telephone lines (parallel hunting lines) were also added to handle the call load in the EOC. The capacity of the Health Department call center (104 Toll-free number) was also increased to manage the incoming calls coming from various parts of the state and beyond. Apart from the state and district EOCs, and Health Department call centre, helplines were also established at the Resident Commissioner's Office, New Delhi, and the Chief Minister Secretariat, Patna, to help migrant

[2] https://aapda.bih.nic.in/.

[3] Jeevika is a World Bank aided program of Government of Bihar, meant for socioeconomic empowerment of rural poor. The program undertakes livelihood creation activities through women self-help groups.

workers. The State EOC was coordinating with District EOCs and other departments of the state to manage the COVID-19 situation. The EOC played a crucial role in COVID-19 management in coordinating with districts, departments of the government, and national authorities.

5. The vulnerability and resilience discourse from COVID-19 lens

5.1 The vulnerability discourse

The use of vulnerability in the disaster context started in the 1970s (Emrich & Cutter, 2011). The importance of fundamental characteristics of the environment, economics, social, and political causes of vulnerability was recognized during the 1980s (Fatemi et al., 2017). Some of the most common indicators identified in vulnerability context include population, density, socioeconomic status, and public health conditions (Kasperson et al., 1988; Kelly, 1987; Pelling et al., 2004). Vulnerability from a social perspective is assessed based on the degree of exposure, preparedness, and resilience of individuals and social groups (Fatemi et al., 2017; Wisner & Luce, 1993). Economically poor people in comparison to rich people are more vulnerable to disasters. Poverty is considered an important aspect of increased vulnerability due to its linkage with direct access to resources affecting coping and response mechanisms (Neil Adger, 1999). However, in the context of COVID-19, vulnerability is more than the risk of contracting the infection (Acharya & Porwal, 2020).

5.2 The resilience discourse

Term 'resilience' has been in the use for decades, primarily in the field of engineering, scientific ecology, and development psychology (Bonnano, 2004; Hess et al., 2012). However, resilience has been used in health, public health, and health emergencies in recent times (Turenne et al., 2019). The term was mostly used after the Ebola crisis of 2014 erupted in West Africa (Kieny et al., 2014), and thereafter, WHO emphasized to "develop and implement strategies to make health systems stronger and more resilient" (Thomas et al., 2013). Resilience is the ability to understand risks, anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruption (Knut et al., 2012). Resilience is most often referred to in three types: individual, community, and national resilience (Kimhi et al., 2020). Individual resilience is defined by Cacioppo et al. (2011) as "the capacity to foster, engage in, and sustain positive relationships and to endure and recover from life stressors and social isolation." As per Bonanno et al. (2015) community resilience is the "interaction between individuals and their community and depends on the extent to which members are helped by their community." Patel et al. (2017) have suggested that community resilience is associated with increased local capacity, social support, and resources, and with decreased risks, miscommunication, and traumas. Resilience is measured by several internal and external factors that include government, civil society, and other stakeholders responsible for achieving community resilience (Lwin et al., 2020). Social or community resilience has nine elements: local knowledge, community networks and relationships, community communication, health, governance and leadership, resources, economic investment, preparedness, and mental outlook (Patel et al., 2017). In subsequent sections, these dimensions of vulnerability and resilience are discussed in the context of COVID-19.

5.3 Comparison of COVID-19 in the Indian states of Bihar and Maharashtra

This section deliberates on key COVID-19 parameters of two Indian states, namely, Bihar and Maharashtra. Maharashtra is the third-largest state in terms of area and the second-largest by population. Maharashtra is one of the most progressive states of India and contributes significantly to the economy of the country. On the other hand, Bihar is one of the poorest states of the country in terms of per capita GDP. Maharashtra confirmed its first case on March 9, 2020 (Kumar, 2020). Bihar also received its first case almost after 2 weeks when Maharashtra received its first case. The cases started to emerge in both states from March 2020. From June 2020 onward, Maharashtra registered a sharp rise in caseload as compared to Bihar. Maharashtra has always remained in the first place with the maximum number of cases and casualties till January 31, 2021.

Fig. 18.2 shows the monthwise confirmed COVID-19 cases and Fig. 18.3 shows the monthwise death numbers due to COVID-19 of Bihar and Maharashtra. As total number of positive cases started to increase in both the states, the death numbers also started increasing. While the total number of cases and death numbers increased significantly in Maharashtra from June 2020, these numbers remain almost flattened for Bihar.

Table 18.3 provides some of the key COVID-19 information for both the states as on December 26, 2020. As of December 26, 2020, Maharashtra's cases are almost four times the total number of cases in Bihar. At the same time, Maharashtra reported 49,189 deaths while Bihar reported 1379 deaths. The total mortality rate is much higher in Maharashtra than Bihar. The positivity rate[4] of Maharashtra also remained higher as compared to

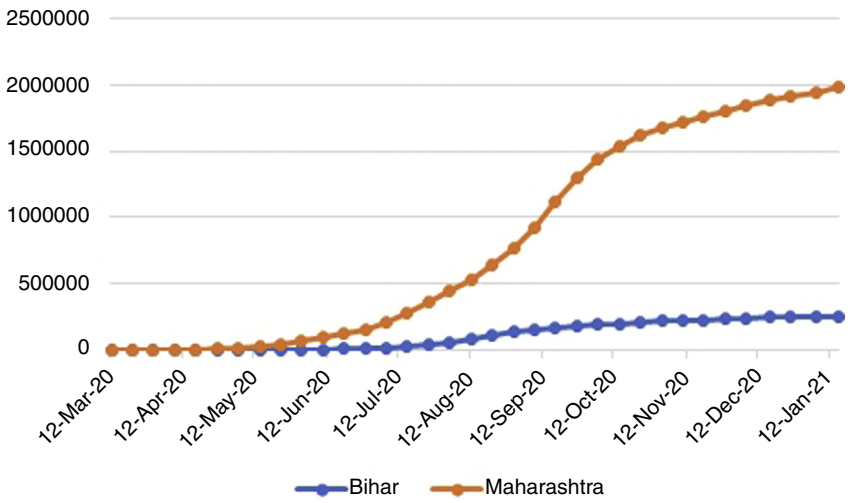

FIGURE 18.2 Daywise confirmed cases of COVID-19 in Bihar and Maharashtra. *Based on data from Ministry of Health and Family Welfare, Government of India.*

[4] Positivity rate refers to the percentage of people who test positive out of total tests performed.

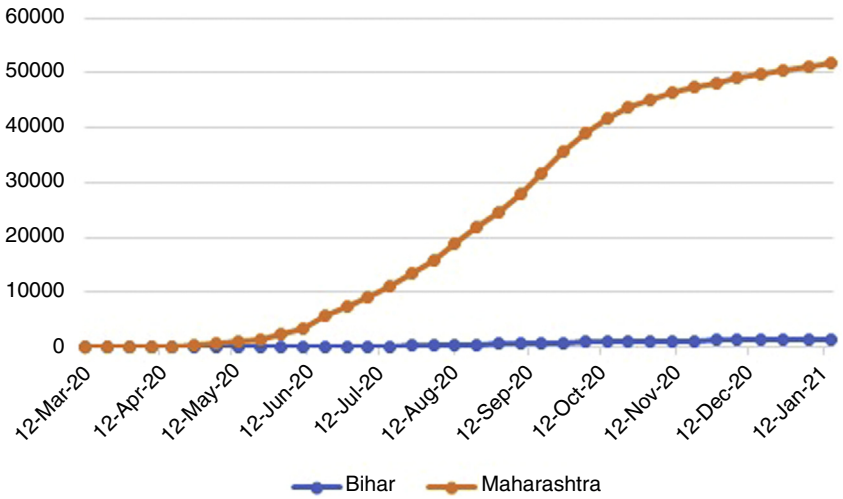

FIGURE 18.3 Daywise death numbers of COVID-19 in Bihar and Maharashtra. *Based on data from Ministry of Health and Family Welfare, Government of India.*

TABLE 18.3 Comparison of few COVID-19 situation of Bihar and Maharashtra (as on December 26, 2020).

Sr. No.	Particulars	Bihar	Maharashtra
1	Number of confirmed cases	250,450	1,916,236
2	Number of deceased	1379	49,189
3	Confirmed per million	2095.5	15,687.2
4	Active ratio	2%	3%
5	Recovery ratio	97.4%	94.3%
6	Case fatality ratio	0.6%	2.6%
7	Tests per million (for every 1 million people in Maharashtra, ~101,937 samples were tested) as of December 25, 2020	148,827.1	101,937.1

Based on data from Ministry of Health and Family Welfare, Government of India.

Bihar. The active ratios[5] remained at 3 and 2, respectively, for Maharashtra and Bihar. In total, Maharashtra remained high in all the parameters except for total tests carried out per million. This implies the situation in Maharashtra was worrying as compared to Bihar.

[5] How many people are infected currently out of every 100 confirmed cases.

6. Discussion

This section debates some of the key vulnerability indicators of demography, socioeconomic, health status, and Health Finance of Bihar and Maharashtra. It is well recognized that vulnerability is a dynamic concept. A person might not be vulnerable in the beginning of the outbreak of the disease but factors such as economic, social, political, public health conditions, and government response may increase the vulnerability to the disease.

The health-related factors and the health institutional system play a crucial role in the pandemic response. Geographies with fewer comorbidity indicators such as diabetes and hypertension have reported less mortality and morbidity. Table 18.4 provides information on the set of vulnerability indicators, their description, and source of data. These indicators have been categorized into four types: demographic, socioeconomic, health, and health finance. Under the demographic category, population, projected population for 2020, and percentage of the population in the age of 60 and above have been selected. In the socioeconomic category, literacy rate, percentage of population below the poverty line, per capita net state domestic product, employment in the organized sector, housing construction material, drinking water supply, and houses with toilets have been considered. In the health indicators, total cases of acute respiratory infection and number of persons diagnosed with diabetes and hypertension are taken, whereas in the health finance indicators, total health expenditure, total per capita health expenditure, and health expenditure as a percentage of state GDP have been considered.

6.1 Demographic indicators

The very prominent nature of COVID-19 that involves the speed of transmission and mortality from infection is dependent on the demographic parameters. Therefore, demographic factors have been considered for the vulnerability index (Acharya & Porwal, 2020). Four indicators representing the demographic composition of a population have been considered in the context of COVID-19: population, projected population by 2020, population density, and percentage of the population in the age of 60 and above.

As per the 2011 census, the population of Maharashtra is higher than Bihar at the same time Maharashtra is bigger than Bihar in the geographic area; however, population density in Bihar is almost three times that of Maharashtra. As per the Census 2011, the population density of Bihar is 1102 people/km^2 as compared to Maharashtra population density of 365 people/km^2 (Census of India, 2011b). The projected population of Maharashtra is also higher than Bihar for the year 2020 (National Commission on Population, 2019). With the higher population density and high infectious nature of coronavirus (Tsou et al., 2020), the spread of disease was less in Bihar than in Maharashtra. The percentage of population in the age of 60 years and above is 6.3% and 9.0% in Bihar and Maharashtra, respectively (Office of the Registrar General & Census Commissioner, 2018). Higher population in the age of 60 and above in Maharashtra might be a contributing factor for higher mortality in the state. Bihar worked on an immediate emergency response to the outbreak drawing from global experiences, with a focus on slowing down and limiting the spread of COVID-19 and preventing the loss of human lives to the greatest extent possible through improved disease surveillance, laboratory capacities, and hospital readiness. Comparison of selected indicators and their respective values are presented in the Table 18.5.

TABLE 18.4 Category of indicators, description, and data source.

Indicators	Indicator description	Source of data
Demographic indicator	Denotes population size, decadal growth rate of population, territorial distribution, gender composition, changes, and component of changes	
Population	Total inhabitants of the state	Census of India (2011a)
Projected population	Estimated population of states by the year 2020	Population projections for India and states 2011–2036. Report of the technical group on population projections
Population density	Population per unit square kilometer	Census of India (2011b)
Percentage of population in the age of 60 and above	Population in the age of 60 and above out of total population in the year 2018	SRS statistical report, office of the registrar general and census commissioner
Socioeconomic indicator	Denotes literacy-, poverty-, income-, employment-, housing-, water-, and sanitation-related indicators	
Literacy rate	Percentage of a population aged 7 and above who can both read and write with understanding in any language	Census of India (2011a)
Percentage of population below poverty line (2011–12)	Percentage of population unable to satisfy basic needs at the minimal socially acceptable level	National institution for transforming India aayog, GOI
*Per capita net state domestic product at current prices base year 2011–12	Sum total of value added by different economic sectors produced within the boundaries of the state calculated without duplication during a year divided by the total population of the state	Ministry of Statistics and Programme Implementation (2011)
Employment in the organized sector in lakhs (2011–12)	Employment in a sector where terms of service and employment governed by the government	Annual employment review (2012), DGE&T, ministry of labour and employment, GOI
Percentage of houses made of grass, thatch, bamboo, wood, mud, etc.	Percentage of houses made of grass, thatch, bamboo, wood, mud, etc.	Census of India (2011a)
Percentage of houses with safe drinking water supply through tap water	Percentage of houses with safe drinking water supply through tap water	Census of India (2011a)
Percentage of households with toilets	Percentage of households with toilets	National sample survey (NSS) 75th round, NSSO, 2018, GOI
Health indicators	Health indicators measure different aspects of health. This provides information on the prevalence of common communicable and noncommunicable diseases	

TABLE 18.4 Category of indicators, description, and data source.—cont'd

Indicators	Indicator description	Source of data
Total cases of acute respiratory infection	Acute respiratory upper and lower tract infection in 2018	National health profile report, 2019, GOI
Number of persons diagnosed with diabetes	Out of the total number of persons diagnosed with diabetes at NCD clinics from January 01, 2018, to December 31, 2018	Ministry of health and family welfare, GOI
Number of persons diagnosed with hypertension	Out of the total number of persons diagnosed with hypertension at NCD clinics from January 01, 2018, to December 31, 2018	Ministry of health and family welfare, GOI
Health finance indicators	Health finance indicators provide information on the financial allocation, investments, expenditure, funding source, and proportion of allocation by the state governments in the health sector	
Total health expenditure in 2015–16 (in million INR)	The amount includes expenditure on medical and family health, family welfare, and other miscellaneous expenditure incurred by the state during financial year 2015–16	Ministry of health and family welfare, GOI
Per capita health expenditure in 2015–16 (in INR)		Ministry of health and family welfare, GOI
Health expenditure as percentage of the state GDP	This is calculated based on the ration of revised estimates of public expenditure on health and actual GSDP for the year 2015–16	Ministry of health and family welfare, GOI

6.2 Socioeconomic indicators

The short-term socioeconomic impact of COVID-19 has been felt across various sectors; however, the long-term impact of the pandemic would be felt in the coming years when it is over (Acharya & Porwal, 2020). The poorest section of the society has felt the maximum brunt of the pandemic (UNDP, 2020); therefore, it becomes imperative to consider the socioeconomic characteristics of a population for COVID-19 vulnerability. Nine socioeconomic indicators have been considered for discussion in this section.

Maharashtra is better placed than Bihar in several of the socioeconomic parameters. The literacy rate is 82.3% and 61.8%; the percentage of the population below the poverty line is 31.6% and 33.7% (Niti Aayog, 2011); per capita State Gross Domestic Product is INR 147,399 and INR 31,454; employment in organized sector is 49.52% and 4.26%, respectively, for Maharashtra and Bihar. On the parameters of housing (made of grass, thatch, bamboo, wood, mud etc.), Maharashtra has just 6.1% whereas Bihar has 31.1% of population living in these types Kaccha houses. 67.9 % of Maharashtra population has safe drinking water

TABLE 18.5 Indicators comparison of Bihar and Maharashtra.

No.	Indicators	Bihar	Maharashtra
A	**Demographic indicator**		
A.1	Population	104,099,452	112,374,333
A.2	Projected population by 2020	1,21,302,000	1,23,295,000
A.3	Population density	1102	365
A.4	Percentage of population in the age of 60 and above (2018)	6.3	9.0
B	**Socioeconomic indicator**		
B.1	Literacy rate (Census 2011)	61.8	82.3
B.2	Percentage of population below poverty line	33.7	31.6
B.3	Per capita net SDP* (2015–16) (in rupees)	31,454	147,399
B.4	Employment in the organized sector (in lakhs)	4.26	49.52
B.5	Percentage of houses made of grass, thatch, bamboo, wood, mud, etc.	31.1%	6.1%
B.6	Percentage of houses with safe drinking water supply through tap water	4.4%	67.9%
B.7	Percentage of households with toilets (rural)	48	77
B.8	Percentage of households with toilets (urban)	92	86
C	**Health status indicators**		
C.1	Total cases of acute respiratory infection (2018)	976,181	1,736,580
C.2	Number of persons diagnosed with diabetes	47,337	155,628
C.3	Number of persons diagnosed with hypertension	24,774	250,875
D	**Health finance indicators**		
D.1	Total health expenditure in 2015–16 (in million INR)	46,530	100,520
D.2	Per capita health expenditure in 2015–16 (in INR)	491	1011
D.3	Health expenditure as a percentage of the state GDP	1.33%	0.60%

Data sources for different indicators are mentioned in Table 18.4

supply through piped water as compared to 4.4% population of Bihar. On similar lines, more number of toilets are avaviable in rural Maharashtra than Bihar. On these socio-economic parameters of vulenrability, Maharashtra stands higher than Bihar. Even the COVID-19 risk is more predominant in Mahrashtra than Bihar.

6.3 Health status indicators

There are health factors better known as comorbidity factors affecting transmissions, morbidity, and mortality due to COVID-19. Three health indicators have been considered

for discussion in this section: total cases of acute respiratory infections, number of persons diagnosed with diabetes, and number of persons diagnosed with hypertension. The available data from National Communicable Disease clinics for 2018, the number of cases for acute respiratory infections (CBHI, 2019), the number of people diagnosed with diabetes, and the number of persons diagnosed with hypertension remain substantially high for Maharashtra than Bihar. This indicates one of the likely reasons for more infection and mortality in Maharashtra.

6.4 Health finance indicators

Health finance indicators show the level of investment by states in the health sector. Total health expenditure in absolute terms and per capita by Maharashtra is almost double that of Bihar. Maharashtra spent INR 100,520 million as compared to INR 46,530 million spent by Bihar that accounts for INR 1011 and INR 491 per person for Maharashtra and Bihar, respectively. However, in terms of percentage of the state GDP, Maharashtra spent less (0.60%) than Bihar (1.33%) on health (National Health Accounts Cell, 2013, pp. 1–53). On several of the above mentioned indicators of vulenrability, Maharashtra is placed better than Bihar. Health status indicators, and health finance indicators could have added positive impact in building capacities to fight the disease.

7. Conclusion

The World Economic Forum (WEF) *Global Risks Report* of 2006 categorically mentioned the impending risk of a global pandemic in near future. The forecast from WEF stated that if the person-to-person infection becomes prevalent and the virus cannot be contained then the vulnerability of interconnected global systems would intensify the human and economic impact. Despite these warnings, the preparedness level of health systems around the world remains insufficient to fight the pandemic (Jovanović et al., 2020). COVID-19 has added a new dimension to the vulnerability of people from biological hazards. Some of the existing vulnerability indicators do not seem to hold value for the comprehensive health emergency risk, especially COVID-19. While Maharashtra has stayed ahead in several of the indicators like demography, socioeconomic, health, and health finance indicators except a few, the COVID-19 situation in Maharashtra remained worrying as compared to Bihar. Bihar featuring lower on several of the vulnerability indicators showed more resilience to the pandemic. Bihar has one the highest population density among the Indian states coupled with the inconveniency of social distancing due to small housing units, lack of access to water, sanitation, and hygiene facilities that can potentially exacerbate infection rates in several clusters. Also, there are many limitations in the state's health-care system, which pose a challenge for the state. Despite standing low on several of the abovementioned vulnerability indicators, the COVID-19 risk management stands better in Bihar. Maharashtra, on the one hand, stands ahead of Bihar in several of the socioeconomic and health indicators, but in COVID-19 impact, Maharashtra suffered more than Bihar. This is a very common trend not only in rich and poor states within India but also evident around the world. As per the World Bank Report (2020), the majority of fatalities reported from the high-income

countries contributing around 79% of total deaths. Upper-middle-income countries reported 18% of total death tolls, but their population is just over one-third of the global population. On the other hand, lower-middle-income countries and low-income countries reported just 3% of global fatalities, despite the fact they contribute almost half of the global population (Schellekens & Sourrouille, 2020). Despite various measures taken by the response agencies and government, the death toll remains concentrated in rich countries. Developing countries represent almost 85% of the global population, only with 21% of the COVID-19 deaths. The death toll reported remained concentrated in few geographies only and the unequal distribution of the cases and fatalities in the favor of developing nations is unusual. This paper provides an initial discussion in the direction of vulnerability and resilience assessment from health emergency management point of view. There shall be an approach to relook, to determine the vulnerability, and resilience indicators for the pandemic especially in the context of COVID-19.

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