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Vulnerability of Major Indian States Due to COVID 19-Spread and Lockdown

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Abstract

Both the spread of COVID-19 and lockdown announced by the governments to contain the spread have put an immense challenge to India's economy, society and health care system. However, the situation is not uniform across the states of India as they vary enormously from one another in terms of risk of the disease spread, size of the population vulnerable to COVID-19, capacity to deal with medical emergency, size of the population economically vulnerable to lockdown and financial capacity of the state governments to take care of the vulnerable population in the absence of adequate assistance from the central government. This study, first attempts to assess the vulnerability of the population due to the possible disease spread; and then tries to assess four different dimensions of vulnerability caused by nation-wide lockdown. The four dimensions that have been considered are (i) poverty, (ii) possible disruption of access to health care for chronic ailments (iii) possible disruption in students' access to school education and mid-day meals; and (iv) ills caused by alcoholism and domestic violence. The major Indian states found to be with higher volume of risky population are Kerala, Andhra Pradesh, Tamil Nadu, West Bengal, Telangana, Odisha and Punjab. The states which would probably face relatively greater challenges in dealing with large hospitalisation cases if the disease is spread to its risky population are Odisha and Madhya Pradesh if their current institutional medical capacity is not improved significantly. When we consider all four dimensions of vulnerability, the major states which seem to be more vulnerable due to lockdown are Bihar, Jharkhand, Odisha, West Bengal and Chhattisgarh as they show higher index values of three or more dimensions of vulnerability out of the total four dimensions. These five major states may require concerted efforts by central as well as state governments to address their problems. The study makes a number of suggestions to deal with the current crisis and similar crisis in future.

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Introduction

The emergence of COVID-19 caused due to novel corona virus, known as Severe Acute Respiratory Syndrome-Coronavirus-2 (SARS-CoV-2), has created an unprecedented challenge for all countries across the world. The first case of COVID-19 was reported in November last year in Wuhan city of Hubei province in China (Wang et al, 2020; Wu and McGoogan, 2020). Since then, within a short span of just over 6-7 months, the infection has spread to over 213 countries across the world, with 4,837,361 confirmed cases and 317304 deaths (as on May 18, 2020).¹ In India the first case was reported on January 30, 2020 in the south Indian state of Kerala and first confirmed death due to COVID-19 was reported around second week of March in another south Indian state, Karnataka.² Since then infections started growing in India at an exponential rate like in any other affected countries. The fatality due to COVID-19 also multiplied but at a much slower speed than many other countries which reported higher disease spread earlier than India did.

Individual state governments started responding to the situation of disease spread in their respective states and initiated measures like closing down of educational institutions, advising citizens to practice measures like washing hands frequently with soaps and wearing masks in case of sickness. After calling for a nationwide voluntary *stay at home* advice on March 22, the prime minister of India announced a total lockdown of the country for three weeks starting from March 25, 2020. By the time of announcing total lockdown, the number of known COVID-19 cases increased to 564 with 10 reported deaths. At the end of initially announced three-week period, lockdown was further extended first till May 3, then till May 17 and May 31 on suggestions from different state governments which were struggling to contain the cases of new infections from COVID-19.

The nation-wide lockdown, though inevitable from a public health point of view and supported by experts across disciplines, was a sudden shock to a large section of vulnerable population which was not much affected by the disease spread and its fatality at the time of lockdown. On the one hand, the lockdown has imposed multiple challenges on India's poor, migrants and socially marginalized groups, chronically ill population, poor students depending only on school for their education and mid-day meal for their regular nutrition. It has also worsened the

¹ <https://www.worldometers.info/coronavirus/countries-where-coronavirus-has-spread/>

² There is still controversy over the first death due to COVID-19 in India. See <https://www.bbc.com/news/world-asia-india-52343241>

lives of those who regularly face violence at home by their family members. On the other hand, the actual spread as well as the fear of spread of the disease has brought an immense pressure on country's health care system which is grossly inadequate due to poor infrastructure, inadequate human resources and low overall funding. However, the situation is not uniform across the states of India. Whereas some of the states are better positioned in terms of lower burden of affected population and better health infrastructure, conditions of some states, especially the most populous states are very challenging. The inequality in the burden and coping up capacities of the states are compounded by varying risks of disease spread.

At this juncture, it may be a useful exercise to assess the vulnerability of major Indian states arising from the spread of COVID-19 and lockdown to contain the possible spread by using available information on various aspects of the economy, society and health sector. The objective of the study, therefore, is twofold. In the first stage, it attempts to assess the vulnerability of the population because of the possible disease spread by considering information on current known level of spread, population density and population-subgroups which might be more vulnerable to the disease. In the second stage, the study tries to assess the vulnerability of the population with regard to livelihood and income, access to essential health care services, access to education and school/ICDS- based nutritional programme and social bad due to alcoholism and domestic violence which are all compounded by lockdown. Both types of vulnerability can then be compared and contrasted with medical as well as financial capacities of the states to understand their possible resilience power to face the vulnerability. The report is organised into the following sections: A section on data and methods briefly describes the data sources used for the study as well as methods applied. The first empirical section presents and analyse the risk prospects due to the spread of COVID-19, risky population, and coping capacity of the states. The next four sections deal with possible effects of lockdown on the population in terms of (i) livelihood and income; (ii) possible disruption of chronic health care need; (iii) possible disruption in school education and nutritional programme; and (iv) social bad due to alcoholism and domestic violence. The last section summarises the discussion and highlights a few policy lessons.

Data Sources and Methods

This study uses multiple data sources for assessing different dimensions of vulnerability caused both by the spread of COVID-19 and lockdown imposed by various state governments as well

as the central government in India to contain the disease spread. The data sources used for the analysis are the following: Ministry of Health and Family Welfare, a non-government COVID-19 tracking site, Census 2011, National Family Health Survey (NFHS) 4 (2015-16) unit record data, National Sample Survey (NSS) 75th round unit record data (2017-18) for Education and Health, NSSO's Periodic Labour Force Survey (2017-18) unit-record data, Reserve Bank of India, Central Bureau of Health Intelligence, CSO database and IndiaStat.com. In addition, we have used information from numerous articles appeared in online news portals and newspapers.

Data on COVID 19

There are two main sources of information on state and national level COVID-19 cases. They are Ministry of Health and Family Welfare (<https://mohfw.gov.in/>) and COVID19INDIA (<https://covid19india.org>).³ We have used data on total confirmed cases from the government sources. Though the Ministry of Health and Family Welfare (MoHFW) website updates the data on covid-19 cases at scheduled times (mostly twice a day), <https://covid19india.org> updates its database of covid-19 cases throughout the day by drawing information from state press bulletins, official (Chief Minister, Health Minister) handles, Press Trust of India, ANI news reports.

Census and Projected Population Data

The Census of India which comes under Office of the Registrar General and Census Commissioner (Ministry of Home Affairs, Government of India), collects and provides information on demographic and socio-economic characteristics of population at the lowest administrative unit (i.e. each revenue village and town and ward of a district). The population census takes place every 10 years. From Census 2011, we have used data on marginal workers and agricultural labourers for each major state. We have used the projected population data for 2020 to normalise some indicators to make them comparable across the states. The projected population has been taken from *Population Projections for India and States 2011 – 2036: Report of the Technical Group on Population Projections*, published by the National Commission on Population, Ministry of Health and Family Welfare, Government of India (National Commission on Population, 2019).⁴

³ The numbers of known cases from both the data sources show very strong correlation.

⁴ The projected population figures for 2020 have been estimated by applying the Component Method, which is a universally accepted method. In population projections, the growth of population is determined by fertility, mortality and migration rates.

NSS Health Data

The NSS 75th round on Health was conducted during July 2017 to June 2018. The survey collected data from 5,55,114 individuals residing in 1,13,823 households (rural and urban combined). The survey covered entire India except for those villages of Andaman and Nicobar Islands which were difficult to access. A stratified multi-stage sampling was used. In the rural sector, the first stage units were the census villages (panchayat wards in Kerala) while in the urban sector, they were the urban frame survey blocks. The final stage sampling units were the households. The survey collected information on basic household characteristics, demographic characteristics of the household members and particulars of ailments and healthcare utilization with appropriate recall periods.

NFHS Data

NFHS 4 was conducted during 2015-16 and covered 29 states and 6 union territories. NFHS 4 collected data for men belonging to 15 to 54 years of age, ever married women of 15 to 49 years of age, and children of below 5 years of age. It provides information on basic household characteristics, demographic characteristics of the household members, morbidity, women and men's background characteristics and domestic violence. The survey collected data from 699,686 eligible women (15-49 years age) and 112,122 men (15-54 years age) belonging to 601,509 households. In order to analyse the population at risk due to coronavirus (COVID-19) outbreak, we have considered the percentage of men (15-54 years age) and ever married women (15-49 years age) currently reporting cancer, diabetes, asthma and heart disease. In order to analyse the social effects of lockdown, we have considered information on men reporting regular drinking of alcohol and women reporting domestic violence by their husband or partner.

NSS Education Data

The NSS 75th round on Education was conducted during 1st July 2017 to 30th June 2018. The main objective of the survey was to build indicators on participation of the persons of age 3 to 35 years in the education system, expenditure incurred on education of the household members and various indicators of those currently not attending any educational institution (i.e., for the persons who never enrolled or ever enrolled but currently not attending). Besides, for persons of age 5 years and above, information was collected on ability to operate computer, ability to use internet and use of internet during the last 30 days. In addition, particulars of current attendance and related expenditure of the households in respect of the erstwhile members of

age 3 to 35 years were also collected. The survey covered both qualitative and quantitative aspects related to educational attainment of the household members and educational services used by them covering whole of the country except the villages in Andaman and Nicobar Islands which are difficult to access. Like the health survey, a stratified multi-stage design was adopted. The survey was spread over 14,285 FSUs (8,097 villages in rural areas and 6,188 Urban Frame Survey Blocks in urban areas) covering 1,13,757 households (64,519 in rural areas and 49,238 in urban areas) and enumerating 5,13,366 persons (3,05,904 in rural areas and 2,07,462 in urban areas). In this survey, the total number of persons of age 3 to 35 years surveyed was 2,86,456 (1,73,397 in rural areas and 1,13,059 in urban areas).

Other Data

The GSDP values for 2018-19 at current prices have been taken from the Central Statistical Office (CSO) database. The value of GDP for India has been taken from Economic Survey 2019-2020. The GSDP value for Maharashtra has been taken from the Economic Survey of Maharashtra 2019-20. The NSDP per capita for 2017-18 at current prices have been compiled from the Handbook of Statistics on Indian States 2019, which is published by the Reserve Bank of India annually. The Projected Tax-GSDP ratios have been taken from www.indiastat.com which is owned by Datanet India and provides ready to use compiled data of secondary level socio-economic variables and other statistical information about India and its states and districts. The corresponding tax revenues for the states have been estimated from GSDP and Projected Tax-GSDP ratio. The data on government hospital beds have been taken from the Central Bureau of Health Intelligence (CBHI) which collects primary as well as secondary data on various communicable and non-communicable diseases, human resources in health sector and health infrastructure from various Government organizations and departments to provide Health Statistics through its annual publication 'National Health Profile (NHP)'. The data for the study has been taken from National Health Profile 2019. The total number of hospital beds has been achieved by adding the total number of government hospital beds with the ESI hospital beds across states.

Methods

Our empirical analysis and descriptions are divided into two parts. The first part tries to assess the possible risk of disease spread across major Indian states by combining known cases of COVID-19 (till the date of analysis) and population density; it then assesses the volume of

risky population by considering age composition and prevalence of chronic conditions which are known to increase the risk of COVID-19. The second part of the analysis assesses the possible impact of lockdown on population – the poor, chronically ill, students and beneficiaries of mid-day meals; and women who are vulnerable to abuse by their husbands. In other words, to assess the possible impact of lockdown on the population, we have considered four dimensions: poverty, disruption of chronic care, disruption of school education (including mid-day meal) and social bad (which includes alcoholism and domestic violence). For assessing the possible situation under each dimension, we have used multiple indicators. For each indicator, the values across the major states are normalised by subtracting minimum value and then dividing by the range of values. This way of normalising the indicator creates a range between 0 and 1 or 0 and 100 when multiplied by 100.⁵ Composite index for a particular dimension is constructed by simple average of individual index values. For each dimension, a composite index is also constructed using the principal component analysis (considering the first component) and correlation coefficient is computed for validating our constructed composite index. As graphical tools, scatter plots and maps are used to explore the association and ranking of major Indian states respectively.

Risk prospect, risky population, and coping capacity of the states

It is difficult to precisely assess the risk of COVID-19 spread for any state (or union territory) for a number of reasons. Whereas, strict implementation of lockdown reduces the scope for further spread, in the absence of enough testing the number of individuals who are actually infected in a given point of time remain unknown. Moreover, the long incubation period and a large percentage of asymptomatic cases of COVID-19 allow infected individuals to spread the virus to others without their knowledge. However, in the absence of large-scale testing, the number of known (tested) cases provides us best available idea about the possible risks. The states with higher number of known cases have larger risk of spreading the virus to their population if infected persons are not identified, their contacts are not tracked down and all tracked down persons are not isolated as soon as possible. The higher population density may work as a catalyst for spreading the virus. In India, the first case of COVID-19 was reported in Kerala, since then it is increasing rapidly. As of May 19, 2020 (8.00 AM), India has 101,139 confirmed cases, 39,174 recovered (including discharged) and 3163 deaths.⁶ Though, the first

⁵ For any indicator I for a state i , (I_i) , index of I_i is defined as $(I_i - \min(I)) * 100 / (\max(I) - \min(I))$

⁶ Accessed from <https://www.mygov.in/covid-19> on May 19, 2020, 11.00 pm.

case of Covid-19 was reported in Kerala, at present Maharashtra is the worst affected state with the highest number of confirmed cases (35058) followed by Tamil Nadu (11760), Gujarat (11745) and Delhi (10054).

Table 1 shows the number of confirmed cases of COVID-19 and population density (persons per square kilometres) for the major Indian states. The same table also shows the index values constructed from confirmed cases of COVID-19 (until May 3, 2020) and population density and a composite index constructed through a geometric mean formula. The overall risk index shows that top five states with very high risk of COVID-19 spread (as on May 3, 2020) were Delhi, Maharashtra, Uttar Pradesh, Tamil Nadu and West Bengal. Though Kerala has been remarkably successful in bringing its new COVID-19 cases under control, because of its high population density it may still be considered as a state with high risk of spread. The same table shows that though Maharashtra has the highest number of known cases, the risk may be higher for Delhi because of its high population density. However, it must also be noted that the COVID-19 cases detected in Maharashtra are also from high population density districts like Mumbai and Pune. A scatter plot showing the known number of COVID-19 cases (up to May 3, 2020) and population density is presented in Figure 1. The scatter plot excludes Maharashtra and Delhi which are already identified states with high risk of spread. The scatter shows that both Tamil Nadu and Uttar Pradesh have high risk of possible spread. There are a number of states which stay behind Delhi, Maharashtra, Uttar Pradesh and Tamil Nadu. These states are Gujarat, Kerala, Madhya Pradesh, West Bengal and Rajasthan. The states like Bihar, West Bengal and Kerala, though having lesser known cases of COVID-19 need special monitoring as they can become vulnerable to further spread after the lockdown given their high population density.

Risky Population

The first and foremost important aspect that we consider for a state is the volume of potentially risky population. Generally, the states with larger population are expected to have larger volume of population potentially risky to possible COVID-19 infection. However, there are two important aspects of a state population that we need to consider: first the number of elderly persons (say, 60 years and above) and number of people with underlying conditions i.e. those suffering from chronic ailments like diabetes, hypertension, heart disease, kidney disease and

lung disease. These are the diseases which enhance the risk of a person if he/she is infected with COVID-19 (World Health Organization, Situation report-51, 2020).⁷

The elderly population is more vulnerable to infectious diseases as they do not have a strong immune system. Moreover, they are more likely to have critical conditions such as heart disease, lung disease, diabetes or kidney disease, which weaken their body's ability to fight infectious diseases (World Economic Forum, 2020). Keeping this in mind, we have identified the risky population across states by considering elderly population (aged 60 years and above) and population having select chronic ailments/diseases.⁸

Even in the absence of COVID-19, a few chronic non-communicable diseases (CNDs) contribute a large part of avoidable deaths among the adult population. Heart diseases and strokes are considered among the top reasons for deaths in India. The number of patients with cardiovascular disease increased from 2.57 crore in 1990 to 5.45 crore in 2016 implying more than 50 per cent in a duration of 25 years with the highest prevalence in Kerala, Punjab and Tamil Nadu.⁹ Chronic Obstructive Pulmonary Disease (COPD) was found to be the second strongest cause of death in India after heart disease is COPD, killing 9.58 lakh people in 2017.¹⁰

Table 2 presents a composite index of risky population across the major Indian states which is a simple average of individual index values constructed from four indicators presented in the same table.¹¹ The table shows that Kerala is the state having the highest index value of risky population (98.4), followed by Andhra Pradesh (73.7), Tamil Nadu (67.0), West Bengal (49.1)

⁷ According to World Health Organization, novel coronavirus shows serious manifestations among elderly (aged 60 and above) and people with chronic conditions i.e. diabetes, cardiovascular disease, kidney disease, and lung diseases like asthma and chronic pulmonary obstructive disorder (COPD) (World Health Organization, situation Report-51, 2020).

⁸ We use two data sources for estimating the prevalence of select chronic ailments. NFHS 4 data provides us prevalence of diabetes, heart disease and asthma for males (15 to 54 years age group) and females (15-49 years age group). NSS 75th round data allows us to estimate prevalence of diabetes, cardiovascular, respiratory ailments for age group 50 years and above.

⁹ <https://www.downtoearth.org.in/news/health/heart-disease-stroke-among-top-killers-in-india-61602>. In the news article they quote a study published in The Lancet by India State-Level Disease Burden Initiative CVD Collaborators

¹⁰ https://www.business-standard.com/article/health/copd-what-we-know-about-the-disease-that-killed-a-million-indians-in-2017-119030400121_1.html. The news article reports Global Burden of Disease Study, 2018. According to the International Diabetes Foundation's Diabetes Atlas, India has the second highest number of diabetes patients (estimated 7.7 crore) of 20-79 years age in 2019.

¹¹ A separate index constructed using principal component analysis (first component) shows 0.9976 correlation with our composite index.

and Telangana (46.6). When we compared index values of the risky population and index value of the risk of spread, Tamil Nadu turns out to be a case for concern – a state with higher index values of risk of spread as well as risky population (Figure 2). The two other states that one should equally be concerned with after Tamil Nadu are Kerala and Maharashtra. Whereas Maharashtra is a state with high risk of spread but lesser risky population, Kerala is a state with lower risk of spread but higher volume of risky population. Just behind Tamil Nadu, Kerala and Maharashtra, there are a few states not much behind in terms of risk of spread-risky population combinations. These states are Andhra Pradesh, West Bengal and Uttar Pradesh. <-

Coping Capacities of the States

According to WHO, 80 per cent of the COVID-19 cases are found to be mild or asymptomatic and remaining 20 per cent may require hospitalisation. Out of the remaining 20 per cent, 5 per cent cases may require critical care including ventilator (WHO, situation report-46, 2020). Though the true mortality rate of COVID-19 will take some time to be fully understood, currently the crude mortality rate (i.e. the number of reported deaths divided by the reported cases) is between 3 to 4 per cent. Since, to a significant extent mortality due to disease is determined by access to and quality of health care, it is important to assess where the states stand in terms of medical capacity to provide necessary health care to the affected individuals. The per capita availability of hospital bed is very low in India compared to countries with good health indicators. If the current pandemic leads to large number of hospitalisations, it is obvious that our health system will not be able to handle the situation. The Global Health Security Index 2019 measures countries' pandemic preparedness on a score of 1-100 based on their ability to prevent, detect, mitigate and cure diseases based on Johns Hopkins Center for Health Security. Out of 195 countries, India ranks 57th in the index. The Global Health Security Index 2019, also indicates that India might be in more vulnerable position than the worse effected countries like USA (at 1) China (at 51) and Italy (at 31) (Johns Hopkins Center for Health Security, 2019).¹²

We have calculated population per government hospital beds for each major state considering the projected population for 2020 to have an idea about state's public and institutional capacity to handle hospitalisation. Higher the number of persons per government hospital bed, poorer is the state's public institutional capacity (Table 3). An alternative way to look at the same

¹² <https://affairscLOUD.com/india-ranked-57th-in-global-health-security-index-2019-us-tops/>

indicator is to calculate the average number of beds per lakh population. In this case, higher the number of persons per hospital bed, better is the state's institutional capacity to deal with hospitalisation.

To assess how the states are currently equipped with their health sector capacities to address any forthcoming challenges due to COVID 19, we need to consider the public sector as well as the private sector. There is no reliable and consistent data on the strength of private health sector for most of the states. The Central Bureau of Health Intelligence provides us data on only government hospital beds. The latest National Sample Survey (75th round: 2017-18) provides us estimates of hospitalisation that are taking place in the public hospitals as well as private hospitals. In the absence of any data on the number of hospital beds in the private sector, we assume that the ratio between number of beds in government and in private hospitals are the same as the ratio between the numbers of hospitalisation in government and private hospitals.¹³ In Table 3, in addition to population per government hospital bed, average number of government hospital beds per lakh population, predicted number of private hospital beds per lakh population and predicted number of hospital beds (government and private together) per lakh population are presented. The beds per lakh population figures give us a rough idea about the current strength of institutional capacity of health sector to handle hospitalisations. If we only consider the government hospital beds, then three south Indian states Kerala, Karnataka and Tamil Nadu lead the list of major Indian states. However, if we consider the predicted size of the private inpatient care sector, it gives us a slightly different picture. Kerala and Karnataka remain the major Indian states with very high hospital beds per lakh population, but Tamil Nadu (which indicates a high risk of spread and high risky population combination) lags behind. The states like Maharashtra, Uttar Pradesh, West Bengal, Andhra Pradesh and Telangana seem to lack adequate capacity to handle large volume of hospitalisation. There is an important caveat here. Higher availability of hospital beds does not necessarily imply that they are better equipped for treating COVID-19 patients because availability of ventilator is an important aspect of medical capacity to deal with severe form of COVID-19. Newspaper report suggests that there are about 8,432 ventilators in government hospitals across the country (Deccan Herald, March 30, 2020).

¹³ This is a crude assumption. Generally, government hospitals often operate with near full or even excess capacity, whereas private hospitals may operate below full capacity. Moreover, the bed-turnover rates may be different for the government and private hospitals with an average hospital beds serving more patients in a given year.

The last column of Table 3 presents the index values of the states' institutional capacity to handle the required volume of hospitalisation. The index values of the states' institutional capacity are presented in Map 3. The map clearly shows that only the south Indian states have relatively higher institutional capacity to handle large numbers of hospitalisation.

Figure 3 plots the index of institutional health capacity against the index of risky population. The horizontal and vertical lines drawn at the median values of both the indices divide the scatter into four quadrants. Whether a state has lower or higher medical capacity relative to its volume of risky population can roughly be identified by looking at which quadrant a particular state lies. States with higher index value of risky population but lower index value of institutional health care capacity can be a matter of concern as they indicate lower health care capacity relative to its their population. Odisha and Madhya Pradesh fall in that list of states.

Lockdown and the Poor

We do not have any recent data on the extent of poverty or poor population from a large survey for the major Indian states. The 2017-18 survey on consumption expenditure by the National Sample Survey Office was not released. In the absence of consumption expenditure data, we use consumption expenditure figures from Periodic Labour Force Survey (PLFS) of 2017-18 as one of the indicators for assessing the level of relative poverty. We use the following 7 indicators from Census, erstwhile Planning Commission and National Sample Surveys to construct an index of income vulnerable population: (1) Percentage of population below the poverty line (Planning Commission Estimates 2011-12); (2) Percentage of marginal worker in total population (Census 2011); (3) Percentage of agricultural labourer in total population (Census 2011); (4) Percentage of population with per capita consumption expenditure less than India's median per capita consumption expenditure (PLFS 2017-18); (5) Percentage of population from self-employed households with per capita consumption expenditure less than country's median in total population (PLFS 2017-18); (6) Percentage of population from casual labour households (PLFS 2017-18) ; (7) Percentage of population from *Others* household with per capita consumption expenditure less than country's median (PLFS 2017-18). The reasons for taking multiple indicators to assess the extent of income vulnerable population are the following: First, we do not have any recent estimates of poverty. The last estimates that we have are from 68th round NSS data (2011-12) and one may argue that the both absolute and relative situations in the states in the last 8-9 years. Second, migrant workers group forms an important component of income-vulnerable population in each state, especially in poor states

(i.e. states with lower per capita income, higher poverty and stagnating employment opportunities). The volumes of inter-state out-migration from poorer states to relatively richer states have increased significantly over the last two decades. The states with higher percentage of poor people, marginal workers and agricultural labourers, such as Jharkhand, Bihar, Chhattisgarh, Madhya Pradesh, Uttarakhand, Uttar Pradesh, Odisha, West Bengal, are found among the states with high volume of out-migration in recent decade. In the absence of any recent state-wise migration data, we assume that these indicators would jointly indicate volumes of out-migration. Third, the disruptions of most of the economic activities due to lockdown are expected to hit the poor self-employed and casual labour households more than the regular wage or salaried households. This suggests us to consider poor self-employed, all casual labourer and poor *other* households for identifying the vulnerable population. The Indicators and composite index are presented in Table 4. Figure 4 shows the scatters depicting pairwise association across indicators.

The states with very high values of poor population index are Bihar, Jharkhand, Odisha, Chattisgarh, Madhya Pradesh, Uttar Pradesh and West Bengal, Assam (Table 4). These are the states where living standard of large segments of population are going to be severely affected by the lockdown unless adequately supported by the governments. Figure 5 and Figure 6 present the index of poor population against index of per capita income (NSDP) and per capita tax revenue respectively. They may indicate the economy and government's capacities relative to the volume of economically vulnerable population they need to support during the lockdown period. Examining the index of poor population against index of tax revenues is important as a state's capacity to take care of its large poor population is constrained by its per capita tax revenues (Figure 6). The disadvantageous states will perhaps require higher central assistance to address their problems – supporting the poor population with minimum income during the period of lockdown.

Lockdown and Disruption of Regular Chronic Care

The lockdown across the country has put a great constraint in accessing all types of non-emergency health care services to the population. Several newspapers have reported that COVID-19 has negatively impacted access to many otherwise essential health care services.¹⁴

¹⁴ There are news coming that COVID 19 has disrupted health care services in rural India and maternal health care services have been severely curtailed <https://www.livemint.com/news/india/how-covid-19-response-disrupted-health-services-in-rural-india-11587713155817.html>

The outpatient departments of the hospitals are largely closed, and numerous clinics and private chambers of the doctors are not accessible by majority of the population. It is reasonable to assume that with no availability of any means of transport, patients who require regular care are facing severe difficulties. Table 5 shows percentage of chronically ill population and percentages of population suffering from a chronic disease like Cancer. Though nearly 4 per cent of our population suffer from chronic ailments (thereby requiring regular health care), roughly 0.5 per cent of the population above 15 years report cancer (considering two separate sources of data viz. NFHS and NSS). The patients suffering from cancer and chronic kidney diseases may require procedures like chemotherapy and dialysis on a regular basis. Since the health sector is forced to treat the current pandemic with priority, there is legitimate apprehension that other critical health care (such as chemotherapy, dialysis) needs may be compromised in the process. There is another dimension to the chronically ill population – they are also more susceptible to the complications due to COVID-19 in case they are infected with the virus.

State-wise analysis shows that Kerala has the highest share of chronically ill population (18.15 per cent), followed by Andhra Pradesh (10.41 per cent) and West Bengal (9.01 per cent). The share of chronically ill persons in a particular state implies the share of population who are vulnerable to COVID-19 infection. A growing number of clinical studies on COVID-19 shows that individuals suffering from multiple chronic illnesses are more prone to have severe symptoms if they are infected with COVID-19 along with a higher probability of death as well (Remuzzi & Remuzzi 2020; Zhou *et al.*, 2020; Yang *et al.*, 2020). A study conducted in Italy on 12462 confirmed cases, showed that more than two-thirds of the patients had diabetes, cardiovascular diseases, or cancer (Remuzzi & Remuzzi 2020). The patients who were severely ill with COVID-19 had pre-existing cases of hypertension or COPD ailments (Yang *et al.*, 2020; Guan *et al.*, 2020; Lippi and Henry 2020).

Estimates on the incidence of select chronic ailments from NFHS data shows that 4 - 4.4 per cent of men and women aged below their mid-50s suffer from any of the three chronic diseases (viz. diabetes, heart disease, asthma). Estimates from NSS data show that for people aged above 50s, the rate is as high as 11.6 per cent for India with Kerala having the highest burden, followed by Andhra Pradesh, West Bengal, Punjab, Maharashtra, Gujarat and Tamil Nadu. Both the data sources suggest that prevalence of cancer, one of the emerging non-

communicable chronic diseases, is not very low in India. States such as Tamil Nadu, Jharkhand and Madhya Pradesh dominates in prevalence rates of cancer for the men aged below mid-50s, while Bihar, Tamil Nadu and Karnataka have higher prevalence rates of cancer for women aged below 50s. For people aged 50 years and above, Kerala, West Bengal, Uttarakhand, Haryana, Punjab and Rajasthan exhibit cancer prevalence rate higher than the national average.¹⁵

These figures clearly portray the large segment of our population which require regular care. However, access to chronic healthcare always pose significant challenges for a large part of chronically ill population because such services primarily exist in secondary and tertiary hospitals located in urban areas. The current situation has forced the health sector to prioritise COVID-19 over other healthcare needs which has affected those requiring regular healthcare services such as chemotherapy, dialysis, blood transfusions or even life-saving drugs.

Many chronically ill patients are now facing the brunt from multiple sides as they are stranded without getting essential care. Many of them, who have gone to far-off places for getting treatment, cannot even return to their homes because of the lockdown. Print and online newspapers are full of stories about their miseries and helplessness. There are reports in various credible print and online news portals that cancer patients staying with their relatives in shelters near the AIIMS in south Delhi require immediate surgeries and treatments. Some of them even borrowed money on interest for their treatments, paid money to the hospital and did the paperwork, but treatment seems to be a far-fetched thing, given the closure of all OPD and speciality services in AIIMS, from March 24th onwards.¹⁶ According to a senior oncologist at Mumbai-based Tata Memorial Hospital, there has also been a sudden dip in the inflow of patients from other states. Although follow-ups are being done telephonically and via online, many people do not have the know-how or access to those means.¹⁷ The situation is not grim for the cancer patients only. There are reports that patients requiring dialysis are facing similar problems due to strict restrictions in mobility and non-availability of transport services, especially for those without personal vehicles. Even for those who can avail transport, the dialysis centres are facing staff crunch along with limited and irregular medical supplies such

¹⁵ Figures are based on author's estimations.

¹⁶ <https://www.thehindu.com/news/cities/Delhi/lesser-patients-in-a-pandemic/article31440359.ece>

¹⁷ <https://economictimes.indiatimes.com/industry/healthcare/biotech/healthcare/covid-outbreak-hinders-cancer-treatment-in-hospitals/articleshow/75033787.cms>

as dialyser, needles and anticoagulants which are essential for the process.¹⁸ Besides, there are several reports that HIV patients are also not able to reach their local ART centres for medicines. Those who are on second- and third-line drugs are reported to face more problems as these medicines are available only in bigger hospitals. They are missing their daily doses which would probably bring down their immunity and make them more susceptible to getting co-morbidities like TB.¹⁹ There has been several cases where patients and their relatives were unable to get essential medicines for HIV, cancer and other lifesaving drugs. Even patients requiring essential diagnostics had to delay their treatment as most of the laboratories are closed due to lockdown.²⁰

The lockdown has affected the provision of medicines and medical devices to hospitals and pharmacies. In addition, some of the district administrations in various states/ UTs have also given directions to close the manufacturing operations in the pharmaceutical and medical device industry as part of measures to contain the spread of coronavirus.²¹ The lockdown has also impacted the volume and frequency of blood donation. With 3321 licensed blood banks, there already exists a documented imbalance between its demand and availability in the non-pandemic times which has only aggravated in the present times.²²

Though central and different state governments have assured that essential services would continue to be provided amidst the lockdown, prioritizing COVID-19 cases, given the limited resources, has certainly compromised the capacity of the health sector to deal with regular health care services. The central ministry of health issued detailed guidelines on 17th April 2020 regarding non-elective surgery and medical interventions and mentioned various measures which includes conducting infant check-ups at home and delivering medicines. It also envisaged that states should 'ensure uninterrupted availability of dialysis and cancer treatment services' and facilitate 'easy movement of these patients to access care.'²³ The reality is

¹⁸<https://theprint.in/health/cancer-dialysis-patients-struggle-for-treatment-as-hospitals-are-stretched-by-covid-19/395097/>

¹⁹<https://www.aljazeera.com/news/2020/03/india-covid-19-lockdown-hits-hiv-chronic-patients-hard-200329200022525.html>

²⁰<https://www.aljazeera.com/news/2020/03/india-covid-19-lockdown-hits-hiv-chronic-patients-hard-200329200022525.html>

²¹<https://economictimes.indiatimes.com/industry/healthcare/biotech/pharmaceuticals/lockdown-resulting-in-drugs-medical-devices-supply-disruption-industry/articleshow/74810847.cms?from=mdr>

²² Ministry of Health and Family Welfare. Lok Sabha Unstarred Question No 4585. Blood bank infrastructure, 20 Mar 2020. Accessed from <http://164.100.24.220/loksabhaquestions/annex/173/AU4585.pdf>

²³ <https://www.mohfw.gov.in/pdf/EssentialservicesduringCOVID19updated0411201.pdf>

multiple hospitals located nearby containment zones or in general had to shut their OPD services and defer surgeries over concerns of coronavirus infection among healthcare workers in the hospital premises. The remaining hospitals have been turned into specialised units for treating COVID-19 cases, with chronic non-COVID patients nowhere to go.²⁴ To add further insult to the injury, COVID-19 tests have been made mandatory before receiving any kind of treatment, irrespective of no contact or symptoms of the patients. This is happening even though the Union health ministry has directed hospitals not to deny treatment to any patients who are not Covid-19-positive.^{25,26} In fact, there have been reports of deaths due to hospitals' refusal to admit patients fearing they might be infected with the virus. While COVID-19 deaths are being tracked on an hourly basis, there are no official death counts from other sources which are attributed to the lockdown itself. But anecdotal evidence from media reports, doctors, and activists suggests they have been happening quite a lot.²⁷ Cardiac specialists are puzzled by the sudden dip in emergency heart attack cases in the lockdown phase and they fear that patients being afraid of getting infected, prefer to die at home.

Estimates from the population-based health survey clearly indicate that the section of population which requires regular chronic care is huge, but it is almost evident from print/online newspapers/portals that chronic care has been jeopardised in the current times. An excessive focus on the COVID positive patients while neglecting the other health care needs, will only aggravate the net disease burden to mammoth levels in the future. Country's health sector must find a way where access to regular essential health care services is not restricted along with its continuing emphasis on identification, isolation and treatment for COVID-19 cases.

The last column of Table 5 shows the index depicting the possible disruption of regular essential care/interventions for the chronically ill. The states like Kerala and Tamil Nadu are on the top among the major Indian states requiring large volume of regular care for their critically ill population which perhaps experienced barriers in access during the lockdown. After Kerala and Tamil Nadu, West Bengal, Bihar, Andhra Pradesh, Karnataka are some of the

²⁴<https://economictimes.indiatimes.com/industry/healthcare/biotech/healthcare/ease-lockdown-let-other-critical-patients-get-treatment-hospitals/articleshow/75310740.cms>

²⁵<https://www.hindustantimes.com/india-news/test-all-patients-getting-hospital-admissions-for-covid-19-centre-to-states/story-Wonk3rpLdKP1s7dDJTrnM.html>

²⁶<https://timesofindia.indiatimes.com/india/as-emergency-patients-await-treatment-many-hospitals-insist-on-covid-19-tests/articleshow/75262116.cms>

²⁷<https://thelivenagpur.com/2020/04/11/where-are-missing-heart-attack-patients/>

states with high requirement of regular care by the chronically ill population. The states need to see that the regular health care requirements of the chronically ill people are not compromised due to lockdown and restriction in access to hospitals due to COVID 19. The relative ranking of the major states with respect to (possible) regular medical care disruption index is presented in Map 5 which shows the major states with possible disruption of chronic health care due to lockdown.

Effects on School Education and Mid-Day Meal Programmes

Lockdown and school education

This crisis might have an immediate impact on children and youth. As Jaime Saavedra points out, there may be losses in learning, increased dropout rates, and children missing their most important meal of the day due to the lockdown.²⁸ We still have huge rich-poor inequalities in terms of access to school education in the country and it is almost certain that the negative impacts will be felt disproportionately by poorer children. The estimates from NSS 75th round, education, data shows that in India only 22 per cent of school going students (6-18 years) have access to internet services (Table 6). This means that around 80 per cent of students do not have potential access to education through internet or ‘remote classrooms’ an idea widely propagated during this lockdown. The lockdown, since the middle of March, has left more than 23 crore students between 6-18 years of age disconnected from school education and restricted to home.²⁹ Many of them are probably not able to continue regular study at home, and have limited access to nutritional supplements which they were receiving from the mid-day meals. Many of them may also be forced to spend more time with abusive family members.

Long period of disengagement from school can result in a further increase in dropouts in India. Remote classrooms have been suggested and taken up by many private schools in India. In order to introduce technology in education meaningfully and not limited to the privileged, what is important is to improve access to computer and internet services for children belonging to all economic classes. In a country where almost 80 per cent of its student population is eliminated from this access, it is only going to increase the already existing digital divide. If this digital gap in education were to increase while schools are closed, learning inequality

²⁸ <https://blogs.worldbank.org/education/educational-challenges-and-opportunities-covid-19-pandemic>

²⁹ The number of school goers between 6-18 years age is 23,51,64,904 (estimated from NSS 75th round data of 2017-18)

and ‘learning poverty’ would also inevitably increase.³⁰ Remote education in India would only mean that learning continuity is ensured for some but denied to others or to most. In addition to this, school is often the only safe place for many vulnerable children. In school, “they are safe from abuse, the only place they get proper meals.”³¹ NSS estimates show that there are many states, including West Bengal, Karnataka, Andhra Pradesh, Telengana, Uttar Pradesh, Tamil Nadu and Bihar, where percentage of access to internet services is less than the national average. In many of these states the educational outcomes as captured by ASER 2018 were already poor.³² In states with better learning outcomes like Kerala, Maharashtra or Punjab it is expected that with better access to internet and already improved educational standards the impact of this lockdown in terms of learning loss will be lesser.

The NSS estimates also show that only 8.6 per cent of students have a computer at home and 7.2 per cent have access to computer and internet services at home.³³ Functionally, it is this 7.2 per cent of students who will be able to appropriately access remote education during the lockdown if offered by their schools. There are many states with lower than the national average in terms of access to computer and internet services. Maharashtra which has the highest number of cases so far has only about 33.2 per cent students with access to internet services. This means that around 67 per cent of the students will not be able to access education during the lockdown as remote learning strategies will not work for them. Additionally, the capacity of the schools and teachers to undertake classes digitally, providing suitable content is another area of concern. Private schools too face a digital gap like ‘the capacities and capabilities of each school to provide individualized, or suitably levelled and sequenced, digital learning for students; to promote and monitor engagement with these materials; and provide feedback that helps maximize learning outcomes’ (Moreno, 2020).³⁴

³⁰ Learning poverty means being unable to read and understand a simple text by age 10 (<https://www.worldbank.org/en/topic/education/brief/learning-poverty>)

³¹ <https://www.theguardian.com/education/2020/apr/14/the-schools-open-during-lockdown-for-some-kids-its-the-only-safe-place>

³² Like in West Bengal almost 50 per cent children in government schools in Standard V cannot read Standard II level text. For Tamil Nadu it is about 54 per cent and in Bihar, it is 65 per cent. On the other hand, there are many states like Kerala (73 per cent), Maharashtra (66 per cent) or Punjab (69 per cent) where a much higher percentage of children in Standard V are able to read Standard II text.

³³ According to NSS 75th computer includes desktop, laptop, palmtop, notebook, netbook, tablets, etc

³⁴ Schools’ readiness for digital learning in the eyes of principals. An analysis from PISA 2018 and its implications for the COVID19 (Coronavirus) crisis response (https://blogs.worldbank.org/education/schools-readiness-digital-learning-eyes-principals-analysis-pisa-2018-and-its?cid=EXT_WBBlogTweetableShare_D_EXT)

Mid-day meal and lockdown

Schools and ICDS centres are often the only space where many children get a full meal in a day.³⁵ The lockdown due to the COVID-19 crisis has left these children without access to meal, though efforts are being made in different states to send uncooked raw materials to the parents of the children who are entitled to meals in schools and ICDS centres but it seems to be limited. In India, according to the latest NSS estimates, 30 per cent children between 0-18 years benefit from the mid-day meals (Table 7) and according to the DISE data (2016-17) 75 per cent of the schools provide mid-day meals. The NSS estimates also show that 35 per cent poor children- (children from below median per capita consumption expenditure households) receive these meals. It is this 35 per cent of children who will be hit the most due to the shutting down of schools. States like Punjab, Haryana, and Uttar Pradesh have the least percentage of children who receive mid-day meals. There are many states where the percentage of children benefitting from mid-day meals is less than the national average. It includes states like Andhra Pradesh, Gujarat, Maharashtra, Madhya Pradesh and Rajasthan. Uttar Pradesh (23 per cent) and Haryana (24 per cent) also have less than one-quarter of poor children receiving such meals.

The last column of Table 7 presents a composite index which captures to what extent the school education and mid-day meals might get possibly disrupted in different major states. The major states which are going to bear the highest disruption in school education are Bihar, Jharkhand, Chhattisgarh, Odisha, Assam, Uttar Pradesh, West Bengal, Madhya Pradesh and Rajasthan. The map below presents the relative ranking of the states in terms of likely disturbances in school education due to lock down.

To sum up, in order to understand the wide-ranging impact on education due to the closing of schools we have tried to analyse internet accessibility and access to mid-day meals simultaneously to get a more complete picture. States like Uttar Pradesh and Andhra Pradesh have both low percentage of children with internet services and low percentage of children receiving mid-day meal. Additionally, Uttar Pradesh also has only 36 per cent Standard V children who can read Standard II texts. It may be easily concluded that states like Uttar Pradesh will be severely pushed into nutrition and learning poverty due to this lockdown. There

³⁵ There are anecdotal evidences appearing in newspaper. One such news talks about Anjum, a class 5 student at the government primary school in Dasna (Ghaziabad) who said that she is eagerly waiting for resumption of her classes. “We have no school work at the moment. The food (mid-day meal) is also not available now and we survive with one meal per day at home,” she said (<https://www.hindustantimes.com/cities/lockdown-govt-school-children-in-gzb-deprived-of-mid-day-meal/story-nsBAbohcnbfJCexpXkbPEN.html> Hindustan Times, Apr 13, 2020).

are states like Odisha, Karnataka where access to internet services maybe low among children but a higher percentage of them receive mid-day meals. So, in these states learning poverty may be lower but health and nutrition for children will face a major setback.

So far, most states have been sending a weekly quota of ration to the families. States like West Bengal and Andhra Pradesh have been sending raw materials to households to compensate for the loss of mid-day meals in the schools. The other states may also be following a similar practice. The ration may however, be just enough to provide the family one meal for a few days. It is likely, that in a gender biased society like ours, women or a girl child may be receiving a smaller portion of the daily food as compared to their male counterparts. The mid-day meal, apart from providing daily nutrition is also an equalizing scheme where both girls and boys till eighth standard would receive similar amount and quality of food. It is important that gender sensitivity is promoted in such trying times through community radio, television and other possible mass media channels.

To offer some solutions to address this pause in classroom education, a few schools have suggested that since most children do not have access to technology at home, teachers will provide printed assignments to the families for the children when they come to collect the food items at the ration shops.

The tremors of this crisis will be inter-generational as poverty will affect not only this generation but even the ones to come and plans to reach the Sustainable Development Goals will be altered and the objective of states governments will also see a paradigm shift. This crisis will determine the political choices that people make as how the governments cope with this will become its ‘defining legacy’.³⁶

Social Bad

Like many other countries violence against women is a persistent and pressing problem in India. In 2013, the WHO estimated that roughly 35 per cent of all women have been victims of physical or sexual violence (Luca, 2015)³⁷. The incidence of marital violence of men toward

³⁶<https://www.hindustantimes.com/columns/covid-19-will-alter-indian-political-life/story-uomMzsoz0hsFGZG2N4wfEP.html>- Hindustan Times, Mar 28, 2020

³⁷Luca, Dara Lee, Emily Owens and Gunjan Sharma, “Can Alcohol Prohibition Reduce Violence Against Women?”, The American Economic Review, Vol. 105, No. 5, PAPERS AND PROCEEDINGS OF THE One Hundred Twenty-Seventh Annual Meeting OF THE AMERICAN ECONOMIC ASSOCIATION (MAY 2015), pp. 625-629

their wives varies across cultures, as do the underlying causes. Studies demonstrate that individual and community factors, and societal responses are linked to marital violence. The co-occurrence of alcohol abuse and domestic violence including forced sex within marriage in India is widely acknowledged (Jeyaseelan, 2007; Duvvury et al., 2002). It is a widely-held belief that alcohol contributes to disinhibition, mood enhancement, and alcohol myopia in men (George and Stoner, 2000). Indirectly, as a mood enhancer, alcohol can also increase existing feelings of anger and frustration and thus tend to raise the incidence of domestic violence within intimate partners (Stanley, 2008). Ever since the lockdown began due to COVID-19, there has been an increase in domestic abuse complaints (ABP News Bureau, April 09, 2020). The media has been reporting cases of these increased incidents of violence across sectors and the lack of protection extended to these women. Women in normal circumstances are often known to run to neighbours or family when violence at home reaches an intolerable level. However, the lockdown now prevents this (Aljazeera, April 18, 2020). The lockdown has metamorphosed into a trap with the abusers for women and children (ABP News Bureau, April 09, 2020). Women without financial security and the ones who are relying on their partners for support are likely to experience more abuse. According to Feminist Economist, Ashwini Deshpande, the lockdown provides the perfect opportunity to the abuser to practice “intimate terrorism”—dictate and control all actions and movements of women, with violence if needed (Quartz India, April 16, 2020).³⁸ Women from low-income households are worst hit with their partners now out of job due to the outbreak would resort to abuse to take out their pent-up frustration (ABP News Bureau, April 09, 2020). The ‘Childline India’ has received more than 92,000 calls within 11 days of lockdown asking for protection from the violence (The New Indian Express, April 08, 2020).

Based on NFHS 4 data, we have estimated the percentage of men (15-54 years age) drinking alcohol, percentage of ever married women reporting domestic violence, percentage of ever married women (15-49 years age) reported their husband drinking alcohol, and percentage of ever married women with drunken husband reporting domestic violence.³⁹ Though about 15.6 per cent of the men all over India report that they drink alcohol regularly whereas, 29.7 per cent

³⁸<https://qz.com/author/ashwini-deshpande/>

³⁹ Computed by taking only physical violence into consideration i.e. ever been pushed, shook or thrown something by husband or partner, ever been punched by fist or hit by something harmful by husband or partner, ever been kicked or dragged by husband or partner, ever by strangled or burnt by husband or partner, ever been threatened by knife or gun or other weapon by husband or partner, and ever had arm twisted or hair pulled by husband or partner.

for the women have reported that their husbands consume alcohol, indicating under-reporting of in men's survey (Table 8).⁴⁰ The percentage of married women reporting cases of domestic violence is found to be highest in Tamil Nadu (5.0 per cent) followed by Andhra Pradesh (4.4 per cent), Telangana (4.4 per cent). The percentage of women with drunken husband reporting domestic violence is highest in Bihar (66.9 per cent) across different states, followed by Andhra Pradesh (57.6 per cent), Tamil Nadu (57.3 per cent) and Uttar Pradesh (56.3 per cent).

The data from Bihar shows that 33 per cent women have reported cases of drunkard husbands. This is surprising given the fact that there is prohibition of alcohol in the state. Notably, Bihar also has the highest percentage (67 per cent) of women with drunkard husband reporting cases of domestic violence. According to the NFHS-4 estimates, 4 per cent women in the state with or without drunkard husbands have reported cases of marital violence. There are many states in India, including Gujarat, that have a higher percentage of women experiencing domestic violence with drunkard husband as compared to the national average. The lockdown is likely to affect these sections of women much adversely as they are locked at home with their abusers who are likely to get more violent in the absence of liquor. The National Commission for Women (NCW) on 17th April, 2020 said it registered 587 domestic violence complaints between March 23 and April 16 - a significant surge from 396 complaints received in the previous 25 days between February 27 and March 22 (Aljazeera, 18 April, 2020). The last column of Table 8 presents the social bad index which combines the drinking prevalence among men and the occurrence of domestic violence. The major states with very high values of social bad index are Tamil Nadu, Telangana, Andhra Pradesh and Odisha. The ranking of states based on index values are presented in the Map 7.

Summary, Policy Lessons and Limitations of the Study

Both the spread of COVID-19 and lockdown announced by the governments to contain the spread have put a huge challenge to India's economy, society and health care system. While the actual spread as well as the fear of spread of the disease has brought an immense pressure on country's health care system which lacks capacity to handle a public health emergency like the current one due to inadequate infrastructure, human resources and funding, the lockdown aiming at containing the disease spread has inflicted immense challenges to the lives and future

⁴⁰ However, there is another possibility. Since husband/spouse sample is a subset of men sample, the percentage of men who drink regularly may actually lower than that reported by the women about their husband drinking alcohol.

of India's poor (viz. socio-economically disadvantaged, marginalised groups), chronically ill population, students from poor households and vulnerable individuals exposed to different forms of abuses at home. However, the situation is not uniform across the states of India as they vary enormously from one another in terms of risk of the disease spread, size of population vulnerable to COVID-19, capacity to deal with medical emergency, size of population economically vulnerable to lockdown and state's financial capacity to take care of vulnerable population in the absence of adequate assistance from central government. This study, first attempts to assess the vulnerability of the population due to the possible disease spread; and then tries to assess four different dimensions of vulnerability caused by nation-wide lockdown. The empirical exercise of assessment is carried out by utilising all available information and numerous reports published in newspapers and news portals.

Table 9 summarises the major empirical findings obtained in the previous sections. The top 7 major states with higher volume of risky population are Kerala, Andhra Pradesh, Tamil Nadu, West Bengal, Telangana, Odisha and Punjab. The top 7 major states with higher institutional capacity to handle large volumes of hospitalisation are Karnataka, Kerala, Delhi, Tamil Nadu, Telangana, Punjab and Uttarakhand. If institutional medical capacities are not improved, the states which would probably face relatively greater challenges in dealing with large cases of hospitalisation if the disease is spread to its risky population are Odisha and Madhya Pradesh.

The top 7 major states where the lives of large population of poor and vulnerable are going to be severely affected because of lockdown are Bihar, Jharkhand, Odisha, Chhattisgarh, Madhya Pradesh, Uttar Pradesh and West Bengal (Table 9). All these states figure among the bottom 10 states in terms of per capita income (per capita NSDP) or per capita tax revenue. This indicates that these states do not have inadequate capacity to take care of the large poor population if economic activities and government revenues are stopped for a longer time. Moreover, these are also the states with high inter-state out-migration. With migrant workers' income getting stopped and they are returning to their villages, these states would definitely face tremendous hardship to take care of their population.

The top 7 major states with larger requirement of regular chronic care are Kerala, Tamil Nadu, West Bengal, Bihar, Andhra Pradesh, Karnataka, Haryana and Jharkhand (Table 9). This is due to their higher share of chronically ill population, people suffering from diseases like cancer.

These states cannot afford to keep their OPD closed in hospitals for a long time, shift priorities to COVID-19 at the cost of other healthcare services or sealing of hospitals in large numbers. The top major states where school education (including mid-day meals) is likely to be severely affected are Jharkhand, West Bengal, Assam, Odisha, Chhattisgarh, Karnataka and Bihar. (Table 9). These are the states where fewer percentage of school going children have access to both computer and internet services and/or large percentage of children and students avail meals from ICDS Centres and Schools. The top major states, which might be vulnerable due to alcoholism and domestic violence are Tamil Nadu, Telangana, Andhra Pradesh, Odisha, Chattisgarh, Assam and Bihar (Table 9). When we consider all four dimensions of vulnerability, the states which seem to be more vulnerable due to lockdown are Bihar, West Bengal, Odisha, Jharkhand and Chhattisgarh as they show higher index values of three or more dimensions of vulnerability out of total four dimensions. These five states may require concerted efforts by central as well as state governments to address their problems.

Policy Lessons

- While extending the lockdown or lifting it fully or partially, governments need to consider three parameters: current level of risk of spread, size of the population which is medically vulnerable to COVID-19 and population which is economically vulnerable. Whereas the public health experts can assess the first two parameters, assessment of the third parameter needs to be left to judgement of the economists and other social scientists.
- The vulnerability of the states due to lockdown is not similar in nature. Sector specific interventions are needed. Addressing some form of vulnerability may be beyond the scope of a state government and will require intervention and financial assistance from the Central Government. For example, states with lower revenue capacities will not be able to handle economic vulnerability of the large poor population. They need to get higher share of central assistance in accordance with their population.
- The migrant workers, especially the unskilled and semiskilled ones, appear to be the most vulnerable population sub-groups affected by lockdown. A National Register of Migrant Workers needs to be prepared for tracking and knowing current status of migrant workers in future. A migrant worker is an asset for both source state and destination state as he contributes to the economic prosperity of the destination state and send remittances to the source state. In the destination state, migrant workers must

be entitled to all benefits and rights which are available to the local residents/voters (e.g. ration, health care benefits etc.). Other states need to follow the example of Kerala which introduced health card for the migrant workers long time back Each state needs to have a dedicated department dealing with the migrant workers (both in-migrants and out-migrants) and there should be full coordination of such department across the states in India.

- Similar to what has been done for COVID-19 patients, a helpline must be started for chronically ill patients (patients requiring chemotherapy, dialysis etc) and those who might require urgent care (maternal care, immunisation). The helpline also needs to address the mental health care need of those who are affected by the pandemic, lockdown and associated loss in livelihood and normal life.
- One of the data constraints we faced in assessing the capacity of the health sector for responding to any increased demand for hospitalisation is absence of data on the private sector. This compelled us to estimate the number of private hospital beds in an approximate and crude manner. Information on private health infrastructure and human resources must be collected by the government and should be made available in the public domain on real time basis for anybody who needs to access. There is also need for real time data on various aspects of the economy, society and health sector.
- Disruption of the normal school education is a serious issue which can be addressed by private-public partnership and other innovative means. Since there is a huge uncertainty about when educational institutes can restart their functionings, innovative efforts must be undertaken to reach the students with study materials/lectures through television (both government and private satellite channels), radio (AM and FM) and mobiles.
- Though excise duty on liquor is an important part of government revenues in many states, selling of liquor must be restricted in states with higher values of social bad index. Similar to what has been recently done to protect health staff and doctors from public attack, special provision should be made in the laws so that perpetrator of domestic violence or other abusive behaviour can attract stricter punishment and penalty especially when such crimes are reported during lockdown.

Limitations

- Much of the information used for the construction of vulnerability index is based on surveys which were conducted 2-5 years ago, however, they are the latest available

data. The computation of risk of disease spread is based on data on April 18, 2020. Since then figures have changed significantly, altering the absolute positions of different states. Therefore, assessment of risks needs to be always done on a real time data.

- All the analysis is done at the state (or UT) level. Within a state, districts vary considerably in terms of many indicators relevant for vulnerability and in this case spread of COVID 19. Therefore, the state level risk, vulnerability and capacity to cope up with risk and vulnerability are distributed non-uniformly across districts. Within a state, some districts require much greater interventions than other districts.

Appendix

Indicators and data sources

Indicators and Indexes	Data Source
<i>Population medically vulnerable to COVID-19</i>	
Indicator V11: Percentage of 60 years and above population	Census 2011
Indicator V12: Percentage of men (15-54 years) with any of the 3 chronic ailments (diabetes, heart disease, asthma) in total population	NFHS 4 (2015-16)
Indicator V13: Percentage of ever married women (15-49 years) with any of the 3 chronic ailments (diabetes, heart disease, asthma) in total population	NFHS 4 (2015-16)
Indicator V14: Percentage of population (50 years and above) having any of the 3 chronic ailments (diabetes, cardio-vascular, respiratory).	NSS 75 th Round Health (2017-18)
Index of Risky Population: Composite of Index calculated as arithmetic mean of indexes constructed from V11, V12, V13 and V14	
<i>Vulnerability Dimension: Poor Population</i>	
Indicator V21: Percentage of poor in total population (2011-2012)	Erstwhile Planning Commission estimates based on NSS 68 th round (2011-12) data
Indicator V22: Percentage of marginal worker in total population (2011 Census)	Census 2011
Indicator V23: Percentage of agricultural labour in total population (2011 Census)	Census 2011
Indicator V24: Percentage of population with per capita consumption expenditure (PCCE) less than country's median PCCE	Periodic Labour Force Survey (2017-18)
Indicator V25: Percentage of population from Self-employed households with PCCE lower than median PCCE	Periodic Labour Force Survey (2017-18)
Indicator V26: Percentage of population from casual labour households	Periodic Labour Force Survey (2017-18)
Indicator V27: Percentage of population from other households with PCCE less than median PCCE	Periodic Labour Force Survey (2017-18)
Index of poor population: Composite index computed by taking an arithmetic mean of individual indexes constructed from V21, V22, V23, V24, V25, V26 and V27	
<i>Vulnerability Dimension: Disruption of regular health care</i>	
Indicator V31: Percentage of population chronically ill	NSS 75 Health (2017-18)
Indicator V32: Percentage of men (15-54 years) cancer patients in total population	NFHS 4 (2015-16)
Indicator V33: Percentage of ever married women (15-49 years) cancer patients in total population	NFHS 4 (2015-16)
Indicator V34: Percentage of 50 years and above cancer patients in total population	NSS 75 Health (2017-18)
Index of disruption of regular healthcare: Composite index computed as an arithmetic mean of individual indexes constructed from V31, V32, V33 and V34	

<i>Vulnerability Dimension: Disruption in School Education</i>	
Indicator V41: Percentage of students (6-18 years) without both computer and internet at home in total population	NSS 75 Education (2017-18)
Indicator V42: Percentage of students (up to 18 years) availing mid-day meals in total population	NSS 75 Education (2017-18)
Index of disruption in school education (including mid-day meal): Composite index computed by arithmetic mean of individual indexes constructed from V41 and V42	Average of V41, V42 and V43
<i>Vulnerability Dimension: Social Bad</i>	
Indicator V51: Percentage of male (15-54) who regularly (at least once in a week) drinks out of total population	NFHS 4 (2015-16)
Indicator V52: Percentage of ever married women (15-49 years) reporting domestic violence out of total population	NFHS 4 (2015-16)
<i>Risk of spread</i>	
Indicator R1: Total number of known COVID 19 cases (<i>as on April 18, 2020</i>)	https://covid19india.org
Indicator R2: Population density (2020 population per square km)	Census 2011; Projected Population for 2020
Geometric mean of R1_indec and R2_index	
<i>Medical capacity of the state</i>	
Indicator M1: Government hospital bed per lakh population	Census 2011, Projected Population, National Health Profile (Central Bureau of Health Intelligence)
Indicator M2: Private hospital bed per lakh population	Estimated by using NSS 75 Health (2017-18) and Central Bureau of Health Intelligence data
Indicator M3: Estimated hospital bed per lakh population	
Index of Medical Capacity: Index constructed from M3	
<i>State's economic capacity</i>	
S1: Per capita Net State Domestic Product	RBI
S2: Per capita tax revenue	RBI and IndiaStat.com
Index of per capita income: Index constructed from S1	
Index of per capita tax revenue: Index constructed from S2	

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Tables

Table 1: Known COVID-19 cases, population density and index of disease spread

States	Known COVID 19 Cases (May 3, 2020)	Population density	Index of COVID 19 Cases	Index of Population Density	Risk of spread index
Andhra Pradesh	1583	328	12.6	0.9	3.3
Assam	43	442	0.0	1.7	0.0
Bihar	482	1288	3.6	8.0	5.4
Chhattisgarh	43	215	0.0	0.0	0.0
Gujarat	5055	351	40.9	1.0	6.5
Haryana	394	658	2.9	3.3	3.1
Jharkhand	115	476	0.6	2.0	1.1
Karnataka	606	346	4.6	1.0	2.2
Kerala	500	908	3.7	5.2	4.4
Madhya Pradesh	2846	270	22.9	0.4	3.2
Maharashtra	12296	401	100.0	1.4	11.9
NCT of Delhi	4122	13616	33.3	100.0	57.7
Odisha	160	282	1.0	0.5	0.7
Punjab	772	598	5.9	2.9	4.1
Rajasthan	2772	229	22.3	0.1	1.7
Tamil Nadu	2757	585	22.1	2.8	7.9
Telangana	1063	326	8.3	0.9	2.7
Uttar Pradesh	2626	946	21.1	5.5	10.8
Uttarakhand	59	211	0.1	0.0	0.0
West Bengal	922	1099	7.2	6.6	6.9

Source: Census of India 2011; Report of the Technical Group on Population Projections; Ministry of Health and Family Welfare, Government of India

Table 2: Share of risky population across states and UTs

States	60 & above population (per cent)	Men (15-54 years) with any three chronic diseases (per cent)	Women (15-49 years) with any 3 chronic diseases (per cent)	Persons (50 & above) with any 3 chronic diseases (per cent)	Risky population Index
Andhra Pradesh	11.5	6.7	6.4	28.8	68.7
Assam	6.7	2.9	3	2.3	21.8
Bihar	7.4	3.8	4.6	1.5	26.3
Chhattisgarh	7.8	2	1.9	5.1	21
Gujarat	7.9	3	2.6	12.2	29.5
Haryana	8.7	1.5	3.4	6.2	26.3
Jharkhand	7.1	3.7	1.8	5	21.8
Karnataka	9.5	4.3	4	8.4	40.1
Kerala	12.6	8	8.3	39.9	89.6
Madhya Pradesh	7.9	3.2	4.2	4.5	30
Maharashtra	9.9	3.1	3.6	13.1	39.1
NCT Of Delhi	6.8	2.3	4.6	4.8	27.2
Odisha	9.5	6.1	4.8	8.6	46.8
Punjab	10.3	2.9	4.1	14.9	42.1
Rajasthan	7.5	2.2	2	5.6	19.8
Tamil Nadu	10.4	6.3	7.7	11.6	62.3
Telangana	7.4	6.1	6.8	9.8	47.5
Uttar Pradesh	7.7	2.9	3.3	6.1	25.5
Uttarakhand	8.9	3.1	2.9	3.4	29.1
West Bengal	8.5	4.8	6.2	21.4	51
India	8.6	4.0	4.4	11.6	

Source: Estimated from NFHS 4 (2015-16); NSS 75th Round Health (2017-18) unit record data

Table 3: Population per government hospital bed, hospital beds per lakh population (government, private and total) and index of health sector capacity.

States	Population per govt. hospital bed	Govt hospital bed per lakh population	Predicted private hospital bed per lakh population	Predicted hospital bed per lakh population	Health Sector Capacity Index
Andhra Pradesh	2246	45	92	137	20.0
Assam	2007	50	11	61	7.5
Bihar	10355	10	6	16	0.0
Chhattisgarh	3075	33	16	49	5.5
Gujarat	3179	31	53	85	11.4
Haryana	2412	41	62	103	14.4
Jharkhand	3451	29	20	49	5.5
Karnataka	921	109	205	314	49.2
Kerala	900	111	187	298	46.6
Madhya Pradesh	2606	38	20	59	7.1
Maharashtra	2267	44	98	143	21.0
NCT Of Delhi	784	128	77	204	31.1
Odisha	2324	43	13	56	6.7
Punjab	1620	62	113	175	26.3
Rajasthan	1647	61	36	97	13.4
Tamil Nadu	959	104	93	197	30.0
Telangana	1712	58	126	185	27.9
Uttar Pradesh	2913	34	42	77	10.1
Uttarakhand	1324	76	85	161	24.0
West Bengal	1186	84	34	119	17.0

Source: Census of India 2011; National Sample Survey 75th Round (Health) data; National Health Profile 2019

Table 4: Indicators of poor /marginalized population and index capturing poverty

States	Poor (%)	Marginal workers (%)	Agricultural Labour (%)	Consumption Poor (%)	Poor self employed (%)	Casual Labour (%)	Poor Others (%)	Poor population Index
Andhra Pradesh	9.2	7.6	22.3	34.4	12.9	30.7	2.5	49.1
Assam	32	10.5	5.9	58.7	37.4	16.3	0.8	50
Bihar	33.8	12.9	17.6	80.4	43.5	25.1	7.3	82.4
Chhattisgarh	39.9	15.4	19.9	83.6	53.9	17.3	2	77.2
Gujarat	16.6	7.3	11.3	44.4	28.2	12.9	0.6	38.5
Haryana	11.2	7.5	6	42.7	16.7	16.6	1.2	32.6
Jharkhand	37	19	13.4	77.2	47.5	20.2	6.4	81.8
Karnataka	20.9	7.3	11.7	49.3	27.3	21.2	1.5	46.7
Kerala	7.1	6.9	4	22.5	8.2	24.8	2.4	29.7
Madhya Pradesh	31.7	12.2	16.8	73.5	42.3	24.8	1.5	67.5
Maharashtra	17.4	5.1	12	49.1	25.1	18.5	2.2	43.4
Nct Of Delhi	9.9	1.7	0.2	19.4	7.5	4.7	0.4	10.3
Odisha	32.6	16.3	16.1	78.4	45.2	22.1	5.2	78
Puducherry	9.7	3.6	5.5	13.4	2.7	25.8	2.5	26.8
Punjab	8	5.2	5.7	21.3	6.9	19.2	0.4	22.7
Rajasthan	14.7	12.9	7.2	54.2	33.2	15.5	1.9	45.9
Tamil Nadu	11.3	6.9	13.3	23.6	6.1	29.3	1.8	37.8
Telangana	9.2	7.5	17	42.9	20.6	19.1	3.9	46.6
Uttar Pradesh	29.4	10.6	10	73.9	45.5	19.6	4.8	66.1
Uttarakhand	11.3	9.9	4	45.9	27.2	10.8	1.8	35
West Bengal	20	9.9	11.2	57.3	24.7	28.5	2.7	54.3

Source: (erstwhile) Planning Commission; Census of India 2011, Period Labour Force Survey (2017-18)

Table 5: Percentage of population needing regular/essential care

States	Population chronically ill (%)	Males (15-54 years) with cancer (%)	Female (15-49 years) with cancer	Population (50 years and above) with cancer (%)	Chronic healthcare need Index
Andhra Pradesh	10.41	0.18	0.09	0.08	22.9
Assam	0.58	0.07	0.09	0.09	7.9
Bihar	0.59	0.15	0.61	0.02	28.0
Chhattisgarh	1.33	0.02	0.09	0.03	5.4
Gujarat	3.38	0.05	0.13	0.11	14.3
Haryana	2.21	0.1	0.18	0.27	23.3
Jharkhand	1.44	1.29	0.04	0.05	21.2
Karnataka	1.84	0.09	0.33	0.06	18.9
Kerala	18.15	0.05	0.17	0.51	56.7
Madhya Pradesh	1.55	0.21	0.15	0.03	10.8
Maharashtra	4.12	0.09	0.09	0.14	15.7
NCT Of Delhi	1.39	0	0.03	0	1.2
Odisha	3.47	0.18	0.06	0.13	14.2
Punjab	5.3	0	0.12	0.21	20.9
Rajasthan	2.11	0.05	0.06	0.2	13.9
Tamil Nadu	3.71	1.89	0.38	0.13	50.9
Telangana	2.97	0.11	0.08	0.13	13.4
Uttar Pradesh	2.2	0.08	0.07	0.09	9.5
Uttarakhand	0.79	0	0.09	0.29	17.1
West Bengal	9.01	0.17	0.14	0.44	40.6
India	3.66	0.28	0.17	0.16	

Source: Estimated from NFHS 4 and NSS 75th Round (Health) unit-record data

Table 6: Percentage of students (6-18 years old) who are more vulnerable due to stopping of classes

States	Students (6-18 years) having internet connection at home (%)	Students (6-18 years) having computer at home (%)	Students (6-18 years) having both computer and internet connection at home (%)
Andhra Pradesh	16.8	5.3	3.4
Assam	14.6	6.9	5.7
Bihar	16.9	4.5	3.8
Chhattisgarh	15.7	7.2	6.1
Gujarat	30.7	9.5	8
Haryana	41.8	11.9	10.7
Jharkhand	18.2	3.5	2.7
Karnataka	12.4	6.1	4.7
Kerala	54.3	20.6	18
Madhya Pradesh	15.1	4.7	3.5
Maharashtra	33.2	12	10.3
NCT of Delhi	61.6	36.6	34.3
Odisha	8.5	4	3.1
Punjab	45.4	13.7	11.8
Rajasthan	24	10.6	9.4
Tamil Nadu	19.2	15.7	11.3
Telangana	21.8	8.3	6.7
Uttar Pradesh	16.4	6.8	5.9
Uttarakhand	43.5	12.2	10.1
West Bengal	13.8	6.7	5.9
India	22.0	8.6	7.2

Source: Estimated from National Sample Survey 75th Round (2017-18) unit record data (Education)

Table 7: Maximum percentage of goers (up to 18 years old) who may be vulnerable due to disruption of mid-day meals across Indian states

States	Children/teenagers (0-18 years) receiving mid-day meals (%)	Children/teenagers (0-18 years) below median PCCE households receiving mid-day meals (%)	Index of school education disruption
Andhra Pradesh	29	36.8	47.1
Assam	41.1	43.4	71.5
Bihar	38	39.4	84
Chhattisgarh	40.4	43	83.5
Gujarat	29.8	40.9	36
Haryana	15.8	24.2	39.9
Jharkhand	39.9	42.7	83.7
Karnataka	38.8	47.8	49.6
Kerala	34.1	43.4	36.7
Madhya Pradesh	29.4	32.8	64.5
Maharashtra	30.3	39.2	45
NCT of Delhi	20.5	31.7	18.9
Odisha	37.9	40.4	72.5
Punjab	19.3	33	31.3
Rajasthan	25.6	32.4	58.8
Tamil Nadu	36.3	43.3	44.2
Telangana	28.4	44.7	47.7
Uttar Pradesh	20.2	23	68.9
Uttarakhand	23.5	37	48.7
West Bengal	42.3	44.7	64.7
India	30.4	35.1	--

Source: Estimated from National Sample Survey 75th Round (2017-18) unit record data (Education)

Table 8: Social effects related to alcohol addiction and domestic violence

States	Men reporting regular drinking (%)	Married women reporting domestic violence (%)	Women reporting drunkard husband (%)	Women reporting domestic violence with drunkard husband (%)	Social Bad Index
Andhra Pradesh	23.3	4.4	43	57.6	66.1
Assam	27.1	2.3	31.9	35	47.4
Bihar	15	4	33.3	66.9	42
Chhattisgarh	22.8	3.1	54.5	46.7	51
Gujarat	5	2.9	8.9	50.3	28.7
Haryana	13.2	3	25.3	52.1	39.3
Jharkhand	19	3.1	44.1	48.4	43
Karnataka	20.6	2	22.7	39.3	38.5
Kerala	19.3	1.9	35.6	26.5	33.1
Madhya Pradesh	14.7	2.8	27.7	53.1	38.4
Maharashtra	9.9	1.9	18	50	26.2
NCT of Delhi	12.5	1.9	29.7	53	30.7
Odisha	21.7	3.3	33.5	55	51.1
Punjab	22.5	1.8	33.3	34	39.2
Rajasthan	7	2.3	21.3	46.5	24.2
Tamil Nadu	29.3	5	40.2	57.3	80
Telangana	32.2	4.4	57.5	51.7	75.1
Uttar Pradesh	8.1	2.9	26.7	56.3	30.5
Uttarakhand	18.1	1.1	36	22.7	25.9
West Bengal	11.5	3.2	24	54	41.2
India	15.6	3.0	29.7	50.6	

Source: NFHS-4 (2015-16)

Table 9: Level of different index values

state	index of risk of spread*	index of risky population	index of poor population	index of healthcare disruption	index of educational disruption	index of social bad
Andhra Pradesh	medium	high	medium	high	medium	high
Assam	low	low	medium	low	high	high
Bihar	high	low	high	high	high	high
Chhattisgarh	low	low	high	low	high	high
Gujarat	high	medium	low	medium	medium	low
Haryana	medium	low	low	high	low	medium
Jharkhand	low	low	high	high	high	medium
Karnataka	low	medium	medium	medium	high	medium
Kerala	medium	high	low	high	low	low
Madhya Pradesh	medium	medium	high	low	medium	medium
Maharashtra	high	medium	medium	medium	medium	low
NCT of Delhi	high	medium	low	low	low	low
Odisha	low	high	high	medium	high	high
Punjab	medium	high	low	medium	low	medium
Rajasthan	low	low	medium	low	low	low
Tamil Nadu	high	high	low	high	medium	high
Telangana	medium	high	medium	low	medium	high
Uttar Pradesh	high	low	high	low	low	low
Uttarakhand	low	medium	low	medium	low	low
West Bengal	high	high	high	high	high	medium

Note: *This was computed based on number of COVID-19 cases reported as of May 3, 2020. Depending upon individual state relative progress in testing and containing cases, this ranking might change.

Source: Computed data provided by Ministry of Health and Family Welfare, Government of India; Census 2011, NFHS 4, NSS 75 Education; NSS 75 Health, PLFS (2017-18), Central Bureau of Health Intelligence; (erstwhile) Planning Commission

Figures

Figure 1: Scatter plot showing the known COVID-19 cases (up to May 3) and Population density across major Indian states.

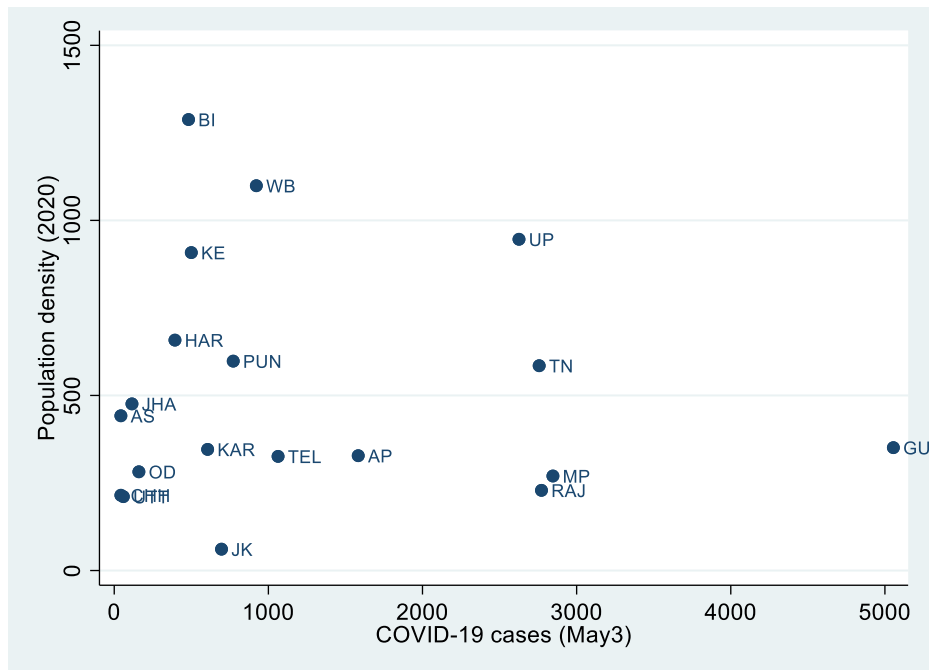


Figure 2: Scatter showing index of COVID spread risk and index of risky population for major Indian states (excluding Delhi)

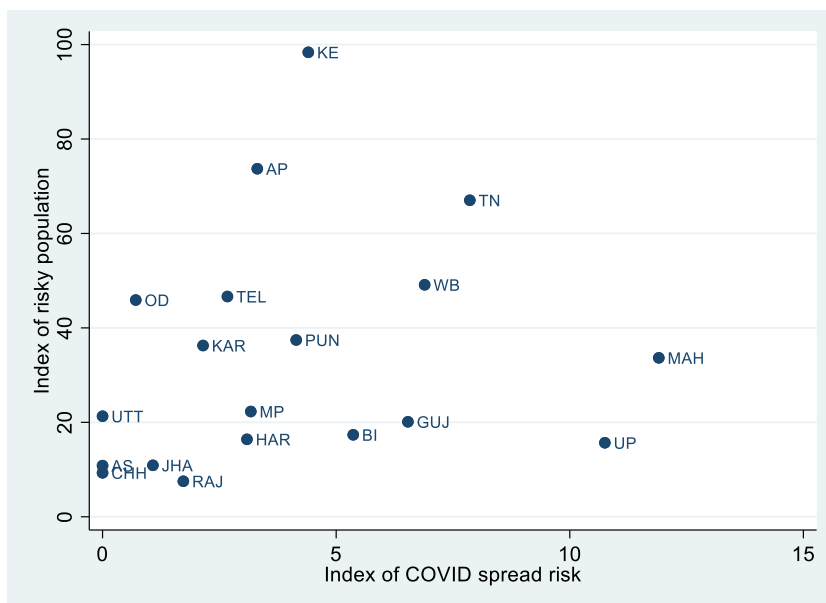


Figure 3: Cluster of states with lower/higher index values of risky population and institutional health sector capacity

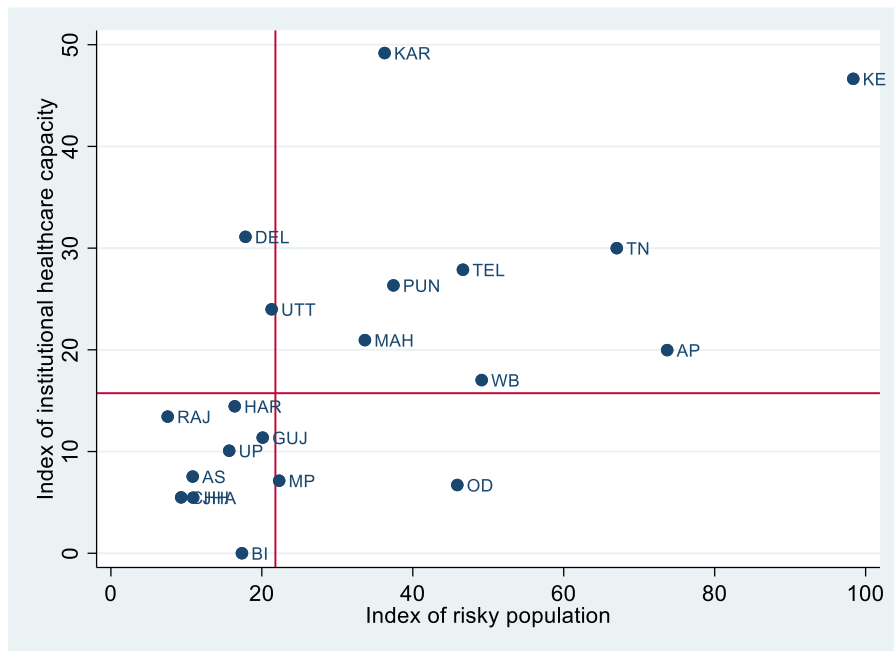


Figure 4: Scatter showing the mutual association between indicators of poor & vulnerable population

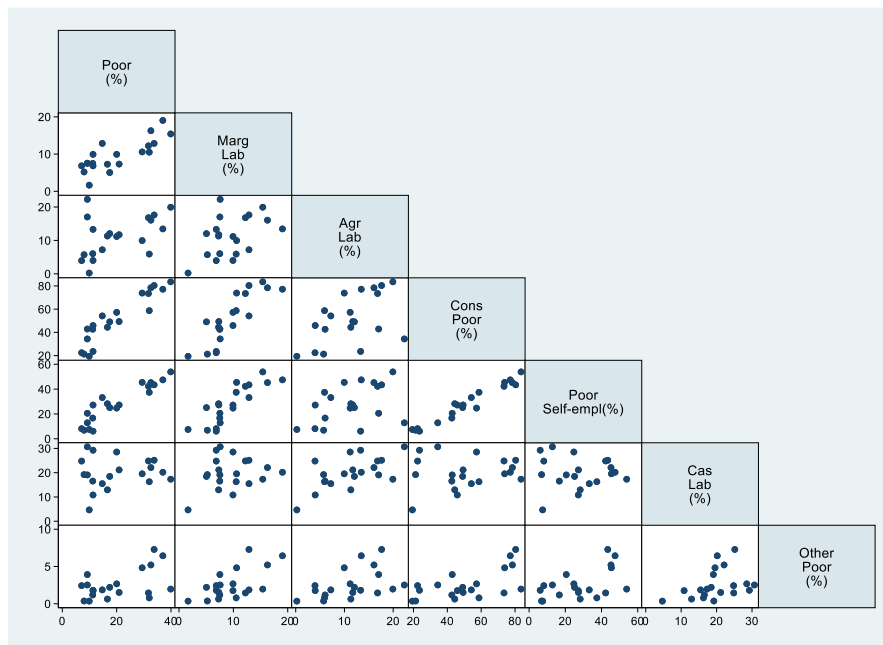


Figure 5: Scatter showing the index values of poor and index values of per capita NSDP for the states

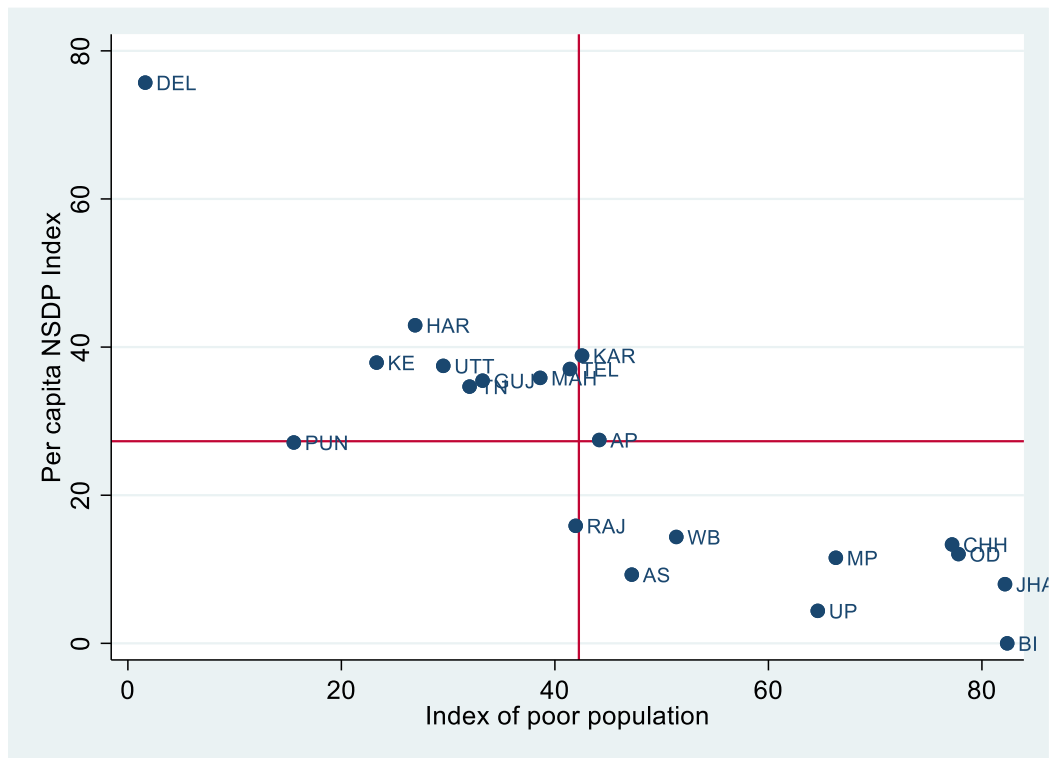
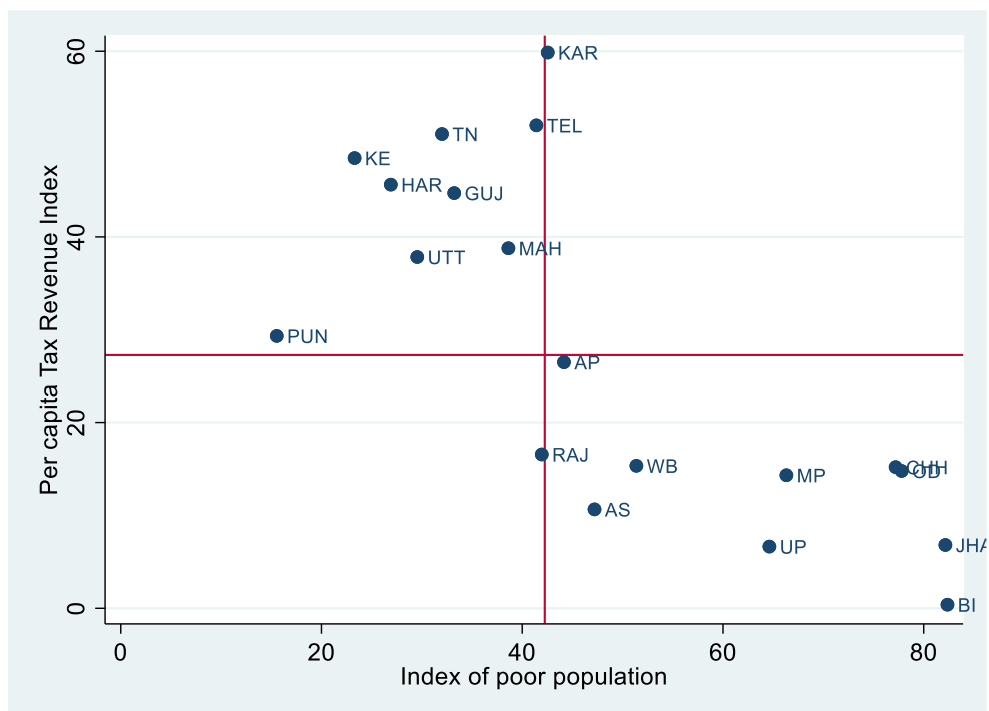
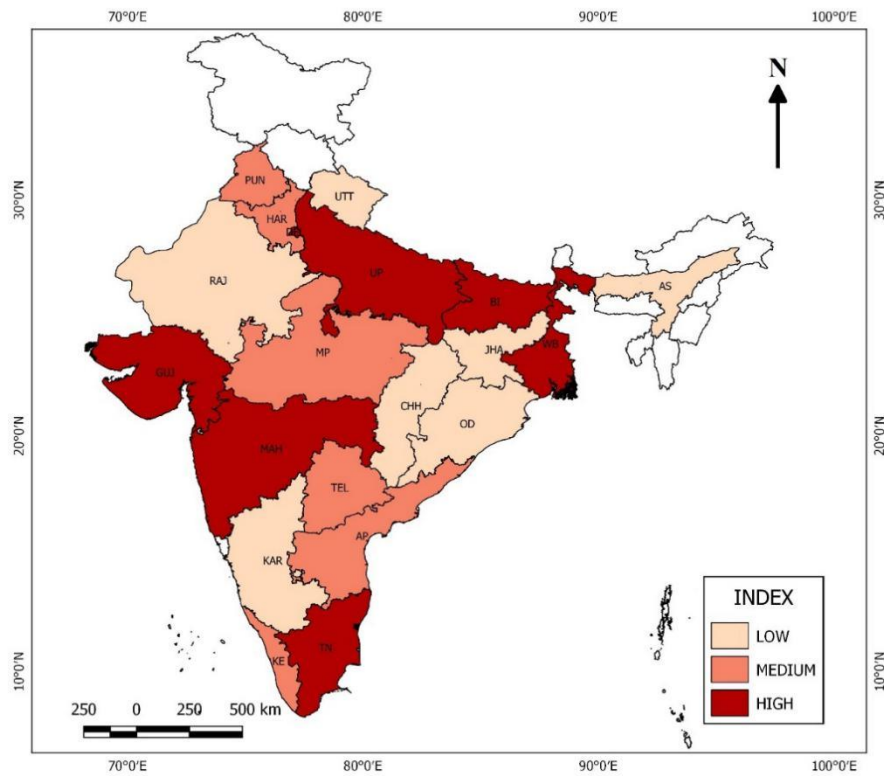


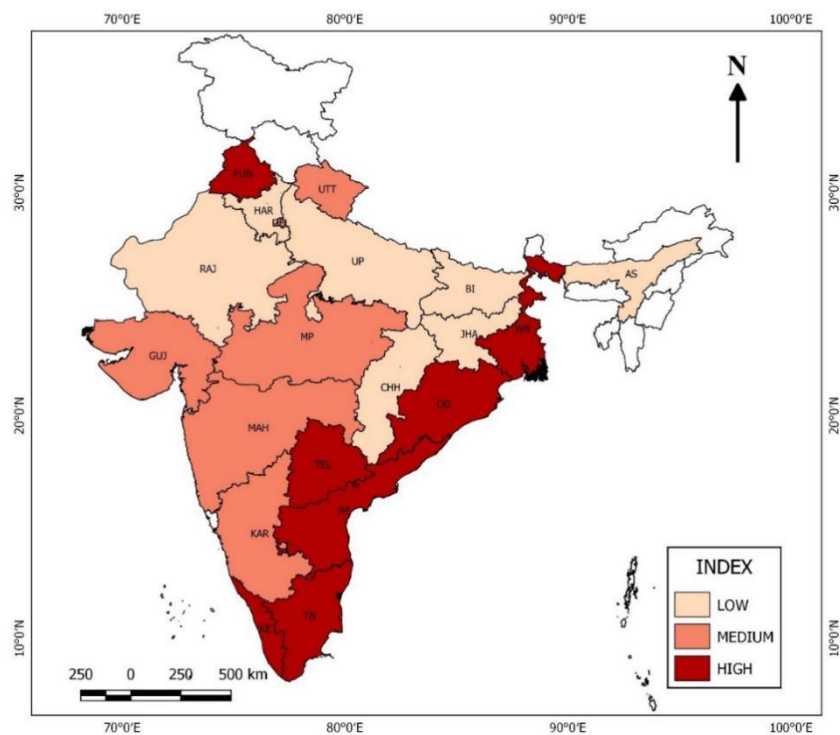
Figure 6: Scatter showing the index values of poor and index values of per capita revenue for the states



Map 1: Showing Index of COVID-19 Spread Risk Across Indian States



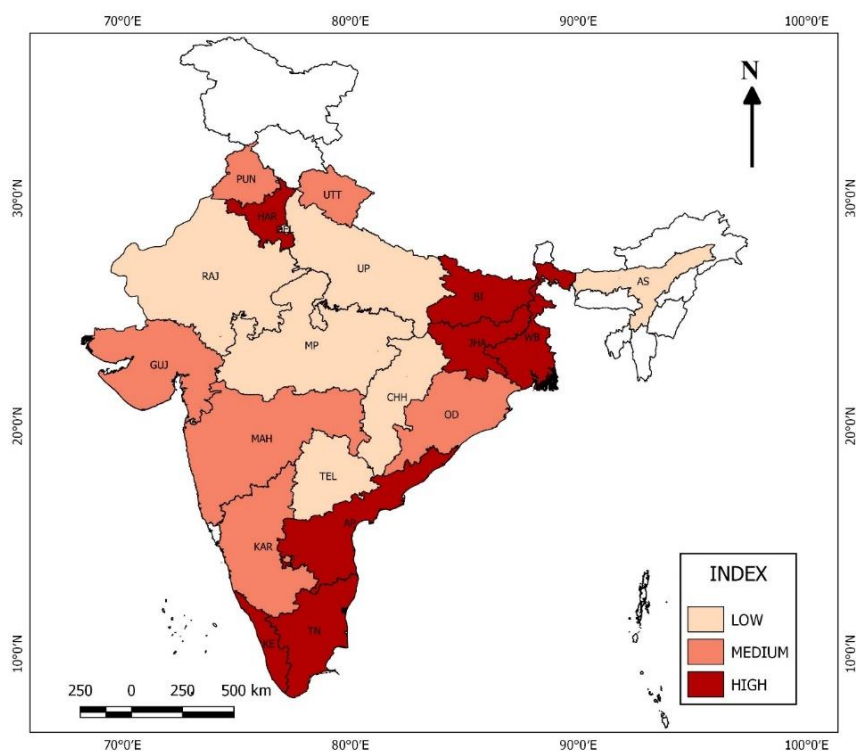
Map 2: Showing Index of Risky Population Across Indian States



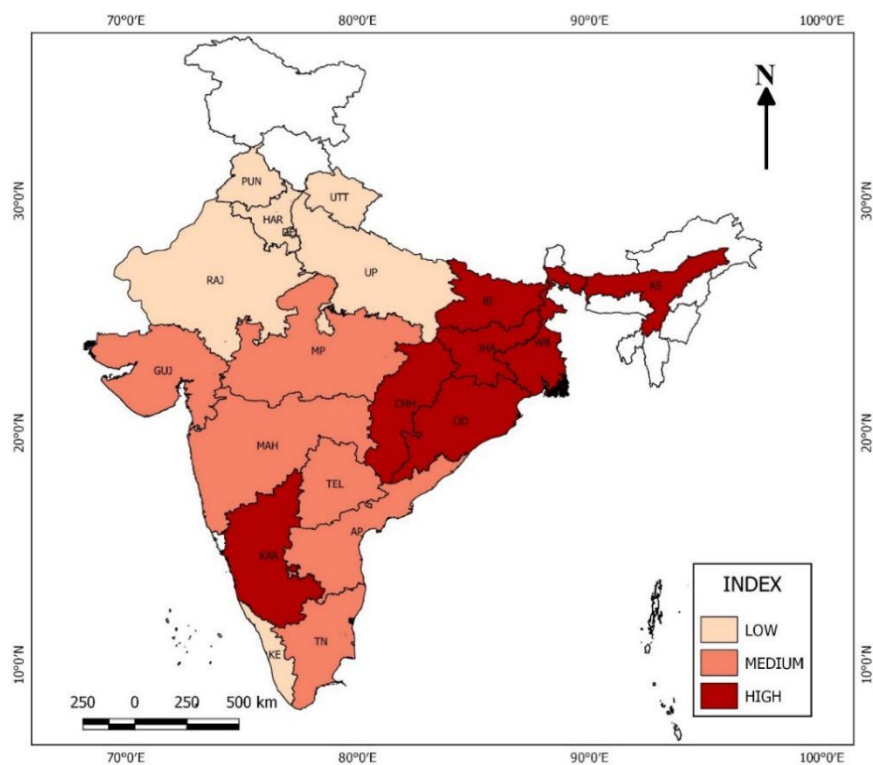
The map displays the spatial distribution of the Index of Agricultural Sustainability (IAS) across India. The states are categorized into three levels of sustainability: Low (light orange), Medium (medium orange), and High (dark red). The High IAS states are concentrated in the northern and western regions, including Punjab, Haryana, Uttar Pradesh, Rajasthan, Gujarat, Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, West Bengal, and Assam. The Medium IAS states are primarily in the central and eastern regions, including Madhya Pradesh, Chhattisgarh, Odisha, Jharkhand, Bihar, and Jammu & Kashmir. The Low IAS states are limited to Himachal Pradesh, Uttarakhand, and Arunachal Pradesh. A scale bar indicates distances up to 500 km, and a north arrow is provided for orientation.

State	IAS Level
Punjab	High
Haryana	High
Uttar Pradesh	High
Rajasthan	High
Gujarat	High
Maharashtra	High
Karnataka	High
Andhra Pradesh	High
Tamil Nadu	High
West Bengal	High
Assam	High
Madhya Pradesh	Medium
Chhattisgarh	Medium
Odisha	Medium
Jharkhand	Medium
Bihar	Medium
Jammu & Kashmir	Medium
Himachal Pradesh	Low
Uttarakhand	Low
Arunachal Pradesh	Low

Map 5: Showing Index of Chronic Care Disruption Across Indian States



Map 6: Showing Index of School Education Disruption Across Indian States



Map 7: Showing Index of social bad Across Indian States

