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COVID-19

VULNERABILITY INDEX:

Mapping for the
Indian States

COVID-19

Vulnerability Index: Mapping for the Indian States

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INTRODUCTION

The unprecedented reality of COVID-19 has led to devastating consequences across the globe, especially affecting vulnerable areas and population the most. Within India, several measures have been taken by the Central and State governments through the initiation of lockdowns, information and awareness generation campaigns, relief packages for the marginalised population, developing protocols to support healthcare workers and bolster healthcare infrastructure.

The Indian state governments have been closely working with the central government by acting as the primary implementing agencies for the efficient application of the lockdown, which has now been extended till 3rd May. With law and order and health being state subjects, Indian state governments become the principal stakeholders in such a health emergency. In such times, it is crucial to develop the capacities of Indian states such that they can effectively control the coronavirus outbreak at the frontline.

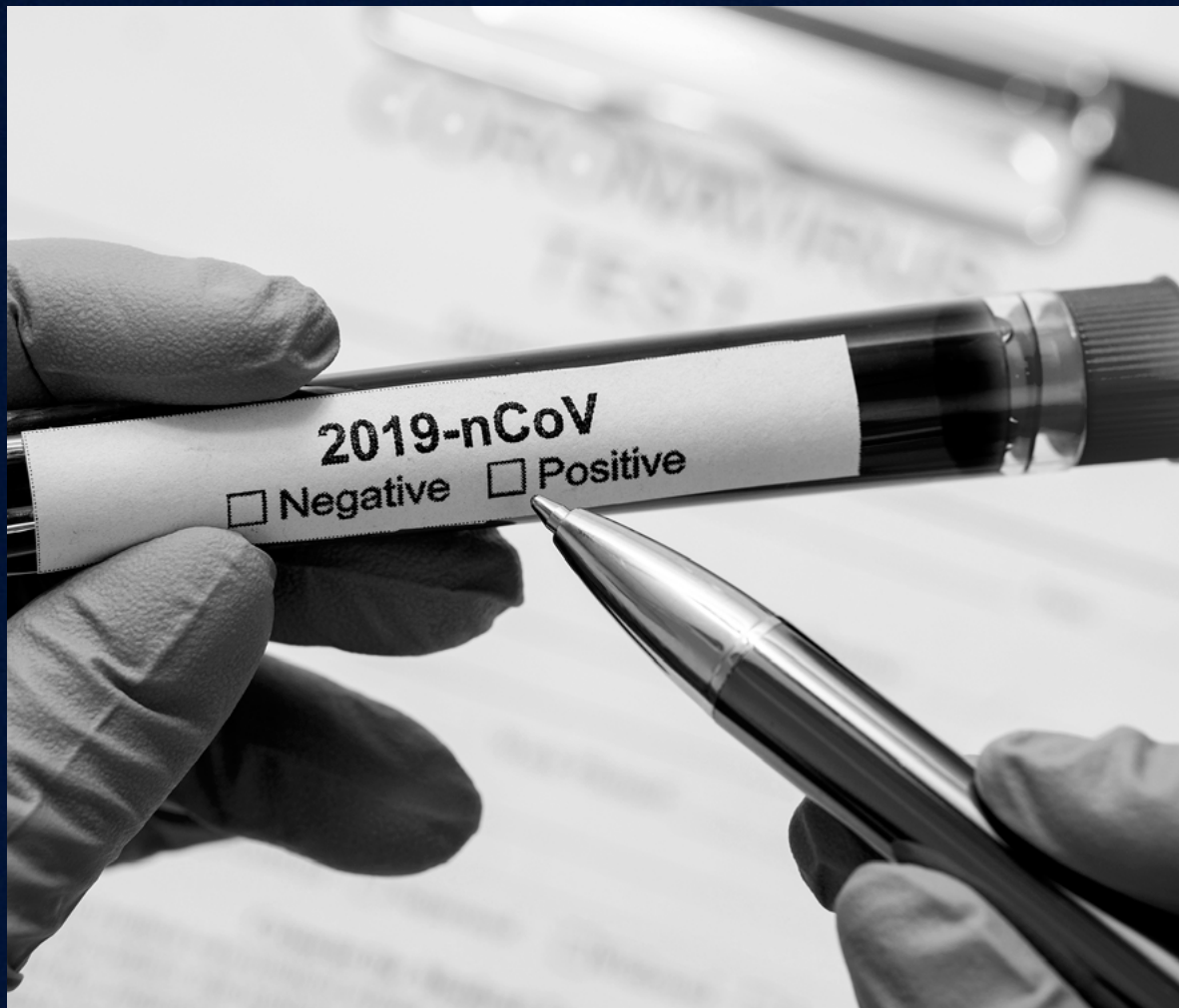
Within the broader ambit of infected cases, it has been noticed that the fatalities tend to be higher for the older population and people with pre-existing medical conditions, such as heart disease, high blood pressure, lung disease, cancer and diabetes due to their poor immune systems¹. Nonetheless, while states have been ensuring that social distancing protocols are met by everyone, there is still a lack of targeted interventions for the elderly and chronically ill demographic within states. Along with the presence of chronically ill and elderly population, states having relatively poor health infrastructure and capital are in a much more susceptible position with respect to dealing with the demands presented by this virus.

Keeping the broader needs of the Indian states in mind, the Institute for Competitiveness has developed a COVID-19 vulnerability index for Indian states by mapping indicators related to health infrastructure, population demographics and underlying health issues of the people residing in Indian states.

¹ World Health Organisation. (2020, April 8). Q & A on coronaviruses (COVID-19). Retrieved from <https://www.who.int/news-room/q-a-detail/q-a-coronaviruses>

This COVID-19 vulnerability index for Indian states has been largely influenced by the U.S. Social Progress Imperative work on mapping USA's 500 largest cities for COVID-19 vulnerability. The Social Progress Imperative tool also measures the vulnerability of cities based on a combination of factors focusing on infrastructure, health and demographic factors².

The data used for making this COVID-19 Indian states vulnerability index has been collected and verified from several sources including National Health Profile (published by the Central Bureau of Health Intelligence), National Family Health Survey, Census of India, Rural Health Statistics (published by the Health Management Information System, Ministry of Health and Family Welfare) and Invest India. This index would only act as a barometer of the Indian states' vulnerability to the virus and is not indicative of the current actions taken by the specific governments to resist the spread of COVID-19. This index could act as an analytical tool for Indian states to pay special attention to the existing vulnerable population as well as develop their long-term health infrastructure and human capital.

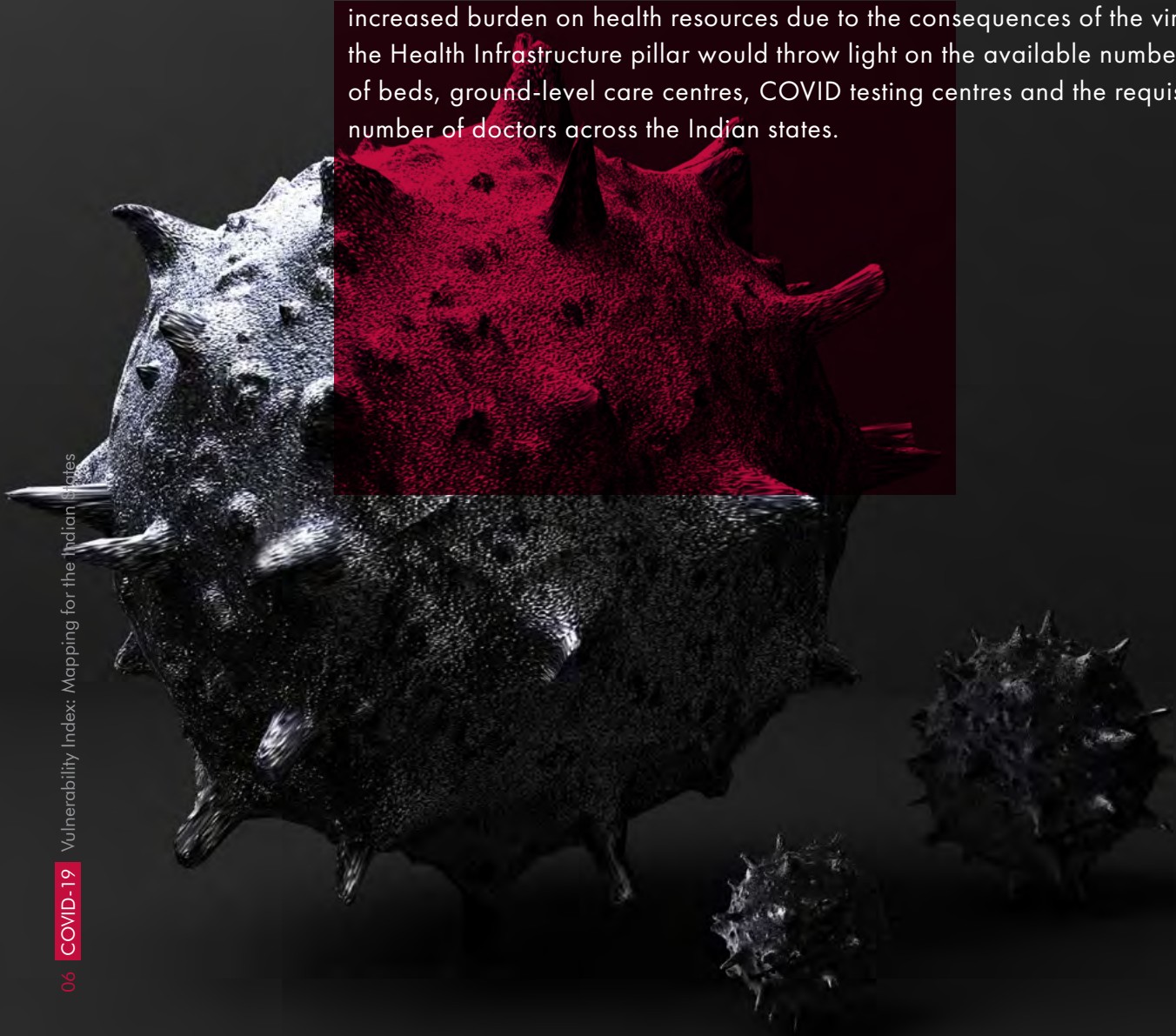


² Social Progress Imperative. (2020, April 3). Covid-19 vulnerability mapping for the US's 500 largest cities. Retrieved from <https://socialprogress.blog/2020/04/03/covid-19-vulnerability-mapping-for-the-uss-500-largest-cities/>

INDIAN STATES' COVID-19 VULNERABILITY INDEX: METHODOLOGY OF THE INDEX

The index has analysed 36 Indian states and Union territories by ranking them according to their vulnerability to COVID-19, with Rank 1 being most vulnerable and Rank 36 being least vulnerable. Fourteen indicators used within this index have been grouped under Health Infrastructure, Population Demographics and Underlying Health Issues.

As mentioned before, the pillars for this index have been chosen, keeping in mind the required resources and the most vulnerable population across states. The indicators for the pillars of Population Demographics and Underlying Health Issues have been selected to provide insights into the number of elderly and chronically ill people across states. Additionally, with increased burden on health resources due to the consequences of the virus, the Health Infrastructure pillar would throw light on the available number of beds, ground-level care centres, COVID testing centres and the requisite number of doctors across the Indian states.



Due to the novelty of the virus, data on the exact relationship of health infrastructure, population demographics and comorbidities on COVID-19 is still lacking. Due to the evolving nature of the research and established significance of these three factors, the pillars of Health Infrastructure, Population Demographics and Underlying Health Issues have been weighted equally.

Nonetheless, the indicators within the pillars have been weighted in accordance with Principal Component Analysis. The weightage on the risk factors is not India-specific due to a lack of research on the same. The indicators and pillars used in the Indian states' COVID-19 vulnerability index are:



0.33

Health Infrastructure



0.33

Population Demographics



0.33

Underlying Health Issues

The weightages of the indicators within the pillars are:

Health infrastructure

Indicator	Weightage	Source
Households with any usual member covered by a health scheme or health insurance (in percentage)	0.129	National Family Health Survey
Total no. of government beds	0.281	National Health Profile 2019
Total no. of Community Health Centres ^{*3}	0.245	National Health Profile 2019
Total no. of testing centres	0.122	Invest India
Vacancy percentage of doctors in district hospitals	0.223	Rural Health Statistics

³ Community Health Centres have been classified as last resort COVID Care Centres and deemed important for essential non-COVID medical services to relieve the pressure from dedicated COVID Hospitals. The Economic Times. (2020, April 7). Government classifies health facilities into three categories for COVID-19 patient care. Retrieved from <https://economictimes.indiatimes.com/news/politics-and-nation/government-classifies-health-facilities-into-3-categories-for-covid-19-patient-care/articleshow/75033608.cms?from=mdr>

Population Demographics

Indicator	Weightage	Source
Population density	0.19	National Health Profile 2019
Population aged 60-69 (as a percentage of the total population)	0.27	Census of India
Population aged 70-79 (as a percentage of the total population)	0.27	Census of India
Population aged 80+ (as a percentage of the total population)	0.27	Census of India
Vacancy percentage of doctors in district hospitals	0.223	Rural Health Statistics

Underlying Health Issues

Indicator	Weightage	Source
Acute respiratory diseases cases (percentage of the total population)	0.206	National Health Profile 2019
Hypertension prevalence in adults (percentage of the total population)	0.206	National Health Profile 2019
Diabetes prevalence in adults (percentage of the total population)	0.221	National Health Profile 2019
Cardio-Vascular Disease prevalence in adults (percentage of the total population)	0.206	National Health Profile 2019
Common cancer prevalence in adults (percentage of the total population)	0.160	National Health Profile 2019

DISCUSSION OF THE FINDINGS

Final Rankings

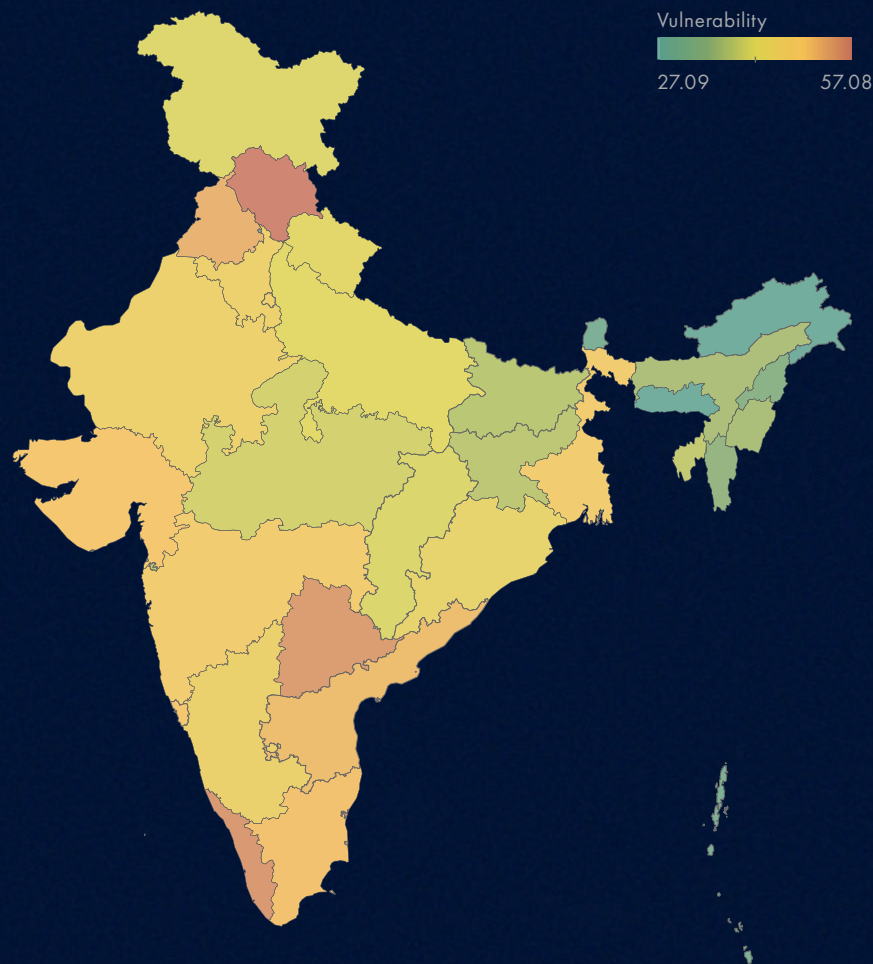


Figure A: State-wise Vulnerability Index Scores

The COVID-19 vulnerability index for all the Indian states and union territories highlight that Himachal Pradesh is the most vulnerable state, while Meghalaya is the least vulnerable. It should be noted that states/UTs with relatively lesser population density have fared better due to a lesser burden on the existing health infrastructure. Moreover, states and union territories have also been categorised as per large and small states (in terms of population), Hill states and Union Territories (as given in the following table). Within this categorisation, Andhra Pradesh, Tamil Nadu and Gujarat are the most vulnerable. Amongst the smaller states, Kerala, Telangana, Punjab and Goa are the most vulnerable. Within the Hill states, Himachal Pradesh is the most vulnerable while amongst Union Territories, Puducherry is the most vulnerable.

States	Scores ⁴	Vulnerability (as per Overall Rankings)
Large States		
Andhra Pradesh	51.14	Most Vulnerable
Tamil Nadu	50.51	Most Vulnerable
Gujarat	49.93	Most Vulnerable
Maharashtra	48.55	High-risk vulnerable
Rajasthan	46.80	High-risk vulnerable
Karnataka	45.43	High-risk vulnerable
Odisha	44.64	High-risk vulnerable
Uttar Pradesh	42.71	Medium-risk vulnerable
Madhya Pradesh	40.84	Medium-risk vulnerable
Bihar	38.38	Medium-risk vulnerable
Small states		
Kerala	55.12	Most Vulnerable
Telangana	54.49	Most Vulnerable
Punjab	52.26	Most Vulnerable
Goa	50.03	Most Vulnerable
West Bengal	48.55	High-risk vulnerable
Delhi	46.90	High-risk vulnerable
Haryana	45.94	High-risk vulnerable
Chhattisgarh	41.59	Medium-risk vulnerable
Jharkhand	38.56	Medium-risk vulnerable
Hill states		
Himachal Pradesh	57.08	Most vulnerable
Uttarakhand	43.13	High-risk vulnerable
Jammu & Kashmir	41.73	Medium-risk vulnerable
Tripura	39.27	Medium-risk vulnerable
Assam	37.06	Medium-risk vulnerable
Manipur	36.73	Low-risk vulnerable
Mizoram	34.87	Low-risk vulnerable
Nagaland	32.83	Low-risk vulnerable
Sikkim	29.23	Low-risk vulnerable
Arunachal Pradesh	27.17	Low-risk vulnerable
Meghalaya	27.09	Low-risk vulnerable
Union territories		
Puducherry	53.90	Most vulnerable
Daman & Diu	44.94	High-risk vulnerable
Dadra & Nagar haveli	40.11	Medium-risk vulnerable
Lakshadweep	36.70	Low-risk vulnerable
Chandigarh	34.59	Low-risk vulnerable
Andaman & Nicobar Islands	29.69	Low-risk vulnerable

⁴ Higher the scores, higher the vulnerability of the given State/Union Territory

Based on the overall rankings,

Himachal Pradesh

has emerged as the most vulnerable state. This is because it has a relatively high elderly and chronically ill population. However, having recognised its vulnerability, the state government has actively carried out an Active Case Finding strategy⁵ which has helped screen their entire population for influenza-like illness, thereby minimising the spread of COVID-19 infection. Furthermore, they are also following a three-pronged strategy of⁶–



Increasing the capacity of testing for COVID-19



Facilitating three types of institutions to deal with COVID 19 confirmed cases – asymptomatic people would be aided in COVID care centres, moderate symptomatic people would be treated at COVID Health Centres and severe symptomatic would be kept in COVID hospitals.



The state government has also ensured that there is adequate availability of PPE kits, masks and ventilators for all the health personnel at hospitals.

Thus, though there is a high number of vulnerable populations in the state, the government has taken proactive measures to minimise the risk for its residents. This has aided in keeping COVID-19 infections in check.

Meghalaya

is relatively less vulnerable than other Indian states because of its lower population density, lesser number of residents (as a percentage of the total population) aged above 60 and a lesser number of chronically ill people (as a percentage of the total population), specifically with respect to acute respiratory fatality, diagnosed cases of hypertension, diabetes, and cardiovascular diseases. However, its number of testing centres (as a percentage of the total population) is relatively less than other states, showing that there is a need to develop the existing health infrastructure.

⁵ The Statesman. (2020, April 27). COVID 19: Himachal's Active Case Finding strategy finds favour with PM. Retrieved from <https://www.thestatesman.com/cities/shimla/covid-19-himachals-active-case-finding-strategy-finds-favour-pm-1502881425.html>

⁶ The Statesman. (2020, April 23). HP moots three pronged strategy to tackle COVID-19 crisis. Retrieved from <https://www.thestatesman.com/cities/shimla/hp-moots-three-pronged-strategy-tackle-covid-19-crisis-1502880132.html>

The Relation between Vulnerability Scores and State-Wise COVID-19 Data

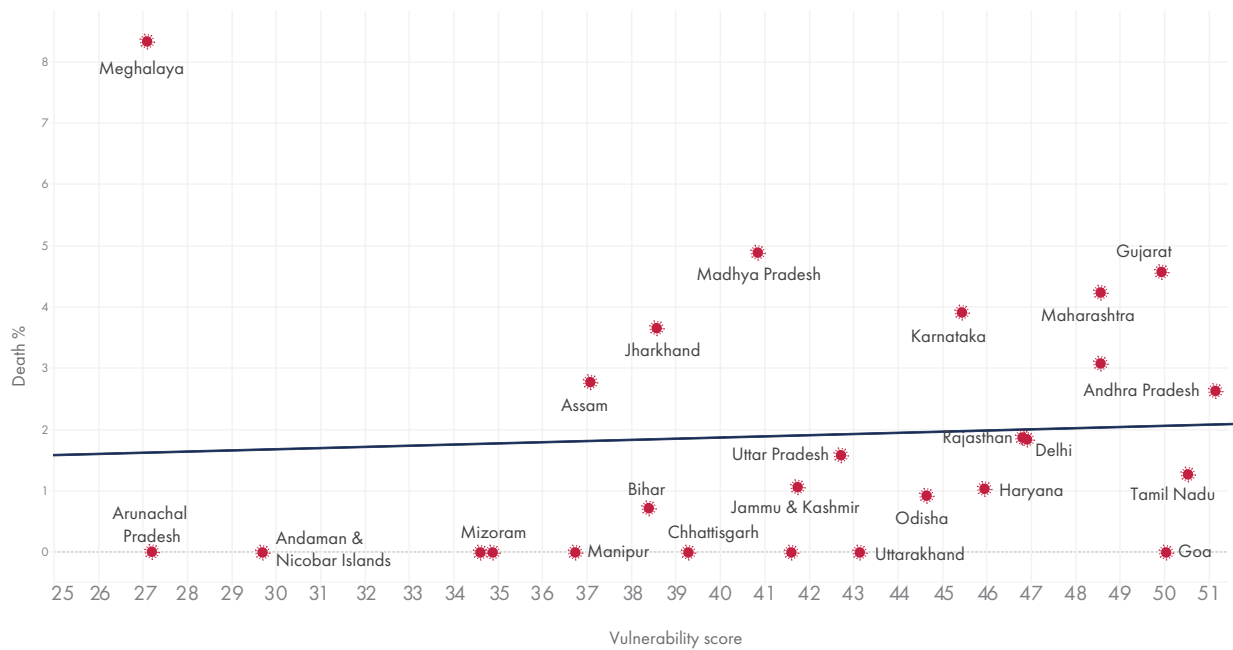


Figure B: Correlation between deaths (as a percentage of total cases) and State-wise vulnerability scores

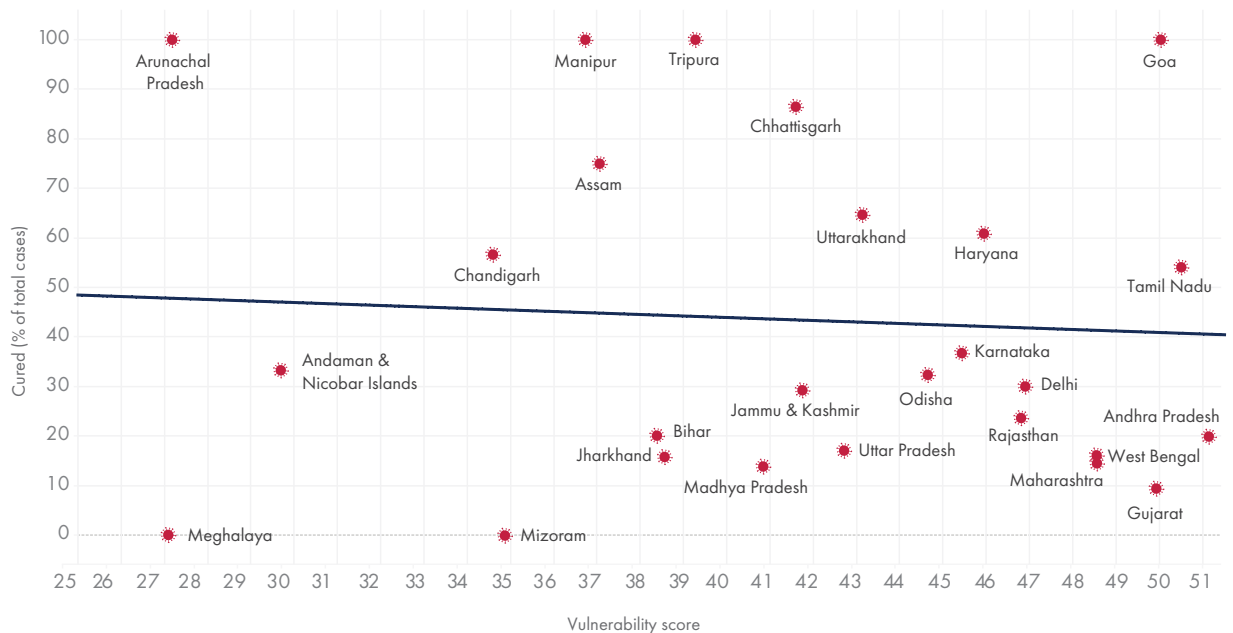


Figure C: Correlation between cured cases (as a percentage of total cases) and State-wise vulnerability scores

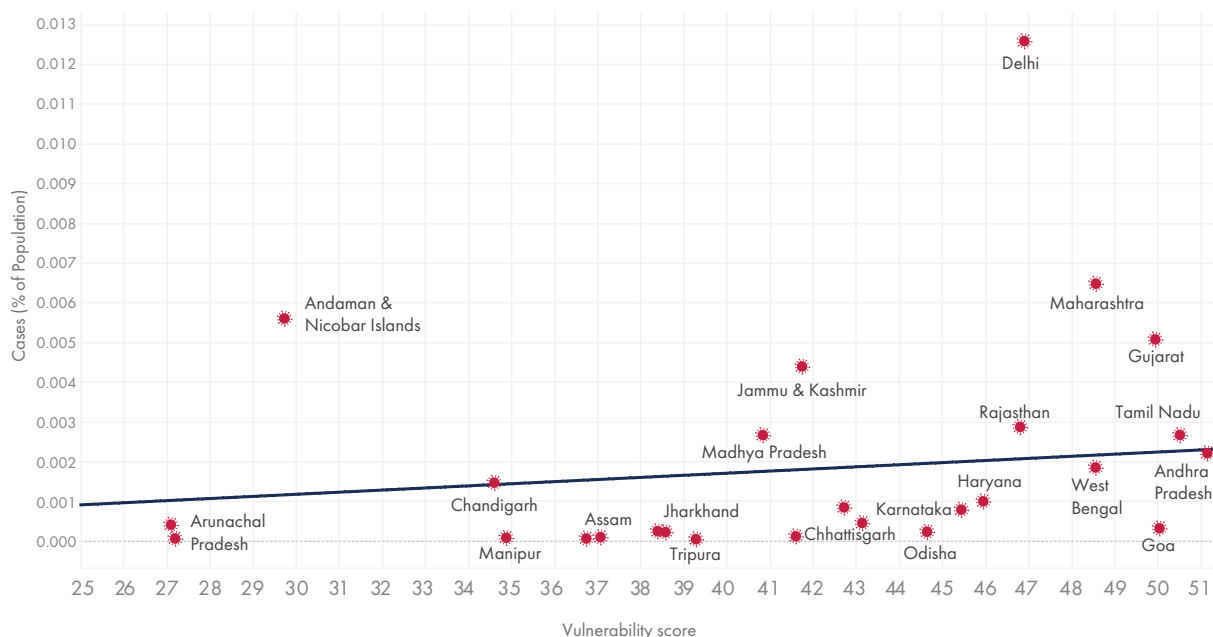


Figure D: Correlation between the total number of cases (as a percentage of the total population) and State-wise vulnerability scores

The overall index scores have also been correlated with state-wise with the total number of cases (as a percentage of the total population), deaths and cured cases (as a percentage of total cases). Figure B highlights that there is a slight positive correlation between deaths (as a percentage of total cases) and vulnerability scores. This implies that there is a possibility of higher deaths in the more vulnerable states/UTs. Figure C shows that there is a slight negative correlation between cured cases (as a percentage of total cases) and State-wise vulnerability scores. This indicates that there could be a greater chance of increased recovery cases in the least vulnerable states. Figure D additionally confirms a positive relationship between the total number of cases (as a percentage of the total population) and state-wise vulnerability scores. This suggests that more vulnerable states are susceptible to a higher number of confirmed cases, indicating that a greater degree of cautiousness is required in such states to minimise the spread of COVID-19.



PILLAR LEVEL ANALYSIS



Health Infrastructure Vulnerability Pillar

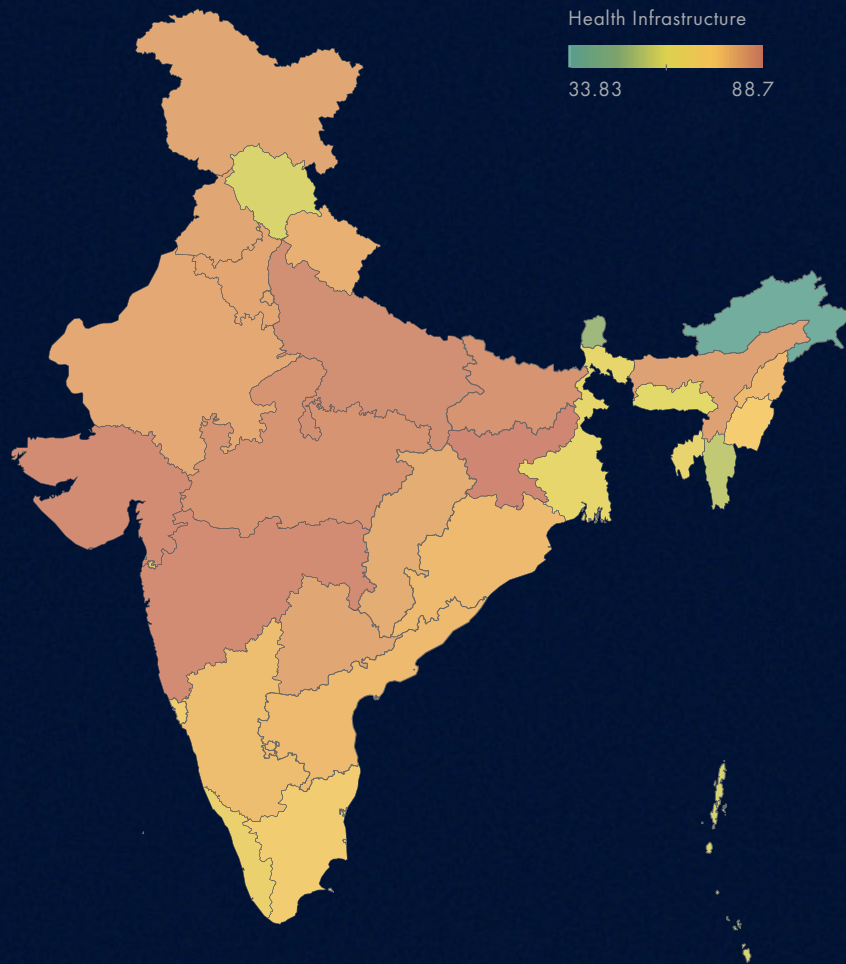


Figure E: State-wise health infrastructure vulnerability rankings⁷

The rankings of this pillar show that Jharkhand is the most vulnerable state in terms of its health infrastructure capacity, whereas Arunachal Pradesh is the least vulnerable state. Apart from Jharkhand, the top 10 most health infrastructure vulnerable states/UTs are:

States/Union Territories	Ranking as per the Health Infrastructure Pillar	States/Union Territories	Ranking as per the Health Infrastructure Pillar
Jharkhand	1	Madhya Pradesh	6
Maharashtra	2	Daman and Diu	7
Gujarat	3	Assam	8
Uttar Pradesh	4	Telangana	9
Bihar	5	Jammu & Kashmir	10

⁷ Higher the score, higher the vulnerability of the state in the pillar



It can be observed that most of the states in the top 10 most vulnerable health infrastructure list, also have a relatively larger population which could create undue stress on their available resources. However, in relation to other states/UTs, Jharkhand has very poor performance in terms of available health infrastructure – Only 13.3 percent of households with any usual member are covered by health scheme/insurance, 31.27 government beds exist per lakh population, 0.5 Community Health Centres (CHCs) are present per lakh population, and there is a 31.72 percent vacancy of doctors at the district hospitals with a population density of just 414 people per sq km (Delhi has a population density of 11320 people per sq km in comparison).

Maharashtra

is the second most vulnerable state in terms of health infrastructure, which is even more concerning as it is the leading state in terms of COVID-19 confirmed cases as of 2nd May 2020 (10498 cases)⁸. Within Maharashtra – only 15 percent of households with any usual members have been covered by health scheme/insurance, 41.85 government beds exist per lakh population, 0.29 CHCs are present per lakh population, and there is a

32.27 % vacancy of doctors
at district hospitals with
an overall state
population density
of 365 persons
per sq km.

⁸ Ministry of Health and Family Welfare. (2020). COVID-19 Statewise Status. Retrieved from <https://www.mohfw.gov.in/>



Population Demographics Vulnerability Pillar

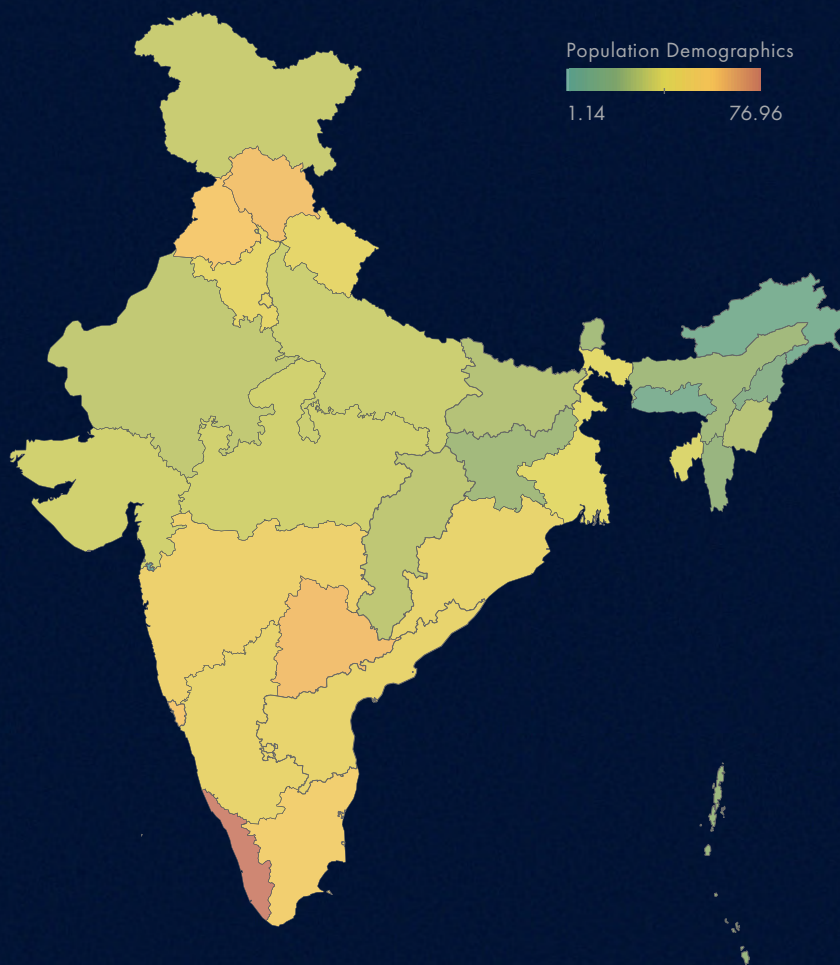


Figure F: State-wise population demographics vulnerability rankings⁹

The rankings of this pillar highlight that Kerala is the most vulnerable state in terms of population demographic, whereas the Union Territory of Dadra and Nagar Haveli is the least vulnerable. The top 10 states/UTs in terms of their population demographic vulnerability are:

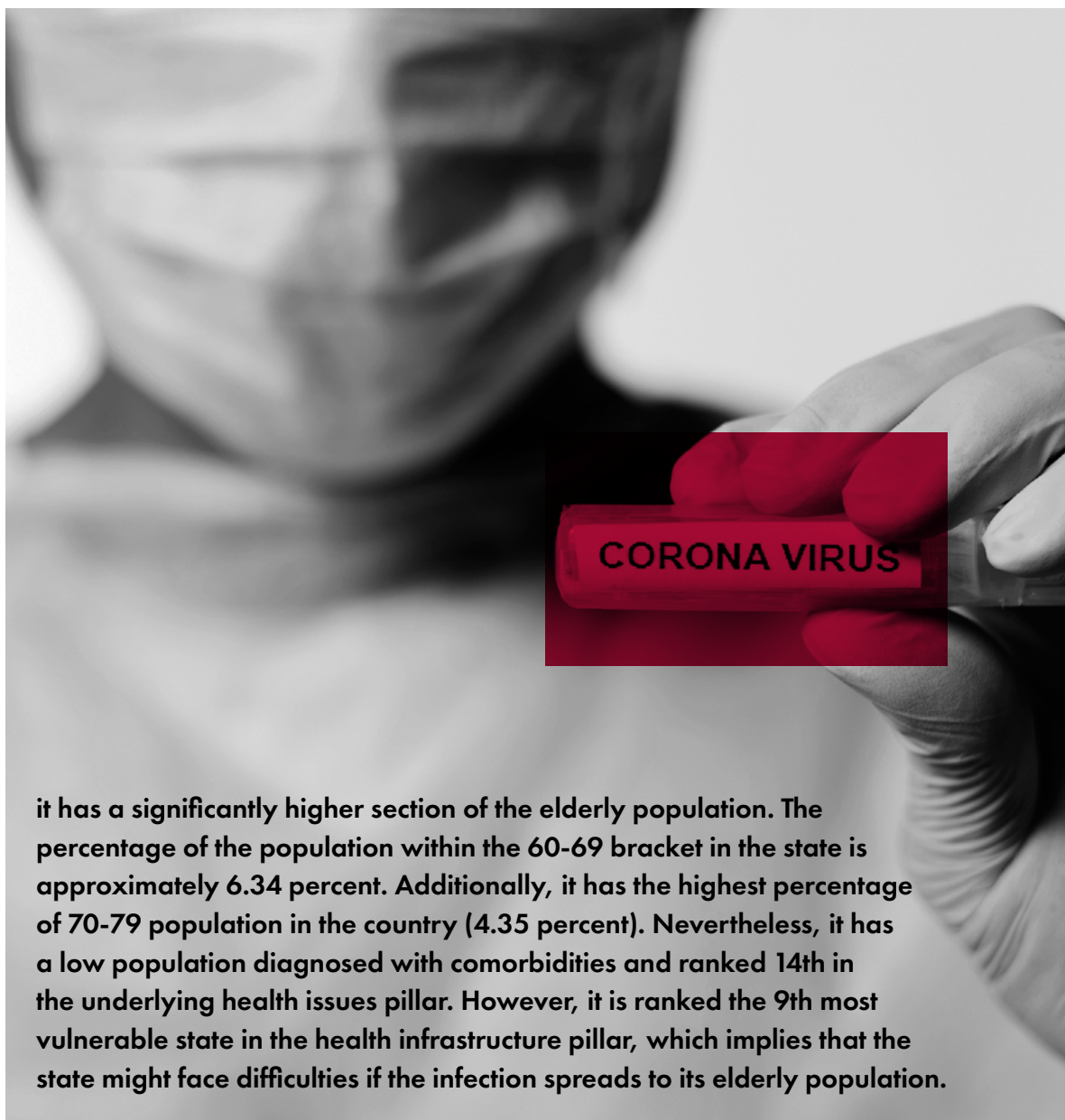
State	Rankings as per the Population Demographics Pillar	State	Rankings as per the Population Demographics Pillar
Kerala	1	Tamil Nadu	6
Telangana	2	Puducherry	7
Himachal Pradesh	3	Maharashtra	8
Goa	4	Karnataka	9
Punjab	5	Andhra Pradesh	10

⁹ Higher the score, higher the vulnerability of the state in the given pillar

Kerala

has a population density of 860 persons per sq km

but the percentage of its elderly population to its total population is significantly high. This state has approximately 7.23 percent of people who fall in the 60-69 bracket, 3.6 percent who fall in the 70-79 bracket and 1.62 percent who fall in the 80+ bracket (as a percentage of the total population). Nonetheless, this has been offset by Kerala's good health infrastructure, being the 25th most health infrastructure vulnerable state out of 36 states/UTs. The Kerala state government has also realised its vulnerability in terms of its elderly and comorbidity population and has made protocols to keep them quarantined even after the mandated COVID-19 lockdown is over¹⁰.



Although **Telangana** has been categorised as a small state and has relatively low population density

it has a significantly higher section of the elderly population. The percentage of the population within the 60-69 bracket in the state is approximately 6.34 percent. Additionally, it has the highest percentage of 70-79 population in the country (4.35 percent). Nevertheless, it has a low population diagnosed with comorbidities and ranked 14th in the underlying health issues pillar. However, it is ranked the 9th most vulnerable state in the health infrastructure pillar, which implies that the state might face difficulties if the infection spreads to its elderly population.

¹⁰ Kumar, S.M.K. (2020, April 5). Coronavirus in Kerala: Elderly to be the focus post April 14. Retrieved from <https://timesofindia.indiatimes.com/city/kochi/coronavirus-in-kerala-elderly-to-be-the-focus-post-april-14/articleshow/74993439.cms>



Underlying Health Issues Vulnerability Pillar

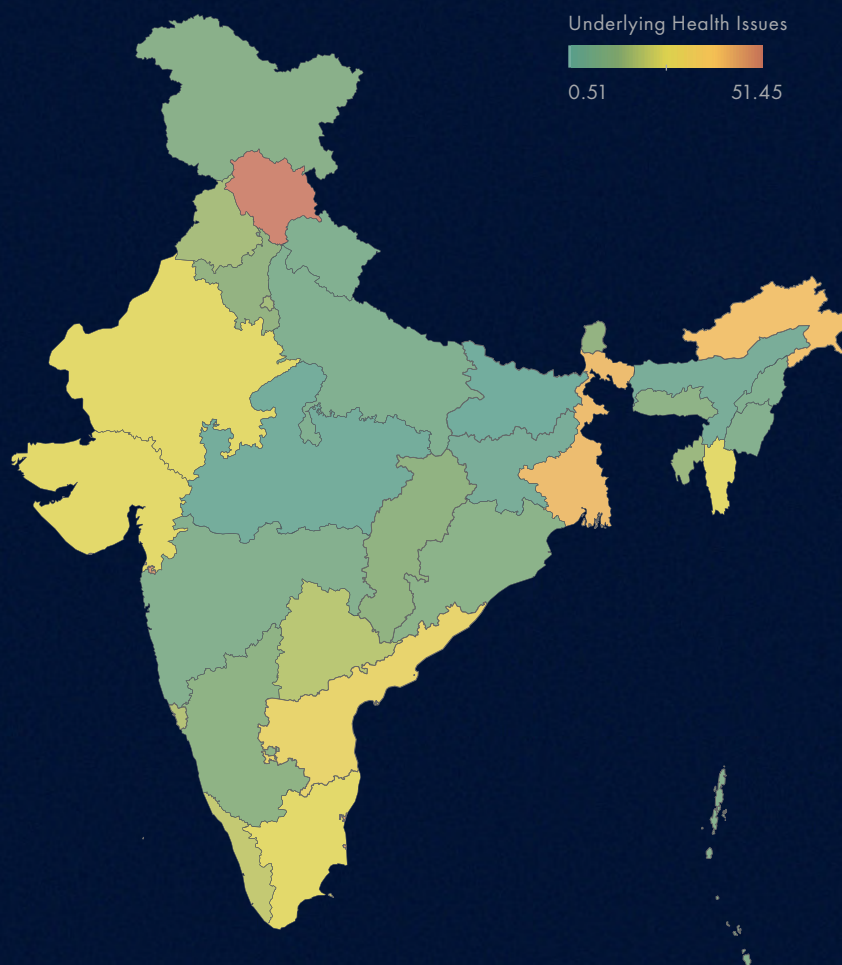


Figure G: Underlying Health Issues Vulnerability Pillar¹¹

Within the underlying health issues vulnerability pillar, Himachal Pradesh is the most vulnerable state, while Bihar is the least susceptible. The top 10 most vulnerable underlying health issues states/UTs are:

State	Ranking	State	Ranking
Himachal Pradesh	1	Daman and Diu	6
Dadra & Nagar Haveli	2	Lakshadweep	7
Puducherry	3	Andhra Pradesh	8
West Bengal	4	Gujarat	9
Arunachal Pradesh	5	Mizoram	10

¹¹ Higher the score, higher the vulnerability of the state in the given pillar

Within the elderly cohort, **Himachal Pradesh** has

5.68%

of population who
are **aged 60-69**

3%

of population who
are **aged 70-79**

1.55%

of people who are
aged 80 and above.

Additionally, it has the highest percentage of the population in the country who are diagnosed with hypertension (1.37 percent) and diabetes (1.08 percent). Nevertheless, Himachal Pradesh has been ranked 30th (out of 36 states and union territories) in terms of health infrastructure vulnerability. This has been reflected in terms of the low number of confirmed cases (40), and deaths (1) in the state.

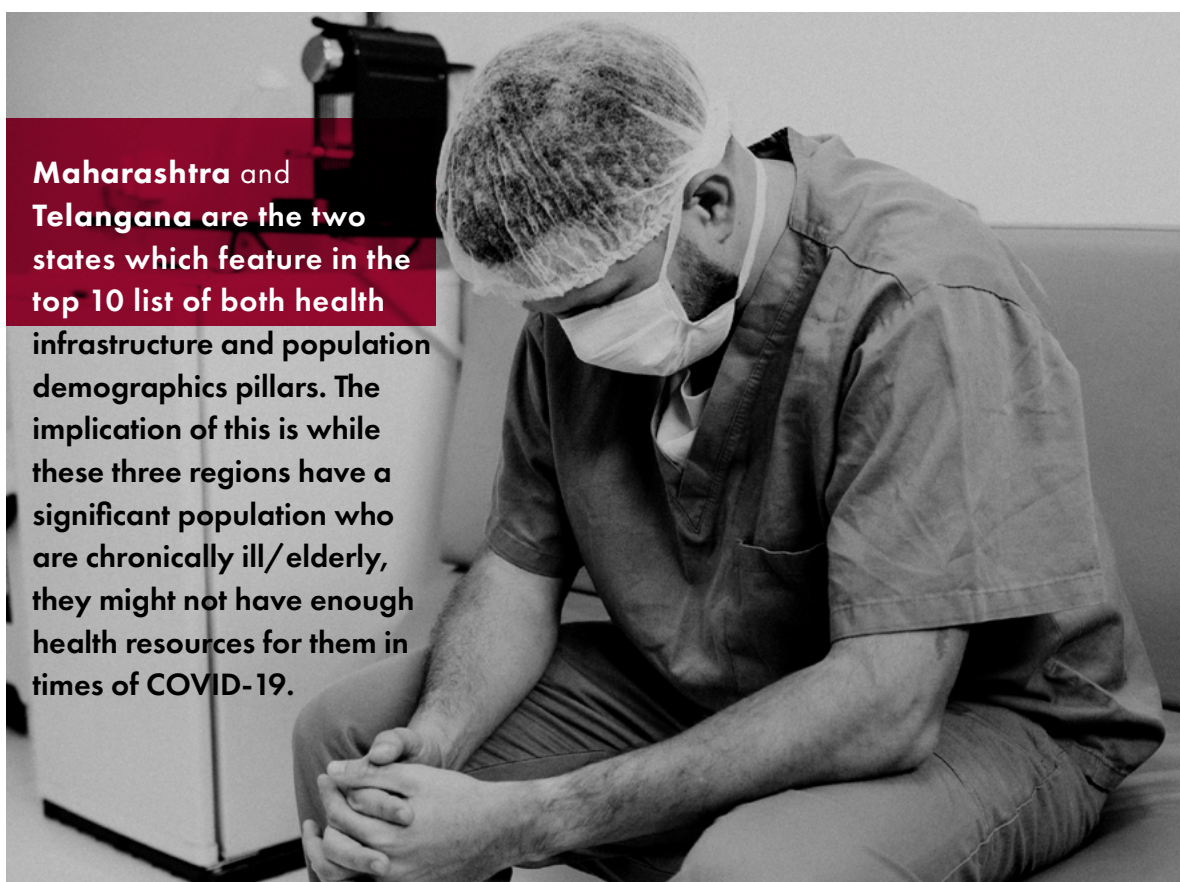
Puducherry, Himachal Pradesh, Tamil Nadu & Andhra Pradesh

feature in the top 10 list of both the population demographics and underlying health issues pillar. This highlights that they have a significantly higher proportionate population of elderly as well as chronically ill people within their states. The implication of this would be these states would have to screen the residing 'vulnerable' category better and take definitive measures to protect them.

Additionally, **Daman and Diu**

is the only region which is in the top 10 list of both health infrastructure and underlying health issues vulnerability.

Maharashtra and Telangana are the two states which feature in the top 10 list of both health infrastructure and population demographics pillars. The implication of this is while these three regions have a significant population who are chronically ill/elderly, they might not have enough health resources for them in times of COVID-19.



SUGGESTED POLICY ACTIONS

The findings of the COVID-19 vulnerability index highlight that Indian states need to pay special attention to their elderly and comorbidity population and create supporting health infrastructure to ensure better protection. The policy actions that could be taken up are:

Policy Action

Short Term



- The lockdown of the states should be eased based on their vulnerability such that they are in a better position to protect their residents.
- Even after the lockdown, the elderly and the chronically ill population should be kept quarantined to prevent the rise in COVID-19 deaths
- Essential food products and medicines should be delivered to the elderly and chronically ill. This would allow them not to have to step out of their houses during the lockdown. States could partner with private delivery services for this task.

Medium Term



- States should identify and monitor the vulnerable demographic to support them in times of need. This is especially necessary for the elderly population who are living alone.
- A larger number of Community Health Centres should be equipped to handle non-COVID related health issues to prevent an excess burden on district hospitals and designated COVID hospitals
- Frontline healthcare and ancillary workers could be trained to treat non-COVID cases in a more efficient manner.

Long Term



- Mass testing should be ensured to identify the number of COVID cases and prevent a further rise in infections.
- Even after the lockdown, social distancing protocols should be adhered to, especially for the vulnerable demographic. Better information dissemination and awareness campaigns can assist in that.

APPENDIX

State-wise vulnerability scores and ranking across three pillars¹²

State	Vulnerability Scores	Vulnerability Ranking	Health Infrastructure ranking	Population demographics ranking	Underlying health issues ranking
Himachal Pradesh	57.08	1	30	3	1
Kerala	55.12	2	25	1	13
Telangana	54.49	3	9	2	14
Puducherry	53.90	4	28	7	3
Punjab	52.26	5	11	5	16
Andhra Pradesh	51.14	6	19	10	8
Tamil Nadu	50.51	7	24	6	9
Goa	50.03	8	22	4	15
Gujarat	49.93	9	3	19	12
Maharashtra	48.55	10	2	8	28
West Bengal	48.55	11	27	15	4
Delhi	46.90	12	13	14	17
Rajasthan	46.80	13	14	23	11
Haryana	45.94	14	12	13	19
Karnataka	45.43	15	20	9	22
Daman & Diu	44.94	16	7	33	6
Odisha	44.64	17	17	11	24
Uttarakhand	43.13	18	16	12	32
Uttar Pradesh	42.71	19	4	21	30
Jammu & Kashmir	41.73	20	10	22	25
Chhattisgarh	41.59	21	15	24	21
Madhya Pradesh	40.84	22	6	20	35
Dadra & Nagar Haveli	40.11	23	23	36	2
Tripura	39.27	24	26	16	18
Jharkhand	38.56	25	1	29	34
Bihar	38.38	26	5	26	36
Assam	37.06	27	8	28	33
Manipur	36.73	28	21	25	29
Lakshadweep	36.70	29	35	18	7
Mizoram	34.87	30	33	31	10
Chandigarh	34.59	31	32	17	26
Nagaland	32.83	32	18	32	31
Andaman & Nicobar Islands	29.69	33	31	30	27
Sikkim	29.23	34	34	27	20
Arunachal Pradesh	27.17	35	36	35	5
Meghalaya	27.09	36	29	34	23

Health infrastructure ranking

Higher the ranking, higher the susceptibility of the state in terms of health infrastructure. Ranking of 1 suggests that the state/UT has relatively the lowest health infrastructure standards in terms of other states, while rank of 36, implies that the state/UT has the highest health infrastructure standard in terms of other states.

Population demographics

Higher the ranking, higher the susceptibility of the state in terms of population demographics. Ranking of 1 suggests that the state/UT has relatively the highest combination of population density and elderly population in terms of other states, while rank of 36, implies that the state/UT has the lowest combination of population density and elderly population in terms of other states.

Underlying health issues

Higher the ranking, higher the susceptibility of the state in terms of underlying health issues. Ranking of 1 suggests that the state/UT has relatively the highest co-morbidity population in terms of other states, while rank of 36, implies that the state/UT has the lowest co-morbidity population in terms of other states.

¹² Ranking: 1 signifies the most vulnerable state/UT – 36 is the least vulnerable state/UT. Scores: Higher the scores, more the vulnerability



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