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Research Article

An Evaluation of the Public Healthcare Services and COVID-19 in the North-Eastern States of India: A Quantitative Study

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A B S T R A C T

Introduction: COVID-19 has caused an impending disaster with combined social and economic effects. The socio-economic effects of the pandemic are devastating whereby millions of the population drove towards poverty; with nearly 690 million population left undernourished. COVID-19 has demanded efficient healthcare to combat the disease, however, the millions of reported deaths indicate insufficient and unprepared public healthcare.

Objective: To analyse the relationship between public healthcare services and COVID deaths.

Methodology: The study used basic descriptive methods: averages, percentages, and correlation. To analyse the effects of healthcare infrastructure and healthcare services on COVID deaths, a multivariate linear regression model was used.

Results: A high positive correlation was found between COVID deaths and healthcare infrastructure and services. Sub-centres and district hospitals have a negative yet insignificant effect on COVID deaths with parameter estimates of -1.07108 and -166.458 respectively. Community Health Centre and Primary Health Centre have positive and insignificant effects on COVID deaths with parameter estimates of 10.28023 and 11.60391 respectively. Nurses and pharmacists (PHC andCHC) have a negative and insignificant effect with parameter estimates of -1.4027 and -3.38527 respectively. Doctors (PHC) and laboratory technicians (PHC and CHC) have a positive and insignificant effect with parameter estimates of 6.124071 and 5.347605 respectively. F-statistic value was found to be significant in both models.

Conclusion: Healthcare infrastructure and services have been insignificant at reducing the recovered COVID cases and COVID deaths.

Keywords: North-Eastern States (NES), COVID-19, Health Infrastructure, Demographic Factors, Preventive Factors

Introduction

The havoc of the COVID-19 pandemic brought unanticipated loss to the world. The healthcare systems and facilities of all countries were put to test, hospital resources were stretched beyond limits and research and development departments were in a race. The socio-economic effects of the pandemic are devastating whereby millions of populations drove to poverty, with nearly 690 million population left under nourished. The efforts to stabilise the pandemic through research and vaccinations have spread out, however, complete stabilisation of the pandemic is a myth even after two consecutive hazardous years.

COVID-19 has validated the insufficient and unprepared status of healthcare across the globe.[1] Excess demand for healthcare has caused physical and emotional breakdowns among healthcare providers.[2] Severe deficiencies were found in Brazil, Romania, Indonesia, and Nepal.[3,4,5,6] The deficiencies of healthcare infrastructure were established in various developed countries such as the USA, Europe, and Austria.[7,8] This has also caused a huge rural-urban disparity among regions of Brazil.[9] In the USA, which has only 4% of the total world's population, there were 26% COVID cases and 24% COVID deaths.[10] Pre-COVID, almost 50% of the American population was covered with health insurance. COVID-19 has led to huge job loss and has left the infected population untreated.[11]

India is not an exception from the deficiency. COVID cases in India have surpassed all countries, followed by Brazil and the USA. India is the worse hit country in Asia.[8] The targets of the National Health Policy remained unmet; hence the consequence of the pandemic is evident.[12] Prediction showed states such as Maharashtra, Punjab, Gujarat, and Delhi would experience higher growth of COVID cases whereas the effective healthcare system of Kerela will stabilise COVID cases.[13] A good collaboration between the people and the government in Kerela has been successful to combat the COVID disease and prevent social disasters.[14]

The population structure of the Indian states has contributed to the increasing COVID cases. In a district-level study, districts of Punjab, Tamil Nadu, Kerala, and Maharashtra were more prone to risk. Particularly, the districts of these four states have a higher elderly population characterised by high chronic diseases and hypertension. On the other hand, socioeconomic factors of the districts of the eastern and central states such as Uttar Pradesh, Bihar, and Madhya Pradesh have pushed the population into a state of COVID risk. Comparatively, these regions have low availability and accessibility of healthcare.[6]

In this background, the availability of well-equipped healthcare is fundamental for fighting and recovering from the current pandemic. The population structure of the North-Eastern States (NES) is characterised by a low density and high rural area. It is imperative to analyse if the current COVID deaths have any relationship with the healthcare infrastructure and services in the states. The reported deaths as of 2021 depict that states such as Arunachal Pradesh, Mizoram, Nagaland, Sikkim, and Tripura have lesser deaths when compared to Assam, Manipur, and Meghalaya. The objective of the study is to analyse the relationship between the availability of health infrastructure and COVID deaths in the NES.

Literature Review

The outbreak of the COVID-19 pandemic has been forewarned by leading scientists around the world.[15] Their warnings were not taken seriously as the lack of unpreparedness of governments was evident from the high fatality rate during the COVID-19 outbreak. The disease outbreak has challenged the world in several ways: social, economic, and political. The healthcare sector was the hardest hit being the first line of defence in the fight, this fact should serve as a reminder to countries to give top priority to their healthcare sector.[1]

Countries around the world have been subjected to healthcare shortages. The incompetence and deficiency of healthcare infrastructure were evident in low and middle-income countries and even in developed countries such as the USA.[7] The under-resourced public healthcare system in the USA paid a heavy price during the unprecedented COVID-19 pandemic.[10] The sudden outbreak has caused a huge job loss among the population that has left the people in a state of unaffordability for the virus treatment.[16] The rural USA faced problems during the COVID-19 outbreak due to limited availability and accessibility of healthcare infrastructure.[9]

In Brazil, states with low healthcare capacity are found to have higher cases of COVID-19, an indication that healthcare capacity matters in reducing COVID-related deaths.[3] Huge disparities among the states of Brazil include rural-urban disparity. States with basic critical healthcare equipment were able to neutralise the reproduction rate of the disease. On the other hand, states such as Sau Paulo with the non-availability of ICU beds, witnessed a severe loss of lives during the migration of COVID patients.[17] In Europe and Austria, basic preventive supplies such as water, power, and transportation were inadequate, hence leading the population torisk. In addition, health policies and health standards were not followed.[11] Temperature and humidity in Western Europe have caused a significantly negative effect on COVID deaths. The lack of protective gear and equipment has also exposed healthcare providers to a great risk of infection while delivering COVID-19 treatment.[2]

Health infrastructure faced overcrowding, inadequate

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delivery, and a disrupted supply chain. Indonesia faced limited healthcare capacity accompanied by shortages of medical staff, medical supplies, a weak patient referral system, and management.[5] The shortages of ICUs and insufficient critical care services have caused thousands of preventable deaths in Nepal.[18] Although many countries have the most advanced technologies in healthcare, the COVID-19 pandemic has rendered them inadequate to check its spread. Comparatively, the less developed countries experienced the highest trauma.[19]

In India, the number of COVID-19 cases was the second-highest in the world, next to the USA, followed by Brazil and the UK. India is also the worst-hit country among the Asian countries.[20] Among the Indian states, Maharashtra has had the highest number of reported cases followed by Kerela and Karnataka.[21] COVID-19 has exposed the fragility and negligence of healthcare. The protective measures did stabilise the transmission however, the large number of COVID-19 cases overwhelmed the healthcare infrastructure. The public healthcare system was inadequately equipped to handle many cases, leaving many to turn to private healthcare providers.[8]

The inadequacy of the healthcare system is widespread with a huge demand for ICU beds, ventilators, and isolation beds in all hospitals and primary care centres in all Indian states.[13] On using a forecasting measure, COVID cases would increase at an exponential rate in states such as Andhra Pradesh, Delhi, Maharashtra, Tamil Nadu, and Telangana.[22] The basic healthcare infection control equipment such as physical space, insufficient ventilation facilities, prevention, and control measures for airborne diseases, N95 masks, and space for examining outpatients are insufficient or completely missing.[23]

The understanding and collaboration between the state government and the local governments in Kerela were commendable. The healthcare was well equipped with the required medical staff and medical supplies. Distribution of rations, cash transfers to self-help groups, and provision of cooked food to the needy has helped the state to save many lives. The state has faced many natural disasters such as the Nipah disease, but the sheer resilience of the state enabled it to combat these disasters.[14]

The national lockdown in India saved the healthcare infrastructure from being overstrained. Based on the data, rapid testing was not spread out all over the region, therefore the possible number of COVID cases could not be accurately estimated. Through the national lockdown, the healthcare system was able to develop to a minimal extent to combat the disease outbreak.[24] In India as a whole, there is a need to reprioritise the budgetary allocation towards the health sector to enable it to provide required services to the people.[25]

Hypothesis

Health infrastructure and services have an inverse and significant effect on the number of COVID deaths.

Data and Methodology

Data: The NES of India comprise eight states namely, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura. Given the objective of the study, several sources have been referred for the attainment of data for analysis. The number of COVID deaths, recovered and total cases have been taken from the Government of India Corona Report.[26] Table 1 represents the total number of COVID deaths, recovered cases and total cases in the NES as on November 26, 2021. Distinctively, the recovery rate is exceptionally amazing despite the terrifying COVID deaths all over the country and the world.

Table 1. Total Corona Cases in NES[26]

State	Deaths	Recovered Cases	Total Cases	Recovered Rate (%)
Arunachal Pradesh	280	54961	55257	99
Assam	6081	608124	615995	99
Manipur	1965	122579	125046	98
Meghalaya	1467	82713	84364	98
Mizoram	484	130927	133118	98
Nagaland	696	31293	32078	98
Sikkim	403	31715	32179	99
Tripura	820	83900	84759	99

Health infrastructure in this study includes Sub-centres (SC), Primary Health Centres (PHC), Community Health Centres (CHC), district hospitals, and manpower in healthcare services such as nurses, doctors in PHC, specialists in CHC (surgeons, OB & GY, physicians, and paediatricians), lab technicians in PHC and CHC, and pharmacists in PHC and CHC.[27]

Methodology: To analyse the objectives of the study, a cross-sectional method was employed. We used a basic descriptive method to find the averages, percentages, and correlations.

Given the data obtained, we have calculated the recovery rate and death rate using the formula:

Recovery rate = (Recovered COVID cases)/ (Total COVID cases)
Death rate = (COVID deaths)/ (Total COVID cases)

The above formula gives us an idea about the intensity of the pandemic in the NES and the possibility of stabilisation in the states.

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The correlation between COVID deaths versus the available healthcare (CHC, district hospital, PHC, SC, doctors in PHC, laboratory technicians in PHC and CHC, nurses, and pharmacists in PHC and CHC) was analysed. Also, the correlation between recovery cases and the available healthcare (CHC, district hospital, PHC, SC, doctors in PHC, laboratory technicians in PHC and CHC, nurses, and pharmacists in PHC and CHC) was calculated. Karl Pearson correlation analysis was used in this study.

After establishing the correlations among the variables, a multivariate linear regression model was used to establish the relationship among the variables.

Specification of Model

$$covid\ death\ s\gamma_{(t)} = \alpha_{(t)} + CHC\ \beta_{(t)} + PHC\ \gamma_{(t)} + SC\ \delta_{(t)} + Dist\ Hosp\ \rho_{(t)} + \varepsilon_t \quad (1)$$

CHC - Community Health Centres; PHC - Primary Health Centres; SC - Sub-centres; Dist Hosp - District Hospitals, ε_t - error term

$$covid\ death\ s\gamma_{(t)} = \alpha_{(t)} + Nurses\ \beta_{(t)}\ Doc\ (PHC)\ \gamma_{(t)} + Lab\ Tech\ (PHC\ \&\ CHC)\ \delta_{(t)} + Phar\ (PHC\ \&\ CHC)\ \rho_{(t)} + \varepsilon_t \quad (2)$$

Doc (PHC) - Doctors in primary health centres; Lab Tech (PHC & CHC) - Laboratory technicians in primary health centres and community health centres; Phar (PHC & CHC) - pharmacists in primary health centres and community health centres.

Specialists in CHC could not be incorporated into the regression model due to the zero value in Mizoram. Also, sub-divisional hospitals could not be incorporated due to zero value in Arunachal Pradesh, Meghalaya, and Nagaland.

A semi-log multivariate linear regression model was employed to find the relationship between recovered COVID cases and available healthcare. The models are as follows:

$$ln\ Recovered\ covid\ cases = \alpha_t + CHC\ \beta_t + District\ hospitals\ \gamma_{(t)} + \varepsilon_t \quad (3)$$

$$ln\ Recovered\ covid\ cases = \alpha_t + PHC\ \beta_t + Sub\ Centres\ \gamma_{(t)} + \varepsilon_t \quad (4)$$

$$ln\ Recovered\ covid\ cases = \alpha_t + Nurses\ \beta_t + Doctors\ (PHC)\ \gamma_{(t)} + \varepsilon_t \quad (5)$$

$$ln\ Recovered\ covid\ cases = \alpha_t + Lab\ techniciancs\ (PHC, CHC)\ \beta_t + Pharmacists\ (PHC, CHC)\ \gamma_{(t)} + \varepsilon_t \quad (6)$$

Empirical Results and Discussion

On taking a constant population growth while using the 2011 population census, we find that the population of Assam is 52 times more than the population of Sikkim. Therefore, given the large population of Assam, Figure 1a clearly shows that the highest number of COVID deaths were observed in Assam with a total number of 6081 as of November 2021. On the other hand, among the smaller states of NES, comparatively higher COVID deaths were observed in Manipur and Meghalaya. The lowest number of deaths was observed in Arunachal Pradesh with a total number of 280.

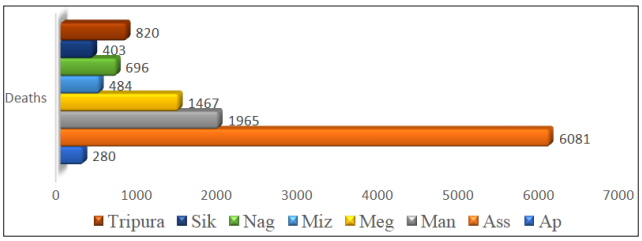

Figure 1a.COVID Deaths (as on November 2021)

Given the total number of COVID cases in the NES, the recovered COVID cases were phenomenal. Figure 1b depicts an extraordinary scenario of the NES with as high as 99% recovered cases in states such as Arunachal Pradesh, Assam, Sikkim, and Tripura. The other states had also not lagged behind as the recovery rate in Manipur, Meghalaya, Mizoram, and Nagaland was 98%.

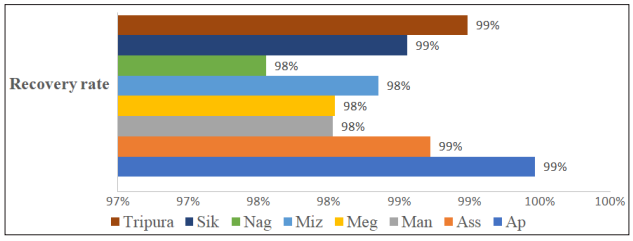

Figure 1b.Recovered COVID Cases

Figure 1c depicts the COVID death rate of the NES. Clearly, we find an extremely low proportion of COVID death rate with a proportion as low as 0.36% in Mizoram, and 1% in Tripura, Sikkim, Arunachal Pradesh, and Assam. The low death rate thus indicates the ability of the states to combat the disease. However, the question of whether the public healthcare facilities have been instrumental in neutralising COVID cases and reducing COVID deaths is answered below given the suitable quantitative techniques employed.

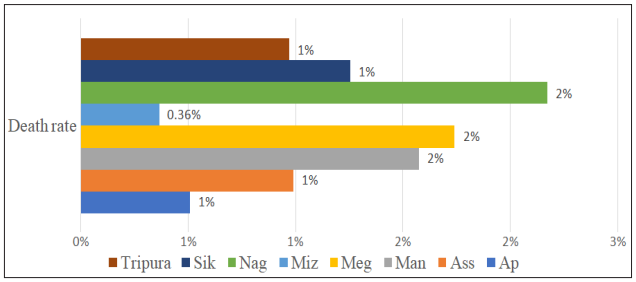

Figure 1c.COVID Death Rate

The infrastructural availability of the NES per lakh population was not encouraging. As shown in Table 2a, SCs and PHCs were not too discouraging. However, on observing CHCs, in states such as Assam, Manipur, Meghalaya, Mizoram, Sikkim, and Tripura, it was seen that there was not even 1

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CHC serving per lakh population. There was not even one district hospital or sub-divisional hospital serving per lakh population. It was alarming to see the non-existence of sub-divisional hospitals in Arunachal Pradesh, Meghalaya, and Nagaland. In addition, the number of healthcare providers serving per lakh population was depressing. Although the number of nurses and doctors in PHC serving per lakh population was minimal yet better. On the contrary, the number of specialists in CHC was negligible as in almost all NES, there was not one specialist in CHC serving per lakh population.

The discouraging healthcare infrastructure and service availability give us the notion to analyse if there is any relationship between COVID deaths and the healthcare infrastructure and services. From Table 2b, we observe a high positive correlation between COVID deaths and the healthcare infrastructure and services. This is clearly an indication of insufficient or inadequate healthcare infrastructure and services.

Table 2c shows a high correlation between recovery cases and CHC, district hospital, PHC, SC, doctors (PHC), laboratory technicians (PHC and CHC), nurses, and pharmacists (PHC and CHC). The correlation was found to be significant. This also indicates a possible ability of healthcare to stabilise the pandemic and to attain a high proportion of recovered COVID cases. This might have been possible through the efficient distribution of vaccinations and ensuring immediate treatment to the affected cases.

The multivariate estimation of models 1 and 2 are depicted in Table 2d. From Model 1, we found that SC and district hospitals have a negative yet insignificant effect on COVID deaths with parameter estimates of -1.07108 and -166.458 respectively. On the other hand, CHC and PHC have a positive yet insignificant effect on COVID deaths with parameter estimates of 10.28023 and 11.60391 respectively. From Model 2, it was found that nurses and pharmacists (PHC and CHC) have a negative and insignificant effect with parameter estimates of -1.4027 and -3.38527 respectively. Doctors (PHC) and laboratory technicians (PHC and CHC) have a positive and insignificant effect with parameter estimates of 6.124071 and 5.347605 respectively. F-statistic value was found to be significant in both models which therefore indicated the fitness of the model used.

Table 2a.Availability of Health Infrastructure (Per 1 Lakh Population[27])

State	SC	PHC	CHC	Nurses	Doc-PHC	Spec CHC	Dist Hosp	SDHP
Arunachal Pradesh	21.26	7.26	3.51	39.77	11.36	0.82	1.00	0.00
Assam	13.00	2.78	0.53	9.93	3.95	0.52	0.07	0.04
Manipur	13.93	3.10	0.57	11.20	10.36	0.13	0.23	0.03
Meghalaya	11.93	3.85	0.75	20.31	5.12	0.11	0.30	0.00
Mizoram	27.83	4.89	0.68	18.43	4.36	0.00	0.68	0.15
Nagaland	21.09	6.96	1.07	16.06	6.10	0.46	0.56	0.00
Sikkim	22.45	3.67	0.29	13.50	4.99	0.29	0.59	0.15
Tripura	24.04	2.69	0.53	17.92	5.33	0.02	0.17	0.29

Table 2b.Correlation Estimates [Deaths vs CHC, Dist Hosp, PHC, SC, Doc (PHC), Lab Tech (PHC and CHC), Nurses, Phar (PHC and CHC)]

	CHC	Dist Hosp	PHC	SC	Doc (PHC)	Lab Tech (PHC and CHC)	Nurses	Phar (PHC and CHC)
Correlation estimates	0.905929	0.722901	0.958004	0.950356	0.979094	0.963882	0.942902	0.970885
P value	0.0019	0.0427	0.0002	0.0003	0.00000	0.0001	0.0004	0.0001

Table 2c.Correlation Estimates [Recovery Cases vs CHC, Dist Hosp, PHC, SC, Doc (PHC), Lab Tech (PHC and CHC), Nurses, Phar (PHC and CHC)]

	CHC	DistHosp	PHC	SC	Doc (PHC)	LabTech (PHC and CHC)	Nurses	Phar (PHC and CHC)
Correlation estimates	0.933424	0.770223	0.971928	0.975758	0.975998	0.975404	0.9601	0.976953
P value	0.0007	0.0253	0.0001	0.000	0.00000	0.00000	0.0002	0.00000

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Table 2d.Multivariate Linear Regression Model (Dependent Variable - COVID Deaths)

Model 1			Model 2		
Independent variables	**Coefficient variable**	**P value**	**Independent variables**	**Coefficient variable**	**P value**
CHC	10.28023	0.7874	Nurses	-1.4027	0.3245
PHC	11.60391	0.2037	Doc (PHC)	6.124071	0.3631
SC	-1.07108	0.5041	Lab Tech (PHC and CHC)	5.347605	0.7292
Dist Hosp	-166.458	0.3799	Phar (PHC and CHC)	-3.38527	0.8536
F-statistic	15.13329	0.024925	F-statistic	25.85969	0.01163
R-squared	0.952781		R-squared	0.971815	

The estimation follows wherein the relationship was estimated; that is, recovered COVID cases as the dependent variable versus healthcare (CHC, district hospital, PHC, SC, doctors in PHC, laboratory technicians in PHC and CHC, nurses, and pharmacists in PHC and CHC). As depicted in Table 2e, CHCs and SCs were found to have a positive yet insignificant effect on recovered COVID cases, with parameter estimates of 0.01908 and 0.000883 respectively. The effect of district hospitals and PHCs on recovered COVID cases was found to have a negative and insignificant effect, with parameter estimates of -0.07502 and -0.00169 respectively. The coefficients derived were extremely low which suggested that recovered cases were not attributed to the available healthcare infrastructure. F-statistic value was found to be significant at a 10% level of significance which therefore depicted the fitness of the model.

The estimation depicted in Table 2f shows the relationship between recovered COVID cases and the available healthcare services (nurses, doctors, lab technicians, and pharmacists). The results obtained were not encouraging again. Doctors of PHC, and lab technicians and pharmacists of PHC and CHC were found to have a positive yet insignificant effect on the number of recovered COVID cases with parameter estimates of 0.002219, 0.134036, and 0.001473 respectively. Nurses were found to have a negative and insignificant effect on the number of recovered COVID cases with a parameter estimate of -0.00018. F-statistic value was significant at 5% level of significance which therefore confirmed the fitness of the model. However, in models 3, 4, 5 and 6, the R-squared value obtained depicted that there were other possible independent variables which could have been significant in stabilising or increasing the recovered cases in the NES.

Table 2e.Semi-log Multivariate Model (Dependent Variable - Recovered COVID Cases)

Independent Variable	Model 3		Model 4	
	Coefficient	**Pvalue**	**Coefficient**	**Pvalue**
CHCS	0.01908	0.1242	-	-
Dist Hosp	-0.07502	0.4873	-	-
PHC	-	-	-0.00169	0.7285
SC	-	-	0.000883	0.4079
F-statistic value	4.65185	0.072244	6.216975	0.044049
R-squared	0.65044		0.713203	

Table 2f.Semi-log Multivariate Model (Dependent Variable - Recovered COVID Cases)

Independent Variable	Model 5		Model 6	
	Coefficient	**P value**	**Coefficient**	**P value**
Nurses	-0.00018	0.8671	-	-
Doc (PHC)	0.002219	0.4134	-	-
Lab Tech (PHC and CHC)	-	-	0.134036	0.827
Phar (PHC and CHC)	-	-	0.001473	0.3106
F-statistic	6.918057	0.036303	5.751968	0.050519
R-squared	0.734552		0.697042	

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Discussion

The pre-existing vulnerabilities have clearly trapped the world during the COVID pandemic. In India, for instance, healthcare has not been well-equipped despite the constitution of several health committees. Healthcare in India has remained inadequate even after years therefore the effects of the pandemic due to inadequacy are inevitable. COVID deaths in India are frightening. Although various other external causes such as the sudden lockdown wherein huge migrant workers have lost their lives during travel, have added to the high deaths in India; inadequacy and unpreparedness of healthcare have caused more havoc during the pandemic.

In the case of the NES, the population of Assam is 50 times more than the population of Sikkim as per the 2011 census. Given the large population in the state, it is also accompanied by a high density of population, high rural population with 84.8% and only 68% of the total population with access to an improved sanitation facility (Table 2g); this clearly justifies the high number of COVID deaths (6081) in the state. On the other hand, the least COVID deaths (280) were found in Arunachal Pradesh.

Since the imposition of the national lockdown in India in March 2020, it was found that the national lockdown has been successful in reducing COVID cases in India as a whole.[15] However, with the lifting of the lockdown, bigger states have found it extremely difficult to follow social distancing given the large density of population per square kilometre and the return of migrant workers. On the other hand, the density of population in the NES is much lesser as compared to other mainland states. For instance, in Arunachal Pradesh, density is 18 per square kilometre as of 2020. Therefore, maintaining and preventing the state's number of COVID cases and deaths was not a herculean task.

Kerala has 5410 SCs, 932 PHCs, 227 CHCs, 48 district hospitals, and 86 sub-divisional hospitals.[27] Quantitatively, the availability of public health infrastructure per lakh population in the NES is not bad when compared to the exemplary public health infrastructure of Kerala. Taking the reference period as 2020, Kerala has 15.15 SCs, 2.61 PHCs, and 0.64 CHCs per lakh population. When we observe health infrastructure availability in the NES (Table 2a), the numbers are not disappointing when we observe an equal weightage to all the states. However, the distinction lies in the qualitative aspects of health infrastructure. From the RHS reports, it was found that Kerala has lesser problems with functional health centres, and with the inadequacy of medical health providers (doctors, nurses, technicians, pharmacists, and others). In addition, the exemplary working of the state government and local government during the pandemic has gained global appreciation. On the other hand, the opposite is observed in the NES.

The analysis clearly shows the inability of health care infrastructure to combat the virus outbreak. Most deaths could have occurred due to the unavailability of healthcare instruments required for treatment. Although the recovery rate of most of the NES could be compared to Kerala, however, the credit could not be attributed to the available healthcare infrastructure and services of the NES. This is also proven from the analysis of models 3, 4, 5 and 6, which clearly show that healthcare availability has been insignificant at stabilising or increasing the recovered COVID cases in the NES.

Given the lower R-squared value obtained, the possible other preventive and demographic factors that have been able to maintain the high recovered COVID cases in the states could be anticipated or projected.

Table 2g.Demographic and Preventive Factors[27,28]

States	Density of Population	Rural Population (Estimated for 2020) (%)	% of Population with Improved Sanitation Facility	% of Population with Improved Drinking Water
Arunachal Pradesh	18	75	81.54	85.52
Assam	444	84.8	68.6	86
Manipur	141	68.3	64.9	77.1
Meghalaya	146	79.4	82.9	79.2
Mizoram	57	45.6	95.3	95.8
Nagaland	131	58	87.7	91
Sikkim	95	56.4	87.3	92.8
Tripura	385	63.7%	73.6	88

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To support the assumption above, the justification could be seen in Table 2g, in which, the demographic structure shows that the majority of the NES has a low density of population excluding Assam with a density of population as high as 444, which is higher than the density of population of India with 413. The lowest density of population is found in Arunachal Pradesh with 18. Given that Arunachal Pradesh is the largest state among the NES, the density of population puts the state in an advantageous position whereby COVID protocols could be possible to a great extent. Given that the urban population in most of the NES is less than 50%, reports have found a huge growth of COVID cases in the urban areas. In this case, we can presume that population distribution (rural and urban) among the NES could be a factor that contributed to the stabilisation of COVID cases. We find that the rural population in Arunachal Pradesh, Assam, Manipur, Meghalaya, and Tripura is 75%, 84.8%, 68.3%, 79.4%, and 63.7% respectively.

On the health preventive factors, we observe that the population with improved sanitation facilities is more than 80% for the majority of the NES as against the all India level excluding Assam and Manipur. The percentage of the population with improved drinking water is more than 79% for all NES. Given the preventive factors available to the majority of the population in the NES, better health status could be attained.

Conclusion

The healthcare infrastructure and services of the NES are clearly inadequate when compared to a state like Kerala. There is still negligence in infrastructure construction in many states which is evident from the slow growth of infrastructure over the years. The number of COVID cases has frightened the world however, the recovery rate in the NES is splendid and worth noting similar to Kerala. Given that the demographic structure of the NES and the preventive factors is much more pronounced and superior to most of the Indian states, we could most likely make two conclusions. First and foremost, healthcare infrastructure and services in the NES have failed to reduce COVID deaths. Secondly, the demographic structure of the NES and the preventive factors could have helped the recovery rate by assuring much better COVID protocols when compared to bigger states such as Maharashtra, Andhra Pradesh, and Delhi. Therefore, the hypothesis could not be accepted. This analysis has the further scope of analysing the effects of socio-economic factors on COVID rates in the NES.

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