

COVID-19 recovery rate and its association with development

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Abstract

Background: The recovery rate, defined as the ratio between the number of cases recovered per total number of cases, is an important determinant of a country's development towards achieving success over the novel coronavirus. The recovery rate is a function of a number of factors - a country's death rate, the number of cases requiring hospitalisation, the quality of care, and discharge policies, among others. India's recovery rate is growing slowly but steadily from a low of 10-11% in the early days of the pandemic. It is imperative to understand the determinants of recovery rate in a country so as to be able to bring about improvements in the same.

Data and Methods: The study uses data from the data sharing portal *covid19india.org* and *MoHFW web page*. The websites provide data on different aspects of the pandemic i.e., total confirmed cases, active cases, deaths and recovered cases. The data till 30th June, 2020 was used to calculate the recovery rate. For socio-economic and other indicators, data from several other sources such as Census of India, 2011, other published sources and health related data from National Health Profile, 2019 and Statista.com. The study uses Ordinary Least Squares (OLS) to understand the relationship between recovery rate and several other socio-economic and health based determinants in India.

Findings: Our analysis points towards the beneficial impact of health system, better economy and lower population density on the recovery of patients. A good investment in health system (proportion of GSDP spent on health and health worker per 10000 population) has proven the success of case recovery by furnishing easy access to health centres, good quality of care and handling emergency health conditions by mobilizing health resources. The study also suggests that the recovery rate from COVID-19 has no strong association with political parties, taken as proxy of administrative efficiency.

Conclusion: The study indicates that there is an imminent need to scale up the health facilities, facilitate decongestion in slums, scale up the medical infrastructure in states with higher proportion of economically weaker sections of the society. It is also imperative to focus on strengthening the health infrastructure and capacity building of the health workers as well as ameliorating long term investments on health, health research and better quality of living.

Key Words: recovery rate, India, Covid 19

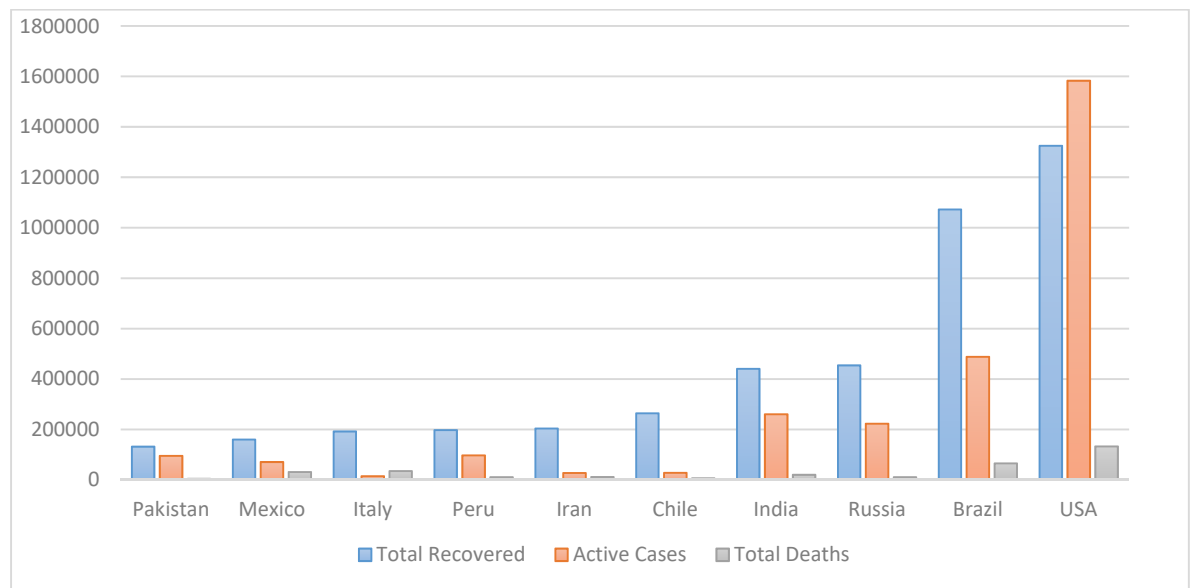
Introduction

Emerging and epidemic infectious disease outbreaks not only pose an extensive public health problem but are also a menace for global health security (Rojek and Horby, 2016). With rapidly changing ecology, escalating urbanization levels, climate change, increased travel and feeble public health systems, epidemics will become incessant, more convoluted and tougher to prevent and contain (Bedford et al, 2019). Epidemics are precarious because they not only cause death and debilitation but are also cumbersome for healthcare systems and healthcare workers and draw resources from services not directly linked to the epidemic. This can leave a legacy of distrust between people, governments and health systems, although more-positive outcomes have been found to strengthen relations between communities and public authorities (Bedford, 2019). Having included the effect on health workers, long-term conditions suffered by 17,000 Ebola survivors, and costs of treatment, infection control, screening and deployment of personnel beyond West Africa, the social and economic costs of the Ebola outbreak in West Africa were estimated to be nearly 53 billion Dollars (Huber, 2018).

As healthcare resources become increasingly allocated to epidemic response, death and disability from other ailments could escalate quickly. Such pressure could cause countries, especially low-income countries, to reach a breaking point. Studies have suggested that spread of infectious diseases is an imminent economic concern and the annual global cost of moderately-severe to severe pandemics could cost nearly 0.7 percent of global income (Fan et al, 2015; Sands et al, 2016) Thus, it is imperative to understand not only the pathways and mechanisms of disease transmission but also identify probable socio-economic determinants of recovery from the disease so as to hasten the process of bringing back the economy and the healthcare systems on track.

Amidst continuous burgeoning cases of coronavirus, India has now become the third worst effected country hit by the novel coronavirus, shortly after The United States of America and Brazil (Business Standard, 2020; The Guardian, 2020). With nearly 0.4 million people recovered till date, India is also at the fourth position in terms of recovery rate (Figure 1).

Figure 1: Countries with highest number of coronavirus cases



Source: Data obtained from worldometers.info as on 7th July, 2020

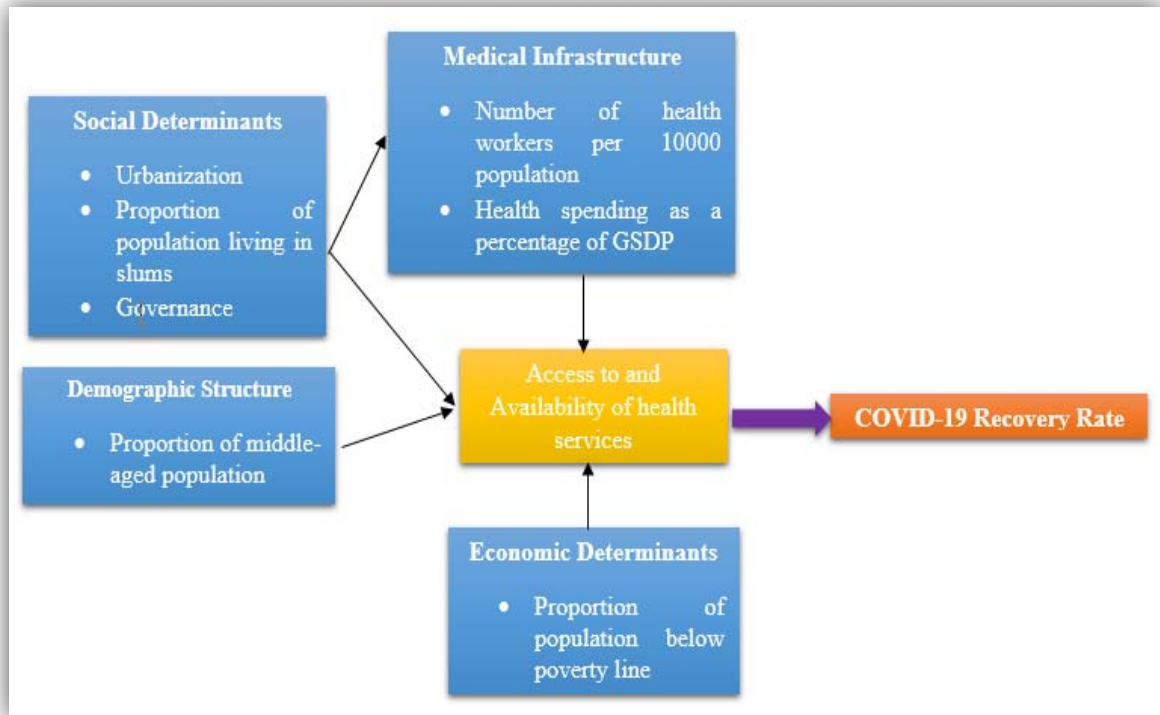
Despite having several bottlenecks in health infrastructure, India has shown remarkable progress in terms of recovery of COVID-19 cases. The recovery rate of COVID-19 continues to steadily improve. As per the latest data, the recovery rate among COVID-19 patients is nearly 59% (MOHFW, 2020). Over time, the spurt in active cases in India has been slower than the overall growth rate, which is an indication of the rising number of recoveries. The recent spike in the recovery rate can also be accorded to change in Health Ministry guidelines for mild and pre-symptomatic cases, more testing (Indian Express, 2020).

Need for the Study

Since the outbreak of the novel-coronavirus in China, there have been a plethora of studies that talk about the pattern of disease transmission, its socio-economic determinants and the mathematical modelling of doubling time and deaths occurring as a result of the disease (Jung et al, 2020; Kucharski et al, 2020; Priyadarsini and Suresh, 2020; Riou and Althaus, 2020; Mogi and Spijker, 2020). There has been, however, a severe dearth of studies that deal with another important aspect of the pandemic i.e., the recovery rate. The recovery rate from COVID-19, defined in the present analysis as number of recovered cases per total positive coronavirus cases, has emerged to be one of the major indicators of measuring the accomplishment of a country in effectively restraining the spread of the current coronavirus pandemic. The current study, thus, tries to understand the association between recovery rate

and several other socio-economic, political, spatial and health based determinants as shown in fig 2.

Fig 2 Conceptual Framework: Determinants of covid 19 recovery rate



Data and Methodology

The variables considered for the analysis have been categorised into four sub-categories:

- **Social/Spatial Determinants:** These are helpful in understanding how a society reacts to a particular situation and is, thus, insightful. The concept of governance encompasses many dimensions, including the level of democracy, control of corruption, and the existence of civil tensions or conflicts, among many others. More democratic governments are more likely to focus on health and related infrastructure and honour human rights (Smith and Haddad, 2000; Ostrom, 1990; Mansbridge, 2014). Similarly, level of urbanisation and proportion of population living in slums are also important factors that determine recovery rate because the geographical location may have an

important impact on the disease and recovery pattern (Kucharski et al, 2014; Braga et al, 2000). Urbanization and % living in Slums are taken from census 2011.

- **Demographic Structure:** The demographic structure of a population determines the vulnerability of a population towards an epidemic and its capacity of recuperating from it. This is because certain age groups may be more susceptible to acquiring a disease and might not be able to recover easily (Wallinga et al, 2006; Erkoreka, 2010; Armstrong et al, 1999; Ainsworth and Dayton, 1999). The data source is from Census 2011.
- **Medical Infrastructure:** The medical infrastructure determines both the quality and quantity of health services received by the people during an epidemic. Countries with advanced health infrastructure are not only able to deal with epidemics strategically (Zanakis et al, 2007; Itzwerth et al, 2006; Whitley and Monto, 2006; Breiman et al, 2007; Adini et al, 2009; Garrett et al, 2009; Oshitani et al, 2008, Gizelis et al, 2017) but are also able to facilitate mass testing and better reporting (Hosseini et al, 2010; Quinn and Kumar, 2014; Hogan et al, 2018). Data sources are from National Health Profile, 2019.
- **Economic Determinants:** Economic indicators taken from census 2011, are representative of a country's ability to intervene in case of a medical emergency (Strauss and Thomas, 1998; Casanovas et al, 2005; Sachs, 2001; Ashraf et al, 2008; Wobst and Arndt, 2004; Markowitz et al, 2010).

Methodology

Simple linear regression has been used to estimate the relationship between recovery rate and various socio-economic and health related determinants. The econometric form of the model is as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \mu$$

Where, Y= recovery rate

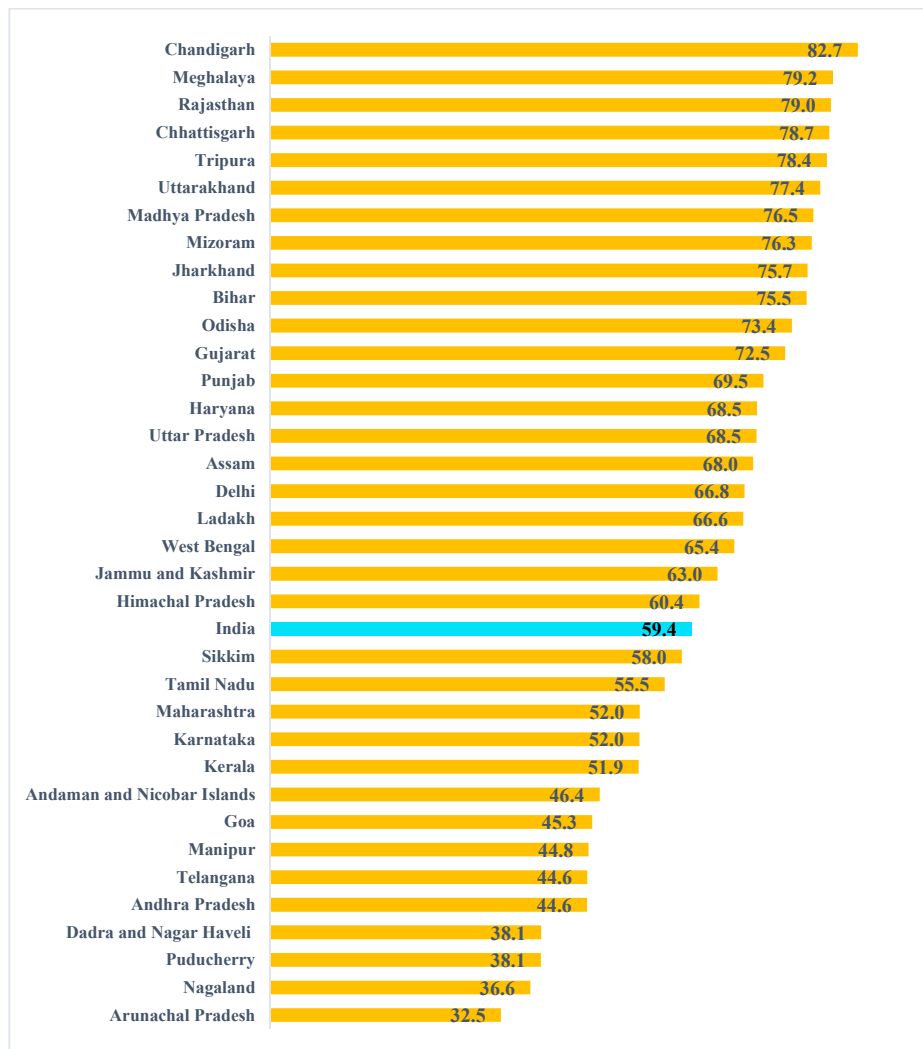
β_1 β_{10} are coefficients for urbanisation, slum population, governance, population aged 60+, middle aged population, population density, number of COVID-19 tests per million, number of health workers per 10000 populations, health spending as a percentage of GSDP and population below poverty line respectively.

Results

Levels of Recovery Rate in Indian States

The recovery rate of India is about 60%. Chandigarh, with a recovery rate of nearly 83%, has the highest recovery rate among all state sand Union Territories. Other states whose recovery rates are impressive are states like Uttarakhand, Rajasthan, Madhya Pradesh, Jharkhand, Odisha, Gujarat, Chhattisgarh, Bihar, Mizoram, Tripura where recovery rates are above 70% (Figure 2).

Figure 2: Recovery Rate in Indian States



Source: Data obtained from covid19india.org as on 30th June, 2020

Determinants of COVID-19 Recovery Rate in India

The current study highlights the possible determinants of recovery rates in India by applying statistical model. A linear regression analysis was done to understand the factors that are helping to recover from COVID-19, based on state specific statistics. Linear regression was applied to comprehend the relationship between recovery rates and state socio-economic, spatial and political variables (like population structure, percentage of population living in slums, percent share of gross state domestic product spent on health, health workers per 10000 populations, ruling party) by fitting a linear equation to the observed recovery rate (Table 1).

Table 1: Linear Regression analysis showing Determinants of recovery rates

Variables	Coef.
Social – Spatial Determinants	
<i>Urbanization</i> ©	0.12**
<i>Slum Population</i> ©	-1.38**
Governance Determinants	
<i>Good Governance Index</i> ©	4.11*
Ruling Party (ref. BJP+Allies)	
<i>Congress + Allies</i>	3.80
<i>Others</i>	6.62
Demographic Structure	
<i>Proportion of middle aged population</i> ©	-3.43**
Medical Infrastructure	
<i>Number of health workers per 10000 population</i>	0.05**
<i>Health spending as a percentage of GSDP</i> ©	2.02*
Economic Determinants	
<i>Population below poverty line</i> ©	-0.28**
R-squared	0.59
<i>*p<0.01, **p<0.05</i>	

Footnotes:

- Middle aged population consists of population in the age group of 45-65; Health workers include doctors, health associates (Includes health assistants, sanitarians, dietitians and nutritionists, optometrists and opticians, dental assistants, physiotherapy associates, pharmacists, and pharmaceutical assistants) and nurses and midwives; Good Governance Index is a composite indicator to assess states and UTs based on their interventions, it has been developed by the Department of Administrative Reforms and Public Grievances using 50 indicators from 10 governance sectors.
- testing rate, population density and geographical area are insignificant factors in the regression.

The results indicate that the recovery rate goes down with an increase in the proportion of population living below poverty line, higher proportion of population living in slums, and more

middle-aged population. An increase in the proportion of gross state domestic product spent on health, urbanization rate, good governance and number of health workers per 10000 populations lead to a significant improvement in the recovery rate. To elaborate, a unit increase in urbanization rate leads to an increase of 0.12 units in the recovery rate. Similarly, with unit change in good governance index, health spending, and health workers per 10000 population, the recovery rate increases by 4.11, 2.02 and 0.05 units respectively. On the contrary, an increase of one unit in the proportion of population living in slums, proportion of middle-aged population and population below poverty line leads to a decline of 1.28 units, 3.43 units and 0.28 units respectively in the recovery rate. Another interesting finding that emerges from the study is that the recovery rate in the states ruled by the BJP or its allies or INC and their allies and other parties have no significant variation, indicating that covid recovery has no strong association with political parties, taken as proxy of administrative strategy.

The R-square value is 0.59, entailing that nearly 60% of the variation in recovery rate can be attributed to the social, economic, health related and political determinants considered in the analysis.

Discussions:

Our analysis specifies the positive role of health system and better economy, urbanization and good governance that remain responsive to the recovery of patients.

A good investment in health system (SGDP share in health and health worker per population) has proven the success of case recovery by furnishing easy access to health centres, good quality of care and handling emergency health conditions by mobilizing health resources. States like Rajasthan and Chattisgarh which have the highest recovery rate in the country also have a considerably higher proportion of their gross state domestic product spent on health and related services and a higher number of health workers per 10000 populations. On contrary, states like Arunachal Pradesh and Nagaland which have the lowest recovery rates in the country also have a meagre proportion of their gross state domestic product that is spent on health and a smaller number of health workers per 10000 populations.

Incidence of continually increasing COVID-19 cases may offset the gains of economic savings, further questioning the strategies to handle COVID-19 amidst insufficient health infrastructure and economic hardship in many states. Slum population and proportion below poverty line

have significant negative relation with recovery rate. It has already been established that there are several factors that make the slum population extremely susceptible to the current pandemic. The analysis corroborates previous studies by adding that the recovery rates in slum areas are lower than that in non-slum areas. Further, the study also stresses the importance of allocating resources for the poor amidst the burgeoning disease burden.

To mention here, our also analysis indicates better recovery with better urbanization, indicating rural population in more disadvantageous state. This could be for obvious reasons like poor health infrastructure and poor investment (BioSpectrum India, 2020) and thus need serious attention.

High working age population (mainly age group of 45-65), slum concentration and poverty are hurdles in COVID-19 recovery. Thus, rural areas, areas with restricted space, having slums, with higher working population who are mostly poor are in a disadvantageous state as is observed in the Mega cities of India. The population in the age group of 45-65 also deserves attention as the recovery rate tends to be lower in states with a higher proportion of middle aged population.

It is imperative to focus on strengthening the health infrastructure and capacity building of the health workers as well as ameliorating long term investments on health, health research and better quality of living. The analysis suggests that government spending is an important determinant of improving the recovery rate. There can be several plausible explanations for this. An increase in health spending points towards a more developed economy and it could also be instrumental in providing better testing and screening facilities. Large scale spending is useful in identifying cases and could, thus, be beneficial in treatment and recovery (Stojkoski et al, 2020).

The relationship of recovery rate and development indices may be time dependent. The ever changing testing rates and infection rates the association may change in future. The paper has not thrown lights on the past due to scarcity of dynamic data and also on how it may change in future as future is not predictable with certainty.

Conclusion:

With India recording its highest spike in cases in the last 24 hours, it becomes imperative to work towards improving the recovery rate. There is an ardent need to scale up the health

facilities, facilitate decongestion in slums, scale up the medical infrastructure in states with more proportion of economically weaker sections of the society.

The study tries to develop a comprehensive understanding of the various determinants of recovery rate at the social, economic and political level. In the absence of an exhaustive framework pertaining to recovery rate and its linkages with other variables in the social, political and economic context, this study is a novel attempt to address the issue and its policy connotations. With a better understanding of the dynamics of recovery rate and related determinants, this study can contribute towards the development of appropriate policy interventions.

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