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INVESTIGATING THE FACTORS INFLUENCING INCIDENCE AND FATALITY OF COVID-19 IN INDIA

Ashi Lama[1]
[1]Assistant Professor,
Department of Economics,
Rajiv Gandhi University,
Itanagar (Arunachal Pradesh)

Amitava Mitra[2]
[2]Pro Vice-Chancellor
and Professor of Economics,
Rajiv Gandhi University,
Itanagar (Arunachal Pradesh)

ABSTRACT

This paper examines the factors influencing inter-State variation in incidence and fatality of Covid-19 in India. The study is based on State level cross-sectional data as on 30 April, 2020. The ordinary least square method of regression analysis was applied to obtain the results. The analysis showed that at the global level incidence was the highest in Spain, Italy and United States of America and fatality was the highest in France, United Kingdoms and Italy. India was found to have low incidence of the disease so far. But exponential growth rate of cases, despite lockdown, was 10.80 % during March 5, 2020 to April 30, 2020. The western region of the country was found to be the most affected by the Covid-19 pandemic. Among the States, incidence was the highest in Delhi and Maharashtra. Whereas the fatality was the highest in Meghalaya, Punjab and Madhya Pradesh. The results of regression analysis showed that incidence was positively affected by population density and international exposure and fatality was found to be negatively influenced by health care infrastructure. The study suggests that there is need to adopt stringent population control policy and reduce international exposure to minimise the incidence of Covid-19. The government should focus on strengthening of healthcare infrastructure to reduce the fatality of Covid-19.

KEYWORDS: ***Covid-19 pandemic, lockdown, incidence, fatality, regression analysis***

INTRODUCTION

The novel coronavirus (Covid-19) which was first reported in Wuhan city of China in November, 2019 spread across the world to become a global pandemic. It has threatened the human population in the entire world. The virus named as SARS-Cov-2 causes respiratory diseases in human beings from common cold to more rare and serious diseases such as the Severe Acute Respiratory Syndrome (SARS) and the Middle East Respiratory Syndrome (MERS), both of which have high mortality rates (WHO 2020). The disease is one of most dangerous diseases in the world. The UN Secretary General described it as the worst crisis being faced by mankind since World War-II. It may lead to enhanced instability, unrest and enhanced conflict (The Economic Times, April 1, 2020). In fact, it is the greatest pandemic after the Great Influenza (popularly known as Spanish flu) of 1918, in which millions of global population were affected within a very short span of time (India Today, April 30, 2020). There is a high risk associated with this disease as it is highly fatal and contagious. The infection of Covid-19 was first detected in Wuhan, the capital of Hubei province of China in November 2019 when the Wuhan hospital reported that there was a cluster of unknown pneumonic cases related to Huanan Seafood Market. It is believed to have been transmitted from wild animal (bat) to human being but its zoonotic source is unknown (WHO, March 2020). A 55-year old from Hubei province could be the first person to have contacted the viral infections on November 17, 2019. Subsequently, Wuhan became the epicenter and it spread rapidly in china and abroad (The Economic Times, March 13, 2020). On January 8, 2020, a new coronavirus was identified as the cause of the pneumonia by the National Health Commission of China.

The disease rapidly spread to most of the countries of the world and became a global pandemic. The lightening spread of the disease across the world is due to very high degree of global economic integration and boon in the international movement of people

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(Harilal 2020). The global Covid-19 cases exceeded 2.6 million with over 1.84 lakh fatalities across over 200 countries which continue to be wreaked by its havoc (Kant 2020). The most affected regions in the world are the European Region (47.84 %) followed by the Regions of the Americas (39 %) (Situation Report, WHO, 2020). The countries which have a high incidence of disease are Spain, Italy, United States of America (USA), United Kingdom, Germany, France, Turkey and Russia. The Covid-19 pandemic has ruptured the world system. The economic impact of the pandemic would be enormous as it has stopped the engines of the world economy at once leading to loss in production, income and employment (Harilal 2020). According to the International Monetary Fund (IMF) projections the global economic growth in 2020 is likely to be -3 % (Gopinath 2020). The world trade in goods is projected to decline by 13 % to 32 % in 2020 (WTO 2020). Thus, the pandemic is going to inflict a deep impact on the world economy, if it is not contained soon.

India has also been facing the problem of Covid-19 since January 2020. The first case of Covid-19 in the country was reported in Kerala on 30th January, 2020. The number of cases in the country has been increasing with the passage of time. However, the growth in the number of cases in India was checked to some extent due to one-day voluntary public curfew (*Janta* curfew) on March 22, 2020 and the implementation of the 21-day nationwide lockdown by the Government of India from the mid night of March 24, 2020. The lockdown was further extended by another 14 days till May 3, 2020, in view of the growing number of infections. It is argued that nationwide lockdown has helped the country to reduce the incidence of the disease. The lockdown had slowed the rate of transmission and increased doubling time (The Hindu, April 25, 2020). Further, the infection rate in India so far, is reported to be 1.7 which is significantly much lower than that in other affected countries. This could be due to India's climatic conditions; high temperature and high relative humidity. SARS virus viability was found to be rapidly lost at higher temperatures and higher relative humidity (Chan *et al* 2011). The increase in cases during the lockdown period can be attributed to violation of lockdown by the people in certain areas (The Hindustan Times, April, 15). It is reported that India has responded more stringently to tackle the pandemic than other countries. However, despite the measures taken by the government, the country is yet to flatten the curve of Covid-19 infections. Since the number of cases was not going down continuously and following a zigzag pattern, the government extended the lockdown for a further period by two weeks till May 17, 2020 to contain the coronavirus outbreak in India (The Economic Times, May 4, 2020). In India, the most affected States are Maharashtra, Gujarat and Delhi. The number of cases has been fluctuating with the passage of time. Hence, there is a high uncertainty about the trend in cases and the shape of the curve, incidence and fatality of Covid-19. Since the country is still battling with the problem of Covid-19, there is a need to identify the factors which are affecting the incidence and fatality of Covid-19 in the country. Keeping this in view, the present paper is an attempt towards a statistical analysis of the determinants of incidence and fatality rate of Covid-19 in India by using the cross-sectional data of Indian States. The study is expected to help the Government in formulating policy and adopting suitable strategy to combat the Covid-19 pandemic and similar type of epidemics in future. The study is based on the following objectives: to analyse the incidence, recovery and fatality rate of Covid-19 in various States of India and to examine the determinants of incidence and fatality rate of Covid-19 in the country.

DATA SOURCE AND METHODOLOGY

The study was mainly based on secondary data. The data were collected from various sources like the website of the Ministry of Health and Family Welfare, Government of India, RBI; Census of India 2011; Indian Tourism Statistics, 2019. The data on Covid-19 cases, recovery rate and deceased rate were collected from the the website of World Health Organisation and mygov.in. The data on population density, literacy rate were collected from the Census of India 2011. The data on health infrastructure were collected from the Health and Family Welfare Statistics of India 2017. The study used cross-sectional data of Indian States to examine the determinants of inter-State variations in incidence and fatality rate of Covid-19. The data were analysed by applying various statistical techniques. The data were processed by using *MSEXCEL* the *STATA*.

The growth in Covid-19 cases was computed by fitting the exponential growth function which is given as follows.

$$Y = ae^{rt}$$

Where, Y is the Covid-19 cases and r is the exponential growth and t is the time.

Taking log on both side, r can be estimated as

$$LogY = loga + rt$$

The incidence of Covid-19 was calculated as the number cases per lakh of population.

$$Incidence = \frac{Number\ of\ cases}{Total\ Population}\ X\ 100000$$

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The Fatality was calculated as the number of deceased per 1000 confirmed cases.

$$Fatality = \frac{Number\ of\ deceased}{Total\ confirmed\ cases} \text{ X } 1000$$

In order to examine the determinants of incidence and fatality, a linear regression model was applied.

The incidence of Covid-19 was taken to be a function of public awareness, population concentration and international exposure. It was difficult to get exact data of the indicators. Hence, the study had to take proxy indicators. For example, literacy rate (LR) was taken to be an indicator of public awareness and population density (PD) and percentage of urban population (URP) were taken as indicators of population concentration. The respective State's percentage share in total foreign tourist (FT) arrivals in the country was taken as the proxy variable of its international exposure. This can be expressed as follows:

Incidence (IR) = f(LR, PD, URP, FT) ……. (1)

The above function was estimated by applying the Ordinary Least Square method. The model is specified as below.

$$\text{Incidence (IR)} = \beta_0 + \beta_1 LR + \beta_2 PD + \beta_3 URP + \beta_4 FT + \varepsilon \text{…….. (2)}$$

Where ε is the error term

The variable literacy rate is expected to negatively influence the incidence. The variables population density, urbanization and international exposure are expected to positively influence the incidence.

The fatality of Covid-19 was taken to taken to be a function of public awareness, ability to spend in treatment and health care facilities (health workers and health infrastructure). The literacy rate (LR) was again taken as an indicator of public awareness while ability to spend was measured in terms of per capita income (PCI) of a State. The health worker was measured in terms of number of doctors and nurses per lakh of population (HW) and health infrastructure was measured in terms of number of hospitals per lakh of population (HSP). The variable per capita income is likely to negatively influence the fatality as people with higher income are expected to have greater ability to spend in better health care. However, the initial regression showed that PCI was not having the expected sign. The high fatality rate of Covid-19 in developed countries also showed that income level was not an influencing factor. Hence, this variable was dropped and regression was done with three variables. In functional form, it can be expressed as follows:

Fatality (FR) = f(LR, HW, HSP) …….. (3)

The above function was estimated by applying the Ordinary Least Square method. The model is specified as below.

$$\text{Fatality (FR)} = \beta_0 + \beta_1 LR + \beta_2 HW + \beta_3 HSP + \varepsilon \text{ …….. (4)}$$

Where ε is the error term

The variable literacy rate is expected to negatively influence the fatality, as educated people are more likely to take proper precautions and avail health care facilities. The variable number of health worker is also likely to negatively affect the fatality rate. Finally, the variable number of hospital is also expected to negatively influence the fatality rate.

INCIDENCE AND FATALITY OF COVID-19: A GLOBAL ANALYSIS

The Covid-19 has affected most of the countries in the world. The most affected country is the United States of America which has highest number of confirmed cases followed by Spain and Italy (table 1). India has registered 33050 cases as on April 30, 2020 till 10.00 AM (WHO 2020). However, the actual number of cases does not properly reflect the incidence of the disease as the countries vary in population size. Hence, incidence of disease was measured in terms of number of cases per lakh of population. The incidence of disease was found to be the highest in Spain (459 cases per lakh of population) followed by Italy (344 per lakh of population) (Figure 1).

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Table 1: Incidence and Fatality of Covid-19 in Selected Countries (As on 30th April up to 10.00 AM)

Countries	Confirmed cases	Deceased	Incidence (cases per lakh population	Fatality (deceased per 1000 population)
United States of America	1003974	52428	311.62	52.22
Spain	212917	24275	459.39	114.01
Italy	203591	27682	342.57	135.97
United Kingdom	165225	26097	251.14	157.95
Germany	159119	6288	194.25	39.52
France	127066	24054	196.33	189.30
Russian Federation	106498	1073	73.97	10.08
China	84373	4643	5.98	55.03
India	33050	1074	2.50	32.50

Source: Situation Reports-101, World Health Organisation

The incidence of Covid-19 in the United States of America was 311.62 and United Kingdom had the incidence of 251.14 per lakh of population. The incidence of Covid-19 in India was 2.50 persons per lakh of population which was very low compared to the USA and European countries. This shows that so far the country has been able to contain the spread of Covid-19. This can be attributed to the stringent measure of 21-day nationwide lockdown implemented in the country from the mid-night of March 24, 2020 (The Hindu, March 24, 2020). The lockdown was necessitated as the death toll had risen to 12 on March 24, 2020. The lockdown was extended by another 19 days till May 3, 2020 as the number of cases in the country surged past the ten thousand mark (The Economic Times, April 1, 2020). The lockdown is likely to have a huge adverse impact on the economy. However, it has helped the country to minimize the rate of infections. As a result, India is still having lower incidence of Covid-19. On the other hand, the number of cases are gradually rising with the passage of time. Hence, there is a need to strictly implement the various guidelines of lockdown to save the people from the deadly disease. ‘

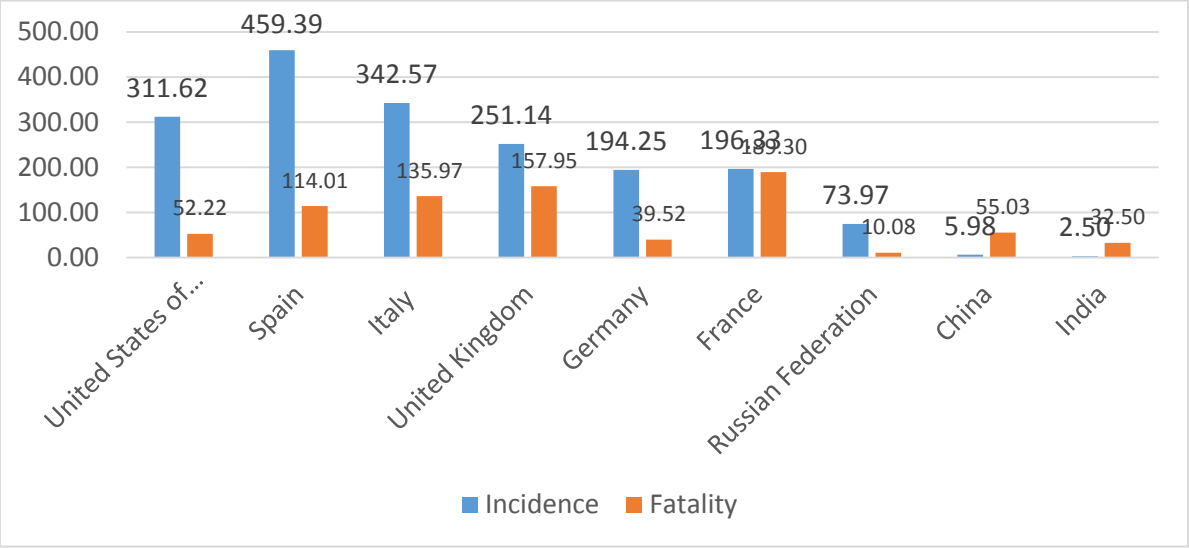

Figure 1: Incidence and fatality of Covid-19 in selected countries.

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Among the selected countries, the fatality was the highest in France (189 per 1000 cases) followed by United Kingdom (157.95 per 1000 cases) and Italy (135.97 per 1000 cases) (Figure 1). The fatality was the lowest in Russian Federation (10 per 1000 cases) followed by India (32.50) and Germany (39.52). The table 1 shows that there is a wide variation in fatality across the countries which could be due to differences in measures adopted to contain the pandemic, differential immunity of population, population composition and variations in health care facilities.

The analysis shows that the developed countries which are opened to a greater extent for international trade, movement of tangible goods and tourism are deeply affected by the Covid-19. On the other hand, the the small and less developed countries like, Bhutan, Nepal, Myanmar, Somalia etc. with limited international exposure were the least affected countries.

TREND AND GROWTH IN COVID-19 CASES IN INDIA: AN INTER-STATE ANALYSIS

The Covid-19 pandemic came to India relatively late. When China was fighting a battle against the disease in December 2019, India had no case of Covid-19 and the country seemed to be safe from it. Since the country is opened to external sector for trade and tourism, it was difficult for it to remain unaffected without stringent measures. The country got the first case of Covid-19 on January 30, 2020 when a person in Kerala was tested positive. In terms of number of cases, Maharashtra is now the worst affected, followed by Tamil Nadu. The day-wise number of confirmed cases and cumulative cases are shown in figures 2 and 3.

The number of cases detected on March 15, 2020 was 26. During the period March 15, 2020 to March 30, 2020, the lowest number of case was detected on March 7, 2020 (4 cases) and the highest on April 29, 2020 (1975 cases). Figure 2 shows the rising trend in the number of confirmed cases each day with some fluctuations during the period under consideration. The exponential growth of confirmed cases during the period March 15, 2020 to March 30, 2020, was 10.80 %. This implies that confirmed cases were growing at double digit everyday on an average, which is an alarming sign for the country. The growth in cases, despite lockdown, indicates that there is a high risk of witnessing community level transmission, if guidelines are not adhered to by the people.

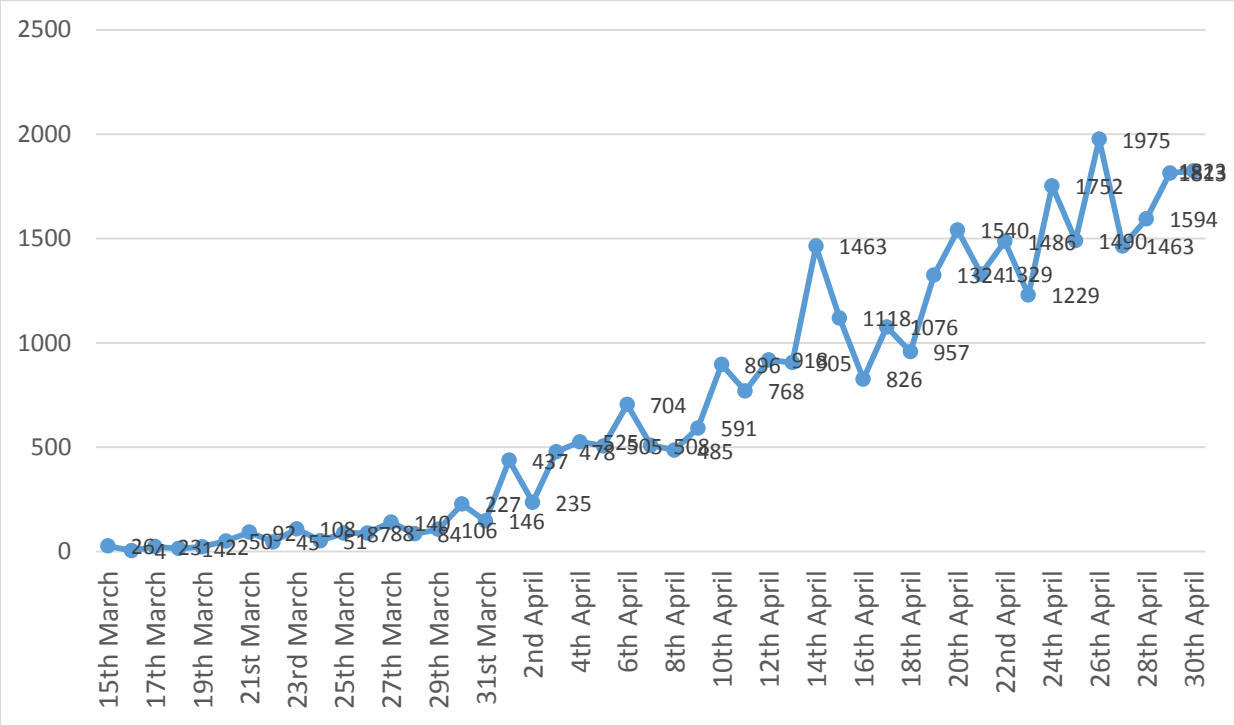

Figure 2: Day-wise confirmed cases in India

Source: mygov.in/covid-19

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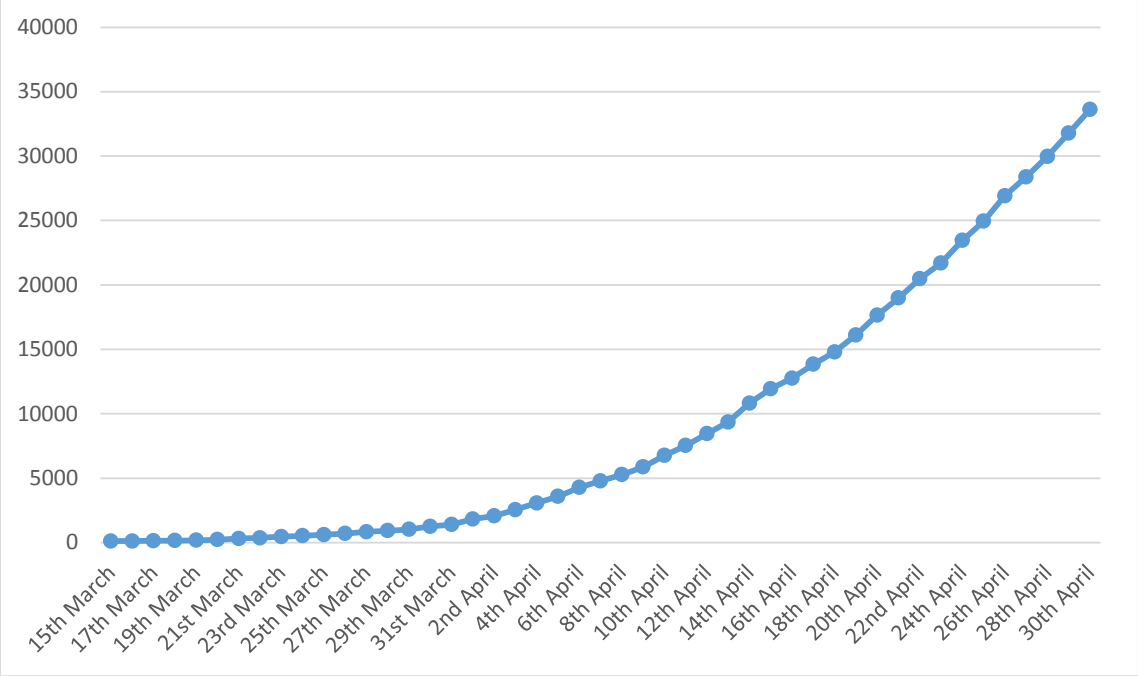

Figure 3: Trend in Covid-19 Cases in India (Cumulative number of cases).

Source: mygov.in/covid-19

Figure 3 shows the rising cumulative number of cases in India. The cumulative number of case increased from 110 on March 15, 2020 to 3360 cases on April 30, 2020. The cumulative curve has an upward bend from March 31, 2020 which shows that the number of cases has increased faster. During the whole of April 2020, the curve has an upward trend. This implies that though lockdown has reduced the rate of infections, it could not fully contain the spread of Covid-19. This indicates that there are many socio-economic factors which are affecting the spread of Covid-19 in the country.

The incidence, recovery rate and fatality of Covid-19 across States and Union territories shows that the incidence of the disease was the highest in Delhi (20.53 cases per lakh population) followed by Maharashtra (8.82 cases per lakh population) and Andaman and Nicobar (8.69 cases per lakh population). The details are given in table 2.

Table 2: Incidence, Recovery Rate and Fatality of Covid-19 across States/Union Territories in India (As on 30th April, 2020 up to 5.00 PM)

States/UTs	Incidence (cases per lakh population)	Recovery Rate (%)	Fatality (per 1000 cases)
Delhi	20.53	31.75	16.28
Maharashtra	8.82	16.07	43.57
Andaman and Nicobar	8.69	45.45	0.00
Gujarat	6.76	12.91	48.26
Chandigarh	5.31	30.36	0.00
Jammu and Kashmir	4.63	33.05	13.77
Madhya Pradesh	3.66	17.33	48.87
Rajasthan	3.55	31.50	20.92
Tamil Nadu	3.00	55.97	12.49

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Andhra Pradesh	1.66	22.88	22.10
Kerala	1.48	74.55	8.08
Punjab	1.29	25.21	53.22
Haryana	1.22	67.42	9.68
Uttar Pradesh	1.10	23.29	17.70
Karnataka	0.91	40.04	37.70
West Bengal	0.83	16.36	29.02
Puducherry	0.64	62.50	0.00
Himachal Pradesh	0.58	62.50	25.00
Uttarakhand	0.54	65.45	0.00
Goa	0.48	100.00	0.00
Meghalaya	0.40	0.00	83.33
Bihar	0.39	16.13	4.96
Jharkhand	0.32	17.76	28.04
Odisha	0.31	30.47	7.81
Chhattisgarh	0.15	89.47	0.00
Assam	0.13	69.05	23.81
Mizoram	0.09	0.00	0.00
Manipur	0.07	100.00	0.00
Arunachal Pradesh	0.07	100.00	0.00
Tripura	0.05	100.00	0.00
Ladakh	NA	72.73	0.00
Telangana	NA	36.26	25.69
All India	2.78	24.91	31.38

Source: Ministry of Health and Family Welfare, Government of India

Figure 4 clearly depicts the incidence of Covid-19 in different States and Union Territories of India. The incidence of Covid-19 was found to be the lowest in hilly States of North East India, like Arunachal Pradesh, Mizoram and Manipur. In fact, Sikkim and Nagaland have not reported any case so far. The inter-State variation in incidence of Covid-19 shows that densely populated and highly exposed States/Union territories were greatly affected by the disease and least densely populated and isolated States of India remained more or less unaffected by the disease. This implies that isolation and remoteness have acted as a boon and a shield against Covid-19.

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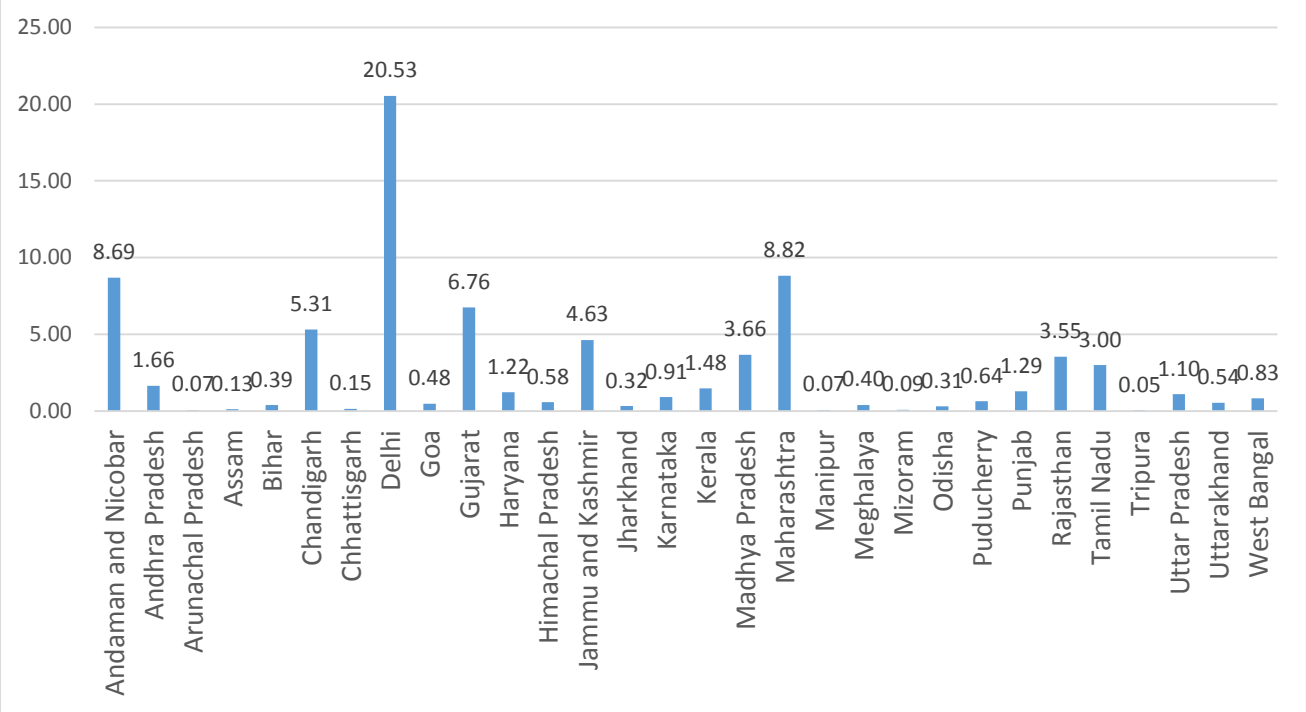

Figure 4: Incidence of Covid-19 in various States/Union Territories of India (As on 30th April, 2020)

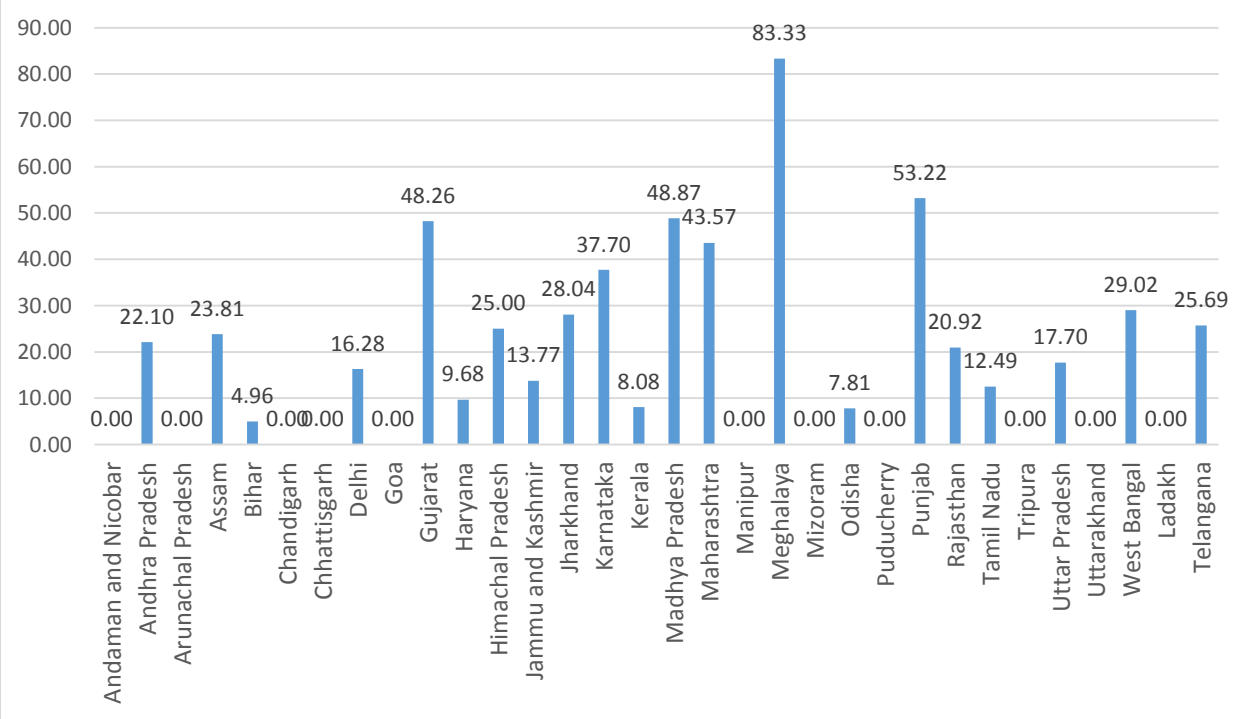

Figure 5: Fatality of Covid-19 in various States/Union Territories of India (As on 30th April 2020)

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The recovery rate from Covid-19 was found to be 100 % in Goa, Arunachal Pradesh, Manipur and Tripura. It was 89.47 % in Chhattisgarh and 72.73 % in Ladakh. The most affected areas Delhi and Maharashtra showed the recovery rate to be 31.75 % and 16.07 % respectively (Table 2).

The fatality rate is a measure of the severity of a disease. It is measured as the proportion of deaths from a certain disease per 1000 confirmed cases for a certain period of time. In order to examine the severity of Covid-19 in various States of India, fatality rate was computed. The fatality rate in different States are depicted in figure 5. The fatality rate was found to be the highest in Meghalaya (83.33 per 1000 confirmed cases) followed by Punjab (53.22), Madhya Pradesh (48.87), Gujarat (48.26) and Maharashtra (43.57). It is quite encouraging to note that there was no fatality of Covid-19 till April 30, 2020 in Andaman and Nicobar Islands, Arunachal Pradesh, Chandigarh, Chhattisgarh, Goa, Manipur, Mizoram, Ladakh, Tripura, Puducherry and Uttarakhand (Table 2).

INCIDENCE AND FATALITY OF COVID-19: A REGIONAL ANALYSIS

The regional analysis was done to identify the regions which are more vulnerable to the disease. The analysis shows that incidence of Covid-19 in India is the highest in Western region (6.75 persons per lakh population) followed by the Northern region (5.32 persons per lakh population). This could be due to greater international exposure and high population density of these regions. For instance, Maharashtra, Delhi and Rajasthan had very high share in foreign tourist arrivals in the country (GoI, 2019). While Delhi and Chandigarh had the highest density of population in the country (GoI, 2011). The details are given in table 3.

Table 3: Region-wise Incidence and Fatality in India (As on 30th April 2020 up to 5.00 PM)

Regions	Incidence (no. of cases per lakh population)	Recovery rate (%)	Fatality (no. of deceased per 1000 cases)
Western Region	6.75	17.61	41.36
Northern Region	5.32	34.15	18.11
Southern Region	2.23	44.26	19.34
Central Region	1.61	21.07	34.10
Eastern Region	0.52	19.85	22.90
North Eastern Region	0.13	56.67	33.33
All India	2.78	24.91	31.98

Source: Ministry of Health and Family Welfare, Government of India

The incidence of Covid-19 was the lowest in North Eastern region of India. This can be attributed to the fact that region has relatively less accessibility and less exposure to the outside world. At the same time, the density of population is also quite low in the region. The recovery rate was also found to be the highest in North Eastern region (56.67 %) which is a remarkable achievement, despite being poor in health infrastructure. This may be due to its pollution free and ecofriendly climatic conditions as well as better immunity of the people owing to consumption of organic food. But it needs to be verified through a proper scientific research. The Southern region had the recovery rate of 44.26 % which can be ascribed to its better health care infrastructure. Kerala, Puducherry and Tamil Nadu had the recovery rate of 74%, 62% and 56% respectively (Table 2). The high recovery rate in Kerala is ascribed to its highly advanced social indicators and participatory governance (Roy and Dave 2020). The recovery rate was found to be the lowest in Western region (17.61 %).

The fatality of Covid-19 was the highest in Western Region (41.36 deceased per 1000 cases) followed by Central region (34.10 deceased per 1000 cases). It was the lowest in Northern region (18.11 deceased per 1000 cases) (table 3). The relatively low fatality in Northern region could be because of better health care facilities and public awareness. For instance, Delhi and Chandigarh had the highest number of health worker per lakh of population (GoI, 2017). At the same, literacy rate is quite high in the States of this region.

The regional analysis revealed that Western region of India had both the higher incidence and

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fatality. At the same time, the same region had lower recovery rate. This implies that Western region of India is at a greater risk from Covid-19. There is a need to identify the factors responsible for these in the Western region through more micro level study.

DETERMINANTS OF INTER-STATE VARIATIONS IN INCIDENCE AND FATALITY OF COVID-19

The analysis of data shows that the cases of Covid-19 has been gradually rising in India, despite adopting stringent measures of a nationwide lockdown and social distancing. Though the incidence is low at the national level as compared to other affected countries, there has been a wide inter-State variation in both incidence and fatality of the disease. The variations could be attributed to different socio-economic conditions and health care facilities. The identification of factors affecting incidence and fatality of the disease can help the decision makers in making better strategy to combat the disease in different States and regions of the country. In this regard, an attempt is made to examine the socio-economic variables which are determining the inter-State variations of incidence and fatality of Covid-19 in the country.

As mentioned in the methodology, four variables namely, literacy rate, population density, percentage of urban population and percentage share in foreign tourists have been taken as factors influencing the incidence of Covid-19. The test for multicolinearity showed a strong correlation between the variables population density (PD) and percentage of urban population (URP). Hence, the variable percentage of urban population (URP) was dropped and the regression was run with three explanatory variables; literacy rate (LR), population density (PD) and percentage share in foreign tourist (FT). The Breusch-Pegan/Cook-Weisberg test for heteroskedasticity indicated presence of this problem (Table 4). Hence, the regression was run with robust standard error to remove this problem.

Table 4: Breusch-Pegan/Cook-Weisberg Test for Heteroskedasticity

Ho: Constant Variance
Variables: fitted values of Incidence

Chi2	8.18***
Prob>Chi2	0.0042

Note: ***denotes significant at 1 % level.

The result of the regression for the determinants of Covid-19 in India is given in the table 5.

Table 5: Regression result for determinants of Incidence of Covid-19.

Variables	Coefficient	Robust Std. Error	t-value	p-value
Literacy rate (LR)	0.026	0.05899	0.46	0.648
Population Density (PD)	0.0007*	0.000385	1.86	0.079
Foreign Tourist (FT)	0.176*	0.09859	1.79	0.086
Constant	-1.37	4.15794	-0.33	0.744
Number of Obs.	30			
F-Statistic	2.99**			
Prob>F	0.0494			
R-Square	0.44			

Note: * and ** denote significant at 10 % and 5 % level respectively.

The result in table 5 shows that F-Statistic is significant at 0.05 level which indicated a good fit of the model. The R-square is 44 % which is fairly high in this situation where the disease incidence depends on a number of factors. The variables, population density and share in foreign tourist had the expected signs. The analysis showed that out of three variables, two variables i.e. population density (PD) and percentage share in foreign tourist arrivals (FT) were found to be statistically significant. Both the variables were found to be positively affecting the incidence of the disease and were significant at 0.10 level. The concentration of population and international exposure were significant variables in determining the inter-State variations in

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incidence of Covid-19 on the basis of availability of secondary data at State level. This implies that densely populated areas of the country are likely to suffer more from Covid-19. At the same time, the States and areas which are internationally more exposed, are likely to have more incidence of the disease. The variable, literacy rate was expected to have a negative sign as educated people are likely to take proper precautions to prevent the infection. However, it was found to be positive but it was not significant.

The fatality of a disease depends on a number of factors. In this study, the fatality of Covid-19 was taken to be a function of literacy rate, health workers per lakh population and hospitals per lakh population. The VIF test for multicolinearity showed that there was no such problem (Table 6). The Breusch-Pegan/Cook-Weisberg test for heteroskedasticity indicated the presence of this problem (Table 7). Hence, the regression was run with robust standard error to remove this problem.

Table 6: VIF Test for Multicollinearity

Variables	VIF	1/VIF
Literacy rate (LR)	1.73	0.577
Health Workers (HW)	1.68	0.594
Hospitals (HSP)	1.04	0.963
Mean VIF	1.48	

Table 7: Breusch-Pegan/ Cook-Weisberg Test for Heteroskedasticity

Ho: Constant Variance
Variables: fitted values of Fatality

Chi2	3.58**
Prob>Chi2	0.054

Note: **indicates significant at 5 % level.

The result of the regression for determinants of fatality of Covid-19 in India is presented in table 8. All the explanatory variables were found to have expected signs.

Table 8: Regression result for determinants of Fatality of Covid-19

Variables	Coefficient	Robust Std. Error	t-value	p-value
Literacy rate (LR)	-0.577	0.4417	-1.31	0.203
Health Workers (HW)	-0.038	0.3156	-1.22	0.233
Hospitals (HSP)	-1.662**	0.6904	-2.41	0.023
Constant	76.69**	32.899	2.33	0.028
Number of obs.	30			
F-Statistic	3.34**			
Prob>F	0.034			
R-Square	0.23			

Note: ** denote significant at 5 % level.

The result of regression analysis in table 8 shows that the model is a good fit as indicated by the F-Statistic which is significant at 0.05 level. The R-square is 23 %. The low value of R-square indicates that there are many other factors which influence the fatality of the disease. The result showed that out of three variables only one variable i.e. number of hospitals per lakh population (HSP) was found to be statistically significant. The variable was found to be negatively affecting the fatality of Covid-19 and it was significant

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at 0.05 level. This implies that the States having better health care infrastructure would have lower fatality rate. Hence, there is a need to invest more in strengthening health care facilities and improve the density of hospitals to mitigate the fatality of such pandemic in future. The variables, literacy rate (LR) and health workers per lakh population (HW) were also found to be negatively affecting the fatality of Covid-19. But they were not significant at any level. However, since these variables had negative influence on fatality, improvement in these indicators are also likely to help in reducing the fatality rate in future.

SUGGESTIONS

On the basis of the findings of the study, the following policy suggestions can be made for combating the pandemic in the country.

1. There is a need to strictly implement the government guidelines by the implementing authority. The growing number of cases, despite two phases of lockdown, indicates that there had been a violation of lockdown in some pockets of the country.
2. The region-wise analysis of the pandemic showed that Western region of the country is the worst affected one. The region has both high incidence and high fatality compared to other regions. At the same time, recovery rate was also low. Hence, there is need to give additional attention to this region.
3. The incidence of the pandemic was positively linked with population desnsity. This calls for adopting more stringent population policy to control population growth and reduce population concentration. As Malthus (1798), a renowned political economist in his theory population stated that people need to control their numbers otherwise nature would control them.
4. International exposure was also found to be positively affecting the incidence of Covid-19. Hence, there is a need to adopt a suitable policy to minimize international exposure for a certain period.
5. The fatality of the pandemic was found to have negative relationship with health care facilities. Hence, there is a need to invest more in building health care facilities in various States of the country. India spent around 5 % on its GDP of health sector (4.7 % in 2014 as per WHO Statistics) which is much lower than that in other countries. In fact, it is high time to entrance investment on public health for making the people healthy and fight against the deadly diseases.

CONCLUSION

The Covid-19 pandemic has emerged as a great threat to the existence of mankind on the planet earth. The disease which was first detected in Wuhan, China in November 2019 engulfed almost the entire world within a short span of time, killing lakhs of people. It did not spare even the most powerful and highly developed countries. India came under its grip in January end, and since then the number of cases has been growing everyday. Despite lockdown and social distancing measures, the curve is yet to be flattened. The exponential growth of confirmed cases in India during March 15, 2020 to April 30, 2020 was 10.80 %. The analysis of the incidence and fatality at global level showed that incidence of the pandemic in the highest in Spain, Italy and USA. Incidence of the pandemic in India so far is low which is a remarkable achievement. The fatality of the pandemic was the highest in France, United Kingdom, Italy and Spain. The high fatality rate in developed countries, with improved health care facilities and high levels of income indicates that there are other factors which determine the fatality of Covid-19 at the global level. The differences in immunity level of population of different countries could be one such factor but needs scientific investigation. The analysis of the inter-State variations in incidence and fatality rate in India revealed that the densely populated and urbanized States like Delhi, Maharashtra and Gujarat. The fatality rate was high in Meghalaya, Punjab, Madhya Pradesh, Gujarat and Maharashtra. The Western region of the country was found to be more severely affected as it had both high incidence and high fatality.

The result of the regression analysis showed that inter-State variations in incidence of the Covid-19 was explained by the literacy rate as a proxy of public awareness, population concentration and international exposure. The incidence was positively linked with population concentration and international exposure. The fatality rate was found to be negatively linked with public awareness, health workers and health infrastructure (hospitals). The number of hospitals was found to be statistically significant. The findings of the study indicate that there is a need to strengthen the health care infrastructure in all the States which have inadequate health care facilities. It is also important to improve awareness among the people about the pandemic and strictly implement the guidelines to win the battle against the invisible enemy of mankind.

Thus, the present study raises a number of vital issues which can be answered more satisfactorily

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with the help of further research, preferably at micro level.

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