



Role of Health Care Infrastructure and Expenditure on COVID19 Pandemic: Scenario from Most Affected Countries

E. Shantanu Kumar Patra¹, Shakti Bedanta Mishra², Subhra Mallisha³, Jatindra Nath Mohanty⁴

¹Department of Critical Care Medicine, IMS and SUM Hospital, SOA deemed to be University, Bhubaneswar, Odisha, India

²KIIT School of Public Health, KIIT Deemed to be University, Bhubaneswar, Odisha, India

³Medical Research Laboratory, IMS and SUM Hospital, SOA deemed to be University, Bhubaneswar, Odisha, India

⁴IMS and SUM Hospital, SOA deemed to be University, Bhubaneswar, Odisha, India

ABSTRACT

Purpose: The recent pattern of the COVID19 have hit hard to the entire world engulfing many lives with in it. We intended to portray the association between the hospital resources such as Hospital beds, Intensive care unit beds (ICU beds), percentage of Gross Domestic Products (GDP) on health with total confirmed cases and total deaths among different countries.

Methods: The data of these available health resources in 45 countries were collected from the secondary data sources. The mortality data were collected from situation report by WHO.

Results: The overall mortality rate was 7.29% across 45 countries. The average number of available Hospital beds, ICU beds, GDP on health was 4.30 ± 2.66 , 11.43 ± 9.03 and 8.31 ± 2.56 respectively. Moreover, the country that spend highest on health face maximum number of confirmed cases ($r^2 = 0.538$) and mortality ($r^2 = 0.516$).

Conclusion: There was found that those countries spent more percentage of GDP on health having a greater number of confirmed cases and deaths, but not found any statistical significance with other health resources.

Keywords: COVID19, GDP, ICU, Mortality

INTRODUCTION

In late December 2019, an outbreak of pneumonia of unknown origin emerged in the seafood wholesale wet market, in Wuhan, Hubei, China which rapidly spread across china.¹ This unknown pneumonia like disease was subsequently named as Severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) by the Corona virus Study Group.² In 11th February 2020 this Pneumonia of unknown origin is identified as COVID-19 by the World Health Organization (WHO).³ The disease rampantly started to attack thousands of people in China including many provinces such as Hubei, Zhejiang, Guangdong, Henan,

Hunan, etc. The burst of case occurred starting from Wuhan, engulfing the entire Hubei province. And subsequently it spread like a wildfire within a span of days and affected almost 210 countries. Therefore, on 30th of January 2020 WHO declared this as Public health emergency of international concern (PHEIC).⁴ The initial mortality rates were 11%–15%, but more recent data were 2%–3%.⁵ So far 25.44 lakhs confirmed COVID19 cases by 23rd April 2020 were present worldwide posing a major public health threat to the entire world.⁶

COVID19 infection is acute without any carrier status. The symptoms usually begin with fever, dry

How to cite this article: Patra ES, Mishra SB, Mallisha S, Mohanty JN. Role of Health Care Infrastructure and Expenditure on COVID19 Pandemic: Scenario from Most Affected Countries. Natl J Community Med 2022;13(2):120-125. DOI: 10.5455/njcm.20211223095025

Financial Support: None declared

Conflict of Interest: None declared

Date of Submission: 23-12-2021

Date of Acceptance: 10-01-2022

Date of Publication: 28-02-2022

Correspondence: Dr. Shakti Bedanta Mishra (Email: shaktibedantamishra@soa.ac.in)

Copy Right: The Journal retains the copyrights of this article. However, reproduction is permissible with due acknowledgement of the source.

cough, fatigue then gradually multiple systems get involved including respiratory (cough, shortness of breath, sore throat, rhinorrhoea, haemoptysis, chest pain) gastrointestinal (diarrhoea, vomiting) muscle ache and neurologic (confusion, headache).⁷ However, the most common symptoms are fever, cough, myalgia, and shortness of breath. The incubation period of the disease is 5.2 days.⁸ Currently it is estimated that the virus is transmitted through droplets, aerosols and direct contact and it is not yet confirmed about the oral-faecal transmission.^{5,7,8} Adults with co-morbidities are at a higher risk of getting affected with COVID19. Hypertension being on the top of the list followed by diabetes, coronary heart disease and chronic obstructive pulmonary disease.^{9,10}

Till now we all are well versed how the COVID19 possess a global threat. With the exponential rise in the COVID19 cases the surge of medical care has increased. As per the data, almost 81% people affected with COVID19 were asymptomatic. But still 14% were developing severe respiratory diseases and 5% patients requiring critical care.¹¹ However, in the availability of health resources like Hospital beds, Critical care beds, percentage of GDP on health still certain loop holes exists mainly in the Low- and Middle-income countries but the actual effect was still unknown.¹² So, we intended to find out the association of these health resources with total confirmed cases and total deaths among different countries.

METHODOLOGY

We have collected the available Hospital beds per 1000 population, ICU beds per 100000 populations, Percentage of GDP on health, Mortality rate by 23rd April 2020 across globe from secondary data sources. Hospital beds per 1000 population was collected from the secondary data published in international organization Organisation for Economic Cooperation and Development (OECD),¹³ ICU beds per 100000 population were collected from respective government official websites^(12,14–16) and some were also collected from different published articles, whereas percentage of GDP on health data were collected from the latest data available in OECD library.¹⁷ Mortality rate were extracted from the latest factsheet published by WHO.⁶ All data were collected in mean.

Statistical Analysis: We presented our data as Mean and Standard deviation (SD). We used Binomial regression to assess the association of Hospital beds per 1000 population, ICU beds per 100000 population and percentage of GDP on health with mortality rate across the countries. Along with we have also used coefficient correlation test to find the association of GDP on confirmed cases and deaths. We consider p value of less than 0.05 for statistical significance. We used IBM SPSS version 25.0, IBM corp., Armonk, NY for analysis.

RESULTS

As per the data collected the overall mortality across 45 countries were 7.29%, but among them France experienced highest mortality rate 18.06% followed by Belgium (14.95%), United Kingdom (13.56%), Italy (13.39%) and Sweden (12.10%). Iceland have experienced lower mortality rate 0.56%. In comparison to these above countries India experienced low mortality rate 3.18%. (Table 1)

The average number of available Hospital beds per 1000 population was 4.30 ± 2.66 across these countries. As per the data, Japan have highest number of hospital beds per 1000 population 13.05 following Korea (12.27), Russia (8.05), Germany (8) and Austria (7.37). Likewise, the average ICU beds available per 100000 populations are 11.43 ± 9.03 and Turkey has highest ICU beds 47.1. As per the data, India has lower number of Hospital beds as well as ICU beds (0.53, 2.3 respectively) compared to other countries. There was no statistical significance of Hospital beds ($p = 0.390$), ICU beds ($p = 0.619$) with mortality rate of COVID 19. (Table 1)

The mean percentage of GDP spent on health is 8.31 ± 2.56 across the countries. United States (U.S.) spending highest percentage of GDP (16.9%) on health then follows Switzerland (12.25%), France (11.2%), Germany (11.2%) and Sweden (11%) respectively, whereas India is spending only 3.6% of GDP on health. It was also observed that these countries have markedly higher number of confirmed cases as well as deaths compared to others. U.S. has highest number of confirmed cases (800926 cases) as well as higher number of deaths (40073 deaths) compared to other highly spent countries. Likewise, Switzerland, France, Germany and Sweden have 28186, 48046, 117961 and 16004 confirmed cases respectively. India is spending lower percentage of GDP on health (3.6%) and also having lower confirmed cases (21393 cases) as well as lower deaths (681 deaths) than high spending countries.

On analysis, it was evident that those countries spent higher percentage of GDP on health have also higher number of confirmed cases ($r^2 = 0.538$) (**Error! Reference source not found.**) and higher mortality ($r^2 = 0.516$) (**Error! Reference source not found.**). There was also statistical significance of GDP on health with total confirmed cases and deaths (p value = 0.000 and 0.000 respectively) due to COVID19. But there was observed no statistical significance with mortality rate ($p = 0.136$, $r^2 = 0.228$) (**Error! Reference source not found.**)

DISCUSSION

The ongoing pandemic of corona virus disease (COVID19) is divesting, despite of extensive implementation of preventive measures. The outbreak was sparked in Hubei province Wuhan, china, and quickly spreading all regions of the world. As per the record

by World Health Organization by 23rd April 2020, almost 25.44 lakhs affected and 1.85 lakhs people died by this deadly virus.⁶This number is going on

increasing day by day and affected almost 212 countries across the globe including all developed and developing nations.

Table 1: Data describing Hospital beds, Critical care beds, Gross Domestic Products (GDP), Confirmed cases, Deaths and Mortality rates

Countries	Hospital beds	ICU beds	GDP	Confirmed cases	Deaths	Mortality rate
Australia	3.93	9.1	9.3	6654	74	1.11
Austria	7.37	21.8	10.3	14924	494	3.31
Belgium	5.66	15.9	10.4	41889	6262	14.95
Canada	2.52	13.5	10.7	38923	1871	4.81
Chile	2.11	3.38	8.9	11296	160	1.42
Czech Republic	6.63	11.6	7.5	7136	210	2.94
Denmark	2.61	6.7	10.5	7912	384	4.85
Estonia	4.69	14.6	6.4	1559	44	2.82
Finland	3.28	6.1	9.1	4129	149	3.61
France	5.98	11.6	11.2	117961	21307	18.06
Germany	8	29.2	11.2	148046	5094	3.44
Greece	4.21	6	7.8	2408	121	5.02
Hungary	7.02	13.8	6.6	2284	225	9.85
Iceland	3.06	9.1	8.3	1785	10	0.56
Ireland	2.96	6.5	7.1	16671	769	4.61
Israel	3.02		7.5	14498	189	1.30
Italy	3.18	12.5	8.8	187327	25085	13.39
Japan	13.05	7.3	10.9	11919	287	2.41
Korea	12.27	10.6	8.1	10702	240	2.24
Latvia	5.57	9.7	5.9	761	11	1.45
Lithuania	6.56	15.5	6.8	1398	38	2.72
Luxembourg	4.66	24.8	5.4	3654	80	2.19
Mexico	1.38	1.2	5.5	9501	857	9.02
Netherlands	3.32	6.4	9.9	34842	4054	11.64
New Zealand	2.71	4.8	9.3	1112	16	1.44
Norway	3.6	8	10.2	7250	169	2.33
Poland	6.62	6.9	6.3	10169	426	4.19
Portugal	3.39	4.2	9.1	21982	785	3.57
Slovak Republic	5.82	9.2	6.7	1244	14	1.13
Slovenia	4.5	6.4	7.9	1353	79	5.84
Spain	2.97	9.7	8.9	208389	21717	10.42
Sweden	2.22	5.8	11	16004	1937	12.10
Switzerland	4.53	11	12.2	28186	1216	4.31
Turkey	2.81	47.1	4.2	98674	2376	2.41
United Kingdom	2.54	6.6	9.8	133499	18100	13.56
United States	2.77	34.7	16.9	800926	40073	5.00
Brazil	2	13	9.2	43709	2741	6.27
China	4.34	3.6	5	84302	4642	5.51
Colombia	1.7	-	7.2	4149	196	4.72
Costa Rica	1.13	-	7.5	669	6	0.90
India	0.53	2.3	3.6	21393	681	3.18
Indonesia	1.04	-	3.1	7418	635	8.56
Russia	8.05	8.3	5.3	62773	555	0.88
South Africa	2.8	8.9	8.1	3635	65	1.79

Table 2: Health Infrastructure Indicators

	Mean ± SD	r Value*	P Value**
Hospital beds per 1000 population	4.30±2.66	-0.133	0.390
ICU beds per 100000 population	11.43±9.03	-0.081	0.619
Percentage of GDP on Health	8.31±2.56	0.228	0.136

*Showing correlation with mortality rate; **Showing statistical significance with mortality rate

As per the situation report published by WHO, up to last of February it was only spreading over western pacific regions but later on outspreaded to all other

regions of the world. At present African regions were mostly affected by this catastrophic virus.⁶ In this study we have seen heterogeneity in the number of

available hospital beds per 1000 population, ICU beds per 100000 population and percentage of GDP spent on health across the globe.

This study found that mortality rate of corona virus infection is 18.06% in France, which was markedly highest and Iceland was having lowest mortality rate of 0.56%. As per the situation report the overall mortality rate across the globe was 6.9%.⁶

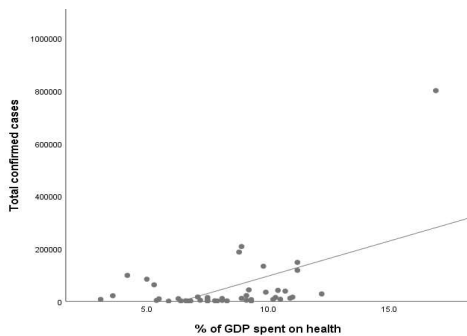


Figure 1: Scatter plot of confirmed cases with percentage of GDP on health

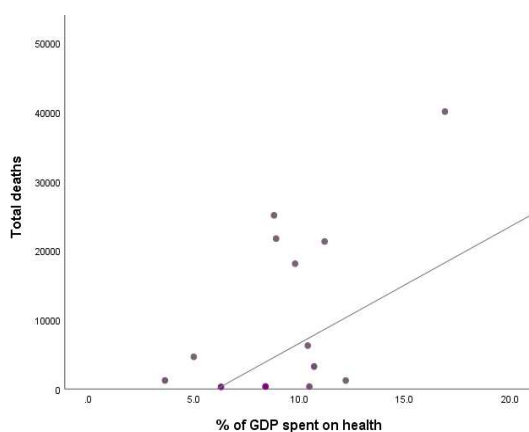


Figure 2: Scatter plot of total deaths with percentage of GDP on health

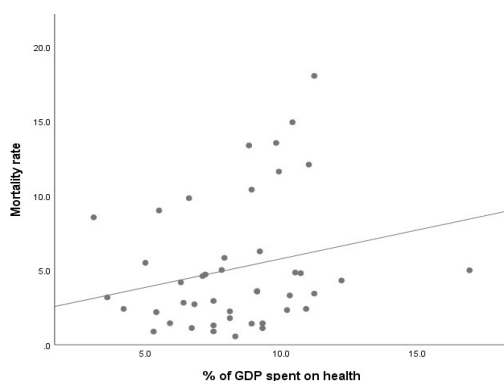


Figure 3: Scatter plot of Mortality rate with GDP

It was observed that 11 countries have higher mortality rate compared to the overall mortality of the world. After France, Belgium have mortality rate 14.95% followed by United Kingdom (13.56%), Italy

(13.39%), Sweden (12.10%), Netherland (11.64%), Spain (10.42%), Hungary (9.85%), Mexico (9.02%) and Indonesia (8.56%) respectively. Brazil having almost similar mortality rate to the world figure of 6.27%. United States having highest number of confirmed cases (800926 people) but having lower mortality rate (5%) compared to others. India was having lower mortality (3.18%) as compared to world data and other countries.¹⁸

The available hospital beds per 1000 population provides an important indication of the resources available for delivering services to the inpatients.¹³ The influence of the supply of hospital beds has been widely documented. Across these 45 countries, the average hospital beds per 1000 population was 4.30/1000 population. Among all these countries, Japan and Korea is having 13.05 and 12.27 hospital beds per 1000 population respectively. Next to these two countries, Russia (8.05), Germany (8), Austria (7.37), Hungary (7.02) respectively. Two-thirds of countries reported between 3 and 13.05 hospital beds per 1000 population, with rates lowest in Mexico (1.38), Costa Rica (1.13), Indonesia (1.04) and India (0.53) respectively. As per the report, there was markedly reduction occurred in Finland, from 7.5 beds in 2000 to 3.3 beds per 1000 population in 2017. On the other hand, Korea has strongly increase of 164% with a significant number of these dedicated to long term care.¹³ This decreased number of beds attributed to medical technology advancement, allowing surgeries to be performed on same day basis or broader policy strategies to reduce the frequency of hospital admission.¹³ There was also observed negative correlation of Hospital beds with mortality rate and was also statistical insignificance ($r^2 = -0.133$, p value = 0.390).

ICU beds per 100000 population is also an important indicator for the assessing health infrastructure of countries.¹⁹ There was marked heterogeneity of available critical care beds.¹⁴ There was observed that Turkey is having 47.1 ICU beds per 100000 populations, which was highest among these countries followed by United States (34.7), Germany (29.2), Luxembourg (24.8), and Austria (21.8) respectively. India is having lower number of ICU beds (2.3/100000 population). It was observed negative correlation of ICU beds with mortality rate ($r^2 = -0.081$, p value = 0.619).

While focusing on to the GDP that is spent on health, the average GDP spend on health is 8.31 ± 2.56 . It was expected that those countries spent maximum of percentage on health could have less people affected by this virus,²⁰ but actual effect is opposite. The top countries who spend maximum GDP on health care United States (U.S.) spending highest percentage of GDP (16.9%) followed by Switzerland (12.25%), France (11.2%), Germany (11.2%) and Sweden (11%) respectively, were having also maximum number of people affected by COVID19. Likewise, higher number people died in these countries.

In this study we found a statistically significant association between GDP spend on health and total confirmed cases and deaths (p value = 0.000 and 0.000 respectively) due to COVID-19. Moreover, our analysis additionally anticipated that those nations who spent higher percentage of their GDP on health also have higher number of confirmed cases ($r^2 = 0.538$) and higher mortality ($r^2 = 0.516$).

If we look to the number of confirmed cases and number of deaths U.S. have highest number of confirmed cases (800926 cases) as well as higher number of deaths (40073 deaths) compared to other highly spent countries. Moreover, Switzerland, France, Germany and Sweden have 28186, 48046, 117961 and 16004 confirmed cases respectively. Though India is spending only 3.6% of GDP on health, there was observed less confirmed cases (21393 cases) and deaths (681 deaths). However, there was no statistical significance exist with the mortality rate (p = 0.136).

As per CENSUS 2010, there was 13% of total population belongs to the age more than 60 years, whereas 0.6% of total population were above 90 years in U.S.²¹ According to the current data, around 72% people died in COVID19 were belongs to age more than 65 years.²² So that can be attributed to high case fatality in United States. Where as in India, there were only 8% of total population belonging to age more than 60 years²³ and case fatality (3.18%)¹⁸ also lower than U.S. In other hand, high number of confirmed cases and deaths in high economic countries may be attributed to increase international travel.²⁴ In this economic transition most of the developed nations mainly focused upon research and development.²⁵ For this purpose, there was also increased number of people travel internationally.

CONCLUSION

There was no correlation between availability of hospital beds and critical care beds with mortality rate across the globe. But there was observed significant association of percentage of GDP spent on health by the countries with total confirmed cases and total deaths due to COVID19.

ACKNOWLEDGMENTS

We would like to thank IMS and Sum Hospital, SOA deemed to be university for the facilities. Authors are grateful to the President professor Manojranjan Nayak, SOA deemed to be university.

REFERENCE

- World Health Organization. Press briefing on WHO Mission to China and novel coronavirus outbreak [Internet]. WHO Press. 2020 [cited 2020 Apr 17]. p. 4. Available from: <https://www.who.int/dg/speeches/detail/press-briefing-on-who-mission-to-china-and-novel-coronavirus-outbreak>.
- Wu F, Zhao S, Yu B, Chen YM, Wang W, Song ZG, et al. A new coronavirus associated with human respiratory disease in China. *Nature*. 2020 Mar 12;579(7798):265–9.
- World Health Organization (WHO). Novel coronavirus - China 11-fev 2020. WHO Bull [Internet]. 2020;(February). Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200211-sitrep-22-ncov.pdf?sfvrsn=fb6d49b1_2.
- World Health Organization. 30 January 2020. WHO Press [Internet]. 2020;(January):1–3. Available from: https://www.who.int/docs/default-source/coronaviruse/transcripts/ihr-emergency-committee-for-pneumonia-due-to-the-novel-coronavirus-2019-ncov-press-briefing-transcript-30012020.pdf?sfvrsn=c9463ac1_2
- Wu YC, Chen CS, Chan YJ. The outbreak of COVID-19: An overview. Vol. 83, *Journal of the Chinese Medical Association*. Wolters Kluwer Health; 2020. p. 217–20.
- World Health Organization (WHO). Coronavirus Disease 2019. WHO Rep [Internet]. 2020;14(6):e01218. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200423-sitrep-94-covid-19.pdf?sfvrsn=b8304bf0_4
- Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet*. 2020 Feb 15;395(10223):497–506.
- Harapan H, Itoh N, Yufika A, Winardi W, Keam S, Te H, et al. Coronavirus disease 2019 (COVID-19): A literature review. *Journal of Infection and Public Health*. Elsevier Ltd; 2020.
- Yang J, Ya Zheng, Xi Gou, Ke Pu, Zhaofeng Chen, Gou Q, et al. Prevalence of comorbidities and its effects in patients infected with SARS-CoV-2: a systematic review and meta-analysis. *Int J Infect Dis* [Internet]. 2020;94(March):91–5. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7194638/>
- Akhtar Hussain, Bishwajit Bhowmik NC do VM. COVID-19 and Diabetes: Knowledge in Progress. *Diabetes Res Clin Pract*. 2020;(January).
- WHO. Clinical management of severe acute respiratory infection when COVID-19 is suspected (v1.2). WHO Rep [Internet]. 2020;1–21. Available from: [https://www.who.int/publications-detail/clinical-management-of-severe-acute-respiratory-infection-when-novel-coronavirus-\(ncov\)-infection-is-suspected](https://www.who.int/publications-detail/clinical-management-of-severe-acute-respiratory-infection-when-novel-coronavirus-(ncov)-infection-is-suspected)
- Ma X, Vervoort D. Critical care capacity during the COVID-19 pandemic: Global availability of intensive care beds. *J Crit Care*. 2020 Apr;
- Organization for Economic Cooperation and Development. Health at a Glance 2019. Health at a Glance 2019. 2019.
- Phua J, Faruq MO, Kulkarni AP, Redjeki IS, Detleuxay K, Mendsaikhan N, et al. Critical Care Bed Capacity in Asian Countries and Regions. *Crit Care Med* [Internet]. 2020 May [cited 2020 May 22];48(5):654–62. Available from: <http://journals.lww.com/10.1097/CCM.0000000000004222>
- Adhikari NKJ, Fowler RA, Bhagwanjee S, Rubenfeld GD. Critical care and the global burden of critical illness in adults. *Lancet*. 2010;376(9749):1339–46.
- Rhodes A, Ferdinande P, Flaatten H, Guidet B, Metnitz PG, Moreno RP. The variability of critical care bed numbers in Europe. *Intensive Care Med*. 2012;38(10):1647–53.
- Organization for Economic Cooperation and Development. Gross domestic product (GDP) on Health [Internet]. OECD library. [cited 2020 May 23]. Available from: https://stats.oecd.org/Index.aspx?DatasetCode=SNA_TABLE1
- Dhillon P, Kundu S, Shekhar C, Ram U. Case-Fatality Ratio and Recovery Rate of COVID-19: Scenario of Most Affected Countries and Indian States Case-Fatality Ratio and Recovery Rate of COVID-19: Scenario of Most Affected Countries and Indian States Preeti Dhillon , Sampurna Kundu , Chander S [Internet]. IIPS. 2020. Available from:

- https://www.iipsindia.ac.in/sites/default/files/iips_covid19_cfr.pdf
19. Fessler, Michael B.; Rudel, Lawrence L.; Brown M. International comparisons of intensive care: informing outcomes and improving standards. *Curr Opin Crit Care* [Internet]. 2012;23(1):1-7. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3551445/pdf/nihms433772.pdf>
 20. Rahman MM, Khanam R and RM. Health care expenditure and health outcome nexus : New evidence from the SAARC-ASEAN region. *Glob Heal* [Internet]. 2018;14(2018):1-30. Available from: <https://globalizationandhealth.biomedcentral.com/track/pdf/10.1186/s12992-018-0430-1>
 21. Poston DLJ, Bouvier LF, Poston DLJ, Bouvier LF. Age and Sex Composition. *Popul Soc* [Internet]. 2012;(May):228-64. Available from: <https://www.census.gov/prod/cen2010/briefs/c2010br-03.pdf>
 22. NYC Health. Coronavirus disease 2019 (COVID19) Daily Data Summary as of April 14, 2020 [Internet]. Vol. 2019. 2020. Available from: <https://www1.nyc.gov/assets/doh/downloads/pdf/imm/covid-19-daily-data-summary-deaths-04152020-1.pdf>
 23. Office of the Registrar General & Census Commissioner I. Population Composition [Internet]. SRS. 2011. Available from: https://censusindia.gov.in/vital_statistics/SRS_Report/9Chap2-2011.pdf
 24. World Health Organization. Coronavirus Disease 2019 situation report - 57 [Internet]. Vol. 14, WHO report. 2020. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200317-sitrep-57-covid-19.pdf?sfvrsn=a26922f2_4
 25. Akcali BY, Sismanoglu E. Innovation and the Effect of Research and Development (R&D) Expenditure on Growth in Some Developing and Developed Countries. *Procedia - Soc Behav Sci*. 2015;195:768-75.