How statistics of World health index react against COVID-19

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ABSTRACT

The counter of COVID-19 seems nerve-wracking right now and the cumulative cases are increasing with an unstoppable speed each second. This outbreak situation brings an anxious time for researchers and scientists, as the pressure is keep mounting on them each second to find any optimal solution of this situation. This work dissect one important section which affected most by this novel corona virus, i.e. world health index. In simple terms, how COVID-19 attack on WHI's top vs mediocre nations. This paper outlines how the countries which has lowest ranking in World Health Index, either escape or least affected from the disease initially compare to the countries which top the WHI affect most and after a period how higher ranking countries in WHI overcome significantly and quickly than lower ranks countries. This work consolidates the data majorly from COVID-19 worldometer and WHI data as a primary source. Moreover, conduct a statistical data analysis to determine the key factors behind larger affected COVID-19 nations and factors which helps those nations who overcome from COVID-19 comparatively. Finally, this work provides prediction for undiscover areas, so that the comparatively saved nations from COVID-19 can work on those vital considerations and avoid severe attack of COVID-19.
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1. Introduction

COVID-19 affirmed as pandemic on 2020 March by World Health Organization (WHO) [1], the virus renamed as Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2). The republic China observed first case of COVID-19 in mainland Wuhan on December 2019. This pandemic is not the only one, there are many pandemics took place in past. Alike, SARS which was also the Severe acute Respiratory Disease outburst in 2002–2003 [2]. Although COVID-19 has surpassed total cases observed for SARS outbreak. Pandemic COVID-19 start from one country and has been spread upto 184 countries with 10.3 M confirmed cases and 506 K deaths worldwide till 30th June 2020. In addition, COVID-19 has affected capability of healthcare system around the globe, leading to problems in providing therapy, especially to those who are in ICUs. COVID-19 is spreading through human transmission via minor droplets or straight interaction [3]. From the pathogens causing respiratory diseases, coronavirus is among the most threatening disease

due to its linear interval (5 to 7.5) and reproductive rate (2 to 3). The CoV fits to single-stranded RNA viruses (+ssRNA) family mostly observed in animals [4].

According to WHO stats [5], COVID-19 has caused severe loss to many countries such as USA (2,699,554 cases; 129,091 deaths), Russia (647,849 confirmed cases; 9320 deaths), Spain (296,351 cases; 28,355 deaths), Brazil (1,383,678 cases; 58,927 deaths), United Kingdom (312,654 cases; 43,730 deaths), Italy (240,578 cases; 34,767 deaths), France (164,260 cases; 29,813 deaths), China (83,531 cases; 4634 deaths). In India there are 585,210 cases along with 17,410 deaths. The particular symptoms for coronavirus is cough (76%), fever (98%), fatigue (44%) [6].

As being Severe Acute Respiratory Disease its tough task to detect COVID-19 symptoms as it takes approximately 4–10 days to show its sign on human beings. Coronavirus is proved deadly for the older age plus the adults with higher complications on the other hand every single person has adverse effect mentally, socially and economically. Many countries took measures to stop pandemic coronavirus by imposing lockdown, ban on social gatherings, etc. This can likely to improve the worst condition with time.

Table 1
Summary stats for country for year 2017–2019 [12,13].

Attributes	Meaning	Range	
		Min	Max
Ladder score	It is the happiness score	2.56	7.80
Upper whisker	Positive affect of life	2.62	7.86
Lower whisker	Negative effect of life	2.50	7.74
Logged GDP per capita	Economic outlook	6.49	11.46
Social support	To count on someone in tough times	0.32	0.98
Healthy life expectancy	Disease free life	45.2	77.10
Freedom to make life choices	To make to your decisions in life	0.39	0.97
Generosity	Related to charity	−0.33	0.56
Perceptions of corruption	Related to Government and business misconduct	0.11	0.94
Dystopia	Undesirable and daunting society to live	1.97	1.97
COVID-19 Total confirmed cases	People suffering from coronavirus	0	10,502,511
COVID-19 total recovered cases	People regained health	0	5,727,537
COVID-19 total deaths	People died due to coronavirus	0	510,812

This work has health statistics related to countries and can map them to know about conditions of them. According to WHO, data analysis tools have 250 indicators that includes mental health, communicable and non-communicable diseases, physical adaptability, injuries, immunization, nutrition etc. The Institute for Health Metrics and Evaluation (IHME) is a self-regulating international well-being exploration center at the University of Washington that includes rigorous and analogous dimension of the world's utmost vital health problems and evaluates the approaches used to address them [7].

1.1. Health data and statistics

Quantitative data, probability theory classification into methods such as parametric and non-parametric consists of statistics. Health measures include both verifiable data and estimates such as transience, misery, risk factors and health organizations. WHO plays a major role in describing health related issues, observations and assessment of health programs and provide technical assistance to countries who are prone to COVID-19 [8].

Statistics refers to both quantitative data, and the classification of such data in accordance with probability theory and the application to them of methods such as parametric and non-parametric. Health statistics include both empirical data and estimates related

to health, such as mortality, morbidity, risk factors, health service coverage, and health systems.

In recent times, life expectancy and common health of individuals have increased due to the advancements in medicine and technology worldwide. However, there are some inequalities exists in health. For example, according to [8] the lowest life expectancy countries in 2017 were located in Africa, while highest life expectancy rate was found in Europe and Asia. Region and income also plays a major role in expenditure of diseases and most common damaging health issues comprises of high blood pressure, high cholesterol, sleep related complications etc.

In this study, the main focus is on healthiest countries and effect of COVID-19 on them. As on global level, it's known by everyone that all countries are not equal, they differ in healthiest ratio, pollution, access to qualitative healthcare, safe drinking water, less garbage etc. According to Bloomberg Global Health Index some features such as life expectancy, death causes, clean water decide about healthiest and unhealthiest countries. By means of these aspects, countries are given a score out of 100. In 2019 rating, the healthiest country worldwide is Spain with a score of 92.75. Spain possess 83.5 years of life expectancy, which is likely to increase by 85.8 by 2040 and would be highest around the globe. Similarly Italy possess score 91.59, Japan 91.38, France 86.34, United Kingdom 84.28, US 73.02, China 62.52 etc. [9]. Also there exists a health care index (HCI) which tells about the quality of healthcare organization, healthcare specialists, workforce, doctors etc. According to HCI, the countries have indexes as Japan (81.14), France (79.99), Spain (78.88), United Kingdom (74.46), United States (69.27), India (67.13), Italy (66.59) etc. [10] These countries having these rates instead of that they are much prone to COVID-19 pandemic. According to WHO Statista May 2019, countries with top share of national governmental healthcare expenditure in year 2016 is as follows: United States (39.5%), Japan (23.4%), Germany (21.4%) etc. [11] Similarly, health expenses as a part of GDP in developed countries in 2016 are United States (17.1%), France (11.5%), Germany (11.1%), United Kingdom (9.8%), Italy (8.9%) etc. [11].

1.2. Statistical analysis

In our study, the dataset used is about World Health Index and total COVID-19 cases. It was collected from [12] and [13]. In accordance to our data, some statistics were included such as happiness response, healthy life expectancy, social support, and COVID-19 cases such as confirmed cases, recovered and deaths etc. For this study the data has been consolidated by integrating World health index data and pandemic data to analyze it using certain tools such as Tableau, Rapid Miner. In this study, total testing of coronavirus cases are considered which are fulfilling a benchmark to find a cor-

Country	Region	Ladder sco	Standard	upperwhi	lowerwhi	Logged GL	Social sup	Health	Freedor	Gener	Perceptio	Ladder sco	Explained	Explained	Explair	Explained	Explair	Explained	Dyst	Confirm	death	recovered
Brazil	Latin A	6.3756	0.040791	6.45555	6.29565	9.566435	0.896724	66.48	0.7998	-0.1	0.770601	1.972317	0.95268	1.363464	0.766	0.483293	0.132	0.106519	2.57	169594	11653	67384
China	East As	5.1239	0.025902	5.174667	5.073133	9.688568	0.798761	69.29	0.8985	-0.18	0.753971	1.972317	0.990533	1.132081	0.867	0.601605	0.079	0.117256	1.34	82919	4633	78171
France	Wester	6.6638	0.037577	6.73745	6.590149	10.58422	0.937104	73.8	0.8255	-0.13	0.583521	1.972317	1.268129	1.458839	1.03	0.514051	0.113	0.227303	2.05	177423	26643	56724
India	South /	3.5733	0.027702	3.627596	3.519003	8.849824	0.592201	60.22	0.8814	0.058	0.772043	1.972317	0.730576	0.644199	0.541	0.581142	0.237	0.105588	0.73	71339	2310	23033
Iran	Middle	4.6724	0.055878	4.781921	4.562879	9.81372	0.69469	66.01	0.6479	0.118	0.714636	1.972317	1.029323	0.886271	0.749	0.301195	0.277	0.142652	1.29	109286	6685	87422
Italy	Wester	6.3874	0.043288	6.472245	6.302556	10.48184	0.889879	73.6	0.6647	-0.04	0.873405	1.972317	1.236396	1.347296	1.023	0.321306	0.17	0.040146	2.25	219814	30739	106587
Russia	Comm	5.546	0.03961	5.623635	5.468365	10.12887	0.903151	64.1	0.7299	-0.15	0.864803	1.972317	1.127	1.378644	0.68	0.3995	0.099	0.045699	1.82	232243	2116	43512
Spain	Wester	6.4009	0.0423	6.483809	6.317991	10.46293	0.921125	74.4	0.752	-0.05	0.76586	1.972317	1.230535	1.421099	1.051	0.425984	0.165	0.10958	2	268143	26744	177846
United St	North /	6.9396	0.047316	7.03234	6.84686	10.92577	0.914219	68.3	0.8426	0.15	0.699715	1.972317	1.373987	1.404743	0.832	0.534608	0.298	0.152285	2.34	1385834	81795	262225

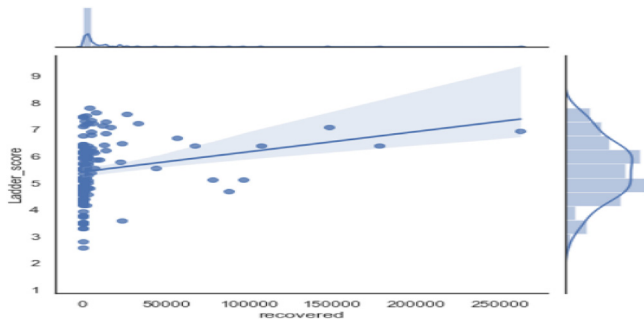**Fig. 1.** Consolidated Data from WHI and COVID-19 worldometer [12,15].

Fig. 2. Ladder_score and recovered cases.

relation between COVID-19 cases and World health. We have several countries which have highest and lowest number of coronavirus tests and still tackled the pandemic COVID-19. In COVID-19, testing is a major informative part about the outbreak as without this no country have a way to understand the pandemic. All those who have lab-confirmed cases can be referred as confirmed cases for a country. As of date 29th June 2020, the countries with highest and lowest testing rates per thousand people are Argentina (0.19), Australia (1.89), Brazil (0.62), Canada (0.99), Finland (0.25), France (0.47), Germany (0.64), India (2.27), Italy (0.42), Japan (0.04), Lithuania (1.25), Myanmar (0.03), Pakistan (0.1), United Kingdom (1.06), United States (1.68) [14].

2. Data preparation

Data preparation is the complex task for this project as it includes the data from several dimensions and sources. A portion of the data which is being used in this work has been taken from [12,14]. Record of the data in this statistical appendix is between the duration of year 2005 to year 2019. Here, some list of attributes are represented with their primary details:

- Ladder score: This is the happiness score which ranges between 0 and 10 where 10 stands for top score.
- GDP: The data is taken from world development indicator tell the 2019 update some specific forecast of real GDP is also taken from OECD economic Outlook numbers 106.
- HLE: Healthy life expectancies taken from World Health organization data repository.

- Social support: Depends on the questionnaire of Survey, whether the person has any support from either relative or friend in his native or living country.
- Freedom: Depends on the questionnaire of survey, whether the person feels the freedom in his living country.
- Generosity: Depends on the questionnaire of survey, whether the person donate something in the charity in the last month [13].
- Corruption perception: Depend on the questionnaire of survey, what a particular person think about his government or his business world in the context of corruption.
- Positive affect: Depends on the questionnaire of survey, the response of positive affect depends on three different questions on happiness, enjoyment and laugh on the previous day.
- Negative affect: Depends on the question of the survey, the response of negative affect depends on three different question on sadness, worry and anger feeling on the previous day.
- Dystopia: is society or community that is undesirable or frightening in which people lead wretched dehumanized, fearful lives (Table 1).

3. Statistical analysis of COVID-19 of majorly affected countries

As COVID-19 has affected major portion of world, this work considers a deep statistical analysis of affected countries and when it started inclining the COVID-19 cases. This work tried to find out it in the context of WHI index, which countries are much affected and when. Fig. 1. Represented how a consolidated data take a final formulation for this work from several sources.

A linear least square is determined between the ladder score of each country and recovered cases of concerning nation in Fig. 2. It clearly suggests that there is strong correlation between the ladder score and recovered cases. The graph is fitted on normally distributed data. It shows that higher the ladder score of any country, greater will be the chance of recovery rate. A graph is also plotted on the happiness score of each country and gives almost the same result. According to that graph, with a greater happiness score of any country, coronavirus patients are being recovered in a quick pace.

Fig. 3 represents the statistics related between life expectancy, social support and GDP of countries in WHI. There is highly strong positive correlation between these three factors. As this graph represents how a strong linear relation exists between these factors of WHI. Hence, this relation will be the base for the next analysis with COVID-19 cases. Moreover, connection of any of these factors with
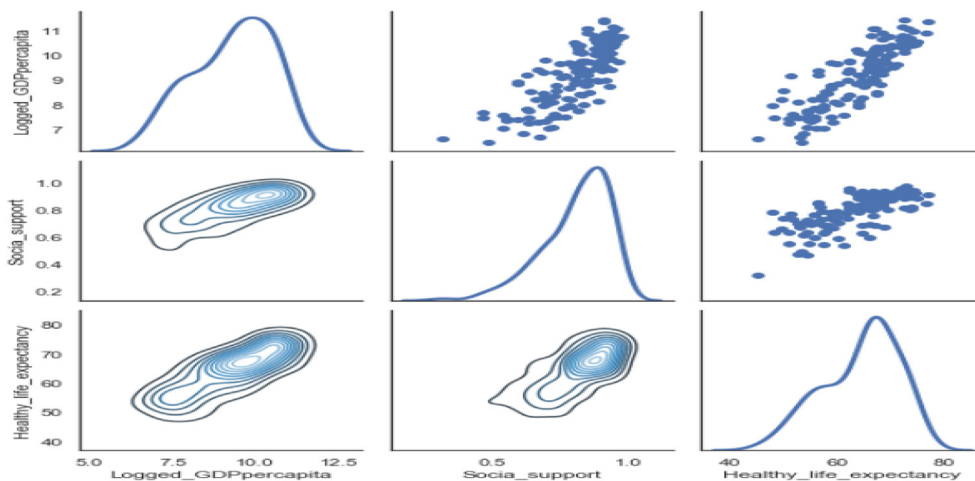

Fig. 3. Correlation between vital factors; GDP per capita, Healthy life Expectancy, and Social support.

Fig. 4. Correlation matrix of consolidated data of WHI and COVID-19.

COVID-19 recovery will be imply to another. Another relation which is determined by this analysis is that a healthy life expectancy is directly proportional to happiness score of any nation in WHI.

4. Result analysis and core findings

After finding the results of the first stage from WHI statistics. These results are fed into the final layer of experimentation, where the undiscovered pattern and factors will be the core finding of this work. For the data preparation for this analysis, normalization is done for the meaningful and statistically approved results. For this data scaling is applied to bring all the data variables into the same scale. After getting the scaled consolidated data, the correlation analysis of these variables is performed. Here in Fig. 4, the correlation matrix of consolidated data (WHI and COVID worldometer) is shown.

The correlation matrix suggest strong positive correlation between recovered cases of COVID-19 and Ladder_Score. There is strong negative correlation between the factor social support and total confirmed cases of COVID-19. This statistical analysis suggests that there is strong positive relationship between GDP per Capita and Healthy life expectancy. Similarly, for social support factor and Healthy life expectancy.

A consolidated result is compiled in the following Table 2, where the COVID-19 status in the different countries is shown. Moreover, according to this immense experimentation and statistical analysis, which WHI factor or factors play a significant role behind the recovery or falling cases, is shown with the inferences in this table. Daily cases of COVID-19 in different nations are shown in Figs. 5-7, which corroborates the analysis of this work.

As per the statistics given [12,15], COVID-19 rooted in China in December 2019 due to which the mass population got affected there, and in a very short duration of time COVID-19 was on its

Table 2
Consolidated result with inference [10,12].

| Country	World health index rank	Ladder score	Gdp Per capita	Social support	Covid current status	Inference
UNITED STATES	69.27	6.93	10.92	0.91	Falling But With A Steady Slow Pace	Align with the results as Ladder Score, GdpPerCapita, And Social Support have strong correlation with COVID recovery cases.
AUSTRALIA	77.38	7.22	10.72	0.94	Overcome In A Very Early Stage	Align with the results as Ladder Score, GdpPerCapita, And Social Support have strong correlation with COVID recovery cases.
BRAZIL	56.29	6.37	9.56	0.89	Increasing A Quick Pace	Align with the results as Ladder Score, GdpPerCapita, And Social Support have strong negative correlation with COVID death rates.
INDIA	67.13	3.57	8.84	0.59	Increasing But Recovery Rate Is Very High	Align with the results as Ladder Score, GdpPerCapita, And Social Support have strong correlation with COVID recovery cases.
PAKISTAN	60.59	5.69	8.48	0.68	Increasing And Recovery Rate Is Ordinary	Align with the results as Ladder Score, GdpPerCapita, And Social Support have strong negative correlation with COVID death rates.
UNITED KINGDOM	74.46	7.16	10.60	0.93	Falling But With A Steady Slow Pace	Align with the results as Ladder Score, GdpPerCapita, And Social Support have strong correlation with COVID recovery cases.
SPAIN	78.88	6.40	10.46	0.92	falling With A Great Pace	Align with the results as Ladder Score, GdpPerCapita, And Social Support have strong correlation with COVID recovery cases.
ITALY	66.59	6.38	10.48	0.88	falling With A Great Pace	Align with the results as Ladder Score, GdpPerCapita, And Social Support have strong correlation with COVID recovery cases.
FRANCE	79.99	6.66	10.58	0.93	Falling With A Great Pace	Align with the results as Ladder Score, GdpPerCapita, And Social Support have strong correlation with COVID recovery cases.
IRAN	51.70	4.67	9.81	0.69	Fall After A Peak But Again Increasing	Align with the results as Ladder Score, GdpPerCapita, And Social Support have strong negative correlation with COVID death rates.
CHINA	64.48	5.12	9.68	0.79	Fall	Align with the results as Ladder Score, GdpPerCapita, And Social Support have strong correlation with COVID recovery cases.
PERU	56.15	5.79	9.45	0.83	Increasing A Quick Pace	Align with the results as Ladder Score, GdpPerCapita, And Social Support have strong negative correlation with COVID recovery cases.

(a) China
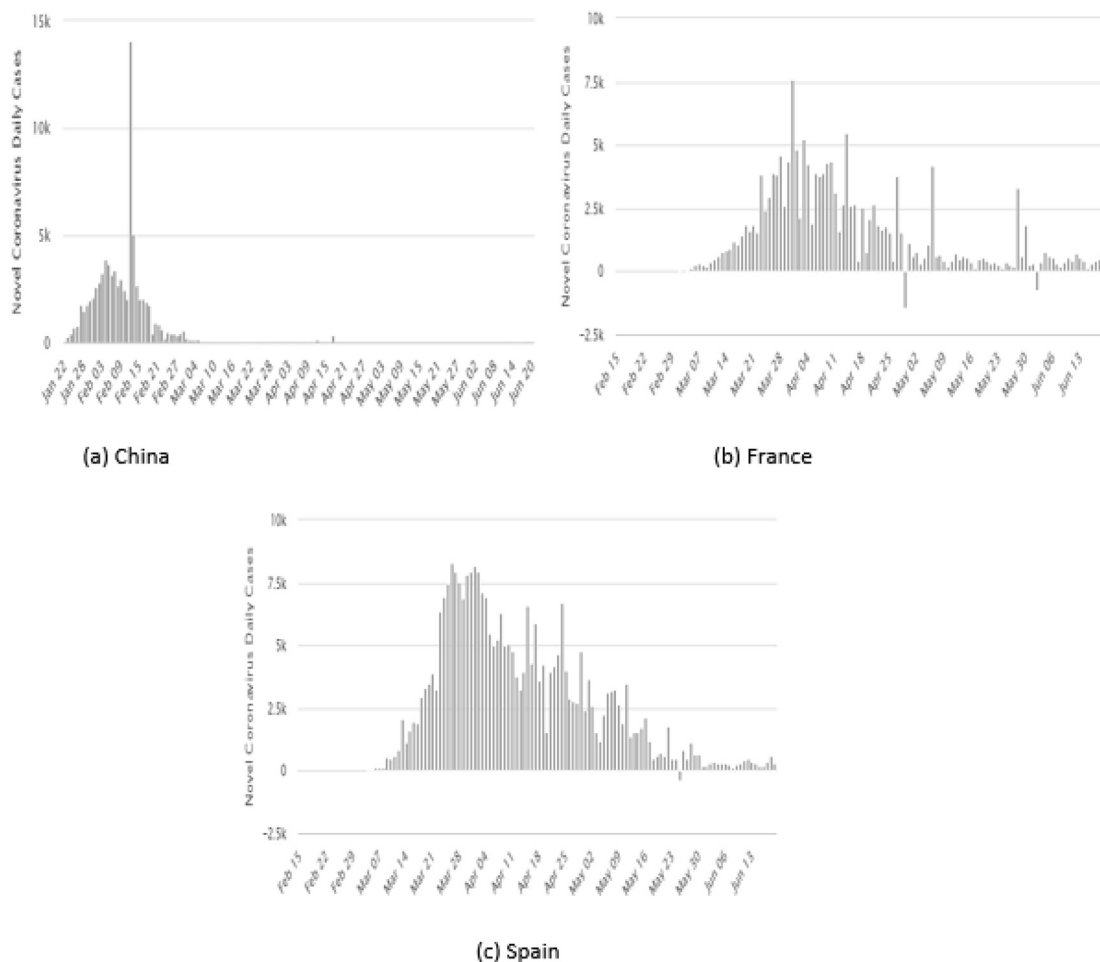
(b) France

(c) Spain

Fig. 5. Daily new COVID-19 cases China, France, Spain [15].

peak and after that a sudden fall in the number of COVID-19 cases were noticed. There is a great alignment of this fall in the cases with the result of this analysis.

As per the Table 2 mentioned above, United States of America, Australia, Italy, Spain, France and United Kingdom (Figs. 5-7) are the nations which come on the top of World Health index. They have the best numbers in GDP per capita, social support, happiness score and ladder Score. In the context of covid-19, they all have been following the same pattern of sudden rise in the start, reach on the peak at very early stage and then sudden fall in death rate and achieve higher recovery weight in covid-19 cases. COVID-19 cases in these nations matched to the provided results of this research, as GDP per capita, happiness score, social support and ladder score have a strong positive correlation with recovery rate of covid-19 cases. Moreover, they have negative correlation with the death rates. Nations like India, Pakistan, Brazil and Peru (Figs. 5-7) are the lowest ranking countries in the world health index. They have not a good number in GDP per capita, happiness score and ladder score. In the context of covid-19 these nations get infected with this pandemic very late however the affected cases are increasing day by day and surpassing the above mentioned top ranked countries covid-19 numbers. Covid-19 cases have been severely hurt these nations most as per the analysis of this research.

It also been observed in Fig. 7, that there was totally different scenario in Iran as there was major decline in COVID-19 cases

but within short span of time there was again jump in the confirmed COVID-19 cases, similarly Brazil is facing though times as its confirmed cases of corona positive patient are at peak once again. By observing the series of novel coronavirus spread worldwide, it is been analyzed that there is different pattern of rise and fall of COVID-19 confirmed cases in countries which can be directly linked to health index ratio of them.

5. Conclusion

The analysis of this research contributes with a worth-full result in this out breaking situation due to the COVID-19. This immense experimentation come up with the undiscovered factors like a correlation between COVID-19 cases rise or fall with the vital factors of WHI index. The core finding of this anomalous experimentation can be measured in terms of. Nations, where this epidemic disease is not reached yet can consider this analysis and work on the factors which has been given as a core finding of this research analysis. According to this statistical analysis, world health index plays a major role for countries in fighting with health calamities. Developed countries such as United States, China, Spain, and United Kingdom have more number of COVID-19 cases as compared to developing countries such as India, Brazil, Pakistan, Bangladesh etc. So the nations which higher ladder score or higher GDP shown their capability to counter the new confirmed cases of COVID-19
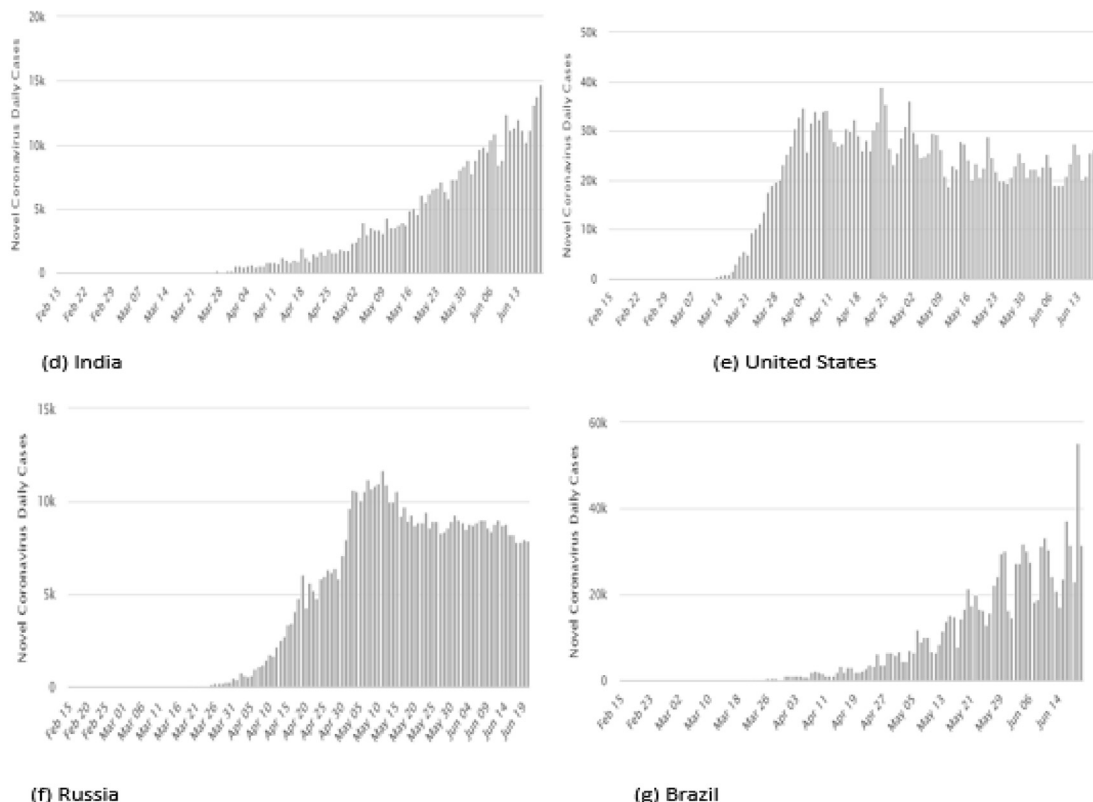
(d) India

(e) United States

(f) Russia

(g) Brazil

Fig. 6. Daily new COVID-19 cases India, United States, Russia, Brazil [15].
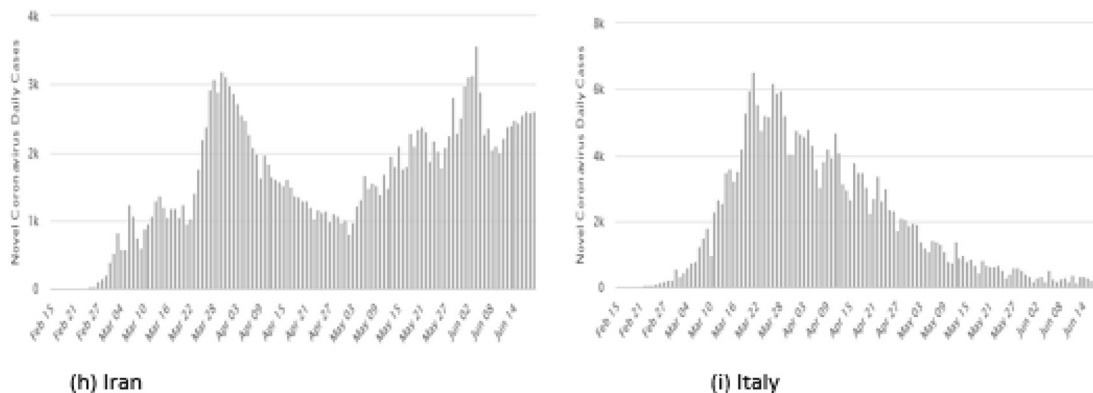

(h) Iran

(i) Italy

Fig. 7. Daily new COVID-19 cases Iran and Italy [15].

e.g. France, Italy, Spain. Whereas countries which doesn't have higher ladder score or higher GDP but higher scale in social support factor have shown great combat against newer confirmed COVID-19 cases and have a higher number of recovery rate, as for example India. By the transitivity rule, one can say that Healthy life expectancy is pretty much represents the recovery from COVID-19 and social support variable plays a significant factor for both Healthy life expectancy and recovery from COVID-19.

CRediT authorship contribution statement

Vikas Tomer: Conceptualization, Data curation, Resources, Methodology, Writing - original draft. **Sonali Gupta:** Writing - review & editing. **Manika Manwal:** Visualization. **D.P. Singh:** Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] M.R. Jimenez-Sotomayor, C. Gomez-Moreno, E. Soto-Perez-de-Celis, Coronavirus, ageism, and Twitter: an evaluation of tweets about older adults and COVID-19, J. Am. Geriatr. Soc. (2020).

[2] K. Roosa, Y. Lee, R. Luo, A. Kirpich, R. Rothenberg, J.M. Hyman, P. Yan, G. Chowell, Real-time forecasts of the COVID-19 epidemic in China from February 5th to February 24th, 2020, Infect. Dis. Model. 5 (2020) 256–263.

[3] J. Tummers, C. Catal, H. Tobi, B. Tekinerdogan, G. Leusink, Coronaviruses and people with intellectual disability: an exploratory data analysis, J. Intellect. Disabil. Res. 64 (7) (2020) 475–481.

[4] P.K. Sethy, S.K. Behera, Detection of coronavirus disease (covid-19) based on deep features, Preprints 2020030300 (2020) 2020.

[5] Coronavirus updates countrywise (2020). https://www.worldometers.info/coronavirus/#countries. Accessed 26 June 2020.

[6] D. Singh, V. Kumar, M. Kaur, Classification of COVID-19 patients from chest CT images using multi-objective differential evolution–based convolutional neural networks, Eur. J. Clin. Microbiol. Infect. Dis. (2020) 1–11.

[7] Data analytics about COVID-19 (2020) https://beckerguides.wustl.edu/c.php?g=299522&p=3738108. Accessed 30 June 2020.

[8] Health statistics country-wise (2020) https://www.who.int/topics/statistics/en/. Accessed 30 June 2020.

[9] Healthiest countries data (2020) https://worldpopulationreview.com/countries/healthiest-countries/. Accessed 30 May 2020.

[10] World health care rankings 2020. https://www.numbeo.com/health-care/rankings_by_country.jsp. Accessed 25 June 2020.

[11] Highest health expenditure (2020). https://www.statista.com/statistics/281589/countries-with-highest-health-expenditure-as-a-percent-of-gdp/. Accessed May 2020.

[12] WHI REPORT-statistical appendix for Chapter 2 of world happiness report 2020 published by John F. helliwell et al in February 29 2020.

[13] COVID-19 dataset country-wise updates (2020). https://in.tradingview.com/covid19/. Accessed 30 June 2020.

[14] COVID-19 tests performed country-wise (2020). https://ourworldindata.org/coronavirus-testing#our-checklist-for-covid-19-testing-data. Accessed 26 June 2020.

[15] Daily new coronavirus cases Country wise (2020). https://www.worldometers.info/coronavirus/#countries. Accessed 26 June 2020.

Further Reading

[1] World health statistics (2020) https://www.who.int/gho/world-health-statistics. Accessed 05 July 2020.