

# Critical appraisal of the Coronavirus preparedness among countries using the global health security index

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## ABSTRACT

**Introduction:** This critical study was aimed to investigate the utility of the Global Health Security Index in predicting the current COVID-19 responses.

**Material and Methods:** Number of infected patients, deaths, incidence and the death rate per 100,000 populations related to 55 countries per week for 26 weeks were extracted. The relationship of GHSI scores and country preparedness for the pandemic was compared.

**Results:** According to the GHSI, the incidence rate in most prepared countries was higher than the incidence rate in the more prepared countries, and which was higher than the incidence rate in the least prepared countries. However, Prevention, Detection and reporting, Rapid response, Health system, compliance with international norms and Risk environment, as well as Overall, the incidence and death rate per 100,000 people have not been like this.

**Conclusion:** Due to mismatch between the GHSI score and fact about COVID-19 incidence, it seems necessary to investigate the factors involved in this discrepancy.

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## INTRODUCTION

The novel coronavirus 2019 (COVID-19) caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-COV-2) is an emerging disease that has become a global health concern as it spreads rapidly around the world [1]. The COVID-19 pandemic so far has affected many countries. The outbreak was first reported in Wuhan, China in late 2019 [2] and was declared a pandemic by the world health organization (WHO) [3]. As of February 13, 2021, there were nearly 108,764,866 confirmed cases of coronavirus and 2,395,030 deaths globally [4]. The COVID-19 crisis has dramatic consequences in many aspects such as economic, social, and behavioral disruptions. The pandemic has certainly led to economic decline across the globe and has affected trade, investment, and employment [5, 6]. There is a rise in unemployment, pay cuts, business closures and other factors impacting the overall livelihood. Worldwide,

several healthcare systems and policy makers are confronted with shortages of medical supplies and human resources necessary for fighting the disease. Limited supply of essential resources has resulted in endangering the lives of many patients [7]. The sudden outbreak of COVID-19 has therefore, disrupted the normal functioning of all aspects of life. Considering there is no specific treatment for the disease yet, all countries are focused on control and prevention strategies [8]. A few recommended intervention strategies for prevention and control focused on maintaining social distancing, hand washing, wearing masks, closing schools, universities and other public places, and staying at home [9-11]. In general, a country's preparedness, management and response to epidemic disease outbreaks are very important. Several indicators such as the Joint External Evaluation (JEE) [12], Epidemic Preparedness Index (EPI) [13] and Global Health Security Index (GHSI) have been developed for this purpose [14].

The GHSI is the first comprehensive assessment of a country’s preparedness for epidemic outbreaks such as COVID-19. The GHSI was developed by the Nuclear Threat Initiative, Johns Hopkins Centre for Health Security, and the Economist Intelligence Unit in 2014 to improve International Health Regulations adoption and response to epidemic disease and readiness to confront it [14].

In 2019, a panel of 21 experts from 13 countries developed the comprehensive index to assess a country’s ability to prevent and mitigate outbreaks. The index ranges from 0 to 100 and was used to score the global health security capabilities in 195 countries [14]. Comparison of a country’s performance is based on three levels- ‘most prepared’ (score > 66.7), ‘more prepared’ (33.4-66.6) and ‘least prepared’ (0-33.3); six categories- prevention, detection and reporting, rapid response, health system, compliance with international norms, and risk environment; 34 indicators and 85 sub-indicators [14]. A higher GHSI indicates better preparedness. The average overall GHSI score was reported as 40.2 out of a possible 100. While high-income countries report an average score of 51.9, the index shows that collectively, international preparedness for epidemics and pandemics remain very weak [14].

Since the global spread of COVID-19 in 2020, countries will be looking for measures to identify gaps, mitigate risks and direct efforts towards preventing future outbreaks [14]. The GHSI is one of

the most comprehensive tools available that can be used to evaluate a country’s preparedness in handling the novel COVID-19 pandemic [14]. Conducting a conformity assessment between the GHSI scores and a country’s response strategy to the novel COVID-19 pandemic can be helpful in effective management, prevention, and risk mitigation of the pandemic. Therefore, the objective of this study was to evaluate the utility of the GHSI in predicting the current COVID-19 pandemic responses of countries categorized in three levels as ‘most prepared’, ‘more prepared’ and ‘least prepared’.

## MATERIAL AND METHODS

### Study Population and Data Source

For this cross-sectional study we included participating countries from the 2019 GHSI list [14] that rank and score countries at three levels of preparedness, i.e., ‘most prepared’, ‘more prepared’, and ‘least prepared’. The first four countries based on their rank in each of the three levels, for all six categories, i.e., prevention, detection and reporting, rapid response, health system, compliance with international norms, and risk environment were included. We systematically selected countries in this manner to ensure representation from all three levels of preparedness. If data was unavailable for a given country, the next country in the rank order was included. As a result, a sample of 54 unique countries was identified for analysis (Table 1).

**Table 1: Selected countries for incidence and mortality in terms of dimensions and different levels of GHSI**

Level	Dimensions	Country (GHSI Score)	Date of observation of the 100th infection (In 2020)	Date of the 26th week (In 2020)
Most prepared	Prevention of the emergence or release of pathogens	USA (83.1)	2 March	31 August
		Sweden (81.1)	6 March	4 September
		Thailand (75.7)	15 March	13 September
		Netherlands (73.7)	6 March	4 September
	Early detection & reporting for epidemics of potential international concern	USA (98.2)	2 March	31 August
		Australia (97.3)	10 March	8 September
		Latvia (97.3)	10 March	18 September
		Canada (96.4)	11 March	9 September
	Rapid response to and mitigation of the spread of an epidemic	UK (91.9)	5 March	3 September
		USA (79.7)	2 March	31 August
		Switzerland (79.3)	5 March	3 September
		Netherlands (79.1)	6 March	4 September
	Sufficient and robust health system to treat the sick and protect health workers	USA (73.8)	2 March	31 August
		Thailand (70.5)	15 March	13 September
		Netherlands (70.2)	6 March	4 September
		Canada (67.7)	11 March	9 September
	Commitments to improving national capacity, financing and adherence to norms	USA (85.3)	2 March	31 August
		UK (81.2)	5 March	3 September
		Australia (77.0)	10 March	8 September
		Finland (75.4)	12 March	10 September
	Overall risk environment and country vulnerability to biological threats	Liechtenstein (87.9)	24 Aug	21 February
		Norway (87.1)	6 March	4 September
		Switzerland (86.2)	5 March	3 September
		Luxembourg (84.7)	17 March	15 September
Australia		1 March	8 September	
	Overall Score	USA (83.5)	1 March	31 August

Level	Dimensions	Country (GHSI Score)	Date of observation of the 100th infection (In 2020)	Date of the 26th week (In 2020)
More prepared		UK (77.9)	5 March	3 September
		Netherlands (75.6)	6 March	4 September
		Australia (75.5)	10 March	8 September
	Prevention of the emergence or release of pathogens	Germany (66.5)	1 March	30 August
		Ireland (63.9)	14 March	12 September
		Belgium (63.5)	6 March	4 September
		Brazil (59.2)	13 March	11 September
		Zimbabwe (65.6)	27 May	25 November
	Early detection & reporting for epidemics of potential international concern	Kyrgyz Republic (64.7)	28 March	14 September
		Singapore (64.5)	29 February	27 July
		Philippines (63.6)	14 March	12 September
		Australia (65.9)	10 March	8 September
	Rapid response to and mitigation of the spread of an epidemic	Singapore (64.6)	29 February	27 July
		Slovenia (63.3)	13 March	11 September
		France (62.9)	15 March	13 September
		Denmark (63.8)	10 March	8 September
	Sufficient and robust health system to treat the sick and protect health workers	Australia (63.5)	10 March	8 September
		Switzerland (62.5)	5 March	3 September
		France (60.9)	15 March	13 September
		Ethiopia (65.8)	18 April	12 September
	Commitments to improving national capacity, financing and adherence to norms	Switzerland (65.6)	5 March	3 September
		Uganda (65.4)	6 May	4 November
		Kyrgyz Republic (64.8)	28 March	26 September
		Bulgaria (66.3)	19 March	17 September
	Overall risk environment and country vulnerability to biological threats	Mauritius (66.2)	28 March	26 September
		Oman (65.7)	26 March	24 September
		Romania (65.7)	14 March	12 September
Germany (66.0)		1 March	30 August	
Overall Score	Spain (65.9)	15 February	13 July	
	Norway (64.6)	6 March	4 September	
	Latvia (62.9)	20 March	18 September	
	Qatar (33.1)	11 March	9 September	
Least prepared	Prevention of the emergence or release of pathogens	Niger (32.50)	3 April	2 October
		Ghana (32.2)	26 March	24 September
		Namibia (32.0)	25 June	24 December
		Burkina Faso	24 March	22 September
	Early detection & reporting for epidemics of potential international concern	Malta	23 March	21 September
		Bolivia	31 March	29 September
		Qatar	11 March	9 September
		Lesotho	9 July	7 January
	Rapid response to and mitigation of the spread of an epidemic	Cabo Verde	26 April	25 October
		Saudi Arabia	14 March	12 September
		Croatia	19 March	17 September
		South Africa	18 March	16 September
	Sufficient & robust health system to treat the sick and protect health workers	Estonia	14 March	12 September
		Kyrgyz Republic	28 March	26 September
		Montenegro	31 March	29 September
		Morocco	22 March	20 September
	Commitments to improving national capacity, financing and adherence to norms	Qatar	11 March	9 September
		South Sudan	8 May	6 November
		Andorra	22 March	20 September
		Sudan	20 April	19 October
	Overall risk environment and country vulnerability to biological threats	Madagascar	11 April	10 October
		Mali	12 April	11 October
		Guinea	4 April	3 October
		South Africa	18 March	16 September
	Overall Score	Estonia	14 March	12 September
		Monaco	13 August	12 February
		Mongolia	16 March	14 September

This sample size was deemed appropriate for country wide comparisons (~25% of total 195 countries). We extracted data for positive cases and deaths due to COVID-19 for a period of 26 weeks after the 100<sup>th</sup> case was reported for each of the included country from <https://www.worldometers.info/coronavirus/>.

### Statistical Analysis

Our variables of interest were the weekly standardized number of COVID-19 cases and deaths. We calculated the incidence and mortality rates per 100,000 populations for each country using the formula:

$$M_{ij} = \text{Frequency of case in (j) week/Country (i) population} * 100,000.$$

The incidence and mortality average per 100,000 populations for 26 weeks was calculated as follows:

$$\text{Mean} = \sum_{i=1}^k \sum_{j=1}^{26} M_{ij} / 26 * k$$

Where, K is the number of countries = 13

Based on the data prepared in the first phase, graphs of mortality and incidence rates per 100,000

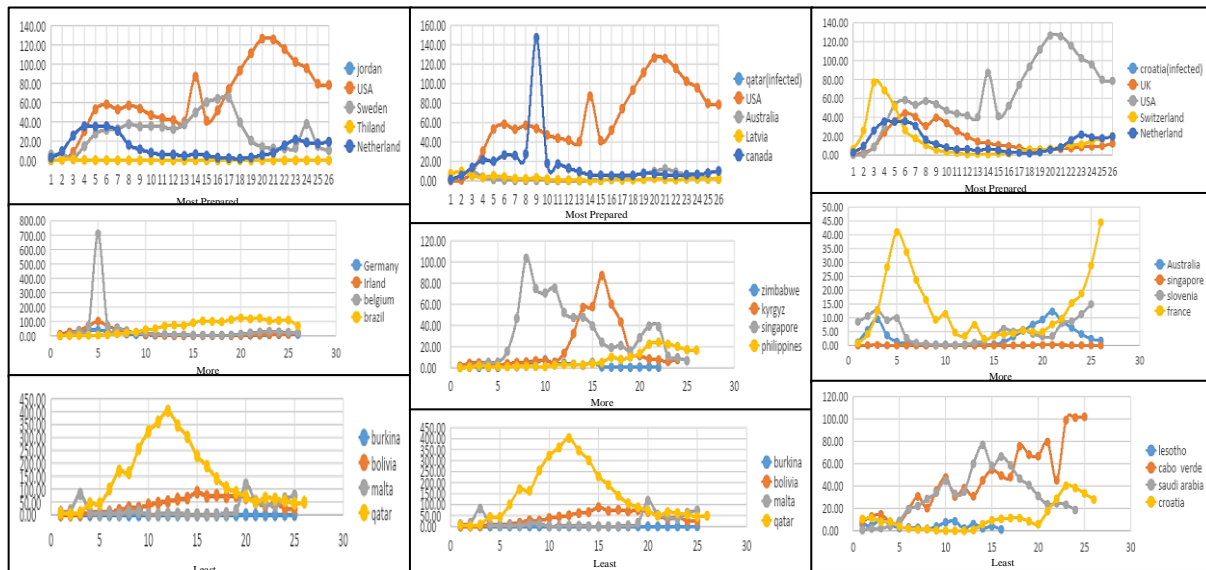
populations of each country were drawn in different dimensions and different levels of GHSI. Based on this, 4 \* 6 \* 3 diagrams were drawn in the form of 18 figures.

## RESULTS

The countries selected for examining in this study, shown in Table 1, were at different dimensions and different levels of GHSI. Firstly, countries were divided into three levels based on the list provided in the document [14]: 'Most Prepared', 'More Prepared', and 'Least Prepared'. Next, the first four countries were considered, then the incidence and mortality rate of 26 weeks after seeing the 100th patient was extracted from [www.worldometers.info/coronavirus](http://www.worldometers.info/coronavirus). In the absence of data for a country on the site, other countries in the next rank were replaced. The extracted data (mortality and incidence rates) for each country were listed in Table 1. Based on the data in Table 1, as well as the population of each country (which is extracted from the same site and can be seen in Table 2), the incidence of Coronavirus per 100,000 population of selected countries at different levels and different dimensions of GHSI were drawn in Fig 1 to 7.

**Table 2: Ranking of infection infected rate per 100,000 populations for countries at different levels of the GHSI index based on mean and range**

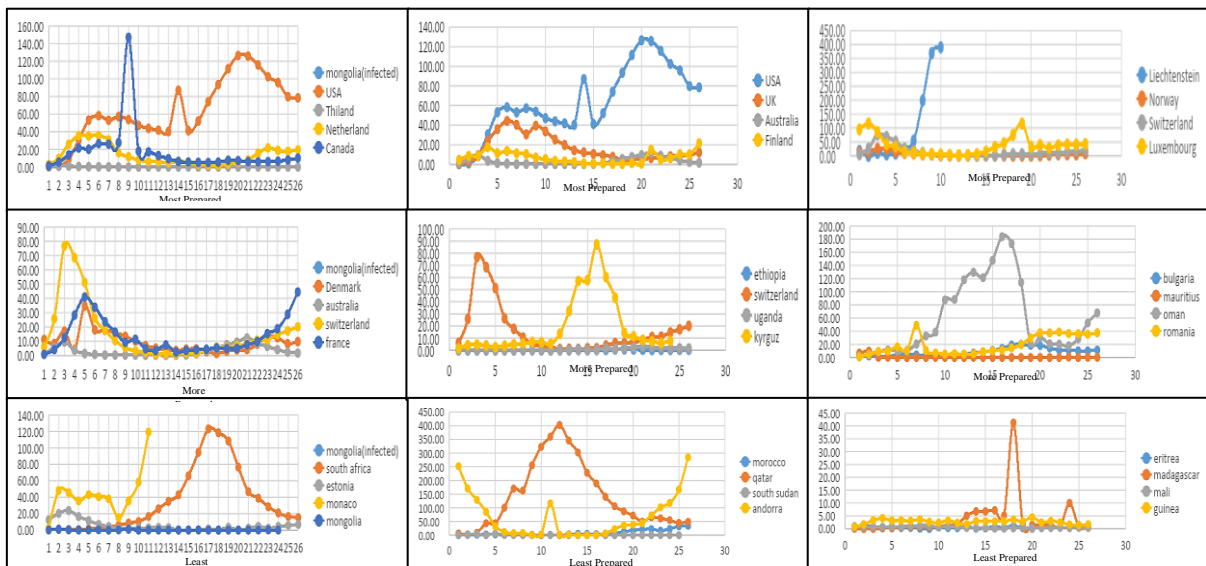
GHSI level	Number of selected countries	Mean	Infection rate per 100000	Observed rank
Prevention				
Most Prepared	4	26.75	0-130	1
More prepared	4	35.50	0-700	2
Least prepared	4	36.07	0-450	23
Detection and reporting				
Most Prepared	4	21.66	0-150	2
More prepared	4	14.44	0-105	1
Least prepared	4	50.45	0-400	3
Rapid response				
Most Prepared	4	27.50	0-130	3
More prepared	4	5.51	0-45	1
Least prepared	4	21.82	0-105	2
Health system				
Most Prepared	4	23.69	0-150	3
More prepared	4	7.54	0-80	1
Least prepared	4	14.84	0-120	2
Compliance with international norms				
Most Prepared	4	22.75	0-130	2
More prepared	4	8.57	0-90	1
Least prepared	4	54.17	0-400	3
Risk environment				
Most Prepared	4	25.29	0-400	3
More prepared	4	17.67	0-185	2
Least prepared	4	1.84	0-42	1
Overall				
Most Prepared	4	24.44	0-140	3
More prepared	4	12.34	0-120	1
Least prepared	4	14.84	0-140	2



1. Prevention

2. Detection and Reporting

3. Rapid Response dimension



4. The Health System dimension

5. Compliance with International Norms

6. Risk Environment

**Fig 1: Coronavirus incidence per 100,000 populations in selected countries in terms of Prevention, Detection and Reporting dimension, Rapid Response, the Health System, Compliance with International Norms and Risk Environment at three levels of Most-prepared, More-prepared, and Least-prepared.**

The incidence of Coronavirus per 100,000 populations in selected countries at different levels, different dimensions of GHSI, and as a whole was plotted in Fig 1 and 2.

The important thing about Figures is that the horizontal axis is represents related to the weeks and the vertical axis is related to the incidence rate per hundred thousand populations.

Part A, section 1 in Fig 1 shows that among the four countries which were ranked the “most prepared” by the GHSI to prevent epidemic crises, the United States had the highest incidence of Coronavirus disease per 100,000 populations in the 26 weeks after seeing the

100th case patient in each country. In the following, Thailand and the Netherlands were not much different and had a lower incidence. Part B shows that among the four countries that according to GHSI are “more prepared” to prevent epidemic crises, within 26 weeks after seeing the 100th case patient in each country, Germany, Ireland, and Belgium had almost the same experience in Coronavirus incidence rates per 100,000 populations. Part C shows that Qatar has experienced the highest incidence than other “least prepared” countries.

In Part A, section 2 in Fig 1, among the four countries that according to GHSI were “most prepared” in terms of Detection and Reporting, during for the 26

weeks after seeing the 100th case patient, the incidence rate in the United States was higher than other countries at the most prepared level, and the incidence rate in other countries was almost the same, regardless of the ninth week peak in Canada. In Part B, among four countries were “more prepared” for detection and reporting, according to the GHSI, Singapore and Kyrgyzstan had peaked at weeks 9 and 16. However, Philippines and Zimbabwe have not seen a significant increase. Part C shows that among the four countries that according to GHSI were the “least prepared” in terms of detection and reporting, within 26 weeks after seeing the 100th case sick person, Qatar has the highest rate of Coronavirus per 100,000 populations. While they were not much different among other countries, also they have experienced a lower incidence.

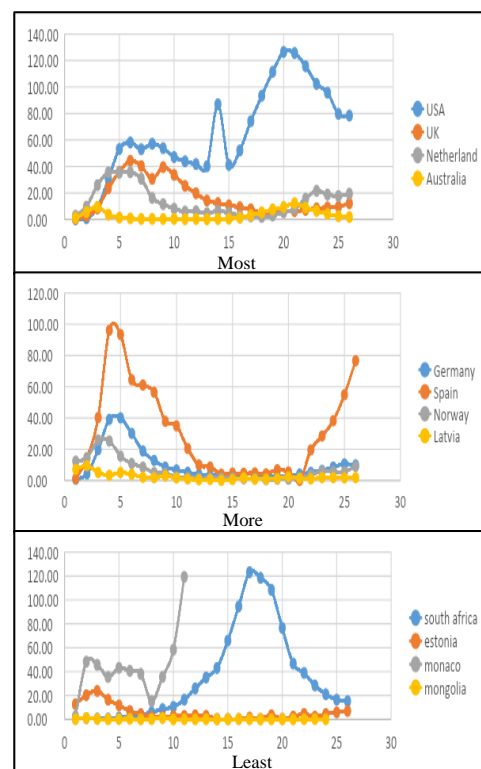
Part A, section 3 in Fig 1 shows that among the four countries with the highest GHSI in terms of rapid response, the United States had the highest incidence of Coronavirus per 100,000 populations, in the 26 weeks following the 100th case patient. While there were not any different differences among other countries. Also they have experienced a lower incidence. Part B in Fig 1 shows that among the four countries that have been “more prepared” according to the GHSI, France has had a higher incidence than other countries in the 26 weeks since the 100th case patient was observed in the country. In Part C, among the four countries that according to GHSI had the “least preparedness” in terms of rapid response, during the 26 weeks after seeing the 100th case patient, Cabo Verde Kaburdeh and Saudi Arabia, had an oscillating trend. Croatia and LesothoLesto have experienced fewer outbreaks, with the explanation that Croatia has peaked in week 25.

Part A, section 4 in Fig 1 shows that among the four countries that have been “most prepared” in terms of Health System according to GHSI, the United States had the highest incidence in 26 weeks, Canada had the peak in week 9, while Netherlands and Thailand have experienced the lowest incidence. Part B shows that among the four countries that were “more prepared” according to the GHSI in terms of Health System, four countries had the same incidence within 26 weeks after seeing the 100th case patient. Part C shows that South Africa had the highest incidence among the four countries that had a low little GHSI preparedness in terms of Health System within 26 weeks of seeing the 100th case patient.

Part A, section 5 in Fig 1 shows that among the four countries that were the “most prepared” according to GHSI in terms of Compliance with International Norms, the United States had the highest incidence and little a small difference was observed in other countries. Part B shows that among the four countries that were “more prepared” in terms of compliance with international norms according to the GHSI,

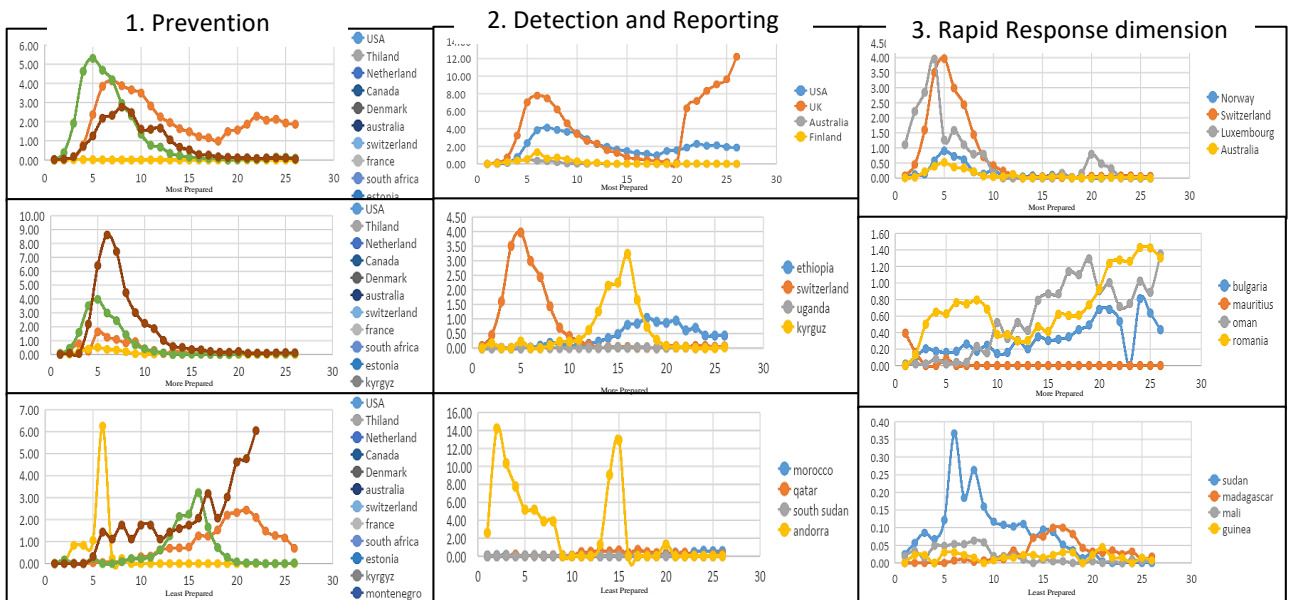
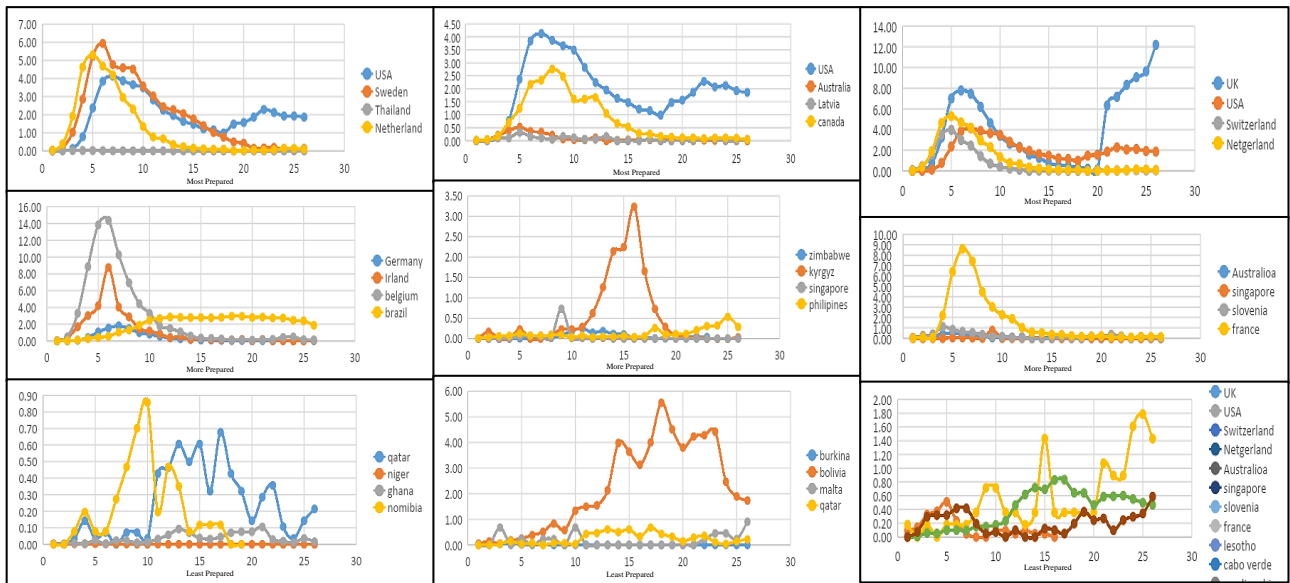
Kyrgyzstan and Sweden had peaked in the same range, while Ethiopia and Uganda had not had a significant increase. In Part C, Qatar has a significant increase compared to other countries among the four countries that according to GHSI were “least prepared” in terms of Compliance with International Norms.

Part B, section 6 in Fig 1 shows that among the four countries that have been” most prepared” according to GHSI in terms of risk environment, Oman had the highest incidence, while they were not much different among other countries. Also, in Part C, Madagascar has a sudden peak among the four countries that were less prepared according to the GHSI in terms of risk environment, and while other countries have not experienced a significant increase.



**Fig 2: Coronavirus incidence per 100,000 populations in selected countries as overall, at three levels of Most-prepared, More-prepared, and Least-prepared, according to GHSI index, during for 26 weeks after observing the 100th confirmed patient case in each country**

Part A in Fig 2 shows that among the four countries that were the “most prepared” according to the GHSI, United States had the highest incidence, and then other countries experienced the similar same incidence. In Part B, among the four countries that have been “more prepared” for prevention, Spain had a significantly high incidence of Coronavirus. In Part C, South Africa had a high incidence among the four countries that are were “less prepared” in general according to GHSI.



**Fig 3: Coronavirus mortality rate per 100,000 populations in selected countries in terms of Prevention, Detection and Reporting dimension, Rapid Response, the Health System, Compliance with International Norms and Risk Environment at three levels of Most-prepared, More-prepared, and Least-prepared.**

The death rate due to Coronavirus per 100,000 population of selected countries at different levels, different dimensions of GHSI, and also in general within 26 weeks after observing the 100th patient case was shown in Fig 3 and 4.

Part A, section 1 in Fig 3 shows that among the four countries which were the “most prepared” for GHSI outbreaks to prevent epidemic crises, the mortality rate was almost the same within 26 weeks of seeing the 100<sup>th</sup> case patient. In Part C, among the four countries that according to the GHSI were “least prepared” to prevent epidemic crises, we have seen mortality with fluctuating rates in Namibia Nomina and Qatar, while the mortality rate in Ghana Qana and

Niger was insignificant. Part B, section 2 in Fig 2 shows that among the four countries that according to GHSI were “more prepared” in terms of Detection and Reporting, at 26 weeks after observing the 100th patient case, Kyrgyzstan had a sudden peak in death rate at 15th weeks, while other countries have not experienced much as many deaths. Also, in Part C, among the four countries that according to the GHSI were “least prepared” to prevent epidemic crises, Bolivia had the highest mortality rate. However, the other three countries had the lowest mortality rate. Part B, section 3 in Fig 3 shows that among the four countries that were “more prepared” for the Rapid

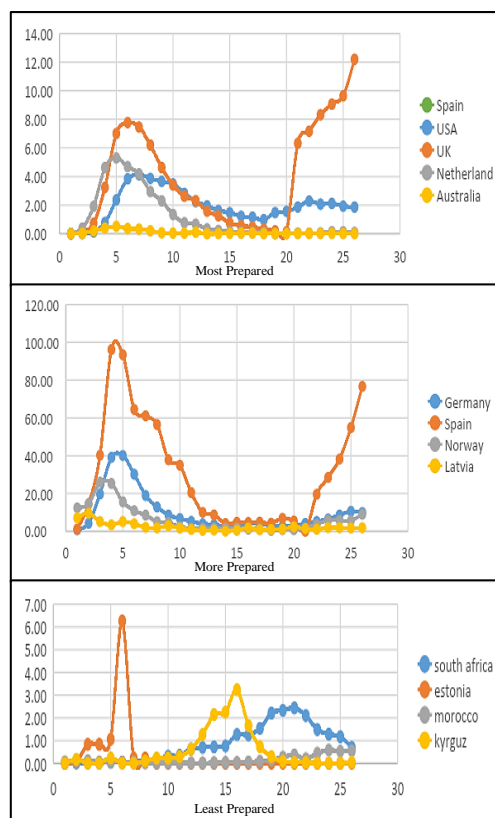
Response according to the GHSI, for during 26 weeks after seeing the 100th confirmed case patient, France had a sudden increase in mortality at week 6, while other three countries have not experienced much as many deaths. Also, in the Part C, among the four countries that according to GHSI are “less prepared” to prevent the occurrence of epidemic crises, all four countries had experienced fluctuated mortality trends.

Part B, section 4 in Fig 2 shows that among the four countries that were “more prepared” according to the GHSI in terms of Health System, France had a sudden increase in mortality at 6 weeks, during for 26 weeks after seeing the 100th confirmed case patient. However, the other three countries have had almost a similar the same experience.

In Part B, section 5 in Fig 3, we have seen two peaks in weeks 5 and 15 for Switzerland and Kyrgyz among the four countries that have been “more prepared” in terms of Compliance with International nNorms according to GHSI. Section C shows that among the four countries that were “least prepared” according to GHSI in terms of Compliance with International Norms, within 26 weeks after seeing the 100th patient case, Andorra had two peaks of mortality rates in the second and the 15th weeks.

Part A, section 6 in Fig 3 shows that among the four countries that were “Most prepared” according to the GHSI in terms of Risk environment, Australia had the lowest mortality rate, in 26 weeks after the 100th patient case. Luxembourg and Switzerland have experienced more deaths in weeks 4 and 5. In Part B, among the four countries that were “more prepared” according to the GHSI in terms of Risk Environment, in the 26 weeks since after the 100th patient case was observed, Mauritius has had fewer deaths as compared to, while the other three countries that have higher and fluctuating mortality rates. Part C shows that among the four countries that, according to the GHSI, were “least prepared” in terms of Risk environment, Sudan has a higher mortality rate than the other three countries within 26 weeks of seeing the 100th sick person case.

Part A in Fig 4 shows that among the four countries, UK had the “most preparedness” in general, within 26 weeks of seeing the 100th confirmed case patient, all four countries had almost the same mortality. In Part B, Spain had the highest mortality rate among the four countries that have been “more prepared” according to the GHSI, within 26 weeks of seeing the 100th case person. Part C shows that among the four countries with the lowest overall GHSI preparedness, Estonia had a peak mortality rate at week 5, within 26 weeks of after seeing the 100th patient confirmed case, and other countries have experienced a similar the same mortality rate.



**Fig 4: Coronavirus mortality per 100,000 populations in selected countries in terms of overall at three levels of Most-prepared, More-prepared, and Least-prepared, according to GHSI index, during for 26 weeks after observing the 100th confirmed case patient in each country**

To evaluate the performance of GHSI leveling in the Coronavirus crisis, the average death rate per 100,000 populations was calculated for selected countries at different levels in each dimension. Tables 2 and 3 shows the average incidence, mortality, and extent of change per 100,000 populations in countries at a certain level in different GHSI dimensions over 26 weeks. Based on the average observed for the countries in each level, the observed ranking was also reported.

There was no correlation between the incidence rate per 100,000 populations in selected countries and different levels of GHSI in terms of different dimensions. According to the GHSI, it was expected that the incidence rate in the Most-prepared countries would be higher than the incidence rate in the More-prepared countries, and higher than the incidence rate in the Least-prepared countries. According to the results in the prevention dimension, in Most-prepared countries, a lower incidence has been observed in infection rate per 100,000 people than in More-prepared and Least-prepared countries. In terms of Detection and Reporting, in More-prepared countries, less incidence was observed in 100,000 people than in Most-prepared countries. In

terms of Rapid Response and Health System, More-prepared countries had lower incidence than Most-prepared countries and Least-prepared countries had lower incidence than Most-prepared countries. In terms of Compliance with International nNorms, More-prepared countries have less occurrence than Most-prepared countries. In terms of Risk

environment, Least-prepared countries have less occurrence than More-prepared, and More-prepared have less occurrence than Most-prepared. In terms of Overall, More-prepared and Least-prepared countries have experienced less incidence than Most-prepared countries.

**Table 3: Ranking of mortality rate per 100,000 populations for countries at different levels of the GHSI index based on mean and range**

GHSI level	Number of selected countries	Mean	Death rate per 100000	Observed rank
Prevention				
Most Prepared	4	1.26	0-6	3
More prepared	4	1.10	0-14	2
Least prepared	4	0.11	0-1	1
Detection and reporting				
Most Prepared	4	0.73	0-4.5	3
More prepared	4	0.18	0-2.5	1
Least prepared	4	0.65	0-6	2
Rapid response				
Most Prepared	4	1.96	0-13	3
More prepared	4	0.48	0-9	2
Least prepared	4	0.31	0-1.8	1
Health system				
Most Prepared	4	0.98	0-5.5	3
More prepared	4	0.68	0-9	2
Least prepared	4	0.49	0-6.5	1
Compliance with international norms				
Most Prepared	4	1.56	0-13	3
More prepared	4	0.40	0-4	1
Least prepared	4	0.84	0-15	2
Risk environment				
Most Prepared	4	0.41	0-4	2
More prepared	4	0.41	0-15	3
Least prepared	4	0.04	0-0.37	1
Overall				
Most Prepared	4	1.80	0-14	3
More prepared	4	0.04	0-12	1
Least prepared	4	0.47	0-7	2

## DISCUSSION

According to the results of the mortality survey, in terms of prevention, the Least-prepared countries had a lower mortality rate than the More-prepared and Most-prepared. In terms of the Detection and Reporting dimension, in More-prepared countries, the mortality rate was lower than in the Least-prepared and Most-prepared countries. In terms of rapid response, the Least-prepared countries had a lower mortality rate than the More-prepared countries and the More-prepared countries had lower mortality than the Most-prepared countries. In terms of Health System, the Least-prepared countries had a lower mortality rate than the More-prepared and the Most-prepared countries. In terms of Compliance with International nNorms, More-prepared countries had fewer deaths than the Most-

prepared and Least-prepared ones. In terms of Risk environment, the Least-prepared countries had lower deaths than the Most-prepared and the More-prepared countries. In general, the Least-prepared and the More-prepared countries had a lower mortality rate than the Most-prepared countries.

With regard to content validity, we found that the WHO situation reports on the COVID-19 pandemic up to 31 July 2020 indicated that a number of countries with high GHSI scores have had large numbers of cases and deaths from COVID-19,36 while some others with modest GHSI scores appear to have successfully contained or suppressed pandemic spread.

## CONCLUSION

The number of infections with coronavirus is

increasing. The spread of the coronavirus remains a cause for concern in all of across the worlds. The sudden outbreak of this disease has created unpredictable conditions all over the world. It has crippled most industries and the economy has also affected all aspects of people's lives. Preparing against epidemic diseases, managing and responding to them at all times has been essential and remains challenging. An index called GHSI has been developed and has expressed the degree of preparedness of different countries in confront of epidemic diseases with a score. This index had considered a high score for the readiness of developed countries, which may be impossible in reality. Therefore, in the present critical study, we examine the relationship between the GHSI score and what is happening in the case of the coronavirus pandemic. Our results suggest that the GHSI is a somewhat valid measure of health security, but remains incomplete. The results of this study can be used to identify the most successful countries in controlling covidCOVID-19 according to their capabilities. The indexes provided by reputable institutions and universities may not necessarily correspond to reality, and the performance of countries may differ from the indicators. With the knowledge gained of earned from the current study, it is possible to change the procedure in order to apply more control measures and apply different interventions in order to prevent the further spread of the virus. The number of new cases of the disease in different countries each week can vary depending on the population, facilities, disease management,

and many other factors. The results of this study can be effective in the management of CovidCOVID-19 and can be useful for modifying current indexes or developing new indexes in the future.

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## AUTHOR'S CONTRIBUTION

EN and HT: Study conception and design; EN and TA: Acquisition of data; EN, HT: Analysis and interpretation of data; HT, EN and TA: Drafting of manuscript; HT: Critical revision; All authors contributed to the literature review, design, data collection and analysis, drafting the manuscript, read and approved the final manuscript.

EN and TA equivalent contributed as first author.

## CONFLICTS OF INTEREST

The authors declare no conflicts of interest regarding the publication of this study.

## FINANCIAL DISCLOSURE

No financial interests related to the material of this manuscript have been declared.

## REFERENCES

1. Paudel S, Dangal G, Chalise A, Bhandari TR, Dangal O. The coronavirus pandemic: what does the evidence show? *J Nepal Health Res Coun.* 2020; 18(1): 1-9. PMID: 32335585 DOI: 10.33314/jnhrc.v18i1.2596 [PubMed]
2. Nazari E, Ebnehoseini Z, Tabesh H. A protocol of scoping review of peak point prediction methods for epidemic diseases: Applicable to coronavirus 2019 prediction. *Frontiers in Health Informatics.* 2021; 10(1): 71.
3. Nazari E, Tabesh H. Outbreak of coronavirus in Iran compared to countries with the highest incidence. *Frontiers in Health Informatics.* 2020; 9(1): 38.
4. Worldometer. COVID-19 coronavirus pandemic [Internet]. 2021 [cited: 13 Feb 2021]. Available from: <https://www.worldometers.info/coronavirus/>
5. Aum S, Lee SY, Shin Y. COVID-19 doesn't need lockdowns to destroy jobs: The effect of local outbreaks in Korea. *Labour Economics.* 2021; 70: 101993.
6. Nazari E, Tabesh H. Corona Virus Outbreak in Iran: A Comparison with China, Italy and South Korea in One Month after Infection. *Journal of Biostatistics and Epidemiology.* 2020 Dec 31;6(3):190-6.
7. Nazari E, Shahriari MH, Tabesh H. Developing a Questionnaire to Investigate the Reasons for Ignoring Home Quarantine by Some Iranians. *Journal of Biostatistics and Epidemiology.* 2020 Dec 13;6(2):115-9.
8. Lu H. Drug treatment options for the 2019-new coronavirus (2019-nCoV). *Biosci Trends.* 2020; 14(1): 69-71. PMID: 31996494 DOI: 10.5582/bst.2020.01020 [PubMed]
9. Nazari E, Shahriari MH, Dadgarmoghaddam M, Saki A, Nahidi M, Mehrabian A, Tabesh H. Home quarantine is a useful strategy to prevent the coronavirus outbreak: Identifying the reasons for non-compliance in some Iranians. *Inform Med Unlocked.* 2020; 21: 100487. PMID: 33251325 DOI: 10.1016/j.imu.2020.100487 [PubMed]
10. World Health Organization. Coronavirus disease (COVID-19) technical guidance: Infection prevention and control [Internet]. 2019 [cited: 13 Feb 2021]. Available from: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/infection-prevention-and-control>
11. Johansen TB, Astrup E, Jorge S, Nilssen H, Dahlberg BB, Klingenberg C, et al. Infection prevention guidelines and considerations for paediatric risk groups when reopening primary schools during

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- COVID-19 pandemic, Norway, April 2020. *Euro Surveill.* 2020; 25(22): 2000921. PMID: 32524956 DOI: 10.2807/1560-7917.ES.2020.25.22.2000921 [[PubMed](#)]
12. Kandel N, Sreedharan R, Chungong S, Mahjour J. The joint external evaluation tool: Changes, interpretation, and use. *Health Secur.* 2019; 17(3): 248-50. PMID: 31173505 DOI: 10.1089/hs.2018.0128 [[PubMed](#)]
13. Oppenheim B, Gallivan M, Madhav NK, Brown N, Serhiyenko V, Wolfe ND, et al. Assessing global preparedness for the next pandemic: Development and application of an epidemic preparedness index. *BMJ Glob Health.* 2019; 4(1): e001157. PMID: 30775006 DOI: 10.1136/bmjgh-2018-001157 [[PubMed](#)]
14. Boyd MJ, Wilson N, Nelson C. Validation analysis of Global Health Security Index (GHSI) scores 2019. *BMJ Glob Health.* 2020; 5(10): e003276. PMID: 33106239 DOI: 10.1136/bmjgh-2020-003276 [[PubMed](#)]