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The institutional capacity of the Health Sector and the response to COVID-19 in a global perspective

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Abstract *This study approaches the Global Health Security Index (GHSI) according to the responses to the first cycle of the COVID-19. The GHSI ranks countries' institutional capacity to address biological risks. We analyzed data regarding the spread of COVID-19 pandemic in 50 countries to assess the ability of GHSI to anticipate health risks. The lack of vaccination determined the spread of the COVID-19 in the first cycle of the pandemic in 2020. Country indicators are correlated and demonstrated by descriptive statistics. The clustering method groups countries by similar age composition. The main restriction that can be attributed to the GHSI concerns the preference of biomedical variables for measuring institutional capacity. Our work shows that the pandemic had a significant impact on better-prepared countries, according to the GHSI, to control the spread of diseases and offer more access to health care in 2020. This paper points out that the health sector depended on the cooperation of governments in the adoption of social distancing during the first cycle of the pandemic. The GHSI failed to consider the role of political leaders who challenge severe health risks by vetoing social distancing.*

Key words *Global Health Security Index, COVID-19, Pandemic, Institutional capacity, Comparative analysis*

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Introduction

This article explores the effects of the first wave of the COVID-19 pandemic in 50 countries according to the Johns Hopkins University's (JHU)[1] Global Health Security Index (GHSI). Few studies have used the GHSI to compare the health security conditions of countries during the first months of the pandemic[2]. This shortage was surprising because the GHSI aggregates extensive documentation and quantitative open access data regarding the institutional capacity of the health sector in the face of catastrophic health risks[3]. Thus, understanding the propositional validity of the GHSI has become particularly compelling given the collective insecurity associated with the global spread of SARS-CoV-2 in 2020.

The GHSI presents a list of complex and valuable indicators on the institutional capacity of countries to address severe global-scale biological threats to social development, and risks of spread of lethal diseases. It consists of six variables: *prevention* of the emergence of epidemics; agility in *detecting and reporting* on epidemics with high-risk potential; rapid *response* to mitigate the spread of epidemics; *accessibility* of the health sector to assist the population; the country's *commitment* to international health regulations, including in financial terms and the country's general *environmental and biological* risk condition[1]. Currently, the highest ranked country is the United States (83.5 points). It is essential to highlight that the biomedical variables of epidemiological surveillance predominate in the GHSI. With the creation of the GHSI, the Johns Hopkins University emphatically defended the inclusion of the topic of biological risks on the agenda of national governments due to the worldwide interconnections that favor the emergence and spread of new pathogens[1].

Given the ongoing extraordinary biological risk event, it is worth considering whether the institutional capacity of the health sector as measured by the GHSI made a difference in mitigating the damage expected from the dissemination of SARS-CoV-2. The ongoing pandemic has imposed a significant stress test on the GHSI due to the scale of cases and deaths associated with the new coronavirus. According to Dalglish[4], global health will never be the same after COVID-19. Based on the sample of countries belonging to the Organization for Economic Cooperation and Development (OECD), for example, Abbey et al.[5] claim that few health systems effectively responded to SARS-CoV-2 in the first months of the pandemic. The low effectiveness of OECD countries in responding to COVID-19 evidences that the GHSI failed to point the most secure countries in cases of health emergencies. The authors argue that the discrepancy between the GHSI classification and the response of OECD countries to the COVID-19 pandemic prove that GHSI underestimated the level of preparedness of many countries and overestimated others. They even demand re-evaluations on the GHSI's scoreboard, especially including the dimension of "national political leadership" due to the successful examples of New Zealand and South Korea at the beginning of the pandemic[5].

The authors' conclusion should be seen with great attention because it confirms the perception that the COVID-19 pandemic interrupted the stable relationship of contemporary society with severe health events, changing the pattern established by the 1918-1919 Spanish flu pandemic.

On such terms, it is reasonable to expect that the dominantly biological qualification parameters proposed by The Johns Hopkins University have been stressed due to the unavailability of pharmacological technologies (specific antiviral and vaccine) for the treatment of COVID-19 and control of SARS-CoV-2 throughout the first pandemic wave (March-December 2020).

It is worth noting that, until the beginning of this century, national states continuously reduced morbidity and mortality through bureaucratic centralization and professional specialization for the provision of collective resources in the health sector[6,7]. In this successful process, McKeown[8] draws attention to technical-scientific interventions, such as vector control, immunization, and the continuous introduction of new drugs, which promoted the decline of morbidity and mortality from infectious diseases, favoring the remarkable increase in the longevity of the world population[8].

Due to the present failure of biomedicine's collective-scale intervention in the successive waves of the pandemic in 2020, governments were called upon to impose massive social distancing combined with testing, contact tracking, and quarantine[9-11]. It should be noted that the first vaccines for COVID-19 were only made available to a few countries in early December 2020, nine months after the declaration of the pandemic status by the World Health Organization (WHO)[12]. Before the vaccine, social distancing measures slowed the spread of SARS-CoV-2 in Asian countries at the start of the pandemic in

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2020[13]. Therefore, over 2020, few countries could claim sustained success in containing SARS-Cov-2 by adopting the massive social distancing (lockdown) advocated by experts[14].

The first cycle of the pandemic, throughout 2020, characterized by the unavailability of vaccines, exacerbated concerns with vulnerable groups[15], mainly due to the extreme lethality of COVID-19 in the elderly population[16,17] and the high risk of deaths of the obese population[18].

Material and methods

This paper explores data from the 50 most populous countries (87% of the world's population in 2019) to test the consistency of the GHSI as an indicator of the preparedness of health systems to extraordinary events. Our work assessed the correlation coefficient (*r*) of the GHSI with the cumulative incidence and mortality per 100,000 population, the lethality per 1,000 cases, the testing rate, and the excess mortality attributed to COVID-19 in the first nine months of the pandemic.

The calculation of the accumulated excess mortality derives from the equation dy/dx, where dy is the country's relative share of the world's total COVID-19 deaths, and dx is the relative share of the country's population in the global population in 2019. When the equation results in values larger than 1, it indicates the country's excess of mortality.

The GHSI also encompasses economic, demographic, and health service provision conditions such as per capita income, the proportion of people aged 65 and over, the proportion of obese people, the average age of the population, and the availability of hospital beds.

The description through the *r* correlation coefficient of quantitative variables aims at identifying the degree of dependence, especially the indicators of incidence and accumulated mortality per 100,000 inhabitants in 2020, on structural variables in the sample of the most populous countries. The indication of whether there is a correlation between the selected variables is the correlation coefficient, which assumes values from -1 to +1. The higher the value of the correlation coefficient, regardless of whether it assumes a positive or negative value, the greater the degree of linear association between the variables[19].

The paper also uses the ranking of 50 national cases in the low, medium, and high institutional capacity strata of the health sector, according to the Johns Hopkins University[1].

The sample of 50 countries differs from the convenience samples of studies evaluating the effectiveness of the GHSI due to regional diversity and high asymmetry in the conditions of wealth and supply of hospital beds.

The indicators are also described by the median distribution and the coefficient of variation to measure the variability of selected cases. The coefficient of variation measures the relative variability of distribution and expresses the percentage of standard deviation[20].

The clustering method[21] is used to group countries by the similarity of age composition (people aged > 65 years and average age of the population).

Information on the first cycle of the COVID-19 pandemic covers the period from March 1, 2020, to November 30, 2020. Data was analyzed using SPSS version 25.

The sources of information were the publications of the Johns Hopkins University[1], The World Bank[22], and the Our World in Data website[23]. Data on the prevalence of obesity in the adult population (BMI≥30) were obtained from the WHO[24,25].

Results

Chart 1 shows that only six countries in the sample (12%) were ranked by the GHSI global score as highly capable in the biomedical field to provide rapid response to severe health events: Canada, France, South Korea, Thailand, the United States, and the United Kingdom United. On the opposite, ten large countries (20%) were placed in the condition of low capacity to respond promptly to high-risk epidemiological events, and most of them were located in Africa. The remaining 34 countries in the sample (68%) present average capacity to respond promptly to emergencies associated with epidemics and pandemics. It is noteworthy in Chart 1 that only one country with a secondary economy (Thailand) was classified as having a high GHSI, as pointed out by Abbey et al.[5]. Graph 1 shows that the rank of countries on the GHSI is positively correlated with country wealth as measured by per capita GDP.

Table 1 shows the accumulated incidence and deaths per 100,000 inhabitants between March 1 and November 30, 2020. The coefficients of variation of the indicators of accumulated incidence and cases are very high (122% and 141%), respectively, indicating that the dissemination of COVID-19 had a completely asymmetrical pattern in the analyzed sample of the 50 largest countries.

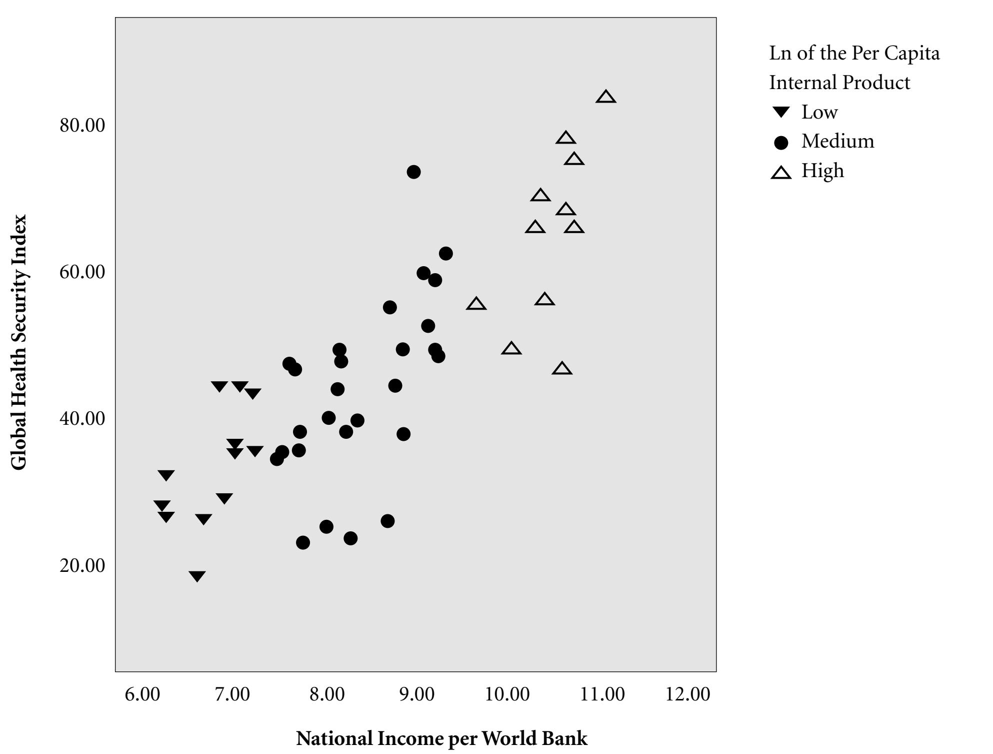
However, Table 2 shows that the countries with the highest health security rates are also the ones with the highest proportion of older adults and average age. High GHSI values are also correlated to nations with large numbers of cases, deaths, and excess mortality by COVID-19 and high prevalence of obese adult population.

The GHSI shows countries that implemented mass testing as an epidemiological surveillance

Chart 1. Top 50 Distribution of Countries by GHSI, November 2019 (n=50).

Condition in the GHSI	Countries	Mean GHSI
High capacity (n=6)	Canada, South Korea, United States, France, United Kingdom, and Thailand	25.8
Medium capacity (n=34)	Germany, Argentina, Saudi Arabia, Bangladesh, Brazil, Colombia, Egypt, Philippines, Ghana, India, Indonesia, Iran, Italy, Japan, Kenya, Malaysia, Mexico, Morocco, Myanmar, Nepal, Nigeria, Pakistan, Peru, Poland, and Russia	46.7
Low capacity (n=10)	Angola, Afghanistan, Algeria, Congo (Democratic Republic), Ethiopia, Iraq, Mozambique, Sudan, Yemen, and Venezuela	74.7

Source: Johns Hopkins, 2019.



Graph 1. GHSI distribution according to per capita GDP, 2019.

Source: Johns Hopkins, World Bank.

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Table 1. Distribution of accumulated incidence and accumulated deaths per 100,000 people attributed to COVID-19 between March 1 and November 30, 2020 in the 50 most populous countries in the world.

Countries	Accumulated incidence	Accumulated mortality
China	6.40	0.33
India	652.50	9.58
United States	3540.10	76.30
Indonesia	176.80	5.70
Pakistan	166.90	3.42
Brazil	2814.20	79.07
Nigeria	31.90	0.57
Bangladesh	267.80	3.83
Russia	1397.80	23.88
Mexico	790.70	77.64
Japan	99.00	1.54
Ethiopia	90.80	1.40
Philippines	377.30	7.30
Egypt	109.40	6.36
Vietnam	1.30	0.04
DR Congo	13.40	0.36
Turkey	510.00	14.16
Iran	954.70	51.13
Germany	1049.80	16.27
Thailand	5.60	0.09
United Kingdom	2140.70	79.21
France	3192.50	72.20
Italy	2146.20	79.17
Tanzania	85.20	0.03
South Africa	1280.90	34.85
Myanmar	137.60	3.08
Kenya	137.80	2.47
South Korea	58.50	0.98
Colombia	2408.40	68.32
Spain	3329.50	90.45
Uganda	37.50	0.35
Argentina	2985.70	8.03
Algeria	163.40	5.07
Sudan	34.30	2.68
Ukraine	1334.20	23.71
Iraq	1315.70	29.42
Afghanistan	113.30	4.24
Poland	2105.30	31.94
Canada	836.60	29.85
Morocco	844.10	13.79
Saudi Arabia	1018.30	16.46
Uzbekistan	212.30	1.80
Peru	2863.00	107.50
Angola	42.30	1.01
Malaysia	159.70	5.70
Mozambique	47.10	0.38
Ghana	162.90	1.04
Yemen	7.00	2.04
Nepal	738.00	4.38
Venezuela	347.00	3.04
Mean	867	22
Coefficient of variation	122	141

it continues

Table 1. Distribution of accumulated incidence and accumulated deaths per 100,000 people attributed to COVID-19 between March 1 and November 30, 2020 in the 50 most populous countries in the world.

Source: Our World in Data, 2020.

strategy and have a greater supply of hospital beds. Even so, bed supply density is not correlated with a lower cumulative incidence of deaths.

Therefore, Table 2 shows that countries with higher GHSI do not have significantly different lethality from other countries, although their national health systems have suffered tremendous pressure in 2020. The hospital beds availability *only* made a difference in mitigating the lethality of SARS-CoV-2 in high-ranking countries when compared to developing countries.

Table 3 shows that two high-ranked countries did not implement mass testing to guide government decisions regarding social distancing (France and Thailand). Overall, testing as a COVID-19 epidemiological surveillance tool was not implemented in 19 (38%) large countries, indicating that information on the number of cases and even deaths in the sample may be of low reliability for many countries. Low-ranked countries showed an extraordinary lack of commitment to implementing mass testing – only 2 in 10 did so in 2020.

Until November 2020, Brazil and France were also in a condition of *epidemiological information deficit*, due to the low testing, despite the *excessive mortality* by COVID-19. The other large countries with information deficit due to the low testing, but with reported mortality below expectations were Afghanistan, Algeria, Angola, Ar-

Table 2. Correlation of GHSI, per capita GDP, mean age of the population, proportion of older adults, test performance, dummy for excess mortality, incidence, accumulated cases of COVID-19, and beds per thousand inhabitants (n=50).

	GHSI	Per capita GDP in 2019 (US$)	Obesity in 2016	Proportion of the population >65 years	Tests per 100 thousand inhabitants	Excess morta-lity	Cases per 100 thousand inhabitants	Deaths per 100 thousand inhabitants	Beds	Fatality
GHSI	1									
Per capita GDP in 2019 (US$)	0.763*	1								
Obesity in 2016	0.401*	0.463*	1							
Proportion of the population >65 years	0.653*	0.784*	0.386*	1						
Tests per thousand inhabitants	0.573*	0.664*	0.587*	0.556*	1					
Dummy for excess mortality by COVID-19	0.469*	0.486*	0.782*	0.479*	0.471*	1				
Cases por 100 thousand inhabitants	0.553*	0.526*	0.632*	0.519*	0.525*	0.723*	1			
Deaths per 100 thousand inhabitants	0.493*	0.483*	0.579*	0.446*	0.488*	0.781*	0.846*	1		
Beds per 100 inhabitants	0.408*	0.505*	0.192	0.732*	0.269	0.245	0.2015	0.70	1	
Fatality	-0.215	-0.072	0.068	-0.120	-0.083	-0.010	-0.106	0.068	-0.145	1

*Significance level of 0.001.

Source: Johns Hopkins, Our World in Data.

Table 3. Implementation of Mass Testing in Countries according to GHSI in Populous Countries (>above 28 million inhabitants) (n=50).

Rank on the GHSI scale	Does not perform mass Testing (A)	Total (B)	(Ratio A/B) * 100
Low	8	10	80%
Medium	9	34	26%
High	2	6	33%
Total	19	50	38%

Source: Johns Hopkins, Our World in Data.

gentina, China, Democratic Republic of Congo, Egypt, Kenya, Mozambique, Myanmar, Sudan, Tanzania, Thailand, Uzbekistan, Venezuela, Vietnam, and Yemen.

Finally, the data in Table 4 shows that demographic structure was a risk factor for mortality associated with the spread of the new coronavirus throughout 2020, as indicated in the literature. Countries with a high proportion of older adults, except for Japan, had a mortality rate 24 times higher than countries with a young demographic structure. The data in Table 4 also highlight the slow demographic transition of African countries in the sample: the proportion of the elderly population is residual in the cluster of countries aggregated as "very young population" (3%). The predominance of African continent nations in this cluster is remarkable.

Conclusion

In this paper we discuss the Johns Hopkins University's GHSI as an effective indicator to estimate the responsiveness of health systems during the first cycle of the COVID-19 pandemic in 2020, especially while vaccines were unavailable. The main restriction that can be attributed to the GHSI concerns favoring biomedical variables for measuring the institutional capacity. Because of this configuration, this paper shows that countries with the highest GHSI scores were signifi-

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Table 4. Median of the proportion of people aged >65 years, gross domestic product per capita and deaths per 100,000 inhabitants by COVID-19 by country cluster, according to the demographic structure.

Rank on the Demographic Structure	Proportion of the Population >65 years	GDP per capita per PPC (US$) - 2019	Beds per 1000 inhabitants	Deaths by COVID-19 per 100 thousand inhabitants
Very Young Population Cluster (n=14)	3	1010	0.65	1.2
Young Population Cluster (n=22)	6.5	4050	1.6	7.7
Older Population Cluster (n=13)	18	31850	4.3	29.9
Japan (n=1)	28	40260	13.1	1.5
Total (n=50)	6.5	3085	1.6	5.7

Very Young Population Cluster: Angola, Afghanistan, Congo (Democratic Republic), Ethiopia, Ghana, Iraq, Pakistan, Kenya, Mozambique, Nigeria, Sudan, Tanzania, Uganda, and Yemen. Young Population Cluster: Argentina, Algeria, Bangladesh, Brazil, Colombia, Egypt, India, Indonesia, Iran, Peru, Malaysia, Mexico, Morocco, Myanmar, Nepal, Philippines, Saudi Arabia, South Africa, Turkey, Uzbekistan, Venezuela, and Vietnam. Older Population Cluster: Germany, Canada, China, South Korea, France, Spain, Italy, Poland, Russia, Thailand, Ukraine, United Kingdom, and the United States.

Source: Our World in Data.

cantly challenged by the lack of pharmacological measures to control the spread of SARS-CoV-2 and mortality caused by COVID-19 in 2020.

The lack of medication and vaccines in these countries left the health sector heavily dependent on the cooperation of society and governments to implement social distancing. The GHSI did not consider the hypothesis that political leaders could ignore the severity of the situation, refusing to implement social distancing measures. This paper draws attention to the fact that the prescription of social distancing to control the spread of SARS-CoV-2 was the object of a political veto by the central government throughout 2020 in many prominent and wealthy countries.

Thus, the specific issue of governmental leadership's orientation vis-à-vis science[10] weakened JHU's attempt to build an index of institutional capacity in the health sector globally. Many countries failed to build consensus on the severity of COVID-19 due to denialism of authorities. The examples of denialism from the governments in Brazil[26,27], the United States[28], and Mexico[29] are emblematic. The United States responded erratically to the 2020 pandemic cycle by denying scientific evidence during the Trump[30] administration, despite the country's first place in the GHSI ranking. The GHSI can undoubtedly improve its metrics to give more prominence to the political and institutional variables of the nations.

There is already a consensus that the governments' roles in the swift implementation of social distancing and disseminating scientific information made difference in specific countries, allowing the health sector to gain the support of most of the society during the first cycle of the pandemic of 2020[31].

The low incidence of cases and deaths in countries with low GHSI scores can also be explained by societal choices, shown in the experience of other equally severe epidemics in this century[32].

As Dalglish[4] points out, the social learning regarding the control of the spread of the new coronavirus within Asian countries was also mimicked by nations with low GHSI scores. Undoubtedly, the civic mobilization and governments' induction of these societies helped mitigating the catastrophic biological threat of the global spread of SARS-CoV-2 throughout 2020.

The biggest paradox highlighted in this paper is that the pandemic declared by the WHO on March 11, 2020[25], had a devastating impact on countries considered better-prepared to control the spread of diseases and offer more access to health care in 2020 according to the GHSI. The analysis based on the sample of large countries thus highlights the failure of national health systems in most affluent and emerging nations to protect populations against the SARS-CoV-2. The excessive mortality produced by COVID-19 was directly correlated to the health systems of high-income countries that received the classification of high institutional capacity to address health emergencies in the GHSI. Contrary to expectations, these countries were not able to address the emergence of SARS-CoV-2 in 2020 accordingly.

Some structural features of high-income countries can explain this failure. This paper identifies the influence of demographic structure and obesity distribution in the surprising concentration of excessive mortality in high-ranked countries when compared to countries with a younger population structure. The unavailability of pharmacological measures has also contributed to the relative failure of most wealthy nations to provide care for older adults and obese people, even in health systems with sufficient hospital beds.

On the other hand, countries with young populations had good performance even though they have been low-ranked in the GHSI. However, it is also necessary to draw attention to the possibility that, in the information disclosed by the website Our World in Data, countries with low GHSI scores may have benefited from systemic underreporting resulting from the government's inability to detect and report diseases and causes of deaths. As shown in this paper, it is noteworthy that almost 80% of the most populous countries with low GHSI scores and residual incidence rates of COVID-19 did not carry out mass testing for the screening of cases and causes of deaths, calling into question the validity and the reliability of the data released throughout the 2020 cycle.

Collaborations

NR Costa participated in the design, analysis, and interpretation of data, writing of the paper, and approval of the version to be published. PRF Silva, MJ Lago and A Jatobá participated in the design and interpretation of data for the work, critical review of the intellectual content, and approval of the version to be published.

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