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Measures to fight the COVID-19 pandemic and the impact of health systems: a comparative analysis between Brazil, Italy, and the USA

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Abstract

The COVID-19 pandemic required a great mobilization of the world's health systems, mainly due to the high rate of transmissibility of the disease and the state of uncertainty of the global one. Therefore, this study aimed to compare the structure of the Brazil, Italy, and the United States of America (USA), the measures taken to fight the pandemic, and the results obtained between the period of December/2019 and August/2020 in each country. This is a qualitative study, which used an Evaluation Matrix, with the information organized into Structure, Process, and Result, according to Donabedian's triad. Country characteristics such as the Human Development Index (HDI); demographic density; models of health and social protection systems; OxCGRT algorithm; and disease-related indicators; among others were compared. It was noted that the health systems of the study countries needed to be applied and reorganized to deal with the pandemic. The HDI of the countries did not demonstrate any relationship with the spread of the disease, but they may interfere in the way in which the countries organized themselves to face the problem. Countries that adopted more severe and nationally coordinated measures had better results in combating COVID-19, achieving control over the number of cases in a shorter time span. Screening tests, when present, proved to be cornerstones in governments' decisions in the face of the pandemic. The results found in this study can provide support for other comparisons, using the same methodology, which clarifies the different realities and elucidates which governmental measures were more effective in the face of the COVID-19 pandemic.

Keywords: Health System. COVID-19. Health care. Health Management. Pandemics

INTRODUCTION

Coronavirus disease, caused by the SARS-CoV-2 virus, was named COVID-19 by the World Health Organization (WHO) in 2020, and in March of the same year it was defined as a pandemic state, due to the spread of the disease to approximately from 114 countries with 118,000 registered cases (90% still in 4 countries) and 4,291 deaths. Although the Coronavirus family has been known since 1937, this was the first time that this specific subtype had appeared. The origin was in Wuhan, China, and was recognized when a series of atypical Pneumonia cases were observed followed by the identification of the new Coronavirus in the locality, in late 2019[1]. Due both to the alarming levels of dissemination and severity, as well as the frightening lack of global response, it was assessed by the WHO that COVID-19 could be

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characterized as a pandemic.[1]

Although the outbreak of the new Coronavirus was initially considered an isolated occurrence for the rest of the world, it quickly spread to different regions of the globe, proving that it is a highly transmissible virus. Faced with this scenario of uncertainties in the COVID-19 pandemic, there were many challenges to be overcome by the countries, especially ensuring the need to obtain rapid control through the countries' public health policies, using, for example, previously collected data on symptomatology and disease progression in previous outbreaks of SARS-CoV and MERS-CoV[2]. However, a lack of standardization in global management was noted, with countries opting for milder measures throughout the first pandemic wave and others for measures more severe beginning from the appearance of the first cases[1,3,4].

The Brazilian situation has been delicate since there are no easy measures to be taken against the new Coronavirus. It has been up to government and health leaders to organize actions with the objective of generating the least possible damage to society, both in the economic aspect and to the health of the population[1,3,4]. The procedures guided by the WHO that were to be adopted aimed to limit transmission with social distancing and early identification of infected patients, through health actions and an active search especially for patients with a history of recent travels[2].

Despite the pandemic context, so far, no effective treatment has been presented and approved for mild cases of COVID-19; nevertheless, several vaccines have already been tested and approved by health authorities in Brazil and in many other countries around the world. This shows the importance of science for preventing and reducing disease severity. However, each country responds differently, according to structure, socioeconomic level of the population, measures adopted, among other variables discussed in this paper.

In this sense, it is of fundamental importance to carry out comparative assessments in order to identify which procedures demonstrated the best results and which did not contribute positively to pandemic control. Therefore, more assertive measures may be suggested in similar situations that may arise in the future. It is expected that countries with more organized, universal health systems, with better socioeconomic conditions and more severe coping measures would display a better performance in fighting the disease.

The aim of the present study was to analyze, comparatively, the measures adopted during the COVID-19 pandemic in Brazil, Italy, and the United States of America (USA). In this sense, the specific characteristics of each country, structure of their health systems, and measures taken to fight the disease during the period from December 2019 to August 2020 were taken into account. In addition, another objective was to identify which actions in each country had the greatest positive/negative impact on the fight against the pandemic.

METHODOLOGY

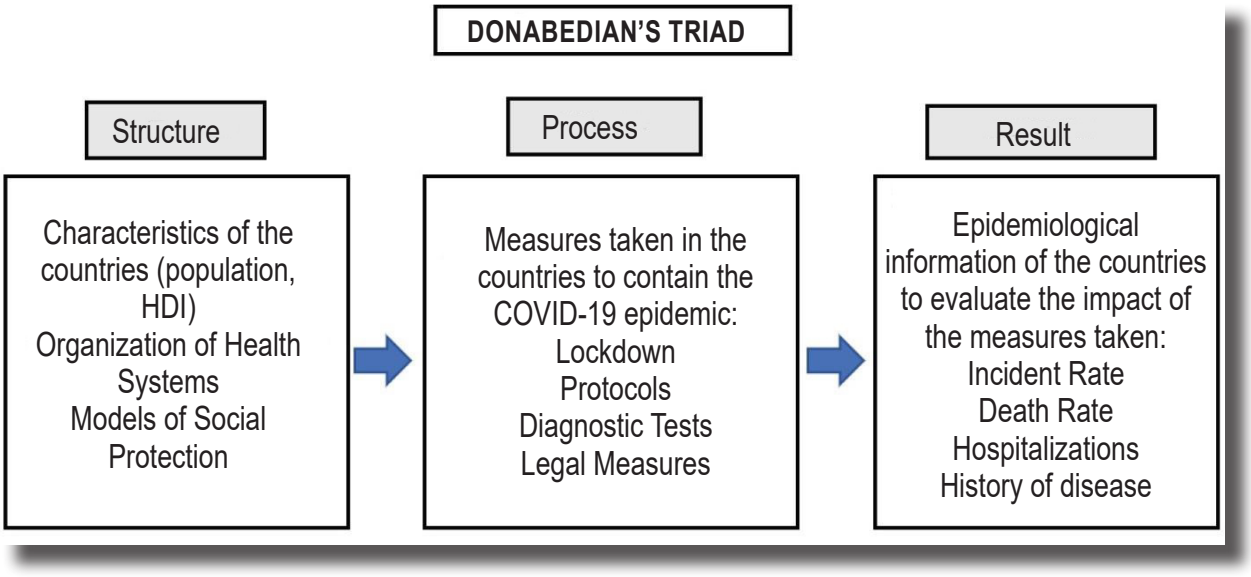
This was a qualitative, evaluative study, which used the Evaluative Matrix[5] as a basis, which is organized according to the triad proposed by Donabedian: structure, process, and result[6]. The purpose of this model is to assess the quality of health care, assuming that this quality will be achieved with the support of the practical application of technology and science in health systems[6,7].

All three process variables have specific

components, exemplified in Figure 1.

The choice of the three countries for the study (Brazil, Italy, and the United States of America) was due to the great impact that the disease had on them, during the period evaluated from December 2019 to August 2020, in addition to the different conducts and organizations of the national health service systems[1,3,8].

To assess government protocols and measures, the Oxford COVID-19 Government Response Tracker (OxCGRT) severity assessment index was used, created by the University of Oxford in England. To date, 150 countries have entered the analysis of this index, including the countries in this study. The index evaluates countries, scoring from 0 to 100, where the closer to 100, the greater the severity of the measures adopted were. As for the structure of the index, it includes 17 measures, which are organized into four subgroups: 1) containment and closures (school closures; workplace closures; cancellation of public events; restrictions on public meetings; public transport closures; stay-at-home requirements; internal movement restrictions; and international travel controls); 2) economic response (income support; concession in debts and contracts; fiscal measures; realization of international support); 3) health system (public information campaigns; testing policy; contact tracing; emergency health investments; investments in vaccines for COVID-19); and 4) other responses[9].



Source: Donabedian, 2005[6].

Figure 1– Methodological organization of the research analysis, according to the nature of data proposed by Donabedian Source: Donabedian (2005).

RESULTS

The results found in the study are represented in the Evaluation Matrix (Table 1), whose information was organized according to Donabedian's triad: structure, process, and result. In addition, some additional variables were also chosen[10]:

a. Incidence rate (number of new cases divided by total population)
b. Lethality rate (number of deaths per number of registered cases, in %)
c. Infection rate
d. Proportion of affected population (number of positive tests per number of tests performed, in %)
e. Human Development Index (HDI)
f. Demographic density
g. Oxford COVID-19 Government Response Tracker Index (OxCGRT).

According to the research carried out by the authors, for the presentation of results, the following information was categorized into three topics, according to Donabedian's triad: Characteristics of countries and their health systems (structure); Measures adopted to confront COVID-19 (process); and Indicators (outcome of the pandemic).

Table 1– Evaluative matrix comparing country characteristics, COVID-19 control measures and results, organized according to Donabedian's triad.

DONABEDIAN TRIAD	CRITERIA	BRAZIL	ITALY	USA
STRUCTURE	Health System Model	Universal health system (Unified Health System-SUS). The State directly provides health services, in the outpatient and hospital network[11].	Universal Health System-Servizio Sanitario Nazionale (SSN), with user co-participation of the cost of care[11].	Predominantly private system (70% of the insured population), being complemented by public systems (26% of the insured population)[11].
	Social protection model	Social Security Model[11].	Social Security Model[11].	Private Insurance Model[11].
	Population characteristics	• Population: 211.05 million inhabitants (2019)[8] • Demographic density: 25 inhab/km² (2017)[8] • HDI: 0.76 (2017)[8]	• População: 60.55 milhões de habitantes (2019)[8] • Densidade demográfica: 206 hab/km² (2017)[8] • IDH: 0.88 (2017)[8]	• População total: 329.06 milhões de habitantes (2019)[8] • Densidade demográfica: 36 hab/km² (2017)[8] • IDH: 0.92 (2017)[8]
PROCESS	Elaborated Protocols / Legal measures taken by governments	OxCGRT index reached severity levels >70 as of March 21, 2020: accumulation of 904 confirmed COVID-19 cases. Until then, the country kept levels above this mark, in a stable manner; ranging from 77.31 - 81.02[9].	OxCGRT index reached severity levels ≅70 (69.91%) as of February 23, 2020: accumulation of 79 confirmed COVID-19 cases. The country presented a period of significant increase in the severity index, reaching values >80, up to a peak of 93.52, from March 10th to May 3rd, 200[9].	OxCGRT index reached severity levels >70 as of March 21, 2020: accumulation of 19,624 confirmed COVID-19 cases. The country maintained levels of 72.69 steadily until declining on June 15 to 68.98 in the severity index[9].

to be continued...

.... continuation table 1

DONABEDIAN TRIAD	CRITERIA	BRAZIL	ITALY	USA
	Availability of diagnostic tests	• January 23, 2020 - Start of Testing Policy for COVID-19: Symptomatic patients in risk group only[8]. • May 25, 2020: any symptomatic patient has been tested[8]. • Brazil obtained an average of 11.93 tests performed for every 1,000 people[8].	• January 31, 2020 - Start of Testing Policy for COVID-19: Symptomatic patients in risk group only[8]. • Feb 26, 2020: Any symptomatic patient has been tested[8]. • Italy obtained an average of 105.1 tests performed for every 1000 people[8].	• February 28, 2020 - Start of Testing Policy for COVID-19: Only for symptomatic patients in risk groups[8]. • March 4, 2020: any symptomatic patient was tested[8]. • March 14, 2020: diagnostic tests have become "open to the public" and can be performed on anyone, even asymptomatic[8]. • USA obtained an average of 142.67 tests performed for every 1,000 people[8].
RESULTS	Epidemiological data	• First confirmed case: Feb 25th. 2020. • Confirmed cases: 2,859,073 • Deaths: 97,256 • First confirmed case: Feb 25th. 2020. • Confirmed cases: 2,859,073 • Deaths: 97,256 • Incidence rate: 1,354 cases per 100,000 inhab. • Death rate: 3.41% • Proportion of affected population: 0.0126% Data collected in August/2020	• First confirmed case: January 31st. 2020. • Confirmed cases: 249,204 • Deaths: 35,181 • First confirmed case: January 31st. 2020. • Confirmed cases: 249,204 • Deaths: 35,181 • Incidence rate: 411 cases per 100,000 inhab. • Lethality rate: 14.1% • Proportion of affected population: 0.0041% Data collected in August/2020	• First confirmed case: January 21st. 2020. • Confirmed cases: 4,870,367 • Deaths: 159,864 • First confirmed case: January 21st. 2020. • Confirmed cases: 4,870,367 • Deaths: 159,864 • Incidence rate: 1,479 cases per 100,000 inhab. • Lethality rate: 3.28% • Proportion of affected population: 0.1374% Data collected in August/2020

Characteristics of countries and their health systems (structure)

Brazil occupies the 79th position in the Human Development Index ranking, and is currently undergoing an important demographic transition with an increase in the economically active and elderly population[12,13]. Italy, on the other hand, occupies the 28th position in the ranking and is undergoing the same demographic transition as Brazil, but with a higher concentration of the elderly population[13]. The USA, in turn, occupies the 16th position and, unlike Italy and Brazil, has a higher percentage of its population in the economically active range[19].

Brazilian health is organized by the Unified Health System (SUS), created in 1990, with a public nature, which includes all Brazilian citizens, and possesses the doctrinal principles of completeness, fairness, and universality[14,15]. Italian health care is organized by the Servizio Sanitario Nazionale (SSN), created in 1978, with public/private characteristics depending on the user's financial condition[16]. Unlike SUS, it is organized in levels, namely: national, regional, and municipal, which ensures an important decentralization in the process[17,18]. In contrast to the above, the US health system is essentially private and each state has independent standards. The American health system has one

of the highest per capita expenditures in the world. It has three models, Medicaid, Medicare, and Patient Protection and Affordable Care Act, each of which is aimed at a specific population; those with low income, those over 65 years old, and those under 65 years old, respectively. One of the great advantages of the American system is the great technological and pharmaceutical development[19].

Measures taken to confront COVID-19 (process)

The severity levels of the measures adopted by the countries were presented in this study through the OxCGRT indicator.

Among the items assessed by this indicator are diagnostic tests. In Brazil, since the beginning of the pandemic, there has been a shortage in the amount of diagnostic tests available to the population, as it depends on a significant importation of materials for the production of the tests[20]. The Brazilian testing capacity was low, initially being only for symptomatic patients and at-risk groups, but it testing was expanding to all symptomatic patients as the number of identified cases increased[8]. Moreover, government denial in recognizing COVID-19 as a pandemic and a public health problem was noted. Brazil has increased the testing rate and reached close to 65,000 tests per million inhabitants by August 2020, still lagging far behind other countries around the globe, such as Italy and the USA that make up the study - which presented a rate above 100,000 tests per million inhabitants[21].

Regarding Italy, only symptomatic patients were initially tested, similar to the Brazilian situation. However, with the absurdly increasing number of cases in the country in the early days of the pandemic, mass testing was implemented even of asymptomatic patients[4].

In the USA, the situation was extremely uncontrolled both at the level of the health system and at the governmental level - making social measures uncoordinated such as population testing and lockdown actions, which may have contributed to the first position reached by the country (from March 2020 until the last results in July 2021) both in number of cases and deaths from the new Coronavirus[20]. To increase access to tests, the Food and Drug Administration (FDA) authorized policies for laboratories to use validation tests immediately[22]. During the period evaluated, the country had one of the highest percentages of tests performed (Table 1), due to the release of tests for asymptomatic patients.8

The start of the lockdown in Brazil, another aspect of the OxCGRT indicator, took place in May and June and was implemented in an uncoordinated manner, according to the planning of each state and municipality in the Brazilian territory. The measures adopted by the Ministry of Health in Brazil were initially supported by the decisions of the World Health Organization (WHO), aiming to flatten the growth curve of the pandemic. With the progress of the pandemic, divergences in conduct and guidelines were observed, which culminated in the alarming situation that occurred in Brazil[23].

In Italy, the main problem faced was the collapse of the hospital system at the beginning, with a shortage of beds, which motivated the adoption of drastic measures to combat new cases[20]. In February, entry into cities were blocked and the recommendation for residents to leave only for extreme needs began, preventing schools, face-to-face work, railways, and public meetings from operating. With the evolution of the pandemic scenario, Italy expanded the lockdown throughout its territory in March 2020, being the first of this magnitude to occur in the world due to the pandemic[22].

The US, in turn, instituted a state of public health emergency in January, after a succession of cases identified in the country, thus, imposing 14 days of mandatory quarantine on everyone who had visited Hubei province in China. Only

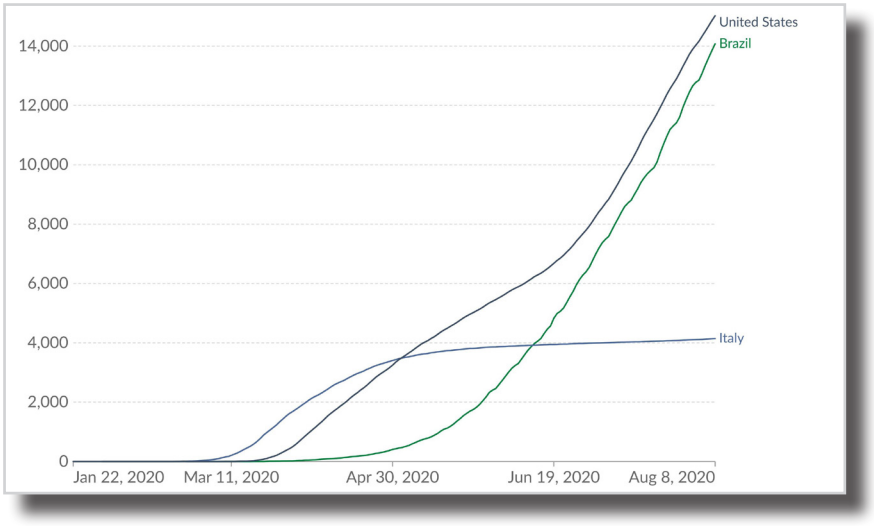
in March were the lockdown measures actually started in the USA, according to the organization of each state, with no joint or coordinated actions. For example, states like California and New York started in March, while Georgia only started in April. In addition, the actions had different durations in different American states, forming different profiles across the country[22].

The first confirmed case of Coronavirus in Brazil occurred in São Paulo, in February 2020. The evolution of the disease in Brazil was slower in the beginning, reaching a peak in July, with a stabilizing tendency (Figure 2).

Until the time of the study, Brazil had 2.8 million cases, with about 97 thousand deaths, which represents an incidence rate of 1,354 per 100 thousand inhabitants and a fatality rate of 3.41%.

In Italy, the first cases were confirmed in January 2020. The evolution of the disease occurred faster, reaching the peak of the curve in the first month, after the first case (Figure 2). This country had 249 thousand cases, with about 35 thousand deaths, with an incidence rate of 411 per 100 thousand inhabitants and a mortality rate of 14.1% at the time of this study.

The first diagnosis of COVID-19 in the USA was registered in January 2020 and the curve started to grow from the month of March, declining between the months of April and June, and returning to its increase after this month (Figure 2). The number of confirmed cases in this country exceeded 4.8 million at the time of this study, with a death toll of around 160,000, an incidence rate of 1,479 per 100,000 inhabitants and a mortality rate of 3.28%.



Source Ritchie *et al.*, 2000[8].

Figure 2– Number of confirmed COVID-19 cases per million inhabitants, in Brazil, Italy, and the USA, from December/2019 to August/2020.

DISCUSSION

The COVID-19 pandemic has been addressed in different ways around the world. Despite constant WHO guidelines and warnings about the seriousness of the situation that was developing, the global picture has become a mosaic: countries like Italy managing to flatten the spread curve within four months of the first diagnosis, while others like the US and Brazil maintained a constant growth of new cases. The crucial difference between the outcome of these countries is understood by analyzing two major factors: (a) organization of government spheres and (b) structuring of the local health system. The term "scientific denial" can be applied to the Brazilian situation, arising especially from the national executive power in controlling cases and testing the population[21].

The HDI, although it may show a positive correlation with the incidence rate of COVID-19, as suggested by articles, was not very clearly demonstrated in this study[24,25]. What it was possible to conclude is that the HDI did not directly influence the performance of countries in facing the pandemic.

Based on the OxCGRT index (Figure 3) that assessed the severity of actions taken by the countries in this study, it was observed that Brazil reached levels of severity above 70 starting from March 2020, when it accumulated 904 confirmed COVID-19 cases. The country maintained, until October 2020, constant levels above this level in a stable manner. In parallel, observing the evolution of the USA, it is possible to notice a later response, as the measures – in the same degree of rigidity as Brazil – took place when the country already had 19,264 confirmed cases of COVID-19. The US maintained levels of 72.69 steadily until its severity index declined in June to 68.98.

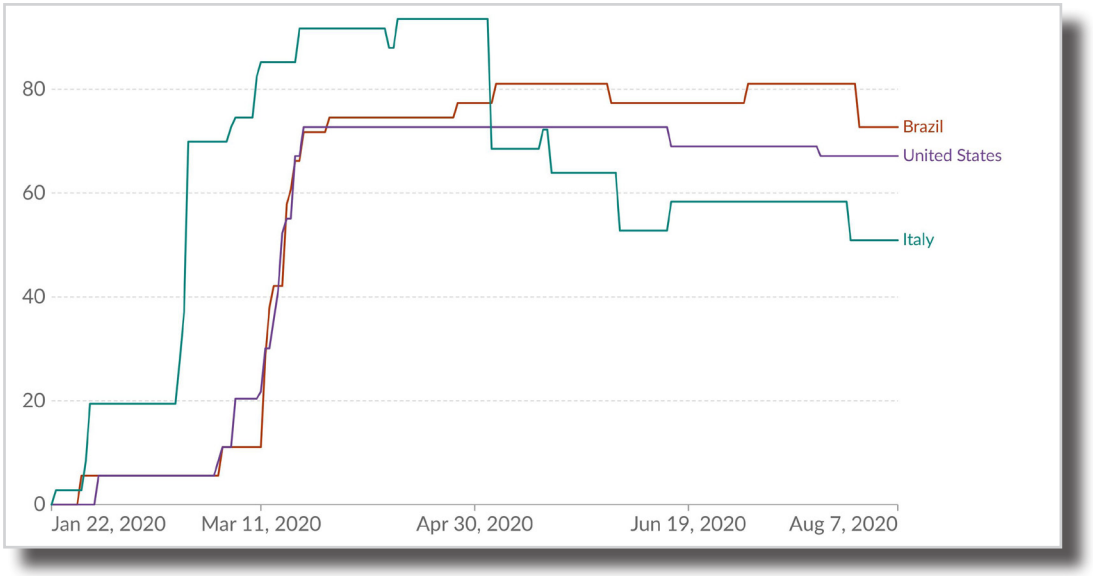
In Italy, the OxCGRT index adopted severity levels above 70 as of February 2020, when the country accumulated 79 cases of COVID-19. This country significantly increased the severity index, reaching values above 80 as of May 2020 – when it began to make measures more flexible, reaching 44 due to the relative control achieved[9].

Italy took a much more severe and decisive actions than Brazil and the USA and obtained better results over time with regards to the control of dissemination, especially considering that the incidence rate of the disease was well lower than in the other two countries in the study. This was demonstrated by the fact that some countries had cumulative incidences as expected and had very high mortality rates when compared to countries with the same testing equivalent. Italy is one of the examples, as it was identified that the large number of comorbidities in patients with COVID-19 - 98.8% with at least one associated comorbidity - made it difficult to identify mortality exclusively due to COVID-19[21,22].

Given this factor, it was observed that the measures adopted in this country were imposing and direct, according to what was pointed out by the OxCGRT index, as one of the strictest responses adopted in the world and is considered the most radical example against the pandemic - outside of China[23].

The US, in turn, carried out a lockdown protocol to contain the spread of the disease, but also chose to try to reopen – even with the growing increase in the number of confirmed cases.

Regarding the transmission rate, when compared to the influenza A (H1N1) 2009 virus, some studies conclude that the transmission of COVID-19 is much more intense, thus, requiring drastic and incisive measures to contain the spread[26].



Source: Ritchie *et al.*, 2000[8] e Hale *et al.*, 2000[9].

Figure 3– Severity of Government Responses to COVID-19, from January to August 2020, according to the OxCGRT index.

The number of cases in Italy increased before the peaks in the USA and Brazil, which may be associated with a smaller territorial area, greater population density, and its communication with countries on the European continent. Although the Italian actions were extremely restrictive, the lethality rate found was exuberant (14.1%) compared to the world average (4.05%), which may be associated with the inefficiency of the hospital system which a major problem faced by Italy. However, it is known that by including mildly symptomatic and asymptomatic individuals through mass testing, as was done in Italy, resulted in greater identification of those infected with SARS-COV 2, which directly impacts the quality of health indices and, consequently, leads to increased rates of incidence and mortality identified by COVID-19[21].

Studies carried out in early April 2020 among 42 countries around the globe showed that a simple 10% increase in a country's testing capacity could boost the identification of cases by 9%, in addition to reducing lethality by 9%[27].

Comparing the USA and Brazil - leaders of COVID-19 cases in the world at the end of the period analyzed (August 2020) - it is possible to notice some important differences, starting with the population. The USA has a majority of its population in the economically active range, or rather, those at risk of acquiring the disease, and has 100 million more inhabitants than Brazil[19]. Moreover, with regards to government actions, the USA acted in a compartmentalized and decentralized way, independently between the states. In Brazil, a similar event occurred, where, even with an integrated system that theoretically should be more coordinated, there was a great dissociation between the measures adopted in different states and municipalities; even adopting procedures that were contrary to each other[28].

Still within a comparative analysis, but with regards to the lockdown measures, the USA

delayed its measures and, probably for this reason, obtained one of the highest incidence rates in the world[19,20]. Brazil, in turn, due to the great difficulty in screening new cases and the deficiency in the number of diagnostic tests available, as described in the Evaluation Matrix, resulted in delays in interventional measures[30].

CONCLUSION

Of all the variables studied, the one that most likely influenced the results of pandemic control was the severity of the measures adopted, as indicated by the OxCGRT indicator. This influence of the severity of the measurements on the results obtained can be demonstrated by the faster flattening of the curve for new cases, as had occurred in Italy, according to the suspected initial hypothesis, as well as was identified in scenarios of the epidemics and pandemics originating from Influenza in the past. Factors such as the organization of the health system were essential for control, since, according to international analyses during the pandemic period, countries that sought to carry out diagnosis and tracking of cases obtained more efficient results, as explained in this study. If we evaluate the correlation of the study with the HDI of the countries, it is possible to see that, based on international analyses up to 2020, there was a positive correlation between HDI and rates of infection and death from COVID-19, mainly in Italy as well as in countries from the regions of the Americas and Africa; however, herein this correlation was not found.

It is possible to identify that qualified health and government structures do not guarantee effective measures, as well as are not predictors of good results. Moreover, they indicate that the existence of an inadequate process and/or structure will hardly achieve positive results.

The results of this study can provide support for other comparisons, using the same methodology, since the evidence helps in the restrictive measures adopted to solve the problems generated by a serious disease.

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