Covid-19 in Brazil: A sad scenario

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ABSTRACT

The main contribution of this article is to report general statistics about COVID-19 in Brazil, based on analysis of accumulated series of confirmed cases, deaths and lethality rates, in addition to presenting graphs of moving averages for states and municipalities. The data show that the pandemic in Brazil has grown rapidly since February 25th (date of the first reported case). Furthermore, the lethality rate of COVID-19 in Brazil is greater than in many other Latin American countries (Chile, Argentina, Uruguay and Paraguay). However, the number of new confirmed cases in Brazil has little statistical relevance because only a small part of the population has been tested. In relation to Brazilian municipalities, we highlight the 10 states with the highest lethality rates, ranked from highest to lowest. Also, predictions about the increaseor decrease innew cases and deaths for states and capital cities are presented. These results can help managers and researchers to better guide their decisions regarding COVID-19.

1. COVID-19 in Brazil: statistics and data sources

Most of the information about COVID-19 in Brazil was calculated from data provided by government programs and organizations; see References [1–5]. One of these programs is called Brasil.IO (http s://brasil.io/home/), which receives contributions from Brazilian volunteers who compile, on a daily basis, epidemiological data bulletins from the state health secretariats [1]. Brasil.IO is an Application Programming Interface (API) used to compile data about COVID-19 in Brazil. In this way, the data provided by the Brasil.IO is a viable way to produce reliable statistics for COVID-19, because the nationwide data reported by the Ministry of Health does not allow building web applications and programs that function for a long time, due to the constant change in the patterns of information availability and the structures of the databases.

Due to this scenario, the descriptions presented below are derived from data reported until October 29, 2020. This database is updated daily [1–5].

The pandemic in Brazil has grown quickly, in absolute terms, since the report of the first case on February 25th. As of October 29, 2020, there were more than 5.4 million confirmed cases, or incidence of 262 cases per thousand inhabitants, and the number of deaths was above

158,969 [1–4]. On that date, there were 42,659 new confirmed cases of COVID-19 nationwide and 669,000 cases followed up, with 1215 new deaths, for a national lethality rate of 2.89 % and mortality rate of 58.53 per thousand inhabitants [3]. The lethality rate for COVID-19 in Brazil is above the levels in countries like Chile (2.78 %), Argentina (2.66 %), Uruguay (1.87 %) and Paraguay (2.21 %), for example, according to data obtained using the COVID-19 Data Hub library (https://covid19da tahub.io/). It is possible to obtain COVID-19 data from this library for several countries, since it provides perfect integration with open data from the World Bank, Google Mobility Reports and Apple Mobility Reports [5].

In absolute numbers, Brazil stands out in the world context in numbers of cases and deaths confirmed by COVID-19. Brazil's numbers are only surpassed by the United States and India. However, several other countries surpass Brazil's lethality rate. For example, South American countries like Ecuador, Bolivia, Peru, Guyana and Colombia, have lethality rates (%) higher than in Brazil (2.89), these being 7.59, 6.15, 3.83, 3.00 and 2.89, respectively.

The number of confirmed cases has little statistical relevance in Brazil, since under 7% of the population had been tested by October 29, and also because of the high numbers of false-negative and false-positive tests. Another factor is the high cost of the various tests, which is not

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Lethality Rate by COVID-19

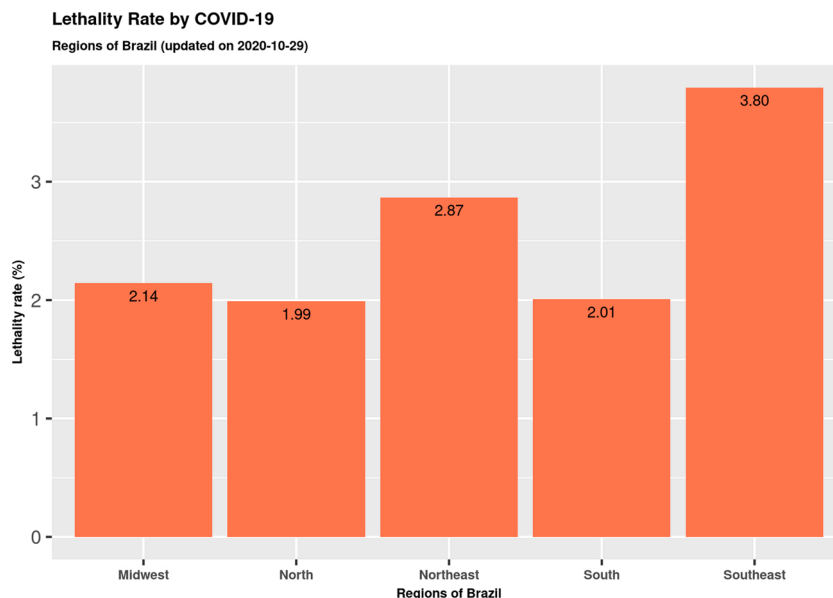Regions of Brazil (updated on 2020-10-29)

Fig. 1. Lethality rates for the five regions of Brazil.

Table 1

Ten states with the highest mortality rates in Brazil*.

States	Cases	Deaths	Estimated population	Confirmed cases per 100.000 inhabitants	Lethality rate (%)
RJ	308,017	20,462	17,366,189	1773.66	6.64
PE	161,740	8599	9,616,621	1681.88	5.32
SP	1,108,860	39,119	46,289,333	2395.50	3.53
CE	273,194	9335	9,187,103	2973.67	3.42
RN	81,295	2582	3,534,165	2300.26	3.18
AM	160,596	4516	4,207,714	3816.70	2.81
MT	143,047	3841	3,526,220	4056.67	2.69
PA	252,389	6738	8,690,745	2904.11	2.67
SE	84,171	2195	2,318,822	3629.90	2.61
MG	355,226	8916	21,292,666	1668.30	2.51

* Data obtained until October 29, 2020 [4].

accessible to low-income people with asymptomatic or mild cases. So, the most reliable data available are the death records in each state. This series is a reasonable approximation for the number of deaths when working with 7-day moving average models (epidemiological weeks), since they can reduce the random errors associated with the differences between the real time of death of the infected person and the time recorded on the death certificate.

Some long-term forecasting models developed 3 or 4 months ago showed appreciable errors in estimating the number of COVID-19 cases in Brazil. Examples of these factors include the great temporal volatility, immense spatial variability in the spread of the virus and erratic behavior by Brazilians with large agglomerations at street produce fairs, beaches, weekend parties and other events.

2. Coronavirus pandemic in Brazil

Brazil is divided into five geographical regions with 26 states and the Federal District (location of the country's capital, Brasília). The North region has seven states, the Northeast nine, the Midwest three, the Southeast four and the South three. Fig. 1 shows the lethality rate for these five regions [4].

Table 1 shows the 10 states with the highest lethality rates in Brazil, ranked from highest to lowest. Regarding the lethality rate of COVID-19, the three largest are in the states of Rio de Janeiro (6.64 %) and São Paulo (5.53 %), in the Southeast; and, Pernambuco (5.32 %) and Ceará

(3.42 %), in the Northeast. The distribution of deaths among states is highly heterogeneous, with four states (São Paulo, Rio de Janeiro, Ceará and Pernambuco) accounting for 52 % of deaths reported to date, although they have only 39 % of the country's population [1–4]. Fig. 2 presents a choropleth map with the mortality rate of COVID-19 for all states in Brazil, including the Federal District, while Fig. 2 does the same for the mortality rate. On these maps it is possible to see the states of Pernambuco (northeast region) and Rio de Janeiro (southeast region) standing out when compared to the other states.

To provide information about the number of new cases or deaths, the Observatory of Respiratory Syndromes of the UFPB Department of Statistics (http://obsrpb.com.br/ufpb) built an application that constantly updates predictions about new cases and deaths for all Brazilian states and their corresponding capitals (https://obsrpb.shinyapps.io/st_pred/). The data registered until October 29, 2020 reveal that new cases of COVID-19 are decreasing in the states of Pará, Rondônia, Acre, Roraima, Tocantins, Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia, Rio de Janeiro, São Paulo, Espírito Santo, Paraná and Santa Catarina. With respect to predictions about new cases in Amazonas, Minas Gerais, Mato Grosso do Sul and Rio Grande do Sul, the number of new cases is increasing, thus requiring constant monitoring and revision of rules imposed on the population, in order to prevent the transmission of COVID-19. In relation to capital cities, there is evidence of stabilization or reduction in the number of new cases in all cities except Teresina, São Luís, Manaus, Palmas, Goiânia, Rio de Janeiro, Curitiba and Porto Alegre. For these cities, there is evidence that the numbers of new cases are increasing. Furthermore, when the data on new deaths reveal that the numbers of new deaths are decreasing in all states except Roraima and Tocantins. In relation to capital cities, there is evidence of stabilization or reduction in the number of new deaths in all capitals except Natal, Maceió, Palmas, Rio de Janeiro, Vitória, Belo Horizonte, Curitiba and Porto Alegre.

3. COVID-19's impact

The Unified Health System (abbreviation in Portuguese is SUS) of the Brazilian Ministry of Health guarantees access to health actions and services in this pandemic to more than 210 million inhabitants of Brazil. The TeleSUS system employs artificial intelligence to actively search for suspected COVID-19 cases via telephone, and individuals with symptoms of infection are able to access health guidelines without leaving

Lethality Rate by COVID-19
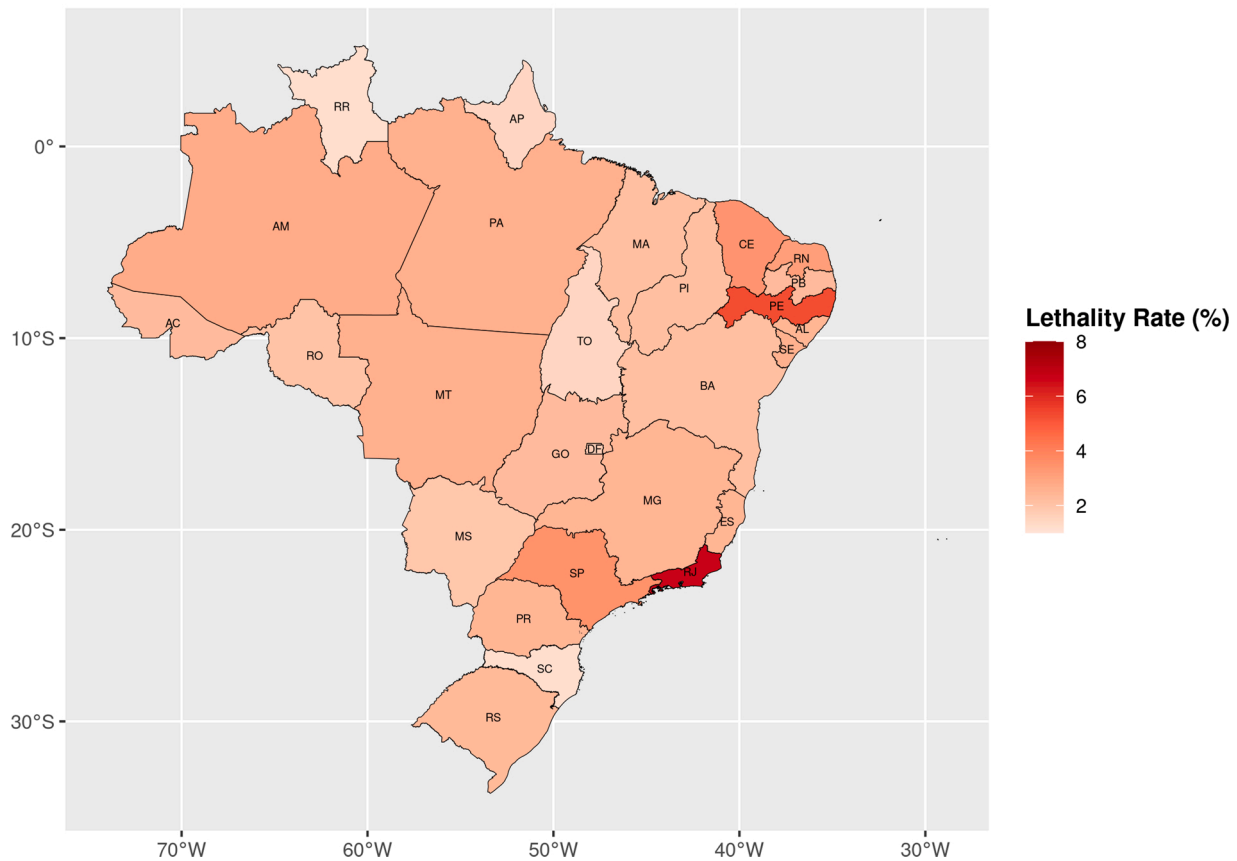### Brazilian states (updated on 2020-10-29)

Fig. 2. Map of the lethality rate (%) by COVID-19 in Brazilian states (data obtained in October 29, 2020).

home [2].

Regardless of all the mitigation measures that have been taken, the COVID-19 pandemic has impacted the population of Brazil profoundly, since Brazil has a large number of people in vulnerable situations, a fact aggravated by the high unemployment rate [6]. Since Brazil has continental dimensions and populations with different characteristics based on social behavior, genetics and economic origins, different social management initiatives are necessary in these regions. This dimension and diversity make issues such as availability of tests and diagnoses, number of intensive care units, access to reliable information about the disease and control of the pandemic extremely chaotic and hard to resolve [7].

The first reaction to the spread of COVID-19 in Brazil was the "panic buying" generated by the prospect of isolation and uncertainties about the maintenance of supplies of foods and other products [8]. Surveys on consumption in different countries affected by the pandemic reflect the increase in demand for basic foods, especially in non-perishable items. However, since these sectors have not experienced interruptions in services during the pandemic period, major supply problems have not been observed in Brazil [9].

4. Future perspectives

Several measures to relax social distancing have recently been adopted in some states and cities. These measures are a response to the reduced incidence of new cases in recent weeks. However, they are somewhat nebulous and based on a descriptive analysis of the data and the climate from a vaccination perspective.

Because these are recent measures, it is difficult to introduce the

effect of breaking social isolation in a probabilistic model. Thus, constant descriptive analysis can be performed to guide prudent decisions. However, these analyses should be interpreted with caution, since small reductions in the number of infected people may not be sufficient to justify breaking social isolation. To assist the constant analysis of COVID-19 data in Brazil, we built a web application that constantly updates the evolution of the disease in all municipalities in Brazil, totaling more than 5500 (https://pedro-rafael.shinyapps.io/shinydashboard/). This COVID-19 application is constantly evolving and has been used by health managers in some states to guide public policies about COVID-19 [4].

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.cytogfr.2020.10.010.

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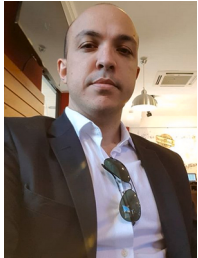
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