



## Influence of social indicators on the occurrence and mortality of COVID-19 in Brazil in June 2020

*Influência de indicadores sociais na incidência e mortalidade da COVID-19 no Brasil em Junho de 2020*

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### ABSTRACT

Current paper analyzes the influence of social indicators in Brazilian regions and verifies their correlation with the occurrence and mortality caused by COVID-19 in Brazil. All the Brazilian Federative States were included in current observational, ecological and analytical study from 06/10/2020 to 06/13/2020. Variables were related to COVID-19's occurrence rate, lethality and accumulated mortality per 100,000 inhabitants. Independent variables comprised human development index, poverty percentage and per capita income. Results show that poorer regions have higher incidence, mortality and lethality by COVID-19 when compared to richer ones. These results demonstrate that social indicators influence the incidence and death rates per 100,000 inhabitants due to COVID-19, in addition to showing significant correlations with each other. The study findings may be used to support and guide actions to combat COVID-19 in the country.

**Keywords:** COVID-19. Incidence. Mortality. Social indicators.

### RESUMO

O estudo tem por objetivo analisar a influência de indicadores sociais das regiões e verificar sua correlação com a incidência e mortalidade causada pela COVID-19 no Brasil no período de junho de 2020. Trata-se de um estudo observacional, ecológico e analítico na qual foram incluídas nas análises todas Unidades Federativas brasileiras de 10/06/2020 à 13/06/2020. Considerou-se como variáveis relacionadas à COVID-19: taxa de incidência e mortalidade acumulada por 100 mil habitantes e taxa de letalidade acumulada. Como variáveis independentes, determinou-se: índice de desenvolvimento humano, percentual de pobreza e renda per capita. Verificou-se que regiões mais pobres (Norte e Nordeste) possuem maior incidência, mortalidade e letalidade por COVID-19 se comparado com as regiões mais ricas do (Sudeste, Sul e Centro-oeste). Esses resultados demonstram que os indicadores sociais possuem influência nas taxas de incidência e óbitos por 100 mil habitantes devido a COVID-19, além de apresentar correlações significativas entre si. Os achados do estudo podem ser usados para embasar e dar direcionamento a ações de combate ao COVID-19 no país, levando à criação de políticas públicas bem estruturadas e garantindo eficácia para o enfrentamento da doença em áreas com vulnerabilidade.

**Palavras-chave:** COVID-19. Incidência. Mortalidade. Indicadores sociais.

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## **INTRODUCTION**

World population is experiencing a pandemic involving a novel, highly transmissible virus called Sars-COV-2, causing a gravely acute respiratory syndrome. The World Health Organization (WHO) called the pathology coronavirus disease 19 or Covid-19 and determined that its causing agent as severe acute respiratory syndrome coronavirus 2 - Sars-CoV-2)<sup>1</sup>.

The most frequent symptoms are fever, dry cough, fatigue, myalgia and dyspnea. Its severe type is characterized by a syndrome of acute respiratory discomfiture, septic shock, metabolic acidosis and bleeding and coagulation dysfunction<sup>2</sup>. Since it is an acute respiratory infectious disease, its transmission mainly occurs through the respiratory tract by means of droplets, respiratory secretion and direct contact<sup>3</sup>.

In Brazil, first notification of the disease occurred on February 2020, with the first death on March 17 of the same year<sup>4</sup>. According to data by the Health Ministry, since this day till the 27<sup>th</sup> epidemiologic week, there were 1.4 million cases, with approximately 62,000 deaths<sup>5</sup>.

During the pandemic, scientific evidence showed the efficaciousness of vaccines against Covid-19, such as the Vaccine Coronavac developed by the Sinovac Life Science Lab of Pekin (China) by using the inactivated virus causing the disease. Result of one study revealed that Coronavac had a good response for

neutralizing antibodies in animals and offered a partial or complete protection against serious interstitial pneumonia in monkeys, without any observable worsening of the infection<sup>6</sup>.

Due to the frantic race by countries for the vaccine, the lack of government planning, discredit in certain scientific tenets and the lack of knowledge of the processes involved from transmissibility till death, the population's immunization occurred slowly and gradually and non-pharmacological interventions became a priority to reduce cases in the country<sup>7</sup>.

Consequently, the main strategies to delay the disease's peak required epidemiological and sanitary measures such as social distancing, hand washing and, in certain regions of Brazil, a partial or total lockdown of trade and circulation of people<sup>7,8</sup>. These measures were the initial response to transmissibility and were crucial to delay the propagation and to protect people with the greatest risks from infection. In fact, elderly people and those with co-morbidities were liable to contracting a grave clinical case and death by infection<sup>9</sup>.

In Brazil, due to its immense territory and the weakness in public health policies, social inequality with populations living in highly precarious housing and health conditions became more and more rife, especially in regions without proper water facilities and in agglomeration conditions<sup>10</sup>. Owing to Covid-19's high infectious capacity in a population in

heterogeneous territories with regard to life conditions, several different risk factors for infection could be detected<sup>11,12</sup>. Consequently, studies should be undertaken that would take into account the social indicators of each region with regard to the occurrence and mortality by Covid-19.

Social indicators that affected the dynamic of Covid-19 in Brazil should be identified to attack the pandemic and its consequences, contributing towards the effectiveness of already extant political policies<sup>13</sup>. In fact, studies that assess specificities of peoples involved, the analysis of the influence of social indicators in the virus's transmissibility rate and sanitary requirements are highly relevant<sup>14</sup>. Current analysis investigated the influence of social indicators, such as the Human Development Index (HDI), Gini Index, per capita income and poverty percentage for the regions and verifies their co-relationship with occurrence and mortality caused by Covid-19 in Brazil.

## METHODS

Current observational, ecologic and analytic study deals with all Brazilian federative units or states. Research was planned through stages in which first investigations dealt with online epidemiological bulletins at the official sites of the state secretaries of each state, in June 2020. The month is crucial since it comprises the period in which the case curve was rising and data referring to

number of cases and deaths were confirmed.

Dependent variables related to Covid-19 comprised accumulated occurrence rate per 100,000 inhabitants (number of accumulated new cases/number of inhabitants in the state\*100,000), accumulated mortality rate per 100,000 inhabitants (accumulated number of deaths divided by number of inhabitants in the state\*100,000), and accumulated lethality rate (number of accumulated deaths/number of cases per inhabitants\*100). Independent variables comprised Human Development Index (HDI), a development classification of a country analyzing life expectancy, schooling and *per capita* income, national level, percentage of poverty which measures the number of people with family income *per capita* lower than a minimum wage and *per capita* income corresponding to mean income of the population, Gini's Index on the vulnerability of the place. Data were retrieved from the Instituto Brasileiro de Geografia e Estatística (IBGE) and from the Departamento de Informática do Sistema Único de Saúde (DATASUS), public domain.

Data were later analyzed by descriptive statistics and quantified in percentiles (25, 50 and 75) through Kolmogorov-Sminorff and Shapiro-Wilke normality tests. Further, p-value was significant at <0.05 by Kruskal-Wallis test. Indicators were tested by Spearman's correlation between social indicators on occurrence, mortality and lethality caused by Covid-19.

Data were first fed on Excel 2016 for primary treatment and later annexed to Statistical Package for the Social Sciences (SPSS 20.0) for final treatment.

Current study did not require approval by the Committee for Ethics and Research (CEP) since data were public, following Resolution 510/2016 by the National Health Council.

## RESULTS

Table 1 shows the percentiles of occurrence and mortality according to regions in Brazil. In the case of confirmed cases and total deaths, it may be said that the southeastern and northeastern regions registered the greatest number in the two variables, with statistical significance  $p=0.042$  and  $p=0.007$ . Highest death rates per 100,000 inhabitants hailed from the North (31.00) and Southeastern (24.00), with statistical significance  $p=0.020$ . In the case of occurrence and lethality per 100,000 inhabitants, albeit without any significant impact, the North and Northeast had the highest occurrence rates (946.00 and 462.00), whereas the Southeast and Northeast had the highest lethality rates (530.00 and 350.00).

Table 2 shows the co-relationship of social indicators with occurrence and lethality rate of deaths by Covid-19 per 100,000 inhabitants. There is a negative co-relationship (-0.42), with statistical significance  $p=0.029$  with HDI, but a positive relationship (0.71) with Gini Index with significance  $p<0.001$ . Per capita income with 100,000 inhabitants may be statistically seen as  $p=0.009$ , a negative co-relationship (-0,49). However, percentage of poverty shows a strong and positive co-relationship (0.55) with occurrence. Death rates have a positive and strong co-relationship with Gini Index (0.59) but moderate with percentage of poverty (0.48), with statistical significance  $p=0.001$  and  $p=0.0010$ .

However, negative and moderate co-relationship (-0.44) with the country's per capita income is significant ( $p=0.010$ ). HDI co-relates with death rates negatively and weakly (-0.34), without any significant impact. Negative and weak co-relationships with IDH (-0.17) and per capita income (-0.21) may be observed, coupled to positive and weak co-relationships with Gini Index (0.20) and poverty percentage (0.23), without any significant impact.

**Table 1.** Occurrence and Mortality Indicators for Brazilian regions. 2020

Occurrence and Mortality Indicators			Regions of Brazil					p-value
			Southeast	Midwest	South	North	Northeast	
N. of confirmed cases	Percentiles	25	18977.25	3138.25	7831	6257	12202	<b>0.042</b>
		50	<b>50522</b>	<b>5657</b>	<b>12594</b>	<b>10547</b>	<b>26556</b>	
		75	136180.75	16212.75	-	52849	48251	
Occurrence of cases per 100,000 inhabitants	Percentiles	25	145	93.25	69	594	351.5	0.07
		50	<b>389.5</b>	<b>115.5</b>	<b>125</b>	<b>946</b>	<b>462</b>	
		75	581.5	518	-	1275	708.5	
Total deaths	Percentiles	25	562.5	56.25	184	188	446.5	<b>0.007</b>
		50	<b>4193</b>	<b>166.5</b>	<b>275</b>	<b>289</b>	<b>660</b>	
		75	9237.25	237	-	2363	2477.5	
Death rate per 100,000 inhabitants	Percentiles	25	7	1.5	2	17	11.5	<b>0.02</b>
		50	<b>24</b>	<b>3.5</b>	<b>3</b>	<b>31</b>	<b>15</b>	
		75	38.75	7.75	-	48	29	
Lethality per 100,000 inhabitants	Percentiles	25	290	117.5	170	200	255	0.191
		50	<b>530</b>	<b>215</b>	<b>240</b>	<b>290</b>	<b>350</b>	
		75	897.5	312.5	-	450	505	

**Table 2.** Co-relationship of social indicators by occurrence, death rate and lethality per 100,000 inhabitants in Brazil. 2020

Social indicators	Occurrence per 100,000 inhabitants	Death rate per 100,000 inhabitants	Lethality per 100,000 inhabitants
	r (p-value)	r (p-value)	r (p-value)
HDI	<b>-0.42 (0.029)</b>	-0.34 (0.079)	-0.17 (0.380)
Gini Index	<b>0.71 (&lt;0.001)</b>	<b>0.59 (0.001)</b>	0.20 (0.304)
Per capita income	<b>-0.49 (0.009)</b>	<b>-0.44 (0.021)</b>	-0.21 (0.273)
Poverty percentage	<b>0.55 (0.003)</b>	<b>0.48 (0.010)</b>	0.23 (0.243)

## DISCUSSION

Current results demonstrated that the North and Northeast regions had the biggest number of confirmed cases and deaths per 100,000 inhabitants by Covid-19 in Brazil. Regarding the occurrence and lethality per 100,000 inhabitants, the North and Northeastern regions have the highest rates, whereas the Northeast and the Southwest have the highest lethality rates.

Results corroborate data retrieved from other research that the northern and northeastern areas are the most affected by the pandemic in Brazil. The northern region should be underscored. Up to May 2020, it concentrated 22% of all cases and all its states revealed poverty index above the national average. Further, the southeastern region has one of the highest lethal rates by Covid-19 in Brazil<sup>15,16</sup>.

When poverty and per capita percentage are co-related to occurrence and death rates per 100,000 inhabitants, they reveal a strong and moderate co-relationship. The above corroborates a study by Sanhigrahi<sup>17</sup> who evaluated the association of poverty and Covid-19 cases in countries in the north of Europe. Similarly, a study by Goutte<sup>18</sup> evaluated different regions of France from the social and economic points of view and detected that low-income populations and socioeconomic conditions feature a greater mortality rate during pandemic.

It is a well-known fact that low-income countries have a dire lack of basic services in health, basic sanitation, proper housing, while high fertility rates is the lot of a great number of people life in small-size spaces without any possibility of maintaining social distance. Further, in the case of people with low socioeconomic levels, a series of factors, such as stress, obesity, diabetes and lack of access to care units, increase risks in contracting Covid-19<sup>19</sup>.

When the country's HDI, co-related to occurrence per 100,000 inhabitants, has a negative coefficient, it evidences a higher HDI and less occurrence of the disease. Gini Index with positive co-relationship and significant impact with occurrence rate and deaths per 100.000 inhabitants indicates that a high Gini Index evidences higher occurrence and mortality by Covid-19.

An investigation by Maciel<sup>20</sup> co-related the occurrence of Covid-19 with HDI of municipalities in the state of Ceará

and reported that municipalities with high indexes also concentrated the highest occurrence rates of the disease due to high demographic density, income and agglomeration of people, very different from smaller towns in the interior of the state. This occurs because people in towns with high HDI have a greater capacity to maintain disease-prevention measures (social distancing, wearing of masks, washing of hands with soap or alcohol gel), whilst people living in areas with low HDI have to face the opposite. Several studies have detected that HDI is an indirect health factor since it takes into account life expectancy, income and schooling as relevant factors within a given population<sup>21</sup>.

With regard to lethality per 100,000 inhabitants co-related to social indicators, even though without significant impacts, it is a negative co-relation with HDI and per capita income and positive co-relationship with Gini Index and poverty percentage. Case number and deaths are evidenced in the lethality rate pattern<sup>22</sup>. Populations with the lowest social development indexes tend towards a greater lethality rate by Covid-19<sup>23</sup>.

People with low social and economic conditions have low sanitary conditions and are not capable of maintaining social distance due to their need for work, with its high risks in virus exposure<sup>22</sup>. Due to such factors, social vulnerability is an influential factor to increase occurrence and mortality by Covid-19<sup>24</sup>.

The same limitations attributed to ecological studies may be mentioned with regard to the methodology in current study. Conclusions at individual levels cannot be taken. They are allowed at aggregate level, coupled to possible weaknesses of data systems related to sub-registration and sub-notification affected even by differences in Brazilian regions.

## CONCLUSION

The occurrence and number of deaths due to Covid-19 in Brazil may be related to social indicators due to the strong and positive correlations presented by Gini Index and poverty percentage. The states with the highest social vulnerability rates are in the country's North and Northeast regions, with high occurrence and mortality rates per 100,000 inhabitants, in addition to a higher lethality in relation to those with lower social vulnerability (South and Southeast).

Results demonstrate the seriousness and severity of social inequality in Brazil since they clearly show the risk that the most vulnerable populations face because of the new coronavirus pandemic. Owing to this situation, it is necessary to solve once and for all, this historical problem in Brazil so that the poorest may not be penalized as they are at present.

One of the weaknesses to be highlighted in the present study is the short observational period. Current researchers tried to investigate the influence of social

indicators at a time of increasing number of cases of Covid-19 in the country.

Results may provide a better basis for actions to combat Covid-19 in Brazil, taking into account the most critical areas for the establishment of better structured public health policies for greater efficacy in coping with the disease. The above should take into account that the most vulnerable population has been the most affected within the period of time in this research.

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