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Human Development Index: Major Factor for COVID-19 Course in Latin America at First 3 Months of Pandemic

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ABSTRACT

Objective: The study considers obesity and Human Development Index (HDI) as factors that affect the number of COVID-19 cases and deaths in some countries in the Americas.

Material and Methods: Data was collected on COVID-19 confirmed cases and deaths per millions of inhabitants of eight American countries using Our World in Data tool by University of Oxford.

We found each country's Human Development Index value at the United Nation reports. Body Mass Index (BMI) average was found at the Global Health Observatory data repository website.

BMI and HDI were matched with the number of COVID-19 deaths for each country. Some descriptive comparison between countries was provided.

Conclusions: It was concluded that Latin America (LA) is entering a new phase of the COVID-19 pandemic due to its lower HDI values and precarious health infrastructure. HDI had a more significant impact on COVID-19 deaths in LA than in NA. In contrast, obesity seems to have a deeper effect on COVID-19 course in the United States.

KEYWORDS: COVID-19 pandemic; Coronavirus; Obesity; BMI; HDI; Latin america

INTRODUCTION

COVID-19 pandemic caused by the novel Coronavirus (SARS-CoV-2) is provoking significant morbidity and mortality worldwide. The medical services had to be adapted to attend the increasing demand for acute respiratory distress without compromising other patients with other diseases [1]. This paper reviews Coronavirus scenario in NA versus LA, given that most studies on the current outbreak focus on China and Europe.

The earliest scientific data on COVID-19 from China shows that people more vulnerable to infection, hospitalization and death have

previous underlying health conditions. That includes diabetes mellitus, hypertension (two important criteria of metabolic syndrome), cardiovascular diseases and chronic inflammation. Many of these illnesses are caused by overfat [2].

Metabolic syndrome-related conditions are known to downregulate key mediators of the host innate immune response to pathogenesis. Chronic diseases share various features with infectious disorders and their complications, such as endothelial dysfunction, the proinflammatory state, and the attenuation of the innate immune response [3].

HDI is a statistical tool that measures three factors of a country: life expectancy at birth, access to education (expected years of schooling of children at school-entry age and mean years of schooling of the adults) and per capita income.

Each factor individually is a criteria able to evaluate health standards of a population.

A study published by PLoS ONE analyzed different health determinants in 149 countries into five levels of child mortality. Numerous aspects are associated with child mortality, including socioeconomic status and education [4].

Tobias-Machado and colleagues analyzed a population of 17 thousand men screened for prostate cancer and observed that illiterate men were at higher risk of being diagnosed of more advanced and aggressive prostate cancer [5].

Raju et al found that rural areas and poverty are independent risk factors for chronic obstructive pulmonary diseases, even among never-smokers [6].

Another research done in a small Brazilian rural district has shown that presence of endoparasitic infection is directly correlated with social class and income [7].

Our study considers obesity and Human Development Index (HDI) as factors that may affect the number of COVID-19 cases and deaths in some countries in the Americas. We aim to discuss what factor is more remarkable in each region.

METHODS

For this study eight countries were considered: Canada, United States of America representing NA and Mexico, Brazil, Colombia, Argentina, Chile and Peru making up LA.

Data on COVID-19 confirmed cases and deaths per millions of inhabitants of each of these countries was collected. For that, the interactive tool "Our World in Data" by University of Oxford was used [8,9].

HDI value was retrieved from the United Nation reports [10]. In addition, BMI average per country was assessed at the Global Health Observatory data repository website [11].

COVID-19 cases and deaths per million inhabitant's charts were created for each country [8,9]; COVID-19 dissemination for each country [12]; and case fatality rate of each country as of June 11 [13]

Finally, the number of COVID-19 deaths per million people BMI average and HDI. Therefore, it was possible to evaluate risk factors for each country.

RESULTS

Figure 1 shows the documented number of COVID-19 cases per millions of inhabitants of eight American countries.

A logarithmic curve is observed for all eight countries over time.

NA leads the statistics, presenting more than a thousand COVID-19 cases per million inhabitants as of May 6, but it should be noted that its first documented case was in January, more than a month earlier than LA.

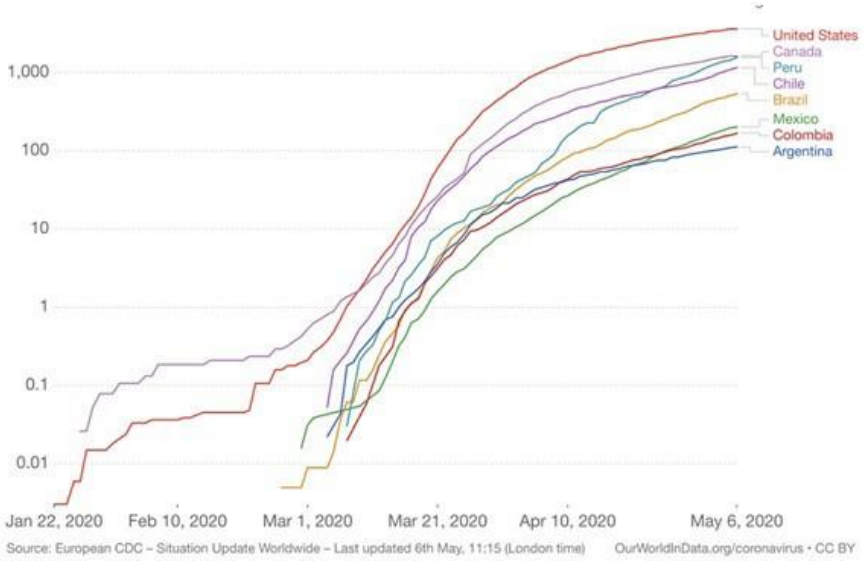


Figure 1: Curves of COVID-19 cases per million people in 8 American countries from January to May 2020 [8]

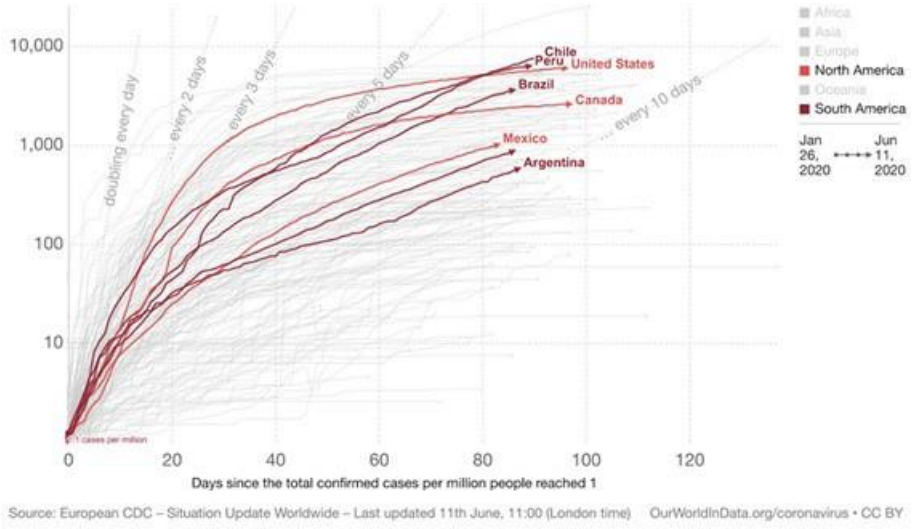


Figure 1.1: Velocity curve of COVID-19 cases per million people. [12]

In May the discrepancy between the number of COVID-19 cases per million people in NA was significantly smaller than in LA (2 times versus 10 times).

Up until day 40, the United States was doubling its COVID-19 cases every 2-3 days.

Canada, Peru and Chile, in the same time period, were doubling the number of COVID-19 infection every 4 days, approximately.

The curve shows that Argentina is the country with the lowest spread rate of the disease. Up until day 40, the number of cases per million inhabitants doubled every 7 days.

In the end of this period, it is observed that Chile and Peru outnumbered the United States in cases per million people. Brazil's curve has a trend to continuous increase.

Figure 2.1 and 2.2 show COVID-19 deaths per million inhabitants in each of the studied countries.

United States and Canada still lead the statistics.

Brazil has more COVID-19 deaths per million people than all latin countries, followed by Peru and Chile.

The disparity between Brazil and Argentina, the two latin countries with highest and lowest COVID-19 deaths per million inhabitants respectively, was twelve times.

The highest fatality rate showed in Map A and Table 1 was in Mexico (11.8%), followed by Canada (8.1%).

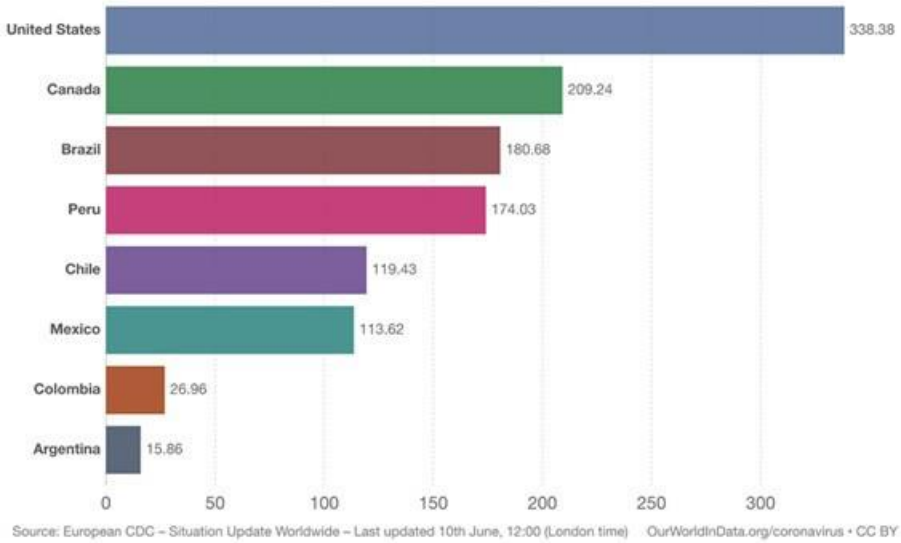


Figure 2.1: COVID-19 deaths per million inhabitants by country as of June 10 [9]

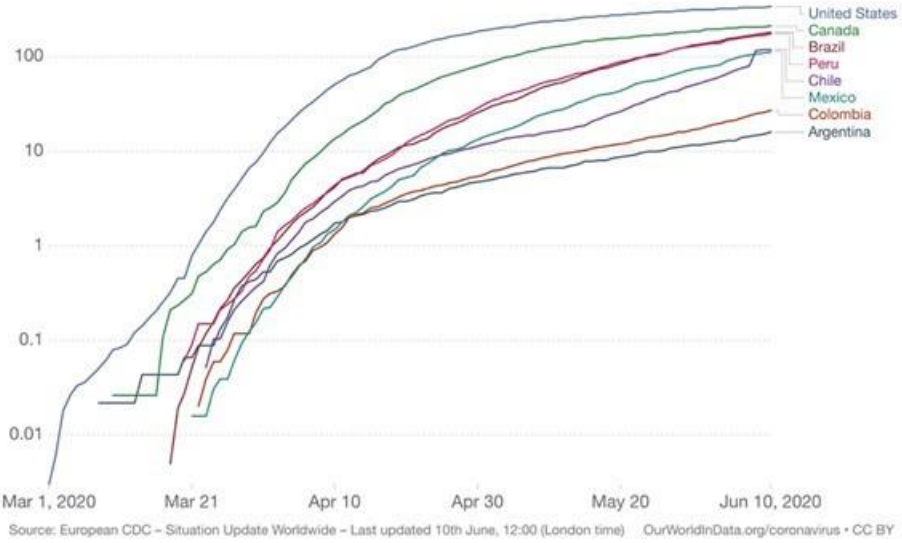
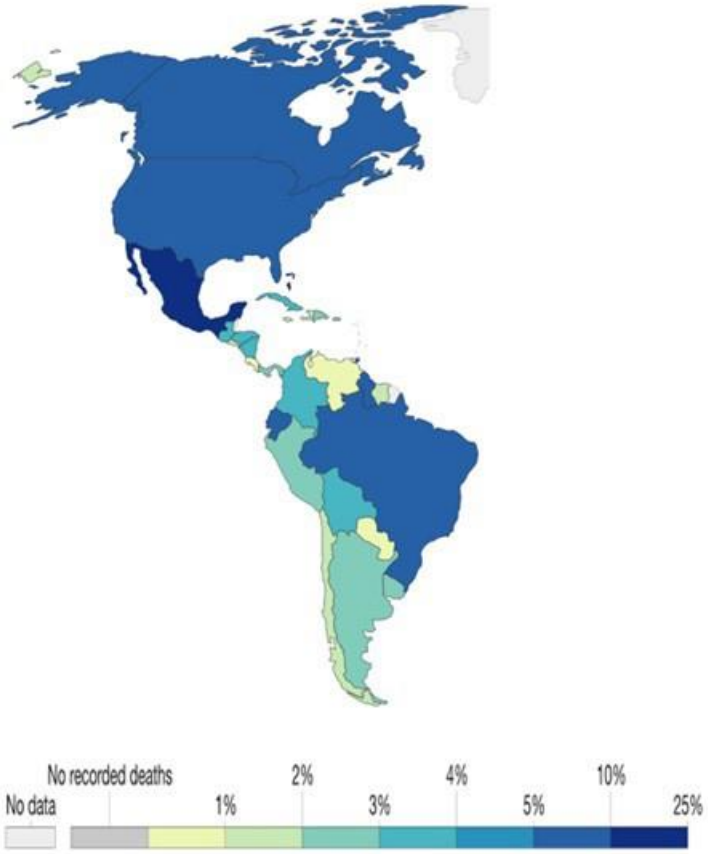


Figure 2.2: COVID-19 deaths per million inhabitants by country as of June 10 [9]



Map A: Case fatality rate of the COVID-19 pandemic as of June 11 2020 [13]

The case fatality rate (CFR) is the ratio between confirmed deaths and confirmed cases. During an outbreak of a pandemic the CFR is a poor measure of the mortality risk of the disease.

Table 1: Case fatality rate of the COVID-19 pandemic as of June 11 2020

Country	Fatality rate (%)
Mexico	11.8
Canada	8.1
United States	5.6
Brazil	5.2
Colombia	3.2
Peru	2.8
Argentina	2.8
Chile	1.6

United States and Brazil have a moderate fatality rate (5.6% and 5.2%, respectively).

The lowest fatality rate was in Chile.

Figure 4 shows different perspectives for Body Mass Index in Northern and Southern american countries

The United States (BMI 28.9 kg/m2) has the highest of all BMI averages. It also has the highest COVID-19 deaths and cases per million people.

Despite Canada is second ranked in COVID-19 deaths per million, this country has an average of BMI of 27 kg/m2.

Argentina (BMI 27.7 kg/m2), Chile (BMI 28 kg/m2), Mexico (BMI 28 kg/m2): these countries have equivalent BMI averages, which for LA standards is high. However, those countries have not shown high Coronavirus mortality rates in our data as in Figure 5.

Brazil (BMI 26.6 kg/m2), Peru (26.7 kg/m2): lower BMI averages and significant death mortalities per million inhabitants.

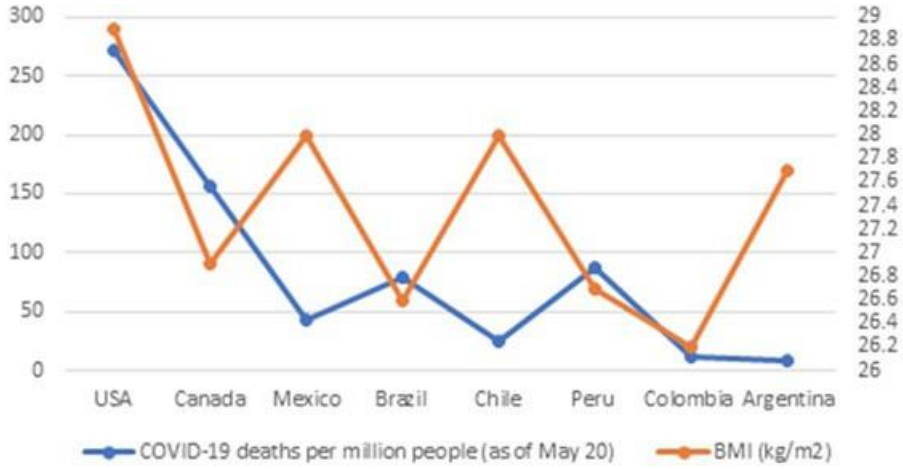


Figure 4: COVID-19 cumulative deaths per million as of May 20 and BMI

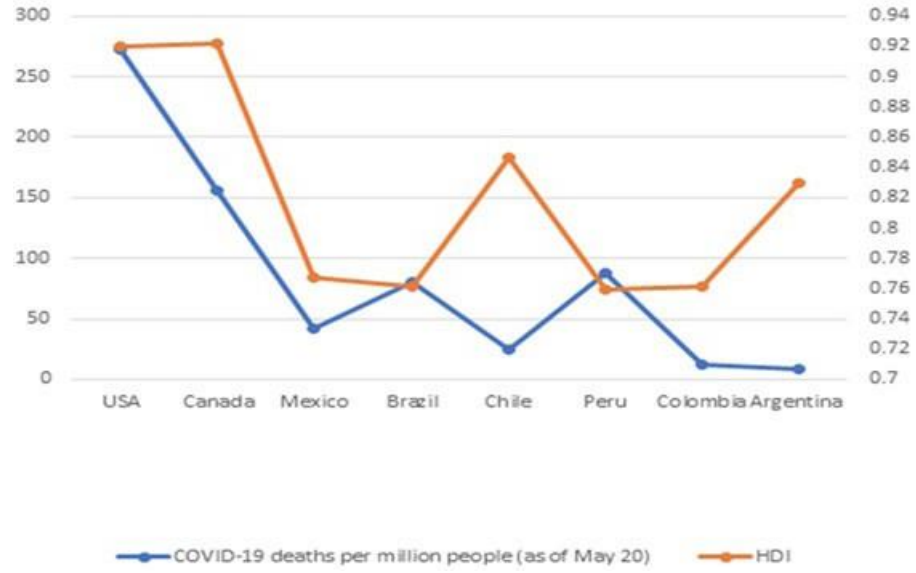


Figure 5: COVID-19 deaths per million people X HDI

US and Canada - the two more developed countries (HDI >0.9) have higher numbers of COVID-19 deaths.

Latin American countries, with the exception of Colombia, appear to show a correlation between HDI and COVID-19.

For example, Argentina has a high HDI for latin standards (0,83), and has the lowest number of confirmed deaths. Chile has the high-

est HDI (0,847) of the listed Latin countries and also has few deaths per million inhabitants.

The two Latin countries with the highest number of confirmed COVID-19 deaths per million people are Peru and Brazil - also present the worst Human Development Index numbers (0,759) and (0.761) of the group.

DISCUSSION

SARS-CoV-2 is the novel agent that emerged in December 2019 in Wuhan, China causing severe acute respiratory syndrome coronavirus 2 [14]. In March 11th, the World Health Organization declared the COVID-19 a pandemic. There have been 7,273,958 documented cases and 413,372 confirmed deaths as of June 11th [15].

Typically, respiratory viruses are transmitted when patients present symptoms. Several evidences suggest that SARS-CoV-2 transmission may be occurring during the asymptomatic incubation period of COVID-19 [16]. Thus, social isolation is important to minimize the transmission.

Clinical presentation may vary from mild flu to severe respiratory insufficiency leading to death. A recent chinese study analyzing 780 COVID-19 cases has shown that 20% of patients required supportive care in medical intensive care units [17]. Most patients had chronic medical comorbidities like pulmonar disorders and obesity associated diseases.

Obesity has virtually tripled globally since 1975. It is a serious, endemic, yet neglected health problem. In 2016, 39% of adults (around 1.9 billion people) - were overweight and 13% were obese [18].

The intake of dietary sugar and other refined carbohydrates plays a primary role in the Obesity pandemic [19].

Recent reports revealed high cytokines levels due to increased inflammation in COVID-19 patients. At the same time, obesity represents a state of low-grade inflammation, with various inflammatory products directly secreted by adipose tissue. Obesity and SARS-CoV-2 share common elements of the inflammatory process (and possibly also metabolic disturbances), aggravating SARS-CoV-2 infection in obese patients [22].

Simonnet et al analyzed the relationship between body mass index (BMI) and the requirement for invasive mechanical ventilation (IMV) in 124 COVID-19 patients. Obesity (BMI >30 kg/m2) and severe obesity (BMI >35 kg/m2) were present in 47.6% and 28.2% of cases, respectively. Overall 68.6% required IMV [23].

In each country it is seen that the ongoing pandemic differs on its course. That is due to numerous factors like disparities in each country's demographics, comorbidities, socioeconomic conditions, notification of cases and political preventive measures adopted.

In this study we focused specifically on overfat and HDI in NA and LA, as there is not so much data on this topic. We used NA data as comparative to evaluate such factors in LA.

COVID-19 pandemic rapidly spread in NA and left a high rate of confirmed deaths, considerably in the United States where more than 40% of the population is obese [20]. Americans also have a high burden of class III obesity, with 9.2% of the population with BMI >40 kg/m2 [24]. The maps reported by WHO indicate this course (maps B and C).

Map B: Obesity in adults, 2016 [20]

Map C: Confirmed COVID-19 deaths per million people [21]

The first reported COVID-19 case in the United States was almost a month earlier than in LA. It is the country with the highest number of cases and deaths. Despite its excellent HDI (0.920) the presence of high comorbidities in the population seems to be a strong aspect, according to our data.

Canada revealed socioeconomic traits similar to the United States, showing HDI with minimal variation (0.002) compared to the US. However, Canada has a good socialized healthcare system, and the canadian government took social isolation and lockdown intensive measures.

We noticed one third of COVID-19 deaths per million people in Canada compared to the US. This disparity between the two countries needs further investigation.

Data suggest that obesity may not be a relevant aspect to COVID mortality in LA. On the other hand, HDI has a significant impact in the number of deaths in this region.

Data from FAO of the UN has shown that 42.5 million people in Latin America face hunger, which is 6.5 percent of the regional population [25].

Therefore, a higher BMI average combined with increased HDI (as observed in Chile and Argentina) may indicate that the popula- tion is healthier, hence less vulnerable to COVID-19.

In contrast Mexico has a high BMI average, and also high rates of hypertension, obesity, and diabetes, all of which are risk factors for COVID-19 [26]. The HDI of this country is low (0.767). The two factors combined might explain the high fatality rate (11.8%) of the infection in the country.

However, most LA cities show a large discrepancy between reported COVID-19 deaths and overall high mortality. Testing remains limited, at about 4000 per million people, and people who die without being tested are not documented [27]. In general, estimates of case fatality ratios might vary slightly from country to country because of differences in prevention, control, and mitigation policies implemented, and because the case fatality ratio is substantially affected by the preparedness and availability of health care [28].

LA faces socio economic challenges that worsen the pandemic - factors such as a fragile healthsystem, poor access to sanitation and clean water [29].

The favelas, where more than 13 million Brazilians live in crowded and precarious conditions, is an example of water scarcity and lack of sanitation, which aggravates the infection spread [30]

Miller and colleagues recently published a study that suggests the new phase that the ongoing pandemic entered (May). The virus is not only spreading geographically (coming to the tropical area) but also geopolitically, coming into a region where poverty, water access and sanitation are serious issues [31].

In LA urban slums, the absence of domestic water delivery results in decreased water usage, limited handwashing, and poor hygiene, leading to widespread fecal contamination [32].

Healthcare is poor in countries such as Brazil and Peru where diseases regularly overwhelm the public system. Additionally, recent submitted data suggested that current interventions in urban centers of Brazil are insufficient to keep virus transmission under control [33]. Understaffing and lack of modern medical equipment and diagnostic supplies are very common [31].

The data presented in this study has shown that Miller's projection for COVID-19 pandemic is confirmed, given that HDI plays an important role in COVID-19 deaths in LA and most of the latin countries are not developed.

COVID-19 pandemic might have an increased severe repercussion in LA, considering a scenario of political conflicts, lack of good healthcare, social inequality and economic limitations [34]. The impact of the disease will be more extreme in LA than in NA.

This study has data limitations since we worked with governmental statistics that widely vary depending on the country. We worked with COVID-19 deaths per million inhabitants due to wide variation of the dosage of the COVID-19 cases.

As other factors described were not deeply studied, a multivariate analysis of risk factors was not carried out. Each event was described in isolation.

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