Analysis of COVID-19 pandemic trends and its impact on the health system of the main urban centers of Minas Gerais, Brazil.

Larissa Pereira Caixeta (Corresponding author)
Student, Nursing Department, Federal University of Uberlandia,
Uberlandia, MG, Brazil,
ORCID: https://orcid.org/0000-0001-6513-7276
Email: larissacaixeta1@gmail.com

Tathiane Ribeiro da Silva
Nurse Audit Specialist, Brazilian Company of Hospital Services (EBSERH),
Uberaba, MG, Brazil.
ORCID: https://orcid.org/0000-0003-2898-8439
E-mail: tathianeauditora@gmail.com

Douglas Eulálio Antunes
Professor, Nursing Department, Federal University of Uberlandia,
Uberlandia, MG, Brazil;
ORCID: https://orcid.org/0000-0001-8091-7158
Email: douglas.antunes@ufu.br

Abstract

***Objectives**: In this study, related to COVID-19, we characterized the epidemiologic, trends and the impact of new coronavirus on the health systems of the main urban centers in Minas Gerais, Brazil. **Methods**: A retrospective time series encompassing data associated with COVID-19 disease, from March to July of 2020, were approached for verifying the trends of social distancing rate and number of daily deaths by means of Mann-Kendall test. The Binomial test was performed to analyzing the differences between percentages of two periods (before and after pandemic) with the goal to measure the impact of disease on health systems. **Results**: Although the social distancing rates for the main urban centers of Minas Gerais presented declining trend along the time series, Juiz de Fora had the best rate and, consequently, flattened the epidemic curve for new cases of the disease, besides of to notify the lowest number of deaths (Mann-Kendall [Belo Horizonte]: -0.77, p<0.001; Mann-Kendall [Juiz de Fora]: -0.74, p<0.001; Mann-Kendall [Uberlandia]: 0.29, p<0.001). The number of oncologic treatments in Belo Horizonte (April 2019 vs April 2020= -41.5%; p<0.001) and clinical treatments in Uberlandia (March 2019 vs March 2020= -51.7%; p<0.0001) have reduced drastically before and after pandemic. **Conclusions**: Therefore, the implementation of a higher social distancing rate could flatten the epidemic curve avoiding an increase in deaths number and to reduce the impact of COVID-19 on health systems preventing the collapse of them.*

Keywords: coronavirus disease 2019; Pandemics; Health Systems; Brazil.

1. Introduction

The infection caused by severe acute respiratory syndrome coronavirus-2 (*SARS-CoV-2*) emerged in Wuhan, China, at the end of December 2019, as a pneumonia outbreak and disseminated to other continents [1].
The transmission from this disease occurs primarily by the airway, on the other hand, the extra-lungs airway should be considered, seeing that the viral RNA was detected in faecal samples from disease cases [2].
Regarding the disease incubation period, the interval between the infection and onset symptoms, varied from 5.1 to 11.5 days, according to a study developed with 181 patients [3].
In relation to the symptoms, the clinical spectrum from the disease is complex, ranging from mild symptoms to major pneumonia. Thus, the main disease symptoms reported were fever, cough, rhinorrhea, headache, diarrhea and dyspnea as the most prevalent [4,5].
There are some factors which promote the viral transmission in the community taking into account the *SARS-CoV-2* persistence in plastic and metal surfaces for 72 hours and the viability in aerosol came to 3 hours [6]. However, mathematic models by means of adjusted incidence rate ratios (IRRs) pointed that, social distancing measures were associated with reductions of 29% in the COVID-19 incidence and 35% in the mortality of this disease [7].
The lethality for age group was 4.6% from 60 to 69 years old, increasing to 9.8% for those from 70 to 79 and achieving 18% in those with 80 years old or more [8].
Brazil presents a lethality rate of 3.20% (113.358/3.532.330) changing as the numbers of deaths and confirmed cases range, indicating a rapid advance of the disease and continuous increase in the hospitalization rate [9]. It represented, in several states of the country, the health systems collapse such as occurred in Ceara state, where 45 days after the notification of the first COVID-19 case, 80.5% of intensive care unit (ICU) beds were overcrowded [10]. In Minas Gerais state, in the main cities from the Central region, South of state and Triangulo Mineiro, the average of ICU occupancy rate was 87.19%.
The information related to the new cases, mortalities, social distancing rate and ICU occupancy are important to the health authorities for the pandemic containment and elaboration of plans for short and long terms.
The purpose of this study is to compare epidemiologic data, trends associated to disease and the impact on the health system of the main urban centers in Minas Gerais, Brazil.

2. Methods

2.1. Study and sample type

This is a retrospective observational study encompassing a time series analysis based on information related to COVID-19 infection, from March to July of 2020 involving 3 urban centers of Minas Gerais State – Brazil. The sample were formed of patient's data that were infected by the new coronavirus and, mainly, deaths records.

2.2 Secondary data/variables

The main epidemiological and demographic variables used in this study were: total deaths, confirmed cases, mortality rate, social distancing rate, comorbidity presence, sex, skin phenotype, age group. The secondary

data associated with care procedures used to this study belongs to Minas Gerais State Health Secretary; Municipal Departments of Health of Belo Horizonte, Juiz de Fora and Uberlandia, besides of records of Computer Department of the Brazilian Unified Health System (Datasus) that summarizes data of hospital information system (HIS/SIH) and authorization forms for hospital admittance (AIH) for Unified Health (SUS). All data were collected from 22 march to 15 July, 2020, that is, from the beginning of pandemic time to the likely peak of the epidemic announced by the government of Minas Gerais.

2.3 Inclusion and exclusion criteria

The study included only data patients affected by COVID-19 that were taken from public domain sites, from 22 March to 15 July 2020 published on official websites of the aforementioned public agencies. Secondary data, before or after the mentioned period of collection did not make part of this tabulation.

2.4 Statistical analysis

The Mann-Kendall test was utilized to verifying the existence of trend along the time series related to social distancing and count of deaths. The binomial test was used to verify the differences between percentages of two periods (before and after pandemic) regarding frequency of to authorization forms for hospital admittance (clinical and surgical care).

The analysis was carried out using the software GraphPad Prism 4.04 (GraphPad Software, Inc., San Diego, CA) and Action Stat, trial version (Estatcamp, São Carlos, SP). The null and alternative hypotheses were tested at a significance level of 5% (0.05).

2.5 Ethical approval

This study does not require appreciation by the Ethics Committee on Human Researches due to the data to be presented in the public domain disclosed by Departments of Health managed by public agencies.

3. Results

3.1. Clinical and epidemiological characterization

The current study characterized the clinical and epidemiological profiles of those patients who had their death associated to COVID-19 in the major urban centers in Minas Gerais. According to table 1, there was a difference among mortality rates when the percentages of the cities were compared, Belo Horizonte and Juiz de Fora ($p=0.0095$); Belo Horizonte and Uberlandia ($p=0.0011$); Juiz de Fora e Uberlandia ($p<0.0001$). Furthermore, in the table 1, it was observed the high percentage of comorbidity among those individuals that died due to COVID-19 infection in one of the 3 urban centers described in this study (Belo Horizonte: 91%, 291/320; Juiz de Fora: 92.4%, 82/89; Uberlandia: 87.5%, 150/171; $p=0.1697$) without statistic difference among the proportions.

In relation to sex, among the deaths caused by COVID-19, the male was more affected in Belo Horizonte (54%; 173/320) and Uberlandia (61.2%; 54/171) as compared with female sex, that consequently predominated in Juiz de Fora with 51.9% of (46/89) of total being infected. There was no difference among the proportions of deaths between male and female (W: 2.74; $p=0.2540$).

The death cases for *SARS-CoV-2* infection in white skin people were predominant in the towns of Juiz de Fora (54.4%;48/89) and Uberlandia (44.1%;75/171). On the other hand, in Belo Horizonte brown individuals (44.1%; 75/171) prevailed among those who died due to this same pathogen (Table 1).
Concerning the age group most affected, in Belo Horizonte, the age group from 80 to 89 years old totalized 24.9% (80/320) from the total amount of deaths. The same occurred in Juiz de Fora (29.2%; 26/89). In Uberlandia the highest percentage of deaths were among those who were from 70 to 79 years old representing 25.7% of cases. There was no association among the age group evaluated per city (W: 19.64; p< 0.1419).

Table 1- Clinical and epidemiological characterization associated with deaths caused by COVID-19 infection from 22 March to 15 July 2020 in the Main Urban Centers of MG.

	Belo Horizonte		**Juiz de Fora**		**Uberlandia**		G–test / *Binomial test	
	n	**%**	**n**	**%**	**n**	%	W	*p-value*
Mortality								*(BH vs JF) 0.0095
Total of deaths	320		89		171			
Confirmed cases	13559		2778		9834			*(BH vs Udi) 0.0011
Fatality rate		2.4		3.2		1.7		*(JF vs Udi) < 0.0001
Comobidity								
Yes	291	91	82	92.4	150	87.5	3.55	0.1697
No	17	5.3	5	5.1	17	9.9		
Not declared	12	3.7	2	2.5	4	2.6		
Sex								
Male	173	54.0	43	48.1	54	61.2	2.74	0.2540
Female	147	46.0	46	51.9	35	38.8		
Phenotype Skin								
White	92	28.8	48	54.4	75	44.1		
Brown	133	41.5	10	11.4	65	38.2		
Black	33	10.3	11	12.7	16	9.2	47.54	< 0.0001
Yellow	3	0.9	0	0	1	0.7		
Not declared	59	18.5	19	21.5	14	7.9		
Age Group								
20 - 29	0	0	1	1.3	0	0		
30 - 39	7	2.2	1	1.3	7	3.9		
40 - 49	21	6.6	4	5	15	8.6		
50 - 59	41	12.9	13	15	17	9.9		
60 - 69	75	23.3	8	8.9	35	20.4	19.64	0.1419
70 - 79	74	23.2	26	29.2	44	25.7		
80 - 89	80	24.9	26	29.2	36	21.1		
≥ 90	22	6,9	9	10.1	18	10.4		

3.2. Trends analysis

Even though the social distancing rates in Juiz de Fora were superior than others urban centers in Minas

Gerais throughout the time series, there were a declining trends in these rates of the 3 urban centers (Mann-Kendall [Belo Horizonte]: -0.77, p< 0.001; Mann-Kendall [Juiz de Fora]: -0.74, p< 0.001; Mann-Kendall [Uberlandia]: 0.29, p< 0.001) (figure 1A). The social distancing rates in these three urban centers started on 1st April and reported percentages lower or equal to 50% (figure 1A).

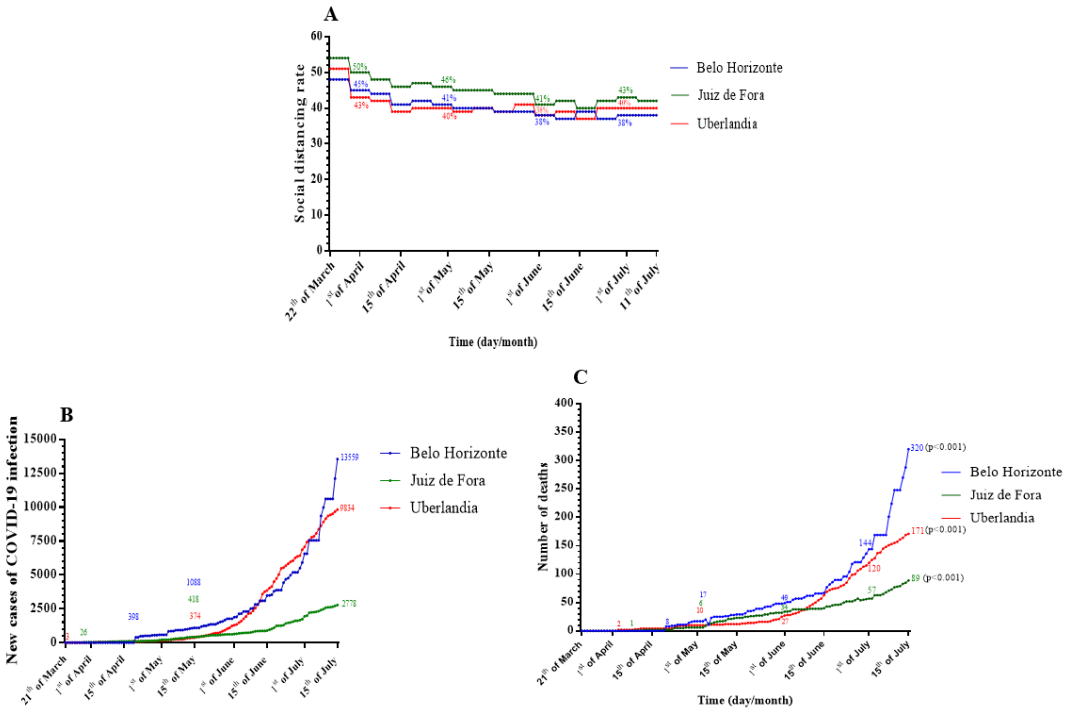

Figure 1 (A) – Social distancing rates from March 22th to July 11th of 2020 in the main urban centers of Minas Gerais indicating declining trends over the time series in Belo Horizonte (Mann-Kendall; -0.77, p< 0.001); Juiz de Fora (Mann-Kendall: -0.74, p< 0.001) and Uberlandia (Mann-Kendall: -0.29, p< 0.001). (B) The number of new cases from 21 March to 15 July on 2020 in the main centers in Minas Gerais pointing to high trends during the time series in Belo Horizonte (Mann-Kendall; 0.96, p< 0.001); Juiz de Fora (Mann-Kendall: 0.97, p< 0.001) and Uberlandia (Mann-Kendall: 0.98, p< 0.001). (C) The number of deaths from 21 March to 15 July 2020 in the main urban centers of Minas Gerais indicating increase tendency during the time series in Belo Horizonte (Mann-Kendall; 0.96, p<0.001); Juiz de Fora (Mann-Kendall: 0.97, p<0.001) and Uberlandia (Mann-Kendall: 0.98, p<0.001).

In Uberlandia, as shown in figure 1B, there was a fast increase in progressive phase of the epidemic curve, when compared with Belo Horizonte and Juiz de Fora, emphasized by the high percentage change in the number of cases. On the other hand, the epidemic curve of COVID-19 in Juiz de Fora flattened, showed by the lower percentage change in the mentioned period (Figure 1B). The epidemic curve showed a rising trend in the three urban centers (Mann-Kendall [Belo Horizonte]: 0.96, p< 0.001; Mann-Kendall [Juiz de Fora]: 0.99, p< 0.001; Mann-Kendall [Uberlandia]: 1, p< 0.001) (Figure 1B).

The figure 1C showed that the cumulative number of deaths from 21st March to 8th July in Belo Horizonte, Juiz de Fora and Uberlandia. There was a high increase on the number cases in those 3 cities and increasing trends (Mann-Kendall [Belo Horizonte]: 0.96, p< 0.001; Mann-Kendall [Juiz de Fora]: 0.97, p< 0.001;

Mann-Kendall [Uberlandia]: 0.98, p< 0.001) such as showed in figure 1C. It was possible to notice that in Juiz de Fora the curve was flattened for the new cases of the disease, and consequently, the curve regarding to the number of deaths was also flattened, on that period in which was filed 89 deaths among the 2778 infected (lethality rate: 3.2).

3.3 Impact of COVID-19 infection on Health Systems

By means of analysis of authorization forms for hospital admittance (AIH) for Unified Health (SUS), the impact of coronavirus pandemic on health systems of the main 3 urban centers of Minas Gerais were assessed comparing the same period of 2020 with 2019 as shown in table 2.

The oncologic treatment, in Belo Horizonte, presented on March, April and May 2020 a reduced number of attendances when compared with the same previous period in 2019 (March 2019 vs March 2020= -28.5%; p= 0.0998 / April 2019 vs April 2020= -41.5%; p< 0.0001/ March 2019 vs March 2020= -73.8%; p< 0.8219) (table 2).

The surgeries of the Digestive Systems had a progressive decline during the quoted period, Mach, April and May 2020, as compared with previous same period in 2019 (March 2019 vs March 2020= -40.5%; p< 0.0001/ April 2019 vs April 2020= -77%; p<0.0001/ March 2019 vs March 2020= -79.8%; p<0.0001) (table2).

The orthopaedic and genitourinary surgeries there were results similar according to the table 2.

With regard to the pandemic impact on Juiz de Fora health system, the digest system surgeries have reduced on March, April and May 2020 (pandemic period) when compared with the same months on 2019 (March 2019 vs March 2020= -10.6%; p= 0.3026 / April 2019 vs April 2020= -80.7%; p< 0.0001/ March 2019 vs March 2020= -86.1%; p < 0.0001) (table 2). In relation to the genitourinary tract surgeries, on April and May the data were similar to the digest system surgery (table 2).

In respect of Uberlandia, it was possible to observe a progressive reduction in the frequency of authorization forms for hospital admittance (AFHA/AIH) for the clinical treatments on March, April and May 2020 when compared with the same period of 2019 (March 2019 versus March 2020= -7.8%; p= 0.4432 / April 2019 versus April 2020= -38.4%; p< 0.0001/ March 2019 versus March 2020= -51.7%; p< 0.0001) (table 2).

Furthermore, it is important to emphasize that the obstetric surgery on March 2020 increased 7.7% (p=0.0841) when compared with March 2019. On the other side, on April and May 2020, the surgery amount decreased to 37.5% (p=0.0467) and 55.2% (p=0.0347) respectively, when compared with the same months of 2019 (table 2).

Table 2. Procedures group according to authorization form for hospital admittance (AFHA/AIH) that was handled during March, April, and May in 2019 (non-pandemic period) and the same period in 2020 (pandemic period) in those major urban centers in Minas Gerais

Procedures Group	Amount of authorization form for hospital admittance (AIH) – Belo Horizonte												May 2020 / May 2019		April 2020 / April 2019		March 2020 / March 2019	
	2019 (non-pandemic period)						2020 (Pandemic period)											
	March		April		May		March		April		May							
	n	%	n	%	n	%	n	%	n	%	n	%	*Per.Var.*	*p-value*	*Per.Var.*	*p-value*	*Per.Var.*	*p-value*
Clinical Treatment	8103	36	8885	38	9159	37	6275	36	4199	39	2211	35	-22.6	0.3712	-52.7	0.0131	-75.9	0.0002
Oncologic Treatment	1314	6	1199	5	1201	5	939	5	702	7	315	5	-28.5	0.0998	-41.5	< 0.0001	-73.8	0.8219
Circulatory system surgery	790	3	808	3	891	4	597	3	333	3	252	4	-24.4	0.7437	-58.8	0.117	-71.7	0.2019
Digestive system surgery	1417	6	1454	6	1406	6	843	5	334	3	284	4	-40.5	< 0.001	-77	< 0.0001	-79.8	< 0.0001
Musculoskeletal system surgery	2088	9	2107	9	2233	9	1636	9	983	9	833	13	-21.6	0.45	-53.3	0.5203	-62.7	< 0.0001
Genitourinary system surgery	954	4	992	4	1048	4	621	4	234	2	419	7	-34.9	0.0014	-76.4	< 0.0001	-60	< 0.0001
Obstetric surgery	891	4	921	4	878	4	737	4	507	5	153	2	-17.3	0.1099	-45	0.0005	-82.6	< 0.0001
Other procedures	7175	32	7270	24	7656	24	5745	24	3477	21	1863	24	-24.1	0.6674	-59.4	< 0.0001	-74.9	0.2689
Total number of procedures	**22732**	100	**23636**	100	**24472**	100	**17393**	100	**10769**	100	**6330**	100	-23.5	-	-54.4	-	-74.1	-
Amount of authorization form for hospital admittance (AFHA/AIH) – Juiz de Fora													*Per.Var.*	*p-value*	*Per.Var.*	*p-value*	*Per.Var.*	*p-value*
Clinical Treatment	1538	39	1557	37	1782	39	1107	35	706	36	348	27	-28	< 0.0001	-54.7	0.236	-80.5	< 0.0001
Oncologic Treatment	239	6	294	7	279	6	286	9	231	12	141	11	19.7	< 0.0001	-21.4	< 0.0001	-49.5	< 0.0001
Circulatory system surgery	164	4	170	4	178	4	118	4	45	2	45	4	-28	0.3026	-73.5	0.0003	-74.7	0.5343
Digestive system surgery	189	5	249	6	273	6	169	5	48	2	38	3	-10.6	0.3026	-80.7	< 0.0001	-86.1	< 0.0001
Musculoskeletal system surgery	328	8	335	8	405	9	226	7	142	7	138	11	-31.1	0.0464	-57.6	0.2517	-65.9	0.0357
Genitourinary system surgery	156	4	177	4	210	5	171	5	33	2	29	2	9.6	0.0055	-81.4	< 0.0001	-86.2	0.0002
Obstetric surgery	270	7	245	6	240	5	258	8	227	11	138	11	-4.4	0.0531	-7.3	< 0.0001	-42.5	< 0.0001
Other procedures	1047	27	1161	28	1196	26	860	27	550	28	400	31	-24.9	0.1113	-65	< 0.0001	-73.1	0.5466
Total number of procedures	**3931**	100	**4188**	**100**	**4563**	**100**	**3195**	**100**	**1982**	**100**	**1277**	**100**	-18.7	-	-52.7	-	-72	-
Amount of authorization form for hospital admittance (AFHA/AIH) – Uberlandia													*Per.Var.*	*p-value*	*Per.Var.*	*p-value*	*Per.Var.*	*p-value*

Clinical Treatment	1594	38	1737	39	1743	37	1470	37	1070	45	841	49	-7.8	0.4432	-38.4	< 0.0001	-51.7	< 0.0001
Oncologic Treatment	98	2	103	2	118	3	120	3	68	3	37	2	22.4	0.0508	-34	0.1512	-68.6	0.4101
Circulatory system surgery	154	4	179	4	208	4	123	3	48	2	13	1	-20.1	0.1629	-73.2	< 0.0001	-93.8	< 0.0001
Digestive system surgery	212	5	204	5	237	5	230	6	66	3	40	2	8.5	0.1286	-67.6	0.0003	-83.1	< 0.0001
Musculoskeletal system surgery	349	8	375	8	409	9	335	8	188	8	103	6	-4	0.8041	-49.9	0.5263	-74.8	0.0004
Genitourinary system surgery	211	5	246	5	257	6	157	4	17	1	16	1	-25.6	0.0213	-93.1	< 0.0001	-93.8	< 0.0001
Obstetric surgery	299	7	339	8	319	7	322	8	212	9	143	8	7.7	0.0841	-37.5	0.0467	-55.2	0.0347
Other procedures	1265	24	1308	29	1451	24	1266	32	740	22	514	30	-5.2	0.89	-49.2	0.375	-67.2	0.037
Total number of procedures	**4182**	**100**	**4491**	**100**	**4649**	**100**	**3942**	**100**	**2377**	**92**	**1699**	**100**	-5.7	-	-47.1		-63.5	-

Legend: Per.Var.: percentage variation

4. Discussion

4.1. Clinical and epidemiological Characterization

It was observed in those three cities, a high percentage of deaths on those individuals infected by COVID-19 and affected by comorbidities, what is in accordance with some studies that pointed diabetes and hypertension as some medical conditions associated with worst prognosis and mortality [11, 12]. In this study, the male sex prevailed among those who was infected and died in 2 urban centers. This result may be associated with the high levels of gene expression of Angiotensin-converting enzyme-2 (ACE 2) receptor in male sex. This receptor have favoured *SARS-CoV-2* and *SARS-CoV* infections [13, 14]. Moreover, immunological factors as low expression of CD200 receptor in women have promoted effective viral clearance due to increased production of type I interferon [15].

Even though the white skin prevailed in 2 urban centers, the brown skin was more susceptible to coronavirus infection in Belo Horizonte. A previous evidence quoted different results, since that black skin individuals had higher risk of being infected by *SARS-CoV-2* when compared with white patients [16]. In relation to age group, this study found a higher percentage of death in elderly independent on the location. This fact is associated with the presence of comorbidities in this group and immunocenescence, seeing that the number of B lymphocytes competent reduces over the years, turn elderly into people more susceptible to infections [17, 18, 19]

4.2 Trends analysis

Although it was observed an increasing trend on the number of new cases during the time series in those three urban centers in Minas Gerais, in Belo Horizonte and Uberlandia there were a gradual increase on the number cases in a short period when compared to Juiz de Fora which registered a flattening on the curve. This difference may be explained by the low social distancing rates in Belo Horizonte and Uberlandia as occurred in other countries. Places which implemented social distancing earlier, experienced a reduction on the COVID-19 new cases, on the hospitalization and the deaths number related to the disease, essential to flatter the cases curve, especially in the absence of vaccines and treatments [20, 21]

The 3 and 4 alert levels were implemented in the urban centers. However, the social distancing rates did not achieve 50% in those places, what promoted the increase on the case number, and consequently, on the death numbers. Different countries in the world as Germany, France, Italy and Chine took 2 weeks to register the decline on the death cases, after the reduction on the new cases associated with an effective social distancing measures. On the contrary, the United States took 4.5 weeks to the number of deaths to decline after implementation of a high level of social distancing [22]

4.3 Impact of COVID-19 infection on Health Systems

We assessed the pandemic impact on the health system in relation to de main procedures performed in the tertiary level in those major urban centers. We emphasized that in Belo Horizonte there were a sharp decline of frequency of attendance and procedures related to the oncologic treatment. This fact corroborates with the scenario seen in United Kingdom, where the chemotherapy procedures have reduced in 60% at the local hospitals [23]. Besides that, the deaths caused by breast and colorectal cancer increased in 9.6% and 16.6% respectively, according to a British survey, because of delay in diagnostic related to the COVID impact in that health system [24]. A study reported that elective surgeries should be restricted to favour the measures of treatment of COVID-19, except for oncologic surgeries, for instance, individuals who need pass for stratification based on priority 1, in order to avoid deaths from oncologic patients [25].

The results showed, in these 3 urban centers, that surgeries of digestive, orthopaedic and genitourinary system and the others which has been suspended, probably are associated to non-urgency classification. Such situation was estimated in studies, pointing to cancellation of elective surgeries due to the COVID-19 impact on the health system, requiring strategic plans for restoring the surgical activities [26]. By providing emergency surgery restriction, the American College of Surgeons, the Royal College of Surgeons of England, Royal College of Surgeons in Ireland and others elaborated an emergency general surgical procedures list that should be priority during the pandemic period, such as intestinal ischemia, incarcerated

hernias, appendectomy with perforation and others, what explain the reduction on the digestive system surgeries and other specialties during this period [27].

We emphasized that new coronavirus pandemic tested the health system of many countries such as United States (US) where prevails privatization of health, the low coverage of population in relation to the public assistance services (Medicare; Medicaid and others) and private systems with or without profit motives. Furthermore, the Brazilian universal health care system showed to be vulnerable amid COVID-19 pandemic presenting structural problems associated to inappropriate financing and unequal allocation of resources [28, 29]. The direct impact of the COVID-19 pandemic on the health system in US and Brazil conduct to 205.208 and 142.161 deaths, respectively, related to the emergency disease [30].

Notwithstanding in Brazil the units of the federation and municipalities have presented contingency plans for response to COVID-19, almost all of them without details about the disease. The Special Committees on Covid-19 Response from these cities and others in Brazil were formed of infectologist doctors, directors and presidents of health institutions, procurators and members of the education area. It would be so important to include others members from different professions for discussing strategies in sectors which could collaborate with the health sector on the implementation of effective social distancing measures, such as economist, administrator, psychologist, traffic engineer for the traffic, geographer, nurse and physical educator. We highlighted that Leadership is primordial during pandemic periods as occurred in countries such as Germany and New Zealand where there were a commended leadership for the action in a timely manner, even though others factors have influenced in the reduction of the deaths [31].

5. Conclusions

Therefore, we conclude that the social distancing rate may flatten the epidemic curve, such as occurred in one of cities assessed in this study, and consequently, avoid an increase in deaths number and to reduce the impact of COVID-19 on health systems preventing the collapse of them.

6. Acknowledgement

Authors declare no financial conflict of interest regarding the content of this article.

7. References

1. Cascella M, Rajnik M, Cuomo A, Dulebohn SC, Di Napoli R. Features, Evaluation, and Treatment of Coronavirus (COVID-19). StatPearls. Treasure Island (FL)2020.

2. Guo W, Li M, Dong Y, Zhou H, Zhang Z, Tian C, et al. Diabetes is a risk factor for the progression and prognosis of COVID-19. Diabetes/metabolism research and reviews. 2020; 3319.

3. Lauer SA, Grantz KH, Bi Q, Jones FK, Zheng Q, Meredith HR, et al. The Incubation Period of Coronavirus Disease 2019 (COVID-19) From Publicly Reported Confirmed Cases: Estimation and Application. Annals of internal medicine. 2020; 172:577-82..

4. Choi SH, Kim HW, Kang JM, Kim DH, Cho EY. Epidemiology and clinical features of coronavirus disease 2019 in children. Clinical and experimental pediatrics. 2020; 63:125-32.

5. Yuan J, Zou R, Zeng L, Kou S, Lan J, Li X, et al. The correlation between viral clearance and biochemical outcomes of 94 COVID-19 infected discharged patients. Inflammation research : official journal of the European Histamine Research Society [et al]. 2020; 69:599-606.

6. van Doremalen N, Bushmaker T, Morris DH, Holbrook MG, Gamble A, Williamson BN, et al. Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1. The New England journal of medicine. 2020; 382:1564-7.

7. Verity R, Okell LC, Dorigatti I, Winskill P, Whittaker C, Imai N, et al. Estimates of the severity of coronavirus disease 2019: a model-based analysis. The Lancet Infectious diseases. 2020; 20:669-77.

8. Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet. 2020; 395:1054-62.

9. World Health Organization. Coronavirus disease 2019 (COVD-19). Situation report – 196 WHO, Geneva, Switzerland (2020). 04 August 2020. https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200804-covid-19-sitrep-197.pdf?sfvrsn=94f7a01d_2

10. Lemos DRQ, D'Angelo SM, Farias L, Almeida MM, Gomes RG, Pinto GP, et al. Health system collapse 45 days after the detection of COVID-19 in Ceara, Northeast Brazil: a preliminary analysis. Revista da Sociedade Brasileira de Medicina Tropical. 2020; 53:e20200354.

11. Aguiar M, Stollenwerk N. Condition-specific mortality risk can explain differences in COVID-19 case fatality ratios around the globe. Public health. 2020; 188:18-20.

12. Sanyaolu A, Okorie C, Marinkovic A, Patidar R, Younis K, Desai P, et al. Comorbidity and its Impact on Patients with COVID-19. SN comprehensive clinical medicine. 2020:1-8.

13. Zhao Y, Zhao Z, Wang Y, Zhou Y, Ma Y, Zuo W. Single-Cell RNA Expression Profiling of ACE2, the Receptor of SARS-CoV-2. American journal of respiratory and critical care medicine. 2020; 202:756-9.

14. Park A. Why women need better sleep. Poor sleep habits make them more vulnerable to heart disease than men. Time. 2008; 171:64.

15. Karnam G, Rygiel TP, Raaben M, Grinwis GC, Coenjaerts FE, Ressing ME, et al. CD200 receptor controls sex-specific TLR7 responses to viral infection. PLoS pathogens. 2012; 8:e1002710.

16. El-Khatib Z, Jacobs GB, Ikomey GM, Neogi U. The disproportionate effect of COVID-19 mortality on ethnic minorities: Genetics or health inequalities? EClinicalMedicine. 2020; 23:100430.

17. Leung C. Risk factors for predicting mortality in elderly patients with COVID-19: A review of clinical data in China. Mechanisms of ageing and development. 2020; 188:111255.

18. Colonna-Romano G, Bulati M, Aquino A, Pellicano M, Vitello S, Lio D, et al. A double-negative (IgD-CD27-) B cell population is increased in the peripheral blood of elderly people. Mechanisms of ageing and development. 2009; 130:681-90..

19. Perrotta F, Corbi G, Mazzeo G, Boccia M, Aronne L, D'Agnano V, et al. Correction to: COVID-19 and the elderly patients: insights into pathogenesis and clinical decision-making. Aging clinical and experimental research. 2020; 32:1909.

20. Zhao T, Cheng C, Liu H, Sun C. Is one- or two-meters social distancing enough for COVID-19? Evidence for reassessing. Public health. 2020; 185:87.

21. Matrajt L, Leung T. Evaluating the Effectiveness of Social Distancing Interventions to Delay or Flatten the Epidemic Curve of Coronavirus Disease. Emerging infectious diseases. 2020; 26:1740-8.

22. Thu TPB, Ngoc PNH, Hai NM, Tuan LA. Effect of the social distancing measures on the spread of COVID-19 in 10 highly infected countries. The Science of the total environment. 2020; 742:140430.

23. Wise J. Covid-19: Cancer mortality could rise at least 20% because of pandemic, study finds. Bmj. 2020; 369:m1735.

24. Maringe C, Spicer J, Morris M, Purushotham A, Nolte E, Sullivan R, et al. The impact of the COVID-19 pandemic on cancer deaths due to delays in diagnosis in England, UK: a national, population-based, modelling study. The Lancet Oncology. 2020; 21:1023-34.

25. Al-Jabir A, Kerwan A, Nicola M, Alsafi Z, Khan M, Sohrabi C, et al. Impact of the Coronavirus (COVID-19) pandemic on surgical practice - Part 1. International journal of surgery. 2020; 79:168-79.

26. Collaborative CO. Elective surgery cancellations due to the COVID-19 pandemic: global predictive modelling to inform surgical recovery plans. The British journal of surgery. 2020.

27. NHS England, Royal College of Surgeons of England. [Internet]. Clinical guide to surgical prioritisation during the coronavirus pandemic. c2020 – [cited 2020 August 12] Available from: https://fssa.org.uk/_userfiles/pages/files/covid19/prioritisation_master_240820.pdf.

28. Himmelstein DU, Woolhandler S. Privatization in a publicly funded health care system: the U.S. experience. International journal of health services : planning, administration, evaluation. 2008; 38:407-19..

29. Santos NR. [The Brazilian Unified Health System (SUS), State Public Policy: its institutionalized and future development and the search for solutions]. Ciencia & saude coletiva. 2013; 18:273-80..

30. World Health Organization. Coronavirus disease 2019 (COVID-19) Weekly Operational, 28 August 2020 [cited 2020 August 28]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200824-weekly-epi-update.pdf?sfvrsn=806986d1_4]

31. Al Saidi AMO, Nur FA, Al-Mandhari AS, El Rabbat M, Hafeez A, Abubakar A. Decisive leadership is a necessity in the COVID-19 response. Lancet. 2020; 396:295-8..