

ARTICLE

<https://doi.org/10.22239/2317-269x.01938>

One year of COVID-19 pandemic: Epidemiological characteristics of COVID-19 in the city of Uberaba, Minas Gerais, Brazil

Um ano da pandemia de COVID-19: características epidemiológicas da COVID-19 na cidade de Uberaba, Minas Gerais, Brasil

Michelli Maldonado^{I,*} 

Ronaldo Junio de Oliveira^{II} 

Mariangela Torreglosa Ruiz
Cintra^{III} 

ABSTRACT

Introduction: The new coronavirus pandemic (COVID-19) is unprecedented in recorded human history. It spread from Wuhan, China, in early December, 2019, crossing the entire planet and reaching Brazilian shores in the following February. It was declared a pandemic on March 11, 2020, with the first case recorded in the city of Uberaba, state of Minas Gerais, Brazil, on March 18, 2020. Since then, we have been collecting data and assessing the evolution of this fatal disease. **Objective:** In this work, we report the epidemiological characteristics of one year of the COVID-19 in Uberaba, and discuss its implications to the general public. **Method:** This is an observational, descriptive, documentary and retrospective study to describe the epidemiological profile of COVID-19 cases in the city of Uberaba from March 18, 2020 to March 17, 2021. **Results:** The study shows that the young-working age population are those who most spread the virus; however, the elderly are those who suffer and die the most, with slight differences regarding sex. This is in line with the reported national and international epidemiological profiles that show a shifting tendency of younger generations to be increasingly active on the evolution of the pandemic. We observed two major peaks on the two epidemiological time-series, confirmed cases and deaths, with an average age of 41 years old for the confirmed cases and 68 for the confirmed deaths. It was also reported that the lethality rate was 2.45%, and 80.00% of the confirmed deaths suffered from some previous health condition. **Conclusions:** In this sense, a permanent epidemiological surveillance has to take place in order to guide public health counter-measurements. The epidemiological characteristics of COVID-19 in Uberaba and related analyses are reported in the online observatory at <https://coviduberaba.github.io>.

KEYWORDS: COVID-19; Epidemiological Characteristics; Surveillance; Statistical Analysis; Coronavirus; Public Health

RESUMO

Introdução: A pandemia do novo coronavírus (COVID-19) é inédita na história humana registrada. Espalhou-se de Wuhan, na China, no início de dezembro de 2019, cruzando todo o planeta e chegando à costa brasileira no mês de fevereiro seguinte. Foi declarada pandemia em 11 de março de 2020, com o primeiro caso registrado na cidade de Uberaba, estado de Minas Gerais, Brasil, em 18 de março de 2020. Desde então, estamos coletando dados e avaliando a evolução dessa fatalidade doença. **Objetivo:** Neste trabalho, relatamos as características epidemiológicas de um ano da COVID-19 em Uberaba e discutimos suas implicações para o público em geral. **Método:** Trata-se de um estudo observacional, descritivo, documental e retrospectivo para descrever o perfil epidemiológico dos casos de COVID-19 na cidade de Uberaba no período de 18 de março de 2020 até 17 de março de 2021. **Resultados:** O estudo mostra que a população jovem em idade ativa é a que mais espalha o vírus, no entanto, os idosos são os que mais sofrem e morrem, com pequenas

^I Departamento de Matemática, Instituto de Ciências Exatas, Naturais e Educação, Universidade Federal do Triângulo Mineiro (UFTM), Uberaba, MG, Brasil

^{II} Laboratório de Biofísica Teórica, Departamento de Física, Universidade Federal do Triângulo Mineiro (UFTM), Uberaba, MG, Brasil

^{III} Departamento de Ciências Biológicas, Universidade Federal do Triângulo Mineiro (UFTM), Uberaba, MG, Brasil

* E-mail: michelli.oliveira@uftm.edu.br

Received: 07 jun 2021
Approved: 02 maio 2022



diferenças em relação ao sexo. Isso está de acordo com os perfis epidemiológicos nacionais e internacionais relatados que mostram uma tendência de mudança das gerações mais jovens a serem cada vez mais ativas na evolução da pandemia. Observamos dois grandes picos nas duas séries temporais epidemiológicas, casos confirmados e óbitos, com média de idade de 41 anos para os casos confirmados e 68 para os óbitos confirmados. Também foi relatado que a taxa de letalidade foi de 2,45%, e 80,00% das mortes confirmadas sofriam de alguma condição de saúde anterior. **Conclusões:** Nesse sentido, uma vigilância epidemiológica permanente deve ocorrer para orientar as contramedidas de saúde pública. As características epidemiológicas da COVID-19 em Uberaba e análises relacionadas são relatadas no observatório *online* em <https://coviduberaba.github.io>.

PALAVRAS-CHAVE: COVID-19; Característica Epidemiológicas; Vigilância; Análise Estatística; Coronavírus; Saúde Pública

INTRODUCTION

Coronaviruses are positive-stranded RNA viruses that taxonomically come under the family Coronaviridae and subfamily Coronavirinae, which can be divided into four genera: Alphacoronavirus, Betacoronavirus, Gammacoronavirus and Deltacoronavirus. In their structure, they are enveloped viruses with a positive-sense single-stranded RNA genome having spherical, oval or pleomorphic shape. Viruses from this family may infect a wide variety of hosts, producing symptoms and diseases that can be mild, moderate or fatal, such as the Severe Acute Respiratory Syndrome (SARS), caused by the SARS-CoV, and the Middle East Respiratory Syndrome (MERS), caused by MERS-CoV. The Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) belongs to genus Betacoronavirus^{1,2}.

The SARS-CoV-2, baptized by the International Committee on Taxonomy of Viruses (ICTV), contains higher conserved sequences in open reading frame (ORF) 1a/1b. SARS-CoV-2 infects humans, and it is the etiologic agent of the Coronavirus Disease 2019 (COVID-19)^{1,2}. The structure of SARS-CoV-2 contains a positive-sense single-stranded RNA genome packed in the virus membrane envelope. The ORF1a is the longest ORF that occupies almost two thirds of the genome. The ORF1b overlaps with ORF1a following shorter subgRNAs (sgRNA) that encodes four structural proteins, spike (S), membrane (M), envelope (E) and nucleocapsid (N), in addition to others accessory proteins. The M protein promotes membrane curvature that helps to bind the nucleocapsid. Protein E executes an important role in viral pathogenesis. The N protein assembles two domains that are able to bind the viral RNA genome by different mechanisms. N protein also interacts with nsp3, helping to pack and to encapsulate the genome structure inside the virions. The SARS-CoV-2 virus surface possesses S proteins that play pivotal roles in viral attachment, fusion and entry, establishing a hot spot to the development of therapeutics against the virus. SARS-CoV-2 S protein includes the receptor binding domain (RBD), known to interact strongly with the receptor angiotensin converting enzyme 2 (ACE2)^{2,3,4}.

On March 11, 2020, the outbreak of COVID-19 was elevated to a pandemic status by the World Health Organization (WHO), meaning that the disease affects several different countries⁵. The first case was described in the Chinese city of Wuhan on December 1, 2019. In Brazil, the first case was reported on February 25, 2020, in the city of São Paulo, whereas the first case in Uberaba was reported on March 18, 2020⁶.

The high transmission of SARS-CoV-2 has caused a greater absolute number of deaths than the combination of the epidemics caused by SARS-CoV and MERS-CoV. By the end of this work, at the end of October, Brazil had a lethality rate of 2.8%, a mortality rate of 289 per 100,000 inhabitants⁶. The epidemiological data of individuals infected by the virus, as analyzed in a Brazilian study, showed a number of 514,200 patients in the period ranging from February 25 to May 31 of 2020. Patients were predominantly male, with an average age of 59 years. The death rate was approximately 5.7% and 83.7% of these individuals confirmed with COVID-19 showed at least one medical condition: 66.5% had cardiovascular disease and 54.5% had diabetes⁷.

Several studies have been carried out in Brazil with the aim of evaluating the incidence and prevalence of COVID-19 in states such as Ceará^{8,9}, Roraima¹⁰, Paraná¹¹, regions such as the Ribeira Valley¹², Amazônia¹³, South¹⁴ and Brazilian municipalities such as Uberlândia¹⁵ and Patos de Minas, in the State of Minas Gerais¹⁶, and Teixeira de Freitas in Bahia¹⁷.

Uberaba, a city in the Triângulo Mineiro, has a land area of 4,539.57 km² and an estimated population of 340,277 people¹⁸. Isolation measures in the city of Uberaba began on March 18, 2020, with the suspension of surgical services, attendance in clinics and other areas related to health. Soon after, the isolation measures took greater proportions, with the closing of commercial establishments, leisure places and restaurants, leaving only services considered essential, such as supermarkets, pharmacies and hospitals open. Establishments were allowed to reopen with mandatory protective measures, such as social distancing, hygiene, and mandatory use of masks in May 2020. By the end of 2020, a decree prevented the operation of in-person teaching networks, restaurants, gyms, parties and the like¹⁹.

With the continuous unfolding of the pandemic, the COVID-19 Observatory - Uberaba²⁰ was created - an initiative by researchers from the Federal University of Triângulo Mineiro (UFTM) in partnership with the Uberaba City Hall. The group presents weekly reports with information about the epidemiology of the disease, helping to provide the population with safe information via website (<https://coviduberaba.github.io>) and contributing to raise awareness about the situation.

Given that, this work aimed to outline an epidemiological profile and to understand the dynamics of the disease in the city of Uberaba.



METHOD

Study region

The city of Uberaba is a Brazilian municipality located in the Triângulo Mineiro region of the State of Minas Gerais (MG). According to the Brazilian Institute of Geography and Statistics (IBGE), the estimated population of Uberaba in 2020 is 340,277 inhabitants, of which 48.8% are male and 51.2% are female¹⁸.

Data collection

This is an observational, descriptive, documentary and retrospective study to describe the epidemiological profile of COVID-19 cases in the city of Uberaba from March 18, 2020 to March 17, 2021. The variables analyzed were: number of cases and deaths by epidemiological weeks, sex and age range of confirmed cases, sex and age range of confirmed deaths and previous indication of medical conditions in the confirmed deaths. Data were organized, tabulated and analyzed using the software Microsoft® Excel version 2000 and the software R-Project 4.0 version 2016 (<https://www.r-project.org>).

Ethics statement

Strict ethical and professional aspects were followed, maintained, and respected as set by the National Health Council in the Resolution n° 466 of December 12, 2012. The resolution recommends that research involving only secondary data from public domain, without nominal identification of the research participants, does not require analysis by the Research Ethics Committees.

Statistical analysis

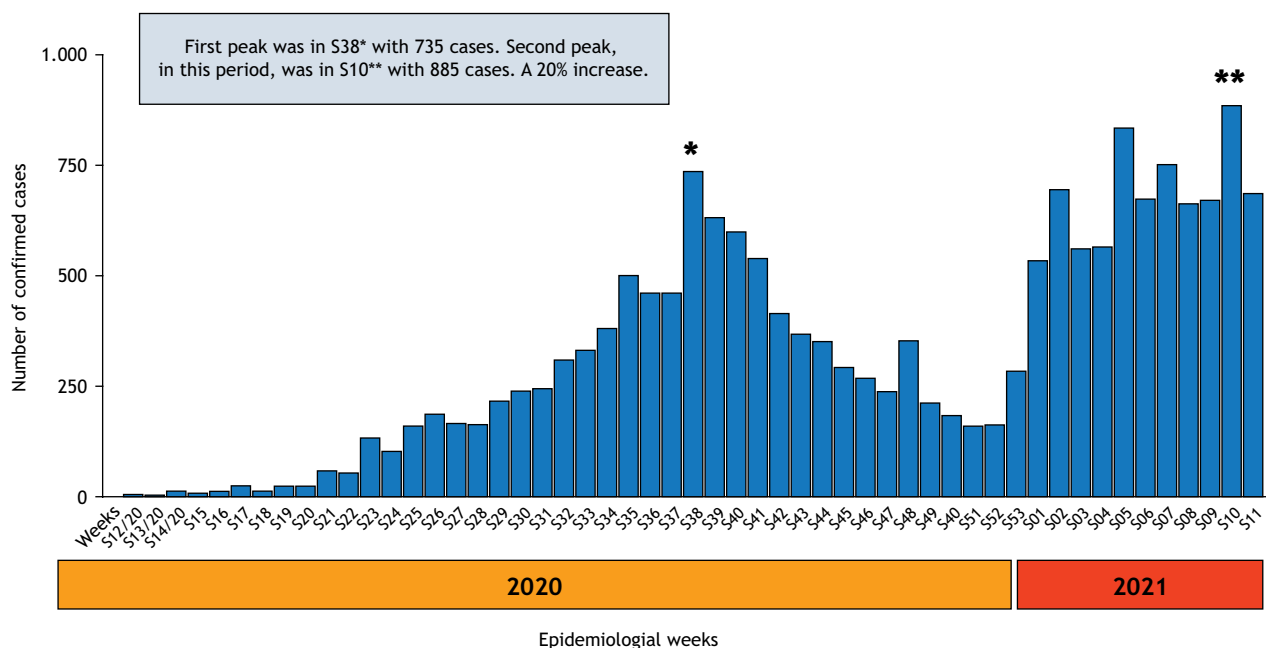
Data were compiled and tabulated to determine simple frequencies (n), relative frequencies (%), means and standard deviation ($\pm$). Results are presented in contingency tables and graphs.

RESULTS

The study presents an analysis of reported cases of COVID-19 in the city of Uberaba, state of MG, Brazil, during one year of the pandemic. The first reported case was on March 18, 2020 and, by March 17, 2021 the city accounted for 17,254 reported cases of people infected by the new coronavirus. The first peak in the city occurred on September 21, 2020, with a moving average of daily cases of 107 cases. After this date, the moving average of daily cases started to decelerate, returning to break records in the second wave that started in the first half of January 2021, with 120 daily cases reported in the moving average and a new peak on March 10, 2021, with a moving average of daily cases of 129 cases.

Figure 1 shows the frequency of reported cases of COVID-19 by epidemiological weeks. The first peak occurred in epidemiological week number 38 (S38) in the year 2020, with 735 cases, while the second peak, in the studied period, was in S10 in the 2021, with 885 cases. This represents a 20.00% increase of the reported cases. In addition, the city reported 9,741 cases in the year 2020. Until March 17, 2021, the city already had 7,513 cases, which represents 77.00% of the total of the previous year.

Considering the sex variable, in Figure 2(a) 51.69% of the reported cases of COVID-19 were female, whereas 48.31% were male. The



Source: Elaborated by the authors, 2021.

Figure 1. Total number of confirmed cases organized by epidemiological weeks in the city of Uberaba, state of Minas Gerais (MG), Brazil, during one year of the pandemic, from March 18, 2020, to March 17, 2021.

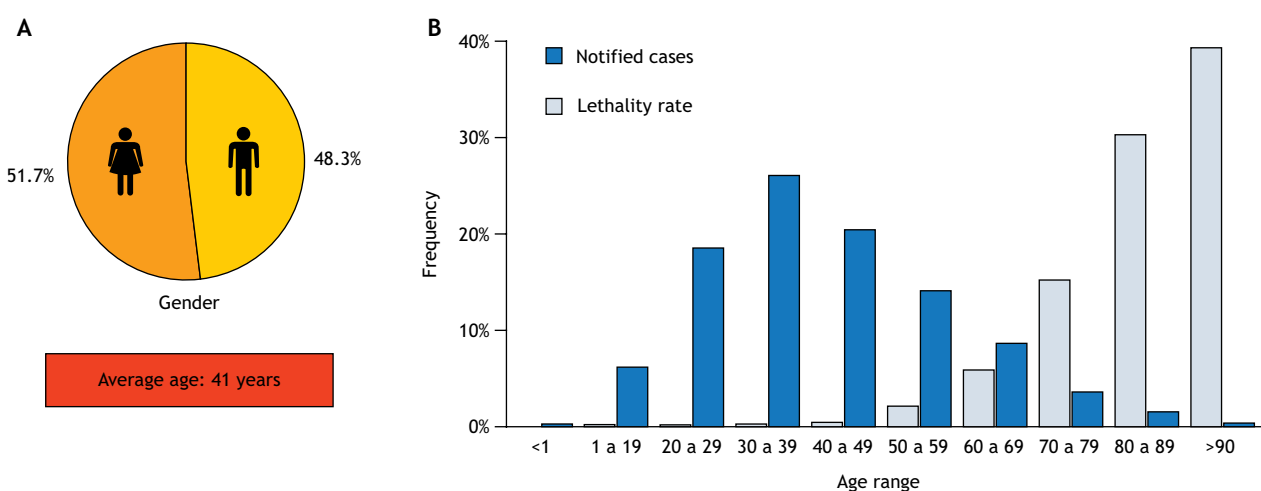


female group was, on average, older ($41.64 \text{ years} \pm 16.97$) than the male group ($40.67 \text{ years} \pm 16.27$). Figure 2(b) shows, in green, the relative frequency of reported cases of COVID-19 by age group in the city of Uberaba from March 18, 2020, to March 17, 2021. The most affected age group was the one ranging from 30 to 39 years, with 25.83% of total cases. The 20 to 49 age group accounts for 64.75% of the reported cases of COVID-19 in Uberaba. The average age of the total number of cases was $41 \text{ years} \pm 16.64$.

COVID-related deaths were also investigated and can be visualized in Figure 3 according to the epidemiological weeks. The first peak occurred in S41 in the year 2020 with 12 deaths, while the second peak appeared in S11 in the year 2021 with 38 deaths.

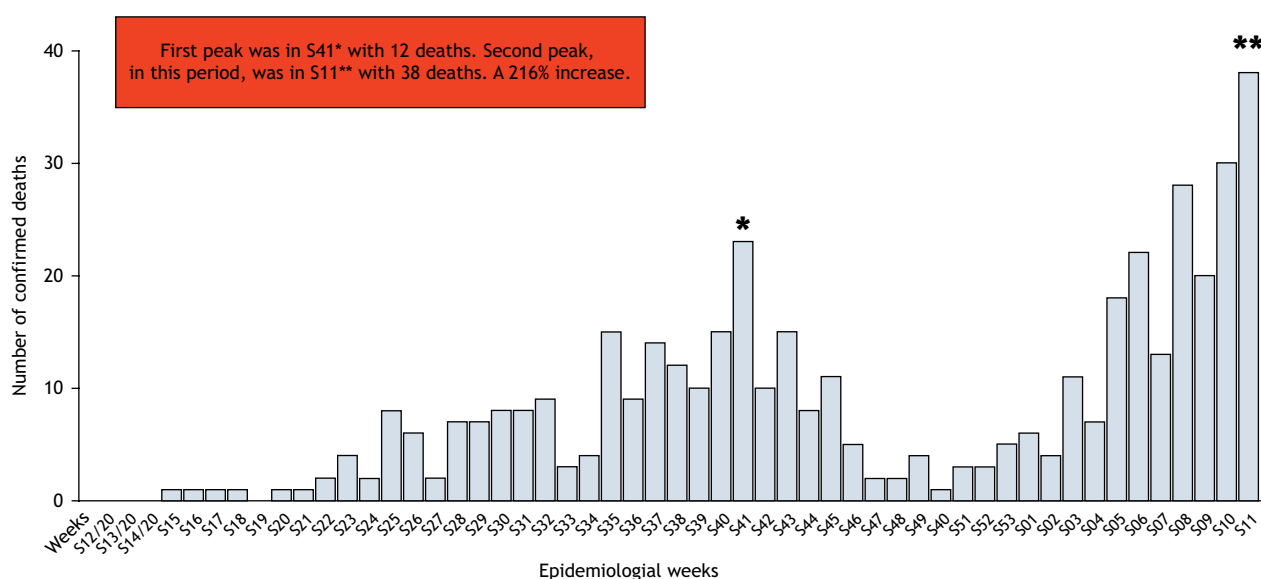
This represents a 216.00% increase. The record in confirmed daily deaths was registered in March 2021, with ten reported deaths. Figure 4(a) shows that the average age of confirmed deaths was $68.85 \text{ years} (\pm 15.68)$. Figure 4(b) shows the relative frequency of reported deaths of COVID-19 in the city of Uberaba grouped by age. As of March 17, 424 deaths were reported, indicating a general lethality rate of 2.45%. The minimum age was one year and the highest age was 103 years. 75.00% of the deceased were older than 59. Figure 4(b) indicates that the age group that stands out is the one from 70 to 79 years, 26.18%.

It is possible to analyze the lethality degree of the new coronavirus by age group. Figure 2(b), in purple, also compares



Source: Elaborated by the authors, 2021.

Figure 2. Total number of confirmed cases organized by the groups gender (2a) and gender (2b) in the city of Uberaba, state of Minas Gerais (MG), Brazil, during one year of the pandemic, from March 18, 2020, to March 17, 2021.



Source: Elaborated by the authors, 2021.

Figure 3. Total number of confirmed deaths organized by epidemiological weeks in the city of Uberaba, state of Minas Gerais (MG), Brazil, during one year of the pandemic, from March 18, 2020 to March 17, 2021.



confirmed deaths with reported cases of COVID-19 by age group of affected population. The younger age population shows the highest incidence of cases, yet with a very low lethality rate. The highest lethality was found in the age group of 90 years or older, with 34.62% of deaths among the reported cases from this age group, as shown in Figure 4(b). Most deaths were from the male sex (57.78%). The lethality rate among men was 2.93%, whereas among women, the rate was 2.00%. The females showing higher average age (71.41 years $\pm$ 15.92) than male (67.00 years $\pm$ 15.30).

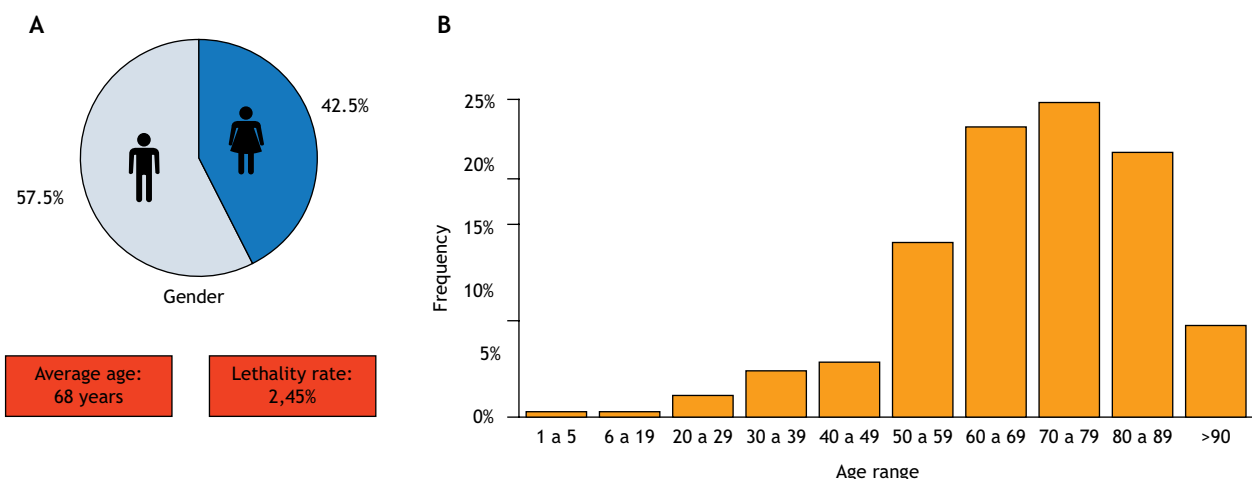
Medical conditions of the deceased were also analyzed and organized in Figure 5(a). According to the frequency of diagnosis, the prevailing medical conditions were: hypertension (39.00%), heart disease (21.43%), diabetes (21.43%), obesity (8.30%) and

other medical conditions (18.15%), as indicated in Figure 5(a). The mean age of the group with no comorbidities who died was lower (61.90 years $\pm$ 17.01) than the group that reported having medical conditions (70.58 years $\pm$ 14.86).

Figure 5(b) groups the number of comorbidities in individuals who died from coronavirus. In relation to 424 deaths, 85 (20.04%) did not indicate any previous comorbidities. Among these, 32.94% were female and 67.05% were male.

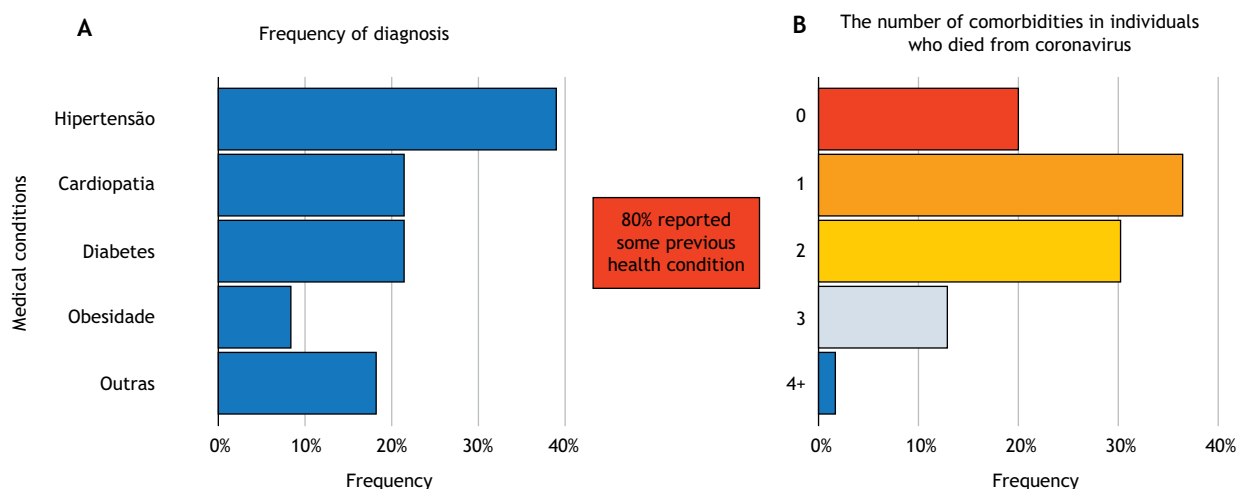
DISCUSSION

This study traced the epidemiological profile of the city of Uberaba-MG in the first year of the COVID-19 pandemic. The results of this epidemiological investigation indicate a greater



Source: Elaborated by the authors, 2021.

Figure 4. Total number of confirmed deaths organized by the groups age and gender in the city of Uberaba, state of Minas Gerais (MG), Brazil, during one year of the pandemic, from March 18, 2020, to March 17, 2021.



Source: Elaborated by the authors, 2021.

Figure 5. Most frequent medical conditions among the 424 recorded deaths from COVID-19 in the city of Uberaba, MG, Brazil, during one year of the pandemic, from March 18, 2020, to March 17, 2021.



involvement of females, aged between 20 and 49 years. Regarding deaths, there is a higher mortality rate in males, aged over 60 years, with a history of hypertension, heart disease, diabetes, obesity, among others.

With respect to contamination, our results show that the most affected age group is the 30-39-year age category, and the most affected sex - despite the slight difference - is the female one. On average, the age of the infected individuals is 41 and females were older than males. That is, infected men are younger than women.

With respect to deaths, the occurrence is more frequent in individuals over 60, with at least one medical condition. The lethality rate for men is 1.5 times higher than that of women, and men were, on average, younger than women. Men dying from COVID-19 are younger and have fewer medical conditions compared to women.

As of March 17, 2021, the COVID-19 pandemic in Uberaba resulted in 17,254 reported cases, with a peak of 129 cases on March 10, 2021. It is observed that the total number of cases in 2021 until March 17, in just eleven weeks, represents more than 77.00% of the total cases in 2020. The biggest peak of the second wave in the city of Uberaba happened in epidemiological week number 20, in mid-June, with more than 1,300 cases per week²⁰. The difference in the total number of cases from the first peak to the second, in the period studied and throughout the rest of the year, is explained by the new variants that emerged in the country that contributed to the increase in the incidence of cases and deaths²¹. The disease was also responsible for 424 deaths in the city, of which 42.60% were notified in the period studied in 2021, coinciding again with the emergence of new variants.

The first peak of reported cases in Brazil occurred on July 29, 2020⁶, and a possible explanation to this difference relates to the fact that the pandemic started in the Brazilian capitals, mainly those with international airports. Based on the sequencing and analysis of viral genomes, another Brazilian study showed that there were more than 100 international entries of the virus in Brazil, mainly from European countries. During the initial stage of the pandemic, capitals with international airports suffered the first peaks of the disease, progressively spreading to interior regions such as the Triângulo Mineiro.

Our study also revealed that the 20-49-year age category gathered the highest number of contaminated individuals. On average, they were 41 years old. These data are in accordance with studies carried out in Pakistan, where contaminated individuals were, on average, 47 years old, with the 20-69 age category showing a higher frequency of infections²². Similar results were observed in one of the first descriptions of the epidemiological characteristics in Wuhan, with a mean age of 49 years old²³ and Australia, mean age of 37²⁴. National studies also came to the same conclusions with the example of Macapá²⁵, with a mean age of 40 years old, and the state of Santa Catarina²⁶, with the same age group revealed as the most affected one. This

scenario can also be explained by the risk factors to which this group is exposed, such as professional occupations, lifestyle, absence of comorbidities or use of medications, which may reflect social and cultural factors²⁷. Possible genetic explanations will be necessary to complete the interaction of age, sex and risk factors²⁸.

With respect to the biological sex of reported cases, our study shows that, although subtle, there are differences both in the frequencies of man and women and in the rate of incidence between the sexes. Women stand out in this phase of the study, a result that differs from the investigation that analyzes the pandemic in Brazil and reveals that 57.00% of those affected are men⁷. However, the frequency of infected men (49.10%) and women (50.90%) is identical to the results presented in January 2021 in Southeast Asia and the Western Mediterranean and is also close to African frequencies (47.00% and 53.00%, respectively)²⁹. The statistical analysis of the data supports that there is a relationship between age and biological sex, and that infected women are older than men²⁰.

Our data revealed that until March 17, 2021, 305 deaths from COVID-19 were registered, indicating a general lethality rate of 2.45%. the mortality rate in Uberaba is higher than the average mortality rate in Brazil (2.45, Uberaba, 2.40, Brazil)⁶, and that of the state of Minas Gerais - 2.09%, considering the same period of study³⁰.

The median age of the individuals who died in the city was 71 years old, most of them were older than 60 and the age category with the highest lethality was that of 90 years old or over. This age pattern found in Uberaba relates with data found in the USA, where 80.00% of the deceased were elderly patients aged 65 or older, and patients aged 85³¹. Also, in national studies such as the one in the state of Macapá¹³, the highest lethality rate was observed in elderly people older than 70. One of the possible explanations is that, in general, infections in older people are atypical and some factors may contribute to the high incidence of death, such as physiological changes caused by the aging process, medical conditions and use of various medications. Advanced age, therefore, is considered the main risk factor for complications of COVID-19³¹. The senescence also affects immune cells, and features of immunosenescence characterized by decreased native T-cells, increased memory T-cells, and poor response to newly encountered antigens³².

In addition to the age factor, some investigations reveal that the biological sex may be associated with the increase in deaths from COVID-19³³. In our study, most deaths are from the male sex. Investigations conducted in China, South Korea, USA and Italy showed a higher death rate in male patients^{22,34,35}. This difference between sexes may be due to a combination of biological factors, such as differences in chromosomal composition, reproductive organs and sex-related hormones. Gender-specific factors may also play a role, such as behavioral differences (smoking and drinking habits) and many medical conditions which are more frequent in men^{28,36}.



Regarding the chromosome difference, human females have two X chromosomes, while human males have just one. It is known that the process of X-inactivation in women occurs so that, physiologically, there can be dosage compensation. However, 15% to 20% of the genes escape from inactivation in humans, resulting in a higher number of copies in women than in men^{37,38}. Hence, as the X chromosome encodes some genes related to immune responses, women have a lower level of viral load and less inflammation compared to men³⁸. Our data showed no difference between contamination of men and women, yet it is documented that women have stronger innate and humoral immune responses than men, and therefore are less susceptible to bacterial, fungal, parasitic and viral infections³⁹.

When it comes to hormonal differences, sex steroids, including testosterone, estrogen and progesterone are potent regulators of immune and inflammatory regulatory responses. Estrogen in women can have immune-boosting effects while testosterone secreted by testicles can have immunosuppressive ones^{40,41}. Testosterone can also predispose men to COVID-19 infection by means of co-regulation of the expression of the angiotensin-converting enzyme 2, which may facilitate the entry of virus in cells, thus increasing the number of infected men and the disease severity⁴².

When analyzing the age of death in men and women, it can be noticed that male individuals have a lower mean age than females. A study that investigated the immune response to SARS-CoV-2 infection showed that male patients have a high level of interleukin 18 (IL-18) with a more robust induction of non-classical monocytes, while women have a more robust activation of T cells than men during infection. A low correlation between the patients' age was associated with a worse prognosis in men than women⁴³, which may also explain the higher frequency of deaths in men at an earlier age. It is also important to note that many factors can accelerate the individual's biological age, including diet, physical exercise, habits and some comorbidities⁴⁴.

Studies analyzing COVID-19 clinical and epidemiological data suggest that some medical conditions increase the risk of infections with worsening lung injury and death. The most common medical conditions are hypertension, cardiovascular diseases and diabetes⁴⁵, in line with our study in which the majority of patients who died presented these medical conditions. Our study shows that the mean age of those from the group with no medical condition who died is lower than those from the group with at least one medical condition who died. In addition, women, on average, have more medical conditions than men.

It is well established that the virus uses angiotensin-converting enzyme 2 (ACE2) receptors, which are on the surface of host cells, to enter the cell. Several comorbidities are associated with this receptor. Hypertensive patients often use ACE2 inhibitors and angiotensin receptor blockers in their treatments.

These inhibitors increase the expression of the ACE2 receptor, leading to an increased susceptibility to SARS-CoV-2 infection⁴⁴. This increase in the expression of recipient cells in the lungs raises the chances of severe lung injury and respiratory failure⁴⁵. When it comes to cardiac patients, there is a high risk due to the presence of ACE2 receptors in the cardiac muscles, increasing the occurrence of acute coronary syndrome that can lead to myocardial injury or infarction. An increase in inflammatory cytokines in COVID-19 can lead to ischemia and thrombosis⁴⁶. In relation to diabetes, there is a protein called furin that is expressed at high levels in patients with this disease. The SARS-CoV-2 spike protein (S) is activated by increased levels of furin. This pre-activation of the protein S allows the entry of the virus into the cell by the ACE2 receptors, which can be life-threatening to diabetic patients⁴⁵.

CONCLUSIONS

Finally, as we already know, the COVID-19 pandemic has brought relevant impacts on people's health and on the mobility dynamics of populations. In Uberaba, the epidemiological characteristics of the pandemic showed a total of more than 17,000 reported cases and more than 400 deaths recorded in a year of the pandemic. The beginning of the year 2021 contributed with many cases and deaths and this increase coincided with the emergence of new variants. The patterns of incidence, age group and biological sex found in this study are similar in different regions of the country and the world. Young people are more affected by the disease; however, older adults show higher lethality rates. Factors such as lifestyle and prevalence of medical conditions are associated with the results and conclusions found.

The analysis of the epidemiological characteristics of individuals affected by the COVID-19 is important so that all branches of the government can determine actions and measures in favor of public health. The dissemination of the epidemiological characteristics and its analysis also serve to alert the population of their conduct in the midst of an unprecedented pandemic like this. The recent vaccination of the population should not be used as a relief to reduce care and prevention against the virus. New variants are spreading faster than the December 2019 Wuhan version, which makes the coronavirus epidemiological surveillance permanent.

Vaccination in the city of Uberaba began on January 20th with health professionals. Until the period studied on March 17, 2021, only the elderly over 85 years old had received the doses. Within the period, it was not possible to affirm a decrease in the mortality rate of the elderly.

We must make sure we use those tools effectively, which means using them in all countries to protect the most at-risk groups. That's the best way to save lives, end the pandemic, restore confidence and reboot the global economy. But we're making progress⁴⁷.



REFERENCES

1. Dhama K, Khan S, Tiwari R, Sircar S, Bhat S, Malik YS et al. Coronavirus disease 2019: COVID-19. *Clin Microbiol Rev.* 2020;33(4):1-40. <https://doi.org/10.1128/CMR.00028-20>
2. Kadam SB, Sukhramani GS, Bishnoi P, Pable AA, Barvkar VT. SARS-CoV-2, the pandemic coronavirus: molecular and structural insights. *J Basic Microbiol.* 2021;61(3):180-202. <https://doi.org/10.1002/jobm.202000537>
3. Bhat EA, Khan J, Sajjad N, Ali A, Aldakeel FM, Mateen A et al. SARS-CoV-2: insight in genome structure, pathogenesis and viral receptor binding analysis - an updated review. *Int Immunopharmacol.* 2021;95:1-9. <https://doi.org/10.1016/j.intimp.2021.107493>
4. Freitas FC, Ferreira PHB, Favaro DC, Oliveira RJ. Shedding light on the inhibitory mechanisms of SARS-CoV-1/CoV-2 spike proteins by ACE2-designed peptides. *J Chem Inf Model.* 2021;61(3):1226-43. <https://doi.org/10.1021/acs.jcim.0c01320>
5. World Health Organization - WHO. Brazil. Geneva: World Health Organization; 2021[access Feb 19, 2021]. Available at: <https://www.who.int/eportuguese/countries/bra/pt>
6. Ministério da Saúde (BR). Pannel de casos de doenças pelo coronavírus 2019 (COVID-19) no Brasil. Brasília: Ministério da Saúde; 2020 [access Feb 19, 2021]. Available at: <https://covid.saude.gov.br/>
7. Souza WM, Buss LF, Candido DS, Carrera JP, Li S, Zarebski AE et al. Epidemiological and clinical characteristics of the COVID-19 epidemic in Brazil. *Nat Hum Behav.* 2020;4(8): 856-65. <https://doi.org/10.1038/s41562-020-0928-4>
8. Gouveia GPM, Gouveia SSV, Vasconcelos SS, Silva ESM, Medeiros RG, Silva RL. Incidência e letalidade da COVID-19 no Ceará. *Cad ESP.* 2020;14(1):10-6.
9. Romero JAR, Silva FAM. Relação entre as condições socioeconômicas e a incidência da pandemia da COVID-19 nos municípios do Ceará. *Bol Conjunt.* 2020;3(7):85-95. <https://doi.org/10.5281/zenodo.3923443>
10. Senhoras EM, Gomes ML. COVID-19 nos municípios de Roraima. *Bol Conjunt.* 2020;3(9):139-49. <https://doi.org/10.5281/zenodo.4036180>
11. Paiva CI, Nasr AMLF, Magato DS, Ditterich RG, Guimarães RRM, Piler RA et al. Perfil epidemiológico da COVID-19 no estado do Paraná. *Rev Saúde Pública Paraná.* 2020;3(supl.1):39-61. <https://doi.org/10.32811/25954482-2020v3sup1p39>
12. Souza ALT, Gusmão JL, Simas JMM, Simas PVM, Ikeda AC. Análise do perfil epidemiológico dos casos confirmados de COVID-19 no Vale do Ribeira, São Paulo, Brasil. *Rev Pre Infec Saúde.* 2020;6:1-12. <https://doi.org/10.26694/repis.v6i0.11105>
13. Silva, AW, Cunha AA, Alves GC, Corona RA, Dias CAGM, Nassiri R et al. Perfil epidemiológico e determinante social do COVID-19 em Macapá, Amapá, Amazônia, Brasil. *Rev Cient Multid Núcleo* Conhec. 2020;4(4):5-27. <https://doi.org/10.32749/nucleodoconhecimento.com.br/saude/covid-19-em-macapá>
14. Lopes LFD, Faria RM, Lima MP, Kirchhof RS, Almeida DM, Moura GL. Descrição do perfil epidemiológico da COVID-19 na região sul do Brasil. *Hygeia.* 2020;16:188-98. <https://doi.org/10.14393/Hygeia16054772>
15. Rosa MFP, Silva WNT, Carvalho WRG, Oliveira SV. Epidemiologia da COVID-19 em Uberlândia (MG): análise preliminar do impacto do grau de abertura comercial. *J Health NPEPS.* 2020;5(2):20-41.
16. Silveira CR, Monteiro EM, Bicalho EAG, Vieira ALS. Incidência e prevalência dos casos notificados de COVID-19 no município de Patos de Minas - MG dentre os meses de abril de 2020 a abril de 2021. *Sci Gen.* 2021;2(2):116-29.
17. Fortuna DBS, Fortuna JL. Perfil epidemiológico dos casos de COVID-19 no município de Teixeira de Freitas-BA. *Braz J Develop.* 2020;6(10):76374-92. <https://doi.org/10.34117/bjdv6n10-166>
18. Instituto Brasileiro de Geografia e Estatística - IBGE. População estimada (2020). Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 2021[access May 5, 2021]. Available at: <https://cidades.ibge.gov.br/brasil/mg/uberaba/panorama>
19. Silva TA, Maldonado M. Avaliação do uso de leitos de UTI de COVID-19 em Uberaba por meio da teoria de filas. *Rev Eletron Mat.* 2021;7(2):1-16. <https://doi.org/10.35819/remat2021v7i2id5123>
20. Universidade Federal do Triângulo Mineiro - UFTM. Observatório COVID-19 Uberaba. Uberaba: Universidade Federal do Triângulo Mineiro; 2020[access Feb 19, 2021]. Available at: <https://coviduberaba.github.io>
21. Orellana JDY, Marrero L, Horta BL. Letalidade hospitalar por COVID-19 em quatro capitais brasileiras e sua possível relação temporal com a variante Gama, 2020-2021. *Epidemiol Serv Saúde.* 2021;30(4):1-12. <https://doi.org/10.1590/S1679-49742021000400024>
22. Khan M, Khan H, Khan S, Nawaz M. Epidemiological and clinical characteristics of coronavirus disease (COVID-19) cases at a screening clinic during the early outbreak period. *J Med Microbio.* 2020;69(8):1114-23. <https://doi.org/10.1099/jmm.0.001231>
23. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet.* 2020;395(10223):497-506. [https://doi.org/10.1016/S0140-6736\(20\)30183-5](https://doi.org/10.1016/S0140-6736(20)30183-5)
24. Department of Health (AU). Epidemiology report 30: fortnightly reporting period ending 22 November 2020: communicable diseases intelligence. Canberra: Department of Health; 2020. Available at: www1.health.gov.au
25. Silva AWC, Cunha AA, Alves GC, Corona RA, Dias CAGM, Nassiri R et al. Caracterização clínica e epidemiologia de 1560 casos de COVID-19 em Macapá/AP, extremo norte do Brasil. *Res Soc Dev.* 2020;9(8):1-20. <https://doi.org/10.33448/rsd-v9i8.5499>



26. Moura PH, Luz RA, Ga MJP, Klokner S, Torrico G, Knapi KJ et al. Perfil epidemiológico da COVID-19 em Santa Catarina. *Rev Interdiscip Estud Saúde*. 2020;9(1):163-80. <https://doi.org/10.33362/ries.v9i1.2316>
27. Cunha AA, Corona RA, Silva DG, Feury AA, Dias CAG, Araujo MHM. Tendência na incidência de acidentes de trajeto em trabalhadores no Brasil entre 2009 e 2016. *Rev Bras Med Trab*. 2019;17(4):490-8. <https://doi.org/10.5327/Z1679443520190439>
28. Bhopal SS, Bhopal R. Sex differential in COVID-19 mortality varies markedly by age. *Lancet*. 2020;396(10250):31748-77. [https://doi.org/10.1016/S0140-6736\(20\)31748-7](https://doi.org/10.1016/S0140-6736(20)31748-7)
29. University College London. African Population and Health Research Center - APHRC. International Center for Research on Women - ICRW. The sex, gender and COVID-19 project. London: University College London; 2021[access Feb 19, 2021]. Available at: <https://globalhealth5050.org/the-sex-gender-and-covid-19-project/>
30. Secretaria de Estado da Saúde de Minas Gerais - SES-MG. Painel de monitoramento de casos: coronavírus. Belo Horizonte: Secretaria de Estado da Saúde de Minas Gerais; 2021[access Feb 19, 2021]. Available at: <https://coronavirus.saude.mg.gov.br/>
31. Nikolich-Zugich J, Knox KS, Rios CT, Natt B, Bhattacharya D, Fain MJ. SARS-CoV-2 and COVID-19 in older adults: what we may expect regarding pathogenesis, immune responses, and outcomes. *Geroscience*. 2020;42(2):505-14. <https://doi.org/10.1007/s11357-020-00186-0>
32. Omarjee L, Perrot F, Meilhac O, Mahe G, Bousquet G, Janin A. Immunometabolism at the cornerstone of inflammaging, immunosenescence, and autoimmunity in COVID-19. *Aging*. 2020;12(24): 26263-78. <https://doi.org/10.18632/aging.202422>
33. Márquez EJ, Trowbridge J, Kuchel GA, Banchereau J, Ucar D. The lethal sex gap: COVID-19. *Immun Ageing*. 2020;17:1-8.
34. Chen T, Wu D, Chen H, Yan W, Yang D, Chen G et al. Clinical characteristics of 113 deceased patients with coronavirus disease 2019: retrospective study. *BMJ*. 2020;368:m1091. <https://doi.org/10.1136/bmj.m1091>
35. Dudley JP, Lee NT. Disparities in age-specific morbidity and mortality from SARS-CoV-2 in China and Republic of Korea. *Clin Infect Dis*. 2020;71(15):863-5. <https://doi.org/10.1093/cid/ciaa354>
36. Gebhard C, Regitz-Zagrosek V, Neuhauser HK, Morgan R, Klein SL. Impact of sex and gender on COVID-19 outcomes in Europe. *Biol Sex Differ*. 2020;11(1):1-13. <https://doi.org/10.1186/s13293-020-00304-9>
37. Haitao T, Vermunt JV, Abeykoon J, Ghamrawi R, Gunaratne M, Jayachandran M et al. COVID-19 and sex differences: mechanisms and biomarkers. *Mayo Clin Proc*. 2020;95(10):2189-203. <https://doi.org/10.1016/j.mayocp.2020.07.024>
38. Schurz H, Salie M, Tromp G, Hoal EG, Kinnear CJ, Möller M. The X chromosome and sex-specific effects in infectious disease susceptibility. *Hum Genomics*. 2019;13(1):1-12. <https://doi.org/10.1186/s40246-018-0185-z>
39. Naqvi S, Bellott DW, Lin KS, Page DC. Conserved microRNA targeting reveals preexisting gene dosage sensitivities that shaped amniote sex chromosome evolution. *Genome Res*. 2018;28(4):474-83. <https://doi.org/10.1101/gr.230433.117>
40. Klein SL, Flanagan KL. Sex differences in immune responses. *Nat Rev Immunol*. 2016;16(10):626-38. <https://doi.org/10.1038/nri.2016.90>
41. Pradhan A, Olsson PE. Sex differences in severity and mortality from COVID-19: are males more vulnerable? *Biol Sex Differ*. 2020;11:1-11. <https://doi.org/10.1186/s13293-020-00330-7>
42. Giagulli VA, Guastamacchia E, Magrone T, Jirillo E, Lisco G, Pergola G et al. Worse progression of COVID-19 in men: is testosterone a key factor? *Andrology*. 2021;9(1):53-64. <https://doi.org/10.1111/andr.12836>
43. Takahashi T, Ellingson MK, Wong P, Israelow B, Lucas C, Klein J et al. Sex differences in immune responses that underlie COVID-19 disease outcomes. *Nature*. 2020;588(7837):315-20. <https://doi.org/10.1038/s41586-020-2700-3>
44. Fang L, Karakiukakis G, Roth M. Are patients with hypertension and diabetes mellitus at increased risk for COVID-19 infection? *Lancet Respir Med*. 2020;8(4):1-1. [https://doi.org/10.1016/S2213-2600\(20\)30116-8](https://doi.org/10.1016/S2213-2600(20)30116-8)
45. Ejaz H, Alsrhani A, Zafar A, Javed H, Junaid K, Abdalla AE et al. COVID-19 and comorbidities: deleterious impact on infected patients. *J Infect Public Health*. 2020;13(12):1833-9. <https://doi.org/10.1016/j.jiph.2020.07.014>
46. Bonow RO, Fonarow GC, O'Gara PT, Yancy CW. Association of coronavirus disease 2019 (COVID-19) with myocardial injury and mortality. *Jama Cardiol*. 2020;5(7):751-3. <https://doi.org/10.1001/jamacardio.2020.1105>
47. Ghebreyesus TA. World Health Organization (WHO) director-general's opening remarks at Munich security conference, Munich, Germany, 19 February 2021. Geneva: World Health Organization; 2021.



Acknowledgement

The authors thank the Municipal Health Department from the Uberaba city hall, for the support and data sharing, and translator Maria Teresa Marques Santos, from the International Cooperation Advisory (UFTM). Financial support was provided in part by the Brazilian agencies *Fundação de Amparo à Pesquisa do Estado de Minas Gerais* (FAPEMIG, APQ-00941-14), *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (CNPq, 438316/2018-5 and 312328/2019-2) and also by the *Universidade Federal do Triângulo Mineiro* (UFTM), with the Call for Researcher's Financial Support (PROPPG/UFTM No. 30/2018).

Data Availability Statement

Publicly available datasets were analyzed in this study. Data can be found at <https://coronavirus.saude.mg.gov.br/> and <https://covid-uberaba.github.io/OneYearData>.

Authors' Contribution

Maldonado M - Conception, planning (study design), acquisition, analysis, interpretation of results and writing of the work. Oliveira RJ, Cintra MTR - Conception, planning (study design) and writing of the work. All authors approved the final version of the work.

Conflict of Interest

Authors have no potential conflict of interest to declare, related to this study's political or financial peers and institutions.



"Attribution-NonCommercial: CC BY-NC" License. With this license you may access, download, copy, print, share, reuse and distribute the articles, provided that for non-commercial use and with the citation of the source, conferring the proper credits of authorship and mention to *Visa em Debate*. In such cases, no permission is required by the authors or publishers.



Available in:

<https://www.redalyc.org/articulo.oa?id=570580071004>

How to cite

Complete issue

More information about this article

Journal's webpage in redalyc.org

Scientific Information System Redalyc
Diamond Open Access scientific journal network
Non-commercial open infrastructure owned by academia

Michelli Maldonado, Ronaldo Junio de Oliveira,
Mariangela Torreglosa Ruiz Cintra

**One year of COVID-19 pandemic: Epidemiological
characteristics of COVID-19 in the city of Uberaba, Minas
Gerais, Brazil**

**Um ano da pandemia de COVID-19: características
epidemiológicas da COVID-19 na cidade de Uberaba,
Minas Gerais, Brasil**

*Vigilância Sanitária em Debate: Sociedade, Ciência &
Tecnologia*

vol. 10, no. 2, p. 23 - 32, 2022

INCQS-FIOCRUZ,

ISSN-E: 2317-269X

DOI: <https://doi.org/10.22239/2317-269X.01938>