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COVID-19 pandemic evolution in the Brazilian Indigenous population

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Abstract

Introduction The COVID-19 pandemic has affected several neglected populations such as the Indigenous peoples, which have suffered a high impact from the pandemic.

Objectives To analyze the impact on the health and disease process according to the COVID-19 evolution in the Brazilian Indigenous population.

Methods Data was collected from press releases by the Health Ministry and a descriptive analysis of the numbers of Indigenous individuals infected with the SARS-CoV-2 in Brazil was carried out.

Results In February 2021, there were 41,855 confirmed cases of Indigenous individuals infected by the SARS-CoV-2, including 4,387 active cases, 36,809 recovered cases, and 549 deaths. The Brazilian Indigenous population is distributed in over 300 ethnic groups and, due to the high number of deaths by the COVID-19, many of these groups are endangered. The elderly are the most affected age group, and they play a fundamental role among the Indigenous population for transmitting their customs mainly orally. Indigenous populations do not have proper access to transport to specialized health centers, since many areas are inaccessible and other cases require air or river transportation, which many times results in late assistance. When managing the COVID-19, it is important to emphasize the need for social isolation to prevent the virus from spreading among the Indigenous groups, mainly due to their contact with other ethnic groups represented by missionaries, hunters, and wood explorers, among others.

Conclusion The adoption of practices that can reduce the virus transmission among the Indigenous population and provide them with better access to treatment, mainly for the elderly, must be prioritized in Brazil.

Keywords Indigenous population · Pandemic · Social isolation · SARS-CoV-2 · COVID-19 · Vulnerable group

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Introduction

On March 11, 2020, the World Health Organization declared that the COVID-19 could be characterized as a pandemic due to the spread of the coronavirus disease 2019 (COVID-19) [1] caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [2]. Facing this scenery, the analysis of the health and disease processes in different social contexts became relevant for the COVID-19 control, mainly when considering the great territorial extension, the social and demographic aspects, and the populational heterogeneity in Brazil. Thus, a detailed analysis of each of the groups that form the Brazilian population is essential, mainly those groups that present higher degree of vulnerability to pandemic situations, such as the Indigenous peoples (Fig.1).

Indigenous peoples, despite representing 0.4% of the Brazilian population, according to the census carried out by the Brazilian Institute of Geography and Statistics (IBGE) in 2000, constitute a cultural heritage that comprises 305 ethnic groups and 274 languages [3]. The struggle for the recognition of Indigenous rights is historical and continues until nowadays. The recognition of the Indigenous citizenship and guarantee of respect to their customs and traditions, health, rights to the lands traditionally occupied by indigenous tribes was only enacted in 1988 with the approval of the Brazilian Federal Constitution. Consequently, an increase in their political representativeness occurred along with achievements in the social area that resulted in a process of ethnic emergence with a 177% indigenous population growth in a period of 20 years [4].

The indigenous peoples' achievements enabled better integration between this group and the rest of the Brazilian population, so that many Indigenous individuals live in the urban zone currently. However, their proximity with other ethnic groups was one of the factors that favored the spread of the SARS-CoV-2, and the first case of infection was associated to the contact with an infected medical doctor [5]. At the same time, wood exploration, deforestation of environmental preservation areas, and illegal mining increased the risk of these native people to be infected with the SARS-CoV-2 and to get other infectious diseases [5–7]. Also, despite the Indigenous peoples having constitutional rights, in practice they are not applicable, contrariwise, they are often violated by the Brazilian government through the adoption of anti-environmental measures that resulted in the highest rates of burning in the Amazon forest in the last 20 years. The federal government attitudes regarding environmental prompted the Brazil forests to devastation being observed a record of loss of vegetation cover, mainly on Amazon lands [8]. The neglection of the federal government in protecting Indigenous peoples against COVID-19 and its lands was described in the literature demonstrating a high impact of the COVID-19 pandemic on this population due the absence of better federal government attitudes [8, 9].

In contrast, state actions related to the Indigenous health started in 1999 through the division of their territory into Indigenous Health Special Districts (DSEIs, Brazilian acronym for Distritos de Saúde Especial Indígena), with the purpose of offering specific health measures to the local groups. Indigenous Health Units and the Indigenous Health Houses (CASAI, Brazilian acronym for Casas de Saúde Indígena) were implemented in the DSEIs, which were responsible for the medical assistance of higher complexity. Another measure adopted was the qualification of Indigenous individuals to work as health agents. The measures showed a beneficial effect on this population health resulting in a reduction in the mortality rate from 7.1% to 4.77%, in the period between 2000 and 2005 [10]. Despite the improvement in the Indigenous assistance, many individuals still refuse their own or the transportation of members of their families to more specialized health centers; for this reason, optimized medical assistance that respect the cultural divergences and traditions of those peoples is required [11]. Concomitantly, equipment, materials, and professionals are scarce, and the difficult access to the health units hampers such assistance [12].

The COVID-19 pandemic is a global challenge and a threat to the Indigenous culture, since many native customs started to be practiced only by the elderly and might get lost after these older individuals' deaths—this is the age group most affected by the COVID-19 [13]. According to all the limitations related to the Brazilian indigenous health, it becomes relevant to analyze how this group has faced the pandemic in a prospective study. Therefore, this study aimed to verify the evolution of the COVID-19 impact on Indigenous peoples, regarding cultural aspects and their survival at a national level based on the epidemiological notes published by the Brazilian Health Ministry. In addition, a descriptive analysis of the number of cases of Indigenous individuals infected with the SARS-CoV-2 in Brazil is provided.

Methods

A prospective data survey was carried out based on the epidemiological notes released by the Brazilian Health Ministry [14]. The full text of all notes published were read and evaluated by the researchers responsible for this study. Notes whose content was about government actions such as the distribution of individual protection equipment (IPE) and clarifying notes by the Health Ministry regarding facts occurred were excluded, while those specifically related to the COVID-19 pandemic progression in the Indigenous population were included.

The data collected from the notes were (i) name of the DSEI of origin of the Indigenous patient; (ii) ethnic group that the Indigenous patient belonged according to the National Indian Foundation (FUNAI, Brazilian acronym for Fundação Nacional do Índio); (iii) age (years); (iv)

Fig. 1 Indigenous painting on canvas. Art by the Brazilian painter Elvis da Silva and purchased by the corresponding author in 2015

comorbidity; and (v) social status within the Indigenous community. In the case of death, the date was recorded. Other information used, whenever available, was the disease transmission history and how many people might have been infected with SARS-Co-V-2 from one confirmed case in the community.

The instructions to the health units on the treatment and monitoring of Indigenous patients were given by the Health Ministry. The DSEI is a management unit decentralized from the Indigenous Health Attention Subsystem, so that the health service becomes guided to a certain ethnic-cultural group. The DSEIs are structured in Indigenous Basic Health Units (simple infrastructure destined to basic procedures and patients' follow-up), base centers (structure with a multidisciplinary team and that might be located inside the indigenous community or in reference municipalities), and the CASAIs (places of support to the indigenous population, for example, to provide accommodation to the Indigenous patient and their families during the treatment, which includes assistance to patients after hospital discharge).

The Indigenous Health System provided information such as the total number of COVID-19-suspected cases (Indigenous individuals with acute respiratory symptoms that left the tribe or that had contact with another suspected or confirmed case in the last 14 days), COVID-19-confirmed cases (cases were described as confirmed after laboratory analysis and by clinical criteria), COVID-19-dismissed cases (suspected case with negative laboratory result for the SARS-CoV-2 identification), COVID-19-infected cases (confirmed cases with active infection), clinical cure (cases confirmed that spent 10 days in home isolation, as of the start of the symptoms, and that were asymptomatic for 24h), and number of deaths (cases presenting death as a result of the SARS-CoV-2 infection and its complications). Finally, the 1st phase of the COVID-19 vaccination program in Brazil considers the Indigenous population living on indigenous land as a priority group.

Results

Description of official notes by the Health Ministry in relation to the COVID-19 evolution in the Indigenous population

Out of the 79 notes evaluated, 70 were selected, which included specific reports of Indigenous cases aiming to evaluate parameters such as death, comorbidity presence, social function, and other problems faced by those individuals. The remaining 9 notes were excluded for only describing the contamination of professionals related to the DSEIs (medical doctors and other health professionals, DSEIs coordinators, 51 Indigenous individuals) without specifying details. There was also a note reporting the death of a FUNAI worker.

Table 1 presents the content of the notes published by the Health Ministry. According to the age range of those infected:

(< 1 year old) two releases described death; malnutrition was reported in one of the cases;

(Individuals between 10 and 19 years old) six releases; five of them reported death. One of these patients presented tuberculosis and congenital cardiopathy;

(Individuals between 20 and 29 years old) three releases; none of them reported death;

(Individuals between 30 and 39 years old) four releases; three of them reported the death of the Indigenous patient, including a tribe chief. Another of these patients who died was diagnosed with diabetes mellitus (DM) and suspected cancer, and the other was a nurse from the Indigenous Health Multidisciplinary Team who was diagnosed with asthma;

(Individuals between 40 and 49 years old) four releases and all of them reported death. One of them was a tribe advisor and had influence in the local leadership. The comorbidities found were autoimmune hemolytic anemia (one patient); chronic kidney disease (one patient); obesity and systemic arterial hypertension (SAH) (one patient);

Table 1 Description of the notes published by the Brazilian Health Ministry reporting the COVID-19 pandemic evolution in the Indigenous population

Note	Ethnic group	DSEI	Age	Comorbidity	Death	Description found in the newsletter
08/04/2020	Kokama	Alto Solimões	20 years old	ND	ND	The Indigenous woman was an indigenous health agent (AIS, Brazilian acronym for Agente Indígena de Saúde) and was the first coronavirus disease 2019 (COVID-19) case in the Brazilian indigenous population. The professional was infected by being in contact with a physician that had been diagnosed with the COVID-19. Since 25/03/2020 up to the date of the publication, the medical doctor and the people that had been in contact to him, including 12 Indigenous individuals and 15 members of the health team, were isolated. Out of the 27 tests carried out, only the AIS tested positive for the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The Indigenous woman had not presented symptoms and the seven people that had been in contact with her were also tested for SARS-CoV-2.
08/04/2020	Kokama	Alto Solimões	37 years old	ND	ND	The Indigenous individual was one of the seven people who had been in contact with the first indigenous woman that tested positive. On the date of publication of the note, the man was in isolation. All the other indigenous that were being monitored were asymptomatic.
08/04/2020	ND	Alto Rio Solimões	ND	ND	ND	Physician infected with the SARS-CoV-2 and asymptomatic returned from his vacation and started to attend patients of the ethnic group Tikuna in the Indigenous health special district (DSEI) in Alto Rio Solimões. As soon as the physician presented symptoms, he reported them to the district coordinator that isolated the medical doctor and the patients he had attended. Health authorities in the Amazonas state were communicated. The DSEI purchased 100 fast tests to identify the SARS-CoV-2 infection.
10/04/2020	ND	Yanomami	15 years old	ND	09/04/2020	First report of death of an Indigenous woman.
11/04/2020	Tikuna	Alto Rio Solimões	78 years old	Heart problems	11/04/2020	Patient being treated for heart problems was admitted in the Tabatinga Hospital in the Amazonas state. Later on, the patient was transferred to the intensive care unit (ICU) of the Delphina Aziz Hospital (Manaus). On 25/03/2020, he was transferred to the Francisca Mendes Hospital. During the treatment period, SARS-CoV-2 was identified.
11/04/2020	Kokama	Alto Rio Solimões	44 years	Autoimmune hemolytic anemia	09/04/2020	The Indigenous woman Kokama had been in hospital since 28/02/2020 in the municipality of Manaus to treat autoimmune hemolytic anemia. Her condition worsened after SARS-CoV-2 infection.
14/04/2020	Galiby Kalinã	Amapá and Norte do Pará	28 years old	ND	ND	Indigenous man that worked as a nurse in the Indigenous health House in the municipality of Oiapoque—state of Amapá. The patient was in social isolation, but without any COVID-19 severe symptoms on the date of the note publication.
16/04/2020	ND	Eastern Roraima	ND	ND	ND	The coordinator of the Eastern DSEI in Roraima tested positive for SARS-CoV-2. After the appearance of the first symptoms, the coordinator took a sick leave from the DSEI and remained in social isolation.
17/04/2020	Sateré-Mawé	ND	67 years old	ND	ND	The Indigenous patient had been in hospital since 13/04/2020 when he had presented the first COVID-19 symptoms. The patient belonged to the Tuxaua ethnic group (Indigenous leader) and had been visited by his son that lived in Salvador and presented cough while visiting the tribe.
18/04/2020	Pitaguary	Ceará		Pulmonary disease	15/04/2020	

Table 1 (continued)

Note	Ethnic group	DSEI	Age	Comorbidity	Death	Description found in the newsletter
			76 years old			A female Indigenous patient was admitted in hospital on 14/04/2020 with symptoms similar to those of the COVID-19. The SARS-CoV-2 test result had not been released until the publication of the note.
24/04/2020	ND	Alto Rio Solimões	ND	ND	ND	30 tests to identify SARS-CoV-2 got positive results at the DSEI Alto Rio Solimões. The test results were a consequence of the contact with the physician that tested positive after return from his vacation.
24/04/2020	ND	Parintins	ND	ND	ND	Thirteen tests had positive results for SARS-CoV-2.
26/04/2020	Palikur	Amapá and Northern Pará	35 years old	Suspected cancer and diabetes mellitus	03/04/2020	The SARS-CoV-2-positive result was only officially informed on 24/04/2020.
30/04/2020	Tikuna	Alto Rio Solimões	63 years old	ND	29/04/2020	Indigenous woman started to have fever on 22/04/2020 and on 29/04/2020 started to present dyspnea and diarrhea. At that moment, she was referred to the emergency service unit (UPA Brazilian acronym for Unidade de Pronto Atendimento) where SARS-CoV-2 infection was confirmed.
30/04/2020	Tikuna	Alto Rio Solimões	68 years old	Diabetes mellitus	29/04/2020	Indigenous woman had fever and headache on 22/04/2020 and on 26/04/2020 started to present dry cough and dyspnea. Her family did not allow her transportation to the municipal reference health unit.
01/05/2020	ND	Guamá-Tocantins	29 years old	ND	ND	On 20/04/2020, the Indigenous woman started to present flu symptoms (fever, body pain, and sneeze) and presented SARS-CoV-2-positive result.
02/05/2020	ND	Yanomami	ND	ND	ND	Five Indigenous individuals and sixteen professionals from the DSEI tested positive for the SARS-CoV-2 infection.
02/05/2020	ND	Yanomami	15 years old	ND	09/04/2020	This note is an update on the monitoring of the suspected and confirmed COVID-19 cases at the DSEI Yanomami. It reports that five Indigenous individuals and sixteen professionals from the DSEI Yanomami tested positive for the COVID-19. A 15-year-old male Yanomami was among the five Indigenous people, he died on 09/04/2020. The health agents were in social isolation.
03/05/2020	ND	Guamá-Tocantins	79 years old	Anemia	ND	ND
09/05/2020	Kariri Xocó	Alagoas and Sergipe	56 years old	Heart, kidney and pulmonary diseases	07/05/2020	ND
09/05/2020	Macuxi	Eastern Roraima	17 years old	ND	09/05/2020	The Indigenous woman started to present symptoms on 04/05/2020.
10/05/2020	Tabajara	Ceará	ND	ND	10/05/2020	During the transportation to a more specialized hospital, an accident occurred on the road that prevented the vehicle from reaching the hospital.
12/05/2020	Pitaguary	Ceará	53 years old	Several comorbidities	02/05/2020	The Indigenous male individual started to present symptoms on 30/04/2020.
12/05/2020	Tikuna	Alto Rio Solimões	ND	ND	07/05/2020	The Indigenous male individual was a basic health agent and an Indigenous leader.
13/05/2020	ND	Xavante	40 years old	Chronic kidney disease	ND	Indigenous individual tested positive for SARS-CoV-2.
16/05/2020	ND	Alto Rio Solimões	70 years old	Impaired sight	15/05/2020	Indigenous male individual started to present symptoms on 04/05/2020, but the family did not allow his transfer to a health service.
18/05/2020	ND	Porto Velho	ND	ND	ND	

Table 1 (continued)

Note	Ethnic group	DSEI	Age	Comorbidity	Death	Description found in the newsletter
						Three Indigenous individuals presented symptoms such as fever, headache, and cough on 07/05/2020 and tested positive for SARS-CoV-2 on 16/05/2020.
20/05/2020	Tikuna	Alto Rio Solimões	76 years old	Systemic Arterial Hypertension (SAH)	19/05/2020	On 29/04/2020, the Indigenous woman presented dyspnea and was admitted in hospital. On 30/04/2020, she tested positive for SARS-CoV-2. Her family did not allow her transfer to a more specialized medical center.
20/05/2020	Apurinã	Alto Rio Purus	16 years old	ND	ND	A 37-week pregnant Indigenous woman tested positive for SARS-CoV-2. She had presented respiratory symptoms and was submitted to an emergency cesarean section. On 19/05/2020, she presented improvement of the general clinical condition.
20/05/2020		Xavante	8 months	Malnutrition and dehydration	11/05/2020	ND
22/05/2020	Tikuna	Alto Rio Solimões	68 years old	ND	20/05/2020	The COVID-19 fast test was carried out on 15/05/2020 and got a positive result. The patient's family did not allow his transfer to a health service unit.
22/05/2020	Tikuna	Alto Rio Solimões	76 years old	Diabetes mellitus and SAH	19/05/2020	On 17/05/2020, the Indigenous woman presented symptoms such as dyspnea and dry cough, with clinical condition worsening, presenting 48% transcutaneous oxygen saturation (SpO_2). The patient was referred to hospital treatment via river transportation (30 min), where the SARS-CoV-2 infection was confirmed.
22/05/2020	Kokama	Alto Rio Solimões	60 years old	Diabetes mellitus	14/05/2020	On 11/05/2020, the Indigenous woman presented acute respiratory symptoms that worsened on 13/05/2020, when the patient was referred to the hospital unit and after being tested for SARS-CoV-2, she got a positive result.
22/05/2020	Tikuna	Alto Rio Solimões	88 years old	Absence of previous comorbidities	21/05/2020	ND
22/05/2020	ND	Alto Rio Solimões	ND	ND	20/05/2020	ND
25/05/2020	Munduruku	Rio Tapajós	78 years old	ND	22/05/2020	In the period between 20/04/2020 and 05/05/2002, the Indigenous man was in treatment in the intensive care unit. The patient was discharged and started to present flu symptoms; he tested positive for SARS-CoV-2 on 18/05/2020 and was admitted in hospital again.
27/05/2020	Apurinã	Alto Rio Purus	56 years old	SAH	25/05/2020	On 12/05/2020, the Indigenous woman presented flu symptoms after having had contact with a COVID-19-infected individual. The SARS-CoV-2 test was carried out on 22/05/2020. She tested positive and was referred to hospital treatment.
28/05/2020	Kokama	Alto Rio Solimões	86 years old	ND	21/05/2020	In the household visit on 13/05/2020, the Indigenous woman presented dry cough, loss of taste and smell, and fever. On that occasion, she was told to go to the hospital, but her family did not accept the advice. On14/05/2020, the patient showed improvement of the symptoms; however, on 15/05/2020 she had difficulties breathing and 89% SpO_2 with rumbles in the pulmonary auscultation. She tested positive for SARS-CoV-2. On 21/05/2020, the patient presented worsened clinical condition and was transferred to the hospital, where she died.
30/05/2020	Munduruku	Manaus	84 years old	ND	29/05/2020	The Indigenous patient was admitted in hospital on 21/05/2020. The transportation to the hospital was by boat and land vehicle. The patient was diagnosed with SARS-CoV-2 on 27/05/2020.
30/05/2020	Tikuna	Alto Rio Solimões	75 years old	ND	28/05/2020	

Table 1 (continued)

Note	Ethnic group	DSEI	Age	Comorbidity	Death	Description found in the newsletter
						On 15/05/2020, the patient presented 80 and 90% SpO_2. At that point, the family refused sending him the hospital. On 20/05/2020, he tested positive for SARS-CoV-2. On 26/05/2020, in the morning, his clinical condition worsened.
30/05/2020	Tikuna	Alto Rio Solimões	11 months	ND	21/05/2020	In a household visit on 20/05/2020, the patient presented respiratory difficulty and was referred to the region reference hospital, where the SARS-CoV-2 test result was positive. On 21/05/2020, the infant's health condition worsened.
31/05/2020	Shawãdawa (Arara)	Alto Juruá	61 years old	Since February, the patient had presented a series of diseases such as dengue, a neck tumor, and malaria	31/05/2020	On 17/05/2020, the Indigenous man tested positive for SARS-CoV-2.
02/06/2020	Yanomami	Yanomami	15 years old	Tuberculosis and congenital cardiopathy	02/06/2020	On 14/05/2020, the patient presented symptoms similar to those of the COVID-19; the patient had a positive result in the SARS-CoV-2 test.
02/06/2020	Kayapó	Kayapó do Pará	61 years old	ND	26/05/2020	On 24/05/2020, the Indigenous man presented cough, fatigue, and fever and was tested positive for SARS-CoV-2. At that moment, he was referred to treatment at the health unit, but his family refused that.
02/06/2020	Apurinã	Alto Rio Purus	17 years old	ND	01/06/2020	The indigenous woman was in the 37th week of pregnancy. On 13/05/2020, she presented symptoms like those in the COVID-19. On 14/05/2020, she underwent a cesarean section, and next, she was transferred to the ICU. On 18/05/2020, she got a positive result in the SARS-CoV-2 test. Her clinical condition worsened on 31/05/2020.
03/06/2020	Munduruku	Rio Tapajós	59 years old	Chronic respiratory disease	02/06/2020	On 25/05/2020, the Indigenous woman presented dyspnea and was referred to the emergency service unit. At that moment, she tested positive for SARS-CoV-2, and on 30/05/2020, the patient's clinical condition worsened.
03/06/2020	Munduruku	Rio Tapajós	71 years old	None	01/06/2020	The Indigenous man was a tribe chief. On 27/05/2020, he had flu symptoms and on 28/05/2020 presented reduced SpO_2 and was admitted in hospital.
03/06/2020	Kayapó	Kayapó do Pará	52 years old	ND	26/05/2020	On 23/05/2020, the patient arrived at the Health Basic Unit presenting acute respiratory syndrome, fever, cough, headache, and 78% SpO_2 . He tested positive for SARS-CoV-2 on 25/05/2020. His family did not allow his transfer to a medical center with higher level of specialization.
04/06/2020	ND	Javari	ND	ND	ND	Four health professionals from the DSEI Vale do Javari tested positive for SARS-CoV-2 on 03/06/2020. At that moment, the professionals were in isolation.
06/06/2020	Kaingang	Interior Sul	64 years old	Obesity	05/06/2020	On 19/05/2020, the Indigenous man presented acute respiratory syndrome symptoms and was referred to the local hospital where he tested positive for SARS-CoV-2. On 28/05/2020, the patient was admitted in the ICU.
08/06/2020	Anacé	Ceará	51 years old	Diabetes and heart diseases	25/05/2020	On 10/05/2020, the Indigenous man presented sore throat, fever, and cough, and, later on, his clinical condition worsened. On 20/05/2020, he was admitted in the Emergency Service unit, where he tested positive for SARS-CoV-2 on 28/05/2020.
08/06/2020	Tapeba	Ceará	85 years old	SAH	16/05/2020	On 11/05/2020, the Indigenous man arrived at the emergency service unit complaining of cough and dyspnea. He was tested for SARS-CoV-2; the positive result was only released after his death.
10/06/2020	Kayapó	Kayapó do Pará	ND	ND	ND	

Table 1 (continued)

Note	Ethnic group	DSEI	Age	Comorbidity	Death	Description found in the newsletter
						The COVID-19 diagnosis was given on 08/06/2020 and the Indigenous man was admitted in the local hospital.
12/06/2020	Kaingang	Interior Sul	44 years old	Obesity and SAH	12/06/2020	The Indigenous woman was admitted in the local hospital on 27/05/2020 complaining of dry cough and dyspnea. After 4 days in hospital treatment, she tested positive for SARS-CoV-2. On 28/05/2020, she was transferred to the ICU.
16/06/2020	Xavante	Xavante	ND	ND	14/06/2020	The Indigenous woman was an indigenous health agent and a leader among the women. She was admitted in hospital with suspected COVID-19. However, the SARS-CoV-2 test result had not been released yet at the moment the note was published.
17/06/2020	Kayapó	Kayapó do Pará	72 years old	ND	17/06/2020	The Indigenous man was a representative of his community and his actions were fundamental in several processes that led to indigenous achievements.
18/06/2020	Kaingang	Interior Sul	76 years old	SAH	17/06/2020	The Indigenous woman was admitted in the local hospital on 02/06/2020 complaining of dyspnea, headaches, vertigo, inappetence, and dry cough. At that moment, she had tested positive for SARS-CoV-2. On 06/06/2020, she was transferred to the ICU.
18/06/2020	Kaingang	Interior Sul	96 years old	Diabetes mellitus	17/06/2020	On 16/06/2020, the female Indigenous patient was admitted in the respiratory unit with dyspnea and tested positive for SARS-CoV-2.
20/06/2020	Kaingang	Interior Sul	82 years old	ND	18/06/2020	On 27/05/2020, the Indigenous man was attended reporting chest pain and dyspnea. On 30/05/2020, he was admitted in hospital and tested positive for SARS-CoV-2. On 02/06/2020, the patient was transferred to the hospital.
02/07/2020	Huni Kuin	Alto Rio Juruá	69 years old	No chronic disease background	30/06/2020	The Indigenous man presented respiratory symptoms on 25/06/2020 and was transferred to the local hospital; simultaneously, the clinical condition worsened with time. The patient was a local leader.
06/07/2020	Shanenawa	Alto Rio Juruá	90 years old	ND	03/07/2020	On 25/06/2020, the Indigenous woman presented respiratory symptoms and was transferred to the local hospital on 27/06/2020. The patient was a midwife in her tribe.
07/07/2020	Xavante	Xavante	60 years old	Diabetes mellitus	06/07/2020	The Indigenous man was a tribe chief and on 25/06/2020 was referred to the local hospital for the COVID-19 treatment. The patient had to wait for a bed in the ICU, which was made available on 06/07/2020.
10/07/2020	Javaé	Tocantins	79 years old	Moderate aortic valvulopathy, SAH, chronic pulmonary disease. He used a pacemaker.	09/07/2020	The Indigenous man was diagnosed with COVID-19 on 24/06/2020 and was transferred to the local hospital; later on, he was discharged and stayed at his daughter's house. She is a nursing technician. On 06/07/2020, his clinical condition worsened, he was sent back to the hospital, where he died.
13/07/2020	Huni Kuin	Alto Rio Juruá	99 years old	Chronic obstructive pulmonary disease and cardiopathy	11/07/2020	On 27/06/2020, the patient was admitted in hospital due to the presence of respiratory symptoms.
13/07/2020	Xerente	Tocantins	83 years old	SAH and diabetes mellitus	12/07/2020	On 01/07/2020, the Indigenous man was diagnosed with acute respiratory syndrome and the SARS-CoV-2 infection was confirmed. The patient presented cerebrovascular accident (CVA), possibly as a result of the COVID-19. On 11/07/2020, the patient was transferred to the ICU.
16/07/2020	Javaé	Tocantins	102 years old	SAH and hyperthyroidism	ND	The Indigenous woman was diagnosed with the COVID-19 on 15/07/2020 and presented clinical stability during hospital treatment.

Table 1 (continued)

Note	Ethnic group	DSEI	Age	Comorbidity	Death	Description found in the newsletter
16/07/2020	Javaé	Tocantins	83 years old	ND	ND	The Indigenous patient tested positive for SARS-CoV-2 infection on 13/07/2020 and the use of oxygen therapy was prescribed; the patient had to wait for a bed in the ICU for a long time.
23/07/2020	Rikbaktsa	Vilhena	46 years old	Absence of chronic diseases	22/07/2020	The Indigenous man was a tribe advisor and had influence among the indigenous leaders. On 09/07/2020, he presented decreased saturation, dyspnea and tachycardia. On 10/07/2020, his clinical condition worsened and he was transferred to the ICU. On 16/07/2020, the COVID-19 diagnosis was confirmed.
05/08/2020	ND	Xingu	71 years old	SAH, hypercholesterolemia, coronary disease and he had an ischemic vacuum-assisted closure	05/08/2020	The Indigenous man was a tribe chief.
12/08/2020	ND	Kayapó do Pará	71 years old	ND	11/08/2020	The Indigenous man was the healer of his tribe and took part in several processes that resulted in achievements for his people. Also, this patient refused to be transported (twice by air transportation and once by land transportation) to a hospital.
03/09/2020	Xavante	Xavante	75 years old	SAH and diabetes mellitus	01/09/2020	The Indigenous man was the chief of his tribe and had high influence among the Indigenous leaders.
04/09/2020	Xikrin	Altamira	78 years old	ND	31/08/2020	The Indigenous man was a tribe chief and was transported by air to the general hospital in Altamira.
08/09/2020	Xavante	Xavante	92 years old	SAH	04/09/2020	ND
10/09/2020	ND	ND	ND	ND	09/09/2020	The note reported the death of the civil servant that worked for the Brazilian National Indian Foundation (FUNAI) and coordinated the Ethnic-Environmental Protection Agency Uru Eu Wau Wau, dedicated to the protection of isolated Indigenous groups in Brazil.
05/10/2020	Krikati	Maranhão	87 years old	Diabetes mellitus	05/10/2020	The indigenous man was a tribe chief and a leader.
15/11/2020	Kariri	Ceará	39 years old	ND	10/11/2020	ND
11/01/2021	Terena	Mato Grosso do Sul	66 years old	ND	10/01/2021	The Indigenous man died of respiratory insufficiency; however, the COVID-19 infection was not confirmed. The patient worked for the Indigenous Health Special Secretariat Social Control, and was known and respected for his serenity, commitment, and diplomacy.
01/02/2021	Nôke Kôi	Alto Rio Juruá	56 years old	Diabetes, SAH and congestive cardiac insufficiency	01/02/2021	The Indigenous man was a tribe chief; he was an important leader in the fight for health, education, and indigenous territorial management.
02/02/2021	ND	Alto Rio Solimões	36 years old	Asthma	02/02/2021	The female Indigenous patient was a nurse in the Indigenous Health Multidisciplinary Team.

ND, nothing declared

(Individuals between 50 and 59 years old) seven releases; death was reported in all of them. One of the patients was a tribe chief that presented comorbidities such as DM and SAH and congestive cardiac insufficiency. A report was found that one of the patient's family did not allow his transfer to a health service with more specialized assistance;

(Individuals between 60 and 69 years old) eleven releases; 10 of them reported death. The comorbidities listed were DM (three patients) and obesity (one patient) and one of the patients was recovering from arboviruses infection (dengue and yellow fever). One of the dead patients was a tribe chief. Three patients did not accept to be transferred to a health center with more specialized service. In one of the reports, the patient died of respiratory insufficiency, but the SARS-CoV-2 contamination was not confirmed;

(Individuals between 70 and 79 years old) fifteen releases; 14 of them reported death. Four of the dead patients were tribe chiefs and one was a tribe healer. Regarding comorbidities, one patient presented cardiac disease, one had pulmonary disease, four had SAH, and two presented DM and SAH. The families of three patients did not allow their transportation to health centers with more specialized service. One patient required river transport and another air transport to reach proper medical assistance;

(Individuals between 80 and 89 years old) nine releases; death was reported in eight of them. As for comorbidities, one individual presented SAH and another had DM. One patient presented both SAH and DM;

(Individuals between 90 and 99 years old) four releases; all of them reported death. One of the female patients had strong influence among the tribe women and was a midwife. Regarding comorbidities, one patient had SAH, one presented DM, and another had chronic obstructive pulmonary disease.

Four notes were also published whose reports did not inform the age of the patients. Two of them reported the death of Indigenous leaders, one of them was a female leader.

Pandemic characterization in the Indigenous population according to the DSEIs

In the early February 2021, the Health Ministry declared that there were 738 suspected cases, 41,949 confirmed cases, 51,235 dismissed cases, 4,300 infected and active cases, 36,986 recovered cases, and 554 deaths related to the COVID-19 (last update: 03/02/2021, 17:00) (Table 2). The notes only reported 62 deaths, that is, only 11.19% of the total deaths. In addition, the frequency of the publications throughout the pandemic was noticed to reduce. In April/2020, fifteen releases were selected for this study, in May/2020, there were 27 releases; in June/2020, seventeen releases were found; in July/2020, nine releases were selected; in August/2020, there were only two releases related to the relevant theme; in September/2020, four releases were found; in October/2020, one release was selected; in November/2020, there was one release; in January/2021, one release was found; and, finally, in February/2021, there were two releases.

Additionally, Table 2 draws attention to the high number of cases in three DSEIs, these are the DSEIs in Mato Grosso do Sul (3,902 cases), Interior Sul (2,284 cases), and Alto do Rio Solimões (2,007 cases). The DSEI in Mato Grosso do Sul also presented the highest number of deaths of Indigenous patients related to the COVID-19 (83 cases), followed by the DSEIs in Xavanté and in Leste de Roraima, with 47 death cases each. The DSEI structure according to the base municipality (Federal Unit); general Indigenous population assisted, number of ethnic groups; number of tribes; number of CASAIs; number of states and municipalities covered by the Indigenous assistance; and number of base centers are described in detail in Table 3.

Indigenous importance in the Brazilian vaccination program development

In the national vaccination program, the Indigenous peoples who live on indigenous lands were included in the first phase and the vaccination overview is presented in Table 4.

Discussion

Cultural and ethnic diversity among the Indigenous peoples

In 1500, the indigenous population in Brazil was estimated in three million people, while in 1957, it was around 70,000. This reduction is the result of several processes faced by these groups, from violent episodes to the outbreak of several epidemics [12]. Currently, there are many laws to protect these peoples, and this, somehow fostered some increase in the Indigenous population. According to the 2010 census, carried out by the IBGE, the indigenous population corresponded to 817,963 inhabitants [15]. This large number includes 305 different ethnic groups that speak 274 different languages (FUNAI), characterizing Brazil as the Latin American country with the greatest diversity of Indigenous ethnic groups.

The ethnic diversity is characterized by a wide range of social and cultural manifestations. In general, Indigenous peoples have certain specific customs such as sharing domestic utensils and community accommodations. These practices, commonly adopted by the Indigenous groups, become hazardous in the COVID-19 pandemic context, since they favor the virus spread among the members of the same community. Another remarkable characteristic of the Indigenous peoples is the use of medicinal therapies based on native herbs, and even if this kind of therapy might have a beneficial effect on the

treatment of many diseases [16], including appearing to have potential in the treatment of COVID-19 symptoms and simple cases [17, 18]; they would hardly be recommended to treat severe cases of the disease, which require admission in the intensive care unit and orotracheal intubation.

In such context, Indigenous peoples should be considered a population at risk for the COVID-19. Additionally, it seems relevant to emphasize that the term "Indigenous population" is generic and represents several ethnic groups that might become extinct because of this virus. In addition, the elderly are known to present higher chances of complication and death in the COVID-19, and this age group plays a crucial role within the Indigenous communities; since they are the individuals that carry the knowledge and customs of that people, with the function of passing on their knowledge, mainly through orality [13].

Difficulty of differentiated access to health centers among Indigenous groups living in different states

After reading the Health Ministry notes, a lack of accessibility faced by the Indigenous populations to the health units was observed. Reports were found of Indigenous patients that could not be transported to places with resources to assist them properly due to deficiencies in the transport system. Also, for them to reach specialized health centers, river and air transportation was required, resulting in delayed medical assistance that might be associated to the mortality of these individuals, mainly the older ones.

Transportation is not always the main accessibility problem. For example, in many cases, the Indigenous patient or their family members refused the transportation to the health unit with higher degree of specialization. This fact might be related, mainly, to the native people's fear of being inserted in a social context different from that where they are used to living. Therefore, the commitment of the health team is necessary to insert the Indigenous patients and their families in a health and disease context, highlighting the importance of treatment and follow-up in units with more complex treatments, mainly in more severe cases, with the presence of comorbidities and/or for affected individuals that belong to older age groups (the elderly).

Whenever possible, the health professionals must guarantee that the Indigenous patients do not abandon their culture; in cases when the use of more modern treatment is required, the health professional should be aware of the Indigenous culture and try to combine as much as possible the modern therapy to that used in the tribe. As a result, the Indigenous patient might feel welcomed and probably the refusal to more modern and effective treatments can be reduced.

Factors associated to the COVID-19 pandemic spread in the Indigenous population

According to Cupertino et al. (2020), with data obtained from the Health Ministry, on 15 May, there were 340 confirmed cases and 21 deaths in the Indigenous population [12]. On March 02, 2021, the number of confirmed cases was 41,855 and there were 549 deaths, showing a fast increase in the disease within this ethnic group. This fast advancement of the disease can be considered multifactorial. Being aware that the SARS-CoV-2 transmission is carried out mainly through interpersonal contact, one important factor of this increase in cases among the Indigenous population might be the Indigenous group proximity with other ethnic groups. The contact might occur through several activities such as tourism, wood exploitation, illegal hunting, drug dealing, missionary actions, and the return of Indigenous individuals from their workplace to the community, among others [5, 19].

Many other factors such as sharing domestic and cooking utensils and also the fact that a large number of Indigenous individuals share the same household might have contributed to the SARS-CoV-2 spread; however, these factors are the Indigenous population sociocultural characteristics, which makes it harder to prevent their occurrence. Even so, it is of great importance that the Brazilian Federal Government, along with the State governments and FUNAI, assist all indigenous populations that need it, by being the most transparent possible regarding the forms of infection by SARS-CoV-2. Simultaneously, information clarifying what the best prevention method is in each community is needed, in such a way that would never impose any sociocultural change, but rather by dialoguing with the Indigenous leaders in order to provide them with information about the best practices and respecting their sociocultural characteristics.

Comorbidities in the Indigenous population and treatment refusal

Belonging to the Indigenous population is a risk factor for respiratory diseases. In children under 1 year old, greater mortality was observed due to acute respiratory infections when compared to the general population [20]. Moreover, during the H1N1 pandemic in 2009, the incidence of severe respiratory condition was seen to be 4.5 times higher in the indigenous population when comparing to the rest of the Brazilian population [21]. Finally, factors such as obesity, SAH, and DM are risk factors for severe cases and higher risk of mortality by the COVID-19 [22] and all these conditions are found in the Indigenous population. According to the study put forward by Freitas et al. (2020) in the Jaguapiru tribe, the prevalence of DM was 4.5%, obesity was 14.2% among male individuals and 30.8% in female individuals, and SAH

Table 2 SARS-CoV-2 infection in Brazilian Indigenous people epidemiological data*

DSEIs	Suspected	Confirmed	Dismissed	Infected (Active)	Clinical cure	Deaths
Alagoas and Sergipe	55	258	442	11	241	4
Altamira	0	1,275	1,527	50	1,222	2
Alto Rio Juruá	0	851	245	24	816	10
Alto Rio Negro	34	2,152	881	129	2,001	20
Alto Rio Purus	0	600	357	0	594	5
Alto Rio Solimões	1	2,062	1,099	12	2,007	37
Amapá e Norte do Pará	25	973	842	36	930	5
Araguaia	0	344	539	21	316	7
Bahia	15	718	1,046	66	645	7
Ceará	30	966	1,738	45	911	8
Cuiabá	31	1,301	771	56	1,221	24
Guamá-Tocantins	4	1,489	2,033	20	1,450	17
Interior Sul	47	2,462	4,015	135	2,284	41
Kaiapó do Mato Grosso	7	985	1,029	6	973	5
Kaiapó do Pará	31	1,213	1,162	3	1,174	9
Leste de Roraima	18	3,748	3,834	1,974	1,720	47
Litoral Sul	8	1,184	2,051	76	1,091	15
Manaus	17	925	1,358	79	823	14
Maranhão	0	1,676	1,042	1	1,643	27
Mato Grosso do Sul	8	4,100	9,893	108	3,902	83
Médio Rio Purus	0	506	15	0	501	5
Médio Rio Solimões and affluents	6	752	953	14	725	11
Minas Gerais and Espírito Santo	60	442	1,424	20	417	4
Parintins	45	569	831	11	544	12
Pernambuco	2	588	1,405	6	570	9
Porto Velho	19	1,266	1,288	121	1,134	10
Potiguara	7	675	860	2	669	4
Rio Tapajós	0	1,959	2,437	47	1,895	12
Tocantins	26	1,165	875	28	1,122	10
Vale do Javari	0	821	364	6	811	2
Vilhena	80	819	1,124	48	755	15
Xavante	3	899	2,525	20	826	47
Xingu	129	892	810	303	573	16
Yanomami	30	1,314	420	822	480	10
Total	**738**	**41,949**	**51,235**	**4,300**	**36,986**	**554**

*Data updated up to the first week of February 2021

appeared in 29.7% in both sexes [23]. Curiously, the prevalence of such comorbidities differs from the national mean, since the self-reported DM in Brazil was around 6.9% in 2013, and the SAH mean varied from 21.4 to 32.3%, depending on the evaluation method used, while obesity was 20.7% in women and 18.7% in men [24, 25], which is probably directly related to the diet of the tribes.

Evaluating the different prevalence of comorbidities in Indigenous tribes is important, since each comorbidities shows a different degree of severity for the COVID-19 [26], which requires different measures in each tribe to decrease the chance of those individuals developing more severe conditions.

How the SARS-CoV-2 spread among Indigenous peoples could have been prevented

The Indigenous population is a risk group for the COVID-19 [9]. Therefore, the adoption of practices to prevent this virus from spreading within the tribes is essential. Thus, restricting transportation of foreigners inside Indigenous areas is necessary, for example, by interrupting

Table 3 Overview of the vaccination in Brazil-PHASE 1 and the Indigenous importance in the public health management

States and federal district*	60-year-old or over institutionalized people	Institutionalized people with disabilities	Indigenous peoples living on indigenous land	34% health workers	Target population-phase 1
Acre (AC)	244	0	12,815	6,343	19,402
Amapá (AP)	76	0	7,616	7,057	14,749
Amazonas (AM)	400	60	101,156	32,813	134,429
Pará (PA)	962	10	23,184	58,334	82,49
Rondônia (RO)	140	0	7,784	15,595	23,519
Roraima (RR)	100	0	36,834	4,833	41,767
Tocantins (TO)	424	0	6,749	13,803	20,976
Northern region	2,346	70	196,138	138,778	337,332
Alagoas (AL)	1,246	10	7,946	32,594	41,796
Bahia (BA)	9,788	285	27,201	142,087	179,361
Ceará (CE)	2,398	132	20,250	86,380	109,160
Maranhão (MA)	264	110	19,626	58,223	78,223
Paraíba (PR)	1,212	120	10,432	42,925	54,689
Pernambuco (PE)	2,462	130	26,506	99,924	129,022
Piauí (PI)	460	10	21	28,651	29,142
Rio Grande do Norte (RN)	1,400	10	0	37,848	39,258
Sergipe (SE)	240	22	250	22,760	23,272
Northeastern region	19,470	829	112,232	551,392	683,923
Espírito Santo (ES)	2,970	210	2,793	42,273	48,246
Minas Gerais (MG)	38,578	1,160	7,878	227,472	275,088
Rio de Janeiro (RJ)	10,892	783	381	220,495	232,551
São Paulo (SP)	42,604	1,357	3,727	598,518	646,206
Southeastern region	95,044	3,510	14,779	1,088,758	1,202,091
Paraná (PR)	12,224	482	10,816	102,959	126,481
Rio Grande do Sul (RS)	9,510	380	14,348	138,523	162,761
Santa Catarina (SC)	3,460	263	8,317	56,540	68,580
Southern region	25,194	1,125	33,481	298,022	357,822
Federal District (FD)	648	178	95	49,629	50,550
Goiás (GO)	8,828	475	320	77,549	87,172
Mato Grosso (MT)	2,382	190	28,758	28,744	60,074
Mato Grosso do Sul (MS)	2,966	95	46,180	26,356	75,597
Center-Western region	14,824	938	75,353	182,278	273,393

missionary actions [13]. Additionally, it is relevant to reinforce the need for social isolation, use of masks, and gel alcohol. This might be a problem, since the adoption of such practices might be interpreted by the Indigenous individuals as loss of their cultural identity, possibly, damaging their mental health [27]. Moreover, although social isolation, use of masks, and gel alcohol and other attitudes are considered a public health measure by the World Health Organization to reduce the contagion rate, several speeches by the Brazilian President Jair Messias Bolsonaro are against this recommendation because he prioritizes the economy. It is a contradictory attitude that

Table 4 Description of the Indigenous Health Special Districts in Brazil

DSEI	Base Municipality (FU)	General indigenous population assisted	Ethnic group	Tribe	CASAI	States covered	Municipalities covered	Base Center
Alagoas Sergipe	Maceió (AL)	12,250	12	31	0	Alagoas and Sergipe	10	ND
Altamira	Altamira (PA)	3,974	10	60	1	Pará	5	1
Alto Rio Negro	São Gabriel da Cachoeira (AM)	40,233	25	707	1	Amazonas	3	25
Alto Rio Juruá	Cruzeiro do Sul (AC)	17,672	17	148	1	Acre	8	7
Alto Rio Purus	Rio Branco (AC)	13,555	7	150	1	Amazonas, Acre, and Rondônia	7	6
Alto Rio Solimões	Tabatinga (AM)	70,519	7	234	1	Amazonas	7	12
Alto Amapá and northern Pará	Macapá (AP)	12,440	11	139	2	Amapá and Pará	4	6
Araguaia	São Félix do Araguaia (MT)	5,562	8	41	1	Mato grosso, Goiás, and Tocantins	12	4
Bahia	Salvador (BA)	29,284	21	77	0	Bahia	23	9
Ceará	Fortaleza (CE)	26,129	15	100	1	Ceará	16	9
Cuiabá	Cuiabá (MT)	6,830	10	120	3	Mato grosso	16	3
Guamá-Tocantins	Belém (PA)	13,913	138	153	5	Tocantins and Pará	17	8
Interior Sul	Florianópolis (SC)	63,118	4	180	0	São Paulo, Santa Catarina, and Rio Grande do Sul	65	8
Kaiapó MT	Colíder (MT)	6,424	4	51	3	Pará and Mato Grosso	6	3
Kaiapó do Pará	Redenção (PA)	5,796	1	50	4	Pará	6	4
Leste Roraima	Boa Vista (RR)	53,213	7	323	0	Roraima	10	34
Litoral Sul	Curitiba (PR)	22,975	11	129	2	São Paulo, Santa Catarina, Rio Grande do Sul, Rio de Janeiro, and Paraná	68	15
Manaus	Manaus (AM)	30,768	35	218	1	Amazonas	15	16
Maranhão	São Luís (MA)	36,060	8	424	3	Maranhão	16	6
Mato Grosso do Sul	Campo Grande (MS)	83,434	8	99	3	Mato Grosso do Sul	129	15
Médio Rio Purus	Lábrea (AM)	6,822	17	105	2	Amazonas	3	10
Médio Rio Solimões and affluents	Tefé (AM)	24,538	16	184	2	Amazonas	14	15
Minas Gerais and Espírito Santo	Governador Valadares (MG)	16,648	10	93	2	Minas Gerais and Espírito Santo	14	18
Parintins	Parintins (AM)	16,911	2	124	2	Amazonas and Pará	5	13
Pernambuco	Recife (PE)	39,231	13	224	1	Pernambuco	15	12
Porto Velho	Porto Velho (RO)	10,311	68	172	6	Rondônia, Mato Grosso, and Amazonas	15	5
Pontiguara	João Pessoa (PB)	14,024	1	33	0	Paraíba	3	3
Rio Tapajós.	Itaituba (PA)	12,722	4	141	4	Pará	4	11
Tocantins	Palmas (TO)	11,908	11	160	2	Tocantins and Goiás	12	5
Vale do Javari	Atalaia do Norte (AM)	6,263	6	59	1	Amazonas	1	8
Vilhena	Cacoal (RO)	7,159	17	172	4	Amazonas	2	4
Xavante	Barra do Garças (MT)	20,653	1	305	1	Mato Grosso	12	6
Xingu	Canarana (MT)	7,213	16	81	4	Mato Grosso	8	4
Yanomami	Boa Vista (RR)	25,486	2	323	1	Roraima and Amazonas	1	37

ND, nothing declared; *CASAI*, Indigenous health houses; *DSEI*, Indigenous Health Special Districts; *FU*, federation unit

can cause a higher number of COVID-19 cases and deaths prompting the population to higher contagion rate with no or limited health supported. This fact can be worst among Indigenous peoples with a low access for health services. Moreover, the Federal Government neglects the Indigenous as a vulnerable group for the COVID-19 pandemic [9]. Because the Indigenous population is a risk group for the COVID-19, they were included in the Brazilian vaccination program as a priority group [28]. This measure is very important, since the control of the virus spread and the immunity of the elderly are fundamental for the preservation of the Indigenous culture diversity.

Other ethnic minority groups and people living on more deprived regions

Brazil is a country with a heterogeneous population, so there are other ethnic minorities besides Indigenous people and other people living on more deprived regions, such as Brown and Blacks. These people can be more susceptible for mortality due to COVID-19 as shown in a study that comprised 11,321 individuals with a positive test RT-PCR for SARS-COV-2 considering ethnic and racial issues on Brazil [29]. Curiously, a higher mortality in Brown and Black individuals comparing to White people was demonstrated [29]. Another interesting fact was the higher hazard ratios for mortality for the people from the northern and northeast regions from Brazil where the access for health services is low [29]. Baqui et al. (2020) demonstrated the outcomes for eight Indigenous according to COVID-19, being described five non-survivors [29]. The North region is the Brazilian region with the largest number of Indigenous people according FUNAI.

The divergence of prognosis to COVID-19 in different ethnicities has been noticed in other countries as well. Millett et al. (2020) conducted a study about American Black population, and it was noticed that cities with a higher concentration of Black people were associated with higher numbers of COVID-19 cases, as well as higher mortality [30]. In the cities with great counties of Black people, also were observed a higher number of comorbidities, elderly people ≥ 65 years of age, unemployment, lack of health insurance, and a higher air pollution index [30]. In brief, it was demonstrated that among the ~20% US counties are disproportionately Black, and they accounted for 52% of COVID-19 diagnoses and 58% of COVID-19 deaths in the USA [30]. Curiously, the same outcome occurred at Baqui et al. on Brazil [29].

Holtgrave et al. also noticed differences of prognosis between white non-Hispanic, Black non-Hispanic, and Hispanic adults in New York City [31]. The mortality risk from COVID-19 in non-Hispanic Black adults and Hispanics was 5.38 and 3.48 times greater, respectively, than non-Hispanic Whites. It is known that the Black population is considered vulnerable, considering that they correspond to an ethnic group with a higher poverty rate and, consequently, less access to health services [32]. The divergence was also noticed in the city of Chicago, and in the states of Louisiana and Michigan [33]. In Chicago and Louisiana, the Black people correspond to ~30% of the population, and ~70% of reported deaths due to COVID-19. In Michigan, Black people constitute 14% of the population and represent ~40% of deaths due COVID-19 [33]. As discussed by Holtgrave et al., Hispanic had differences in infection experience and non-Hispanic Black had differences in both infection experience and in the need for hospitalization due the SARS-COV-2, relative to White to be the cause for the disparities [31].

Also, Lusignan et al. analyzed a population sample from Oxford and noted that the chances of contamination rate by SARS-CoV-2 were higher in people of other ethnicity than White or in people living in poorer areas [34]. The problem behind this situation extends beyond the health issue, also affecting economic issues, considering that the measures of social restriction to combat the COVID-19 pandemic cause huge economic impact, mainly among the people who deserve more attention, due to higher social and economic vulnerability.

Once the social vulnerabilities are identified, it is important to discuss the epidemiological aspects that involve the different minority groups and people living on more deprived regions to implement a better planning to combat the pandemic and to preserve each group. However, it was not the reality. Unfortunately, in state of Connecticut, for example, there was negligence in the racial characterization of the victims of COVID-19: more than 50% of the laboratory reports related to the disease in question did not contain information about race [32].

Brazil should implement measures to deal with the pandemic considering the vulnerability groups related to COVID-19 being the Indigenous peoples the most vulnerable to infection with SARS-CoV-2 and the most impoverished monetarily [35]. Furthermore, Brown and Black people are more vulnerable to infection with SARS-CoV-2 than White and Asian groups, and the states with greatest vulnerability deserve more attention to control the pandemic [35].

Unfortunately, the negligence of minority groups and people living on more deprived regions is not a current problem. For example, it was also noted the different impacts during the H1N1 pandemic among minority groups and people living on more deprived regions. A study done in England during 2009 and 2010 outbreak analyzed the deaths due to H1N1. It was observed that 19.9% of deaths corresponded to non-white ethnicities, while this population corresponds to only 12.5% of the country population [36].

Limitations

There were limitations in the data collection from the Brazilian Health Ministry database. Several published releases (notes) did not present complete information, and in many of the information such as DSEI of origin, ethnic group, age, or the presence of comorbidities was not reported. Additionally, some negligence was observed regarding the publication of information during the pandemic. In May, for example, twenty-seven notes described the criteria determined for inclusion in this paper, while in other months, only one newsletter met the inclusion requirements.

Conclusion

Taking into consideration the concept of universality, the Indigenous population must be assisted in a holistic way, considering their customs and traditions. Therefore, more specialized health units should be made available closer to the tribes to provide proper assistance to this population during the current pandemic and in future emerging problems that might affect that population.

Code availability Not applicable.

Author contribution All authors have approved the manuscript and agreed with its submission to the journal. Also, all authors wrote and revised the manuscript.

Data availability Not applicable.

Declarations

Ethics approval and consent to participate Not applicable.

Consent for publication Not applicable.

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Competing interests The authors declare no competing interests.

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