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Covid-19 morbimortality and vaccination coverage among indigenous populations in a Brazilian Amazon state

Morbimortalidade por Covid-19 e a cobertura vacinal entre indígenas em um estado da Amazônia brasileira

Morbilidad y mortalidad por Covid-19 y cobertura de vacunación en indígenas de un estado de la Amazonía brasileña

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ABSTRACT
Objective: to analyze Covid-19 morbidity and mortality and vaccination coverage among Indigenous populations in a Brazilian Amazon state. **Method:** this is an epidemiological, descriptive, cross-sectional study conducted with secondary data from 8,197 records of Covid-19 cases and deaths and vaccination coverage among Indigenous people from 2020 to 2022 in the state of Pará. The data originated from the Ministry of Health and were analyzed using descriptive statistics after approval by the Research Ethics Committee. **Results:** the study showed a higher proportion of Covid-19 cases in females (n=4,262; 51.99%), among children (n=1,994; 24.32%), and a higher number of deaths in the age group of 71 to 80 years old (n=17; 32.69%). Vaccination coverage was low, with 51.6% (n=4,653) and 52.8% (n=2,177) in the Special Indigenous Health Districts of Rio Tapajós and Kaiapó do Pará, respectively, for the first dose. **Conclusion:** there was an increase in mortality in most Districts and low Covid-19 vaccination coverage.
Descriptors: Covid-19; Indigenous Peoples; Morbidity; Mortality; Vaccination Coverage.

RESUMO
Objective: to analyze Covid-19 morbidity and mortality and vaccination coverage among Indigenous populations in a Brazilian Amazon state. **Method:** epidemiological, descriptive and cross-sectional study conducted with secondary data from 8,197 records of Covid-19 cases and deaths and vaccination coverage among Indigenous people from 2020 to 2022 in the state of Pará. The data originated from the Ministry of Health and were analyzed using descriptive statistics after approval by the Research Ethics Committee. **Results:** the study showed a higher proportion of Covid-19 cases in females (n=4,262; 51.99%), among children (n=1,994; 24.32%), and a higher number of deaths in the age group of 71 to 80 years old (n=17; 32.69%). for the first dose, vaccination coverage was low in the Special Indigenous Health Districts of Rio Tapajós (n=4.653; 51.6%) and Kaiapó do Pará (n=2.177; 52.8%). **Conclusion:** there was an increase in mortality in most Districts and low Covid-19 vaccination coverage.
Descritores: Covid-19; Povos Indígenas; Morbidade; Mortalidade; Cobertura Vacinal.

RESUMEN
Objetivo: analizar morbilidad y mortalidad por Covid-19 y la cobertura de vacunación de pueblos indígenas de un estado de la Amazonía brasileña. **Método:** estudio epidemiológico, descriptivo y transversal, realizado con datos secundarios de 8.197 casos y muertes por Covid-19 y cobertura de vacunación de indígenas, del período de 2020 a 2022, en el estado de Pará. Los datos se obtuvieron del Ministerio de Salud y se analizaron mediante estadística descriptiva, después de la aprobación del Comité de Ética en Investigación. **Resultados:** hubo una mayor proporción de Covid-19 en el sexo femenino (n=4.262; 51,99%), en los niños (n=1.994; 24,32%), y mayor número de muertes en la franja etaria de 71 a 80 años (n=17; 32,69%). Se registró baja cobertura de vacunación en los Distritos Sanitarios Especiales Indígenas Rio Tapajós (n=4.653; 51.6%) y Kaiapó de Pará (n=2.177; 52,8%) relativa a la primera dosis. **Conclusión:** hubo aumento de la mortalidad en la mayoría de los Distritos y baja cobertura de vacunación contra el Covid-19.
Descriptores: Covid-19; Pueblos Indígenas; Morbidad; Mortalidad; Cobertura de Vacunación.

INTRODUCTION

In December 2019, in the city of Wuhan, China, an outbreak of pneumonia of unknown etiology was reported, gaining widespread media coverage starting in 2020. After identifying the virus through genetic material analysis and viral genome sequencing, the new coronavirus strain was named Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), responsible for the infectious viral disease coronavirus disease 2019 (Covid-19)[1-3].

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Due to the high incidence rate and the spread of the disease across continents, the World Health Organization (WHO) declared a public health emergency, recognizing it as a new pandemic. As of December 2023, an estimated 772.8 million cases have been confirmed worldwide, with approximately 6.98 million deaths. During the same period, in Brazil, approximately 38.21 million cases were reported, with over 708,000 deaths[3-5].

The lethality of the infection was estimated to be approximately 14 times that of influenza, primarily due to the absence of specific vaccines and antivirals for treatment and prevention at the onset of the pandemic. Both viral infections present with similar clinical symptoms, such as sore throat, fever, runny nose, and cough. However, the severity of Covid-19 can lead patients to develop dyspnea and hypoxemia from extensive viral pneumonia, or even progress to respiratory failure and multiple organ dysfunction, requiring intensive care to stabilize their health[6,7].

In Brazil, the first case of Covid-19 was recorded in February 2020. From that point on, the virus spread to the major capitals of the country and continued to reach both urban and rural areas[8]. As of epidemiological week #28, in July 2023 (SE 28/2023), the state of Pará, located in the country's northern region, had confirmed 883,709 cases and 19,140 deaths[9].

The distribution of cases was heterogeneous across geographical areas and among human groups, driven by significant socio-spatial inequalities and challenges in accessing healthcare services, particularly for vulnerable populations[10]. Indigenous populations stand out among socially disadvantaged groups, marked by poverty, malnutrition, occupational risks, social conflicts, and elevated morbidity and mortality rates[11,12].

Preliminary data from the 2022 demographic census, conducted by the Brazilian Institute of Geography and Statistics (IBGE), indicate that Indigenous people total approximately 1,693,535 individuals across Brazil. Of this total, 622,100 (36.73%) reside in Indigenous lands, while 1.1 million (63.27%) live outside them. The northern region is home to 753,357 Indigenous people, representing about 44.48% of this population segment[13-15].

Indigenous people have particular characteristics that set them apart from other population groups due to historical, political, socio-cultural, and economic circumstances, identifying them as traditional peoples. They have a specific way of life tied to cultural roots, which reflects in mutual living, shared communal environments, and using nature as a source of nutrition, health, and well-being. However, this distinctive way of life also predisposes them to biological risks and the development of communal diseases[16,17].

Health care assistance for these groups is provided through the Indigenous Health Subsystem (SASI-SUS), which integrates Indigenous health management with the Unified Health System (SUS), aiming to ensure access to available services based on the realities of each locality[16].

Following the approval of the National Health Policy for Indigenous Peoples (PNASPI), the SASI-SUS service network was structured and organized in Brazil into 34 specific subsystems, known as Special Indigenous Sanitary Districts (DSEI), all of which reported Covid-19 cases[11,18]. The DSEIs were strategically organized to provide Primary Health Care (PHC) actions and services integrated with other levels of complexity within SUS[16-19].

Between the first and last Epidemiological Weeks reported in 2022 (SE 44/2022), the Special Secretariat for Indigenous Health (SESAI) recorded around 204,250 cases of Covid-19 across the 34 DSEIs, of which 69,788 (34%) were confirmed, and 70 (0.04%) were suspected cases. Of the confirmed cases, 928 (1.3%) Indigenous individuals progressed to death[20].

To reduce the impact of morbidity and mortality, Indigenous people over 18 years of age were included among the priority groups for vaccination, given their genetic susceptibility and social, environmental, and geographic vulnerabilities, which increase the severity of the disease and the risk of death[17]. This measure was based on the confirmation that the Covid-19 vaccine is a method that helps curb the spread of the disease and alleviate symptoms in those infected[21,22].

Studies show that 88% of Indigenous individuals aged 18 years old or older received the second dose of the Covid-19 vaccine by October 2021[20]. It is important to note that, in general, satisfactory vaccination coverage helps reduce the incidence of vaccine-preventable diseases and associated deaths[23]. These data highlight the need for research on the behavior of the disease among Indigenous populations. Despite the importance of this topic, there are still knowledge gaps concerning illness, mortality, and vaccine implementation in Indigenous territories.

In light of this, the study aimed to analyze morbidity, mortality, and Covid-19 vaccination coverage among Indigenous populations in the state of Pará.

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METHOD

This is an epidemiological, descriptive, cross-sectional study conducted in the state of Pará, located in the northern region of Brazil. The state is home to approximately 80,974 Indigenous people, representing 4.48% of the Brazilian Indigenous population[13]. Approximately one-quarter (24.52%) of Pará's territory is composed of Indigenous lands grouped into DSEIs, whose headquarters in the state are: DSEI Altamira, DSEI Kaiapó do Pará, DSEI Guamá-Tocantins, and DSEI Rio Tapajós[24].

In the state of Pará, there are 84 ethnic groups located in 742 villages that receive Primary Health Care (PHC) services provided by Indigenous Multidisciplinary Health Teams (EMSI) under the supervision of the corresponding DSEI. Specialized care needs, both at the outpatient and hospital levels, are facilitated through the SUS health care network[25].

The study was conducted using restricted-access secondary data from the Ministry of Health (MS), available on the Integrated Ombudsman and Access to Information Platform (Fala.BR), under the custody of the Federal Executive Branch. Covid-19 cases, deaths, and vaccination coverage were analyzed for each DSEI headquartered in the state of Pará. The selection of DSEIs was based on the ethnic characteristics and geographic distribution of Indigenous communities.

The study population consisted of 8,197 cases of Covid-19 morbidity and mortality among Indigenous people across the four DSEIs in the state, reported from 2020 to 2022, along with vaccination coverage data from the same period. Inclusion criteria included all Covid-19 cases and all deaths from the disease with laboratory confirmation reported among Indigenous residents in the DSEIs.

Vaccination coverage data adhered to the same residency and DSEI affiliation criteria and Indigenous population data were obtained from SESAI. Sample comprised all reported cases, and data collection occurred from January to March 2023.

The variables analyzed were age, gender, population count, number of Covid-19 cases, number of deaths, DSEI of residence, location of death occurrence, year of notification, estimated population for vaccination, and vaccine dose.

Data were organized and analyzed in spreadsheets using Microsoft Office Excel® 2019, where cleaning, filtering, and organization were performed according to variables and respective years. Data on demographic profiles and vaccination coverage were analyzed descriptively by DSEI. Incidence and fatality rates by DSEI were calculated, considering the number of cases, deaths, and the local population. Cases were classified based on the date of disease confirmation, while deaths were classified by date of outcome.

Covid-19 incidence rates were calculated for the years 2020, 2021, and 2022, using the Indigenous population count in each DSEI according to the year of notification. The incidence rate per 10,000 inhabitants was determined using the following equation: number of cases divided by the population, multiplied by 10,000.

To calculate vaccination coverage, the estimated population eligible to receive the first dose of the vaccine in 2020 was considered, continuing with the second dose and the booster dose, using the mathematical expression: Vaccination coverage = (number of doses administered) x 100 / estimated population. For the fatality rate, the formula used was: (Number of Covid-19 deaths) x 100 / number of cases.

The research protocol was approved by the Research Ethics Committee of the proposing institution.

RESULTS

A total of 50,947 Indigenous individuals were identified, distributed among the DSEIs as follows: Altamira (n=4,838, 9.5%), Guamá-Tocantins (n=22,026, 43.23%), Kaiapó do Pará (n=6,353, 12.47%), and Rio Tapajós (n=17,730, 34.80%). The demographic profile is described in Table 1.

A total of 8,197 Covid-19 cases were recorded, with the highest proportion in the DSEI Altamira (n=2,611, 31.85%), among women (n=4,262, 51.99%), and in the age group of 1 to 11 years old (n=1,994, 24.32%).

Table 2 shows a reduction in Covid-19 incidence rates over the studied three-year period, except in the DSEI Kaiapó do Pará, where an increase was recorded between 2021 (n=127.5/10,000 inhabitants) and 2022 (n=168.4/10,000 inhabitants), respectively.

The highest incidence rates occurred in 2020, with the DSEI Altamira showing the highest rate (n=2,751.1/10,000 inhabitants) and the DSEI Guamá-Tocantins the lowest (n=630.2/10,000 inhabitants).

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Table 1: Demographic profile of Indigenous individuals affected by Covid-19 in the state of Pará, by DSEI, from 2020 to 2022 (n=8,197). Pará, Brazil, 2024.

Variables		DSEI Altamira n =2,611 (31.85%)	Guamá-Tocantins n =1,621 (19.78%)	Kaiapó do Pará n =1,407 (17.16%)	Rio Tapajós n =2,558 (31.21%)	Total n = 8,197 (100%)
Gender	Female	1,305 (49.98)	848 (52.31)	735 (52.24)	1,374 (53.71)	4,262
	Male	1,306 (50.02)	773 (47.69)	672(47.76)	1,184 (46.29)	3,935
Age group	Under 1 year old	104 (3.98)	34 (2.10)	36 (2.56)	66 (2.58)	240
	1 - 11 years od	888 (34.01)	232 (14.31)	343 (24.38)	531 (20.76)	1,994
	12 - 19 years old	517 (19.80)	237 (14.62)	237 (16.84)	420 (16.42)	1,411
	20-29 years old	450 (17.23)	308 (19.00)	247 (17.56)	439 (17.16)	1,444
	30-39 years old	296 (11.34)	263 (16.22)	209 (14.85)	377 (14.74)	1,145
	40-49 years old	154 (5.90)	229 (14.13)	144 (10.23)	288 (11.26)	815
	50-59 years old	91 (3.49)	112 (6.91)	79 (5.61)	164 (6.41)	446
	60-69 years old	49 (1.88)	90 (5.55)	37 (2.63)	122 (4.77)	298
	70-79 years old	40 (1.53)	81 (5.00)	43 (3.06)	116 (4.53)	280
	80+	22 (0.84)	35 (2.16)	32 (2.27)	35 (1.37)	124
Total		-	-	-	-	**8,197**

Source: Ministry of Health / Fala.BR data. Brazil, 2024.

Table 2: Covid-19 incidence, mortality, and fatality rates in the DSEIs of the State of Pará, from 2020 to 2022. Pará, Brazil, 2024.

	DSEI Altamira	Guamá-Tocantins	Kaiapó do Pará	Rio Tapajós	Total
Incidence					
2020	2,751.1	630.2	1,918.8	1,325.9	-
2021	1.990.5	59.0	127.5	260.0	-
2022	655.2	46.8	168.4	150.7	-
Fatality					
2020	0.2	1.0	0.7	0.8	-
2021	-	2.3	1.2	1.6	-
2022	0.3	-	0.9	-	-
Mortality					
No. of Deaths (n - %)	3 (5.76)	17 (32.69)	11 (21.15)	21 (40.38)	52 (100,00)
2020	2 (66.66)	14 (82.35)	9 (81.81)	15 (71.42)	40
2021	-	3 (17.64)	1 (9.09)	6 (28.57)	10
2022	1 (33.33)	-	1 (9.09)	-	2
Age group					
1 - 19 years od	1 (33.33)	1 (5.89)	1 (9.09)	1 (4.76)	4
20-39 years old	-	-	1 (9.09)	-	1
40-59 years old	1 (33.33)	1 (5.88)	2 (18.18)	1 (4.76)	5
60-79 years old	1 (33.33)	12 (70.58)	4 (36.36)	12 (57.14)	29
80 or older	-	3 (17.64)	3 (27.27)	7 (33.33)	13
Locus					
Health Units	2 (66.66)	13 (76.47)	7 (63.63)	13 (61.90)	35
Village	-	4 (23.52)	4 (36.36)	8 (38.09)	16
Not reported	1 (33.33)	-	-	-	1
Total	-	-	-	-	52

Source: Ministry of Health / Fala.BR data. Brazil, 2024.

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Covid-19 fatality was most significant in the DSEI Guamá-Tocantins, both in 2020 (1%) and in 2021 (2.3%), with the 2021 rate being more than double that of 2020. In 2022, the highest rate was in the DSEI Kaiapó do Pará (0.9%). An increase was observed in most DSEIs, while vaccination coverage showed a decline across all DSEIs.

Regarding Covid-19 mortality, 52 deaths were confirmed by laboratory tests from 2020 to 2022, with the highest number in 2020 (n=40, 76.92%). In terms of age groups, the highest proportions were among individuals aged 71 to 80 years old (n=17, 32.69%), followed by those aged 61 to 70 years old (n=10, 19.23%). As for the location of death, the highest proportion occurred in the DSEI's referral health unit (n=35, 67.30%), followed by deaths in villages (n=16, 30.77%), with one death (n=1, 1.92%) lacking a recorded location.

Findings related to vaccination coverage are presented in Table 3.

Table 3: Covid-19 Vaccination Coverage in the DSEIs, by Dose Type, from 2020 to 2022 Target Para, Brazil, 2024.

DSEI	Target Population	1st Dose	Coverage 1st Dose	2nd Dose	Coverage 2nd Dose	Booster	Coverage Booster
Altamira	3,053	2,692	88.2	2,163	70.8	259	8.5
Guamá-Tocantins	13,803	12,386	89.7	11,005	79.7	7,598	55.0
Kaiapó do Pará	4,125	2,177	52.8	1,448	35.1	286	6.9
Rio Tapajós	9,012	4,653	51.6	3,215	35.7	668	7.4

Source: Ministry of Health / Fala.BR data. Brazil, 2024.

In terms of vaccination coverage, based on the estimated population for vaccination, the highest coverage for the first dose was observed in the DSEI Guamá-Tocantins, reaching 89.7% (n=12,386) of the population. In this same DSEI, 79.7% (n=11,005) received the second dose, and 55% (n=7,598) received the booster dose. DSEI Altamira recorded the second-highest vaccination coverage, with 88.2% (n=2,692) of Indigenous people receiving the first dose, 70.8% (n=2,163) receiving the second dose, and 8.5% (n=259) receiving the booster dose. In the DSEIs Rio Tapajós and Kaiapó do Pará, 51.6% (n=4,653) and 52.8% (n=2,177) of the population received the first dose, respectively, with similar coverage rates for the second dose and booster dose.

DISCUSSION

The data revealed a higher incidence of cases in the DSEI Altamira during the first year of the pandemic. Regarding mortality with laboratory confirmation, the highest proportions were observed in 2020, and vaccination coverage showed low rates across the four districts, particularly for the second and booster doses.

From a demographic perspective, Covid-19 affected females more than males, as well as children up to 11 years old. The greater impact on women may be related, among other factors, to lower vaccine acceptance, as indicated by a study [26], which concluded that women are more resistant to adhering to vaccination than men. It is worth noting that immunization is the most effective way to prevent the spread of the virus and the emergence of new variants, providing community protection against the more severe forms of the disease. Further investigation should focus strictly on the results obtained, emphasizing the new and significant aspects of the study.

Regarding the spread of Covid-19 among Indigenous people, it is important to highlight that respiratory infections were already considered the leading causes of morbidity and mortality in Indigenous populations in Brazil, especially among children, due to historical factors marked by poor sanitation conditions, food insecurity, and limited access to health care services[27]. Additionally, the WHO stated that, for children aged five to 11, adherence to wearing protective masks would depend on the level of virus transmission in their area of residence[28]. However, given community habits, the historical prevalence of infectious diseases, and the noted vulnerabilities, this age group is recognized as having a heightened predisposition to Covid-19[29].

The introduction of Covid-19 into Indigenous communities carried a high potential for spread due to their intrinsic collective living, which shapes their social and cultural organization, as well as their health-disease dynamics. This demonstrates that the outcomes of the disease in Brazil reflect not only the genetic and anatomical-physiological predisposition of individuals but also the social, political, and economic context in which they are situated[27].

In village routines, Indigenous people face the consequences of inadequate health care infrastructure, including shortages of supplies and equipment, a lack of trained professionals, and territorial challenges in transferring patients who

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require medium- and high-complexity specialized care[29]. This, therefore, confirms the limited access to adequate health care services and exposure to factors that delay diagnosis and increase Covid-19 incidence[30].

In 2020, the DSEI Altamira showed the highest incidence of cases compared to the other DSEIs. This phenomenon can be understood in light of certain behaviors typical of Indigenous peoples, such as sharing personal items, traditional hygiene practices, and communal housing, which are important cultural values for these communities but also constitute potential risks for virus transmission. Furthermore, socioeconomic interactions with non-Indigenous individuals did not cease during this period, which may explain the occurrence of cases within these communities[31].

It is worth noting that Covid-19 affects areas with greater social inequality, raising concerns for the Indigenous population due to their history of vulnerability[29]. This scenario connected the high virus transmission to the limited effectiveness of measures to control its spread, as most therapeutic actions were delayed, particularly for this population, which requires multisectoral attention to address specific needs.

Among the 52 deaths recorded in the DSEIs of the state of Pará from 2020 to 2022, 40 occurred in 2020. This phenomenon may be attributed to the lack of standardized strategies for disease prevention and treatment, as vaccines and established therapeutic protocols against Covid-19 were not yet available in 2020[14].

Indigenous people aged 61 to 80 years old showed higher morbidity and mortality rates compared to younger age groups. Historically, in Brazil, the Indigenous population has displayed poor health indicators, which characterizes them as a vulnerable group to infectious diseases. However, the elderly population was considered a high-risk group due to physiological predispositions and associated chronic comorbidities that contribute to more severe disease progression and higher mortality[32].

Previous studies have shown that individuals aged 70 years old or more may experience a faster disease progression than those under 70, as Covid-19 infection often results in a shorter time span from the onset of symptoms to the time of death[32]. In Indigenous communities, the death of an older adult represents a threat to community life, as it compromises the preservation of culture and identity, with the elderly being the guardians of traditional knowledge[33].

At the same time, vaccination is a fundamental measure to contain the spread of vaccine-preventable diseases, contributing effectively to public health issues. From this perspective, vaccines demonstrate their effectiveness by preventing complications and deaths from Covid-19, resulting in reduced mortality rates[34]. However, data on vaccination coverage indicated incomplete vaccination regimens among the estimated population in each DSEI.

In this context, several factors affect the effectiveness and completion of the vaccination regimen among Indigenous populations in these territories. Health care teams face challenging working conditions, including work overload, insufficient infrastructure, and inefficient logistics for transporting supplies—all compounded by geographical obstacles such as forests, rivers, and unique climate conditions. These difficulties constitute everyday challenges in this intercultural context, characterized by high turnover of workers and discontinued actions[35].

The social and geographic isolation of Indigenous populations also hinders the implementation of vaccination strategies due to the lack of effective policy coordination to reduce health disparities among these groups. Under these conditions, the impact of the Covid-19 pandemic led to increased incidence rates and preventable deaths due to social disadvantages, cultural aspects, economic activities, and gaps in Indigenous health conditions[36].

Considered a major public health issue during the pandemic, fake news—referring to false information—spread at an exponential rate. The creation and spread of fabricated, manipulated, and unverified information contributed to the distortion of scientific facts, leading a significant portion of the Brazilian population to doubt scientifically proven findings about vaccines and Covid-19 pathology, thereby interfering with the health-disease process[2,37].

This misinformation altered individual and/or collective perceptions regarding protective and preventive measures against the disease, fostering distrust in vaccine safety. The denialist behavior was even encouraged by the country's main political leader at the time, who raised issues regarding the non-mandatory nature of vaccination, lack of proven efficacy, and potential side effects of the vaccine. As a result, fake news impacted population adherence to vaccines, even affecting entire communities, who came to believe the vaccine was not safe. This hindered the effective control of viral transmission, increasing vaccine hesitancy[2,37,38].

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In light of this situation, the Articulation of Indigenous Peoples of Brazil (APIB) launched a vaccination campaign called *Vacina Parente*, aimed at encouraging vaccination by combating fake news about the vaccine and the disease, and promoting political, judicial, and communicative efforts in support of Indigenous peoples. Through this initiative, it was possible to take action to reduce Covid-19 incidence among Indigenous people, as Covid-19 fatality rates in the DSEIs were higher compared to the general population[14,39].

Covid-19 vaccination began in the United Kingdom on December 8, 2020. In Brazil, however, the vaccination campaign only began in the second half of January 2021, just weeks before the rapid spread of the more aggressive Gamma variant. As a result, there were inequalities in vaccination coverage against the disease both among countries and across regions in Brazil. In Brazil, this delayed distribution was linked to the federal government's Covid-19 response policy at the time, which delayed agreements for vaccine procurement[40,41].

With the introduction of the Covid-19 vaccine in 2021, the impact of vaccination campaigns became evident in the DSEIs of Pará, as a sharp decline in the number of deaths was observed in these Districts in 2021 and 2022. It is also worth noting that this low number of deaths may be associated with underreporting[42]. It is recognized that all regions of Brazil exhibited high levels of underreporting, which is detrimental to public policies aimed at improving Indigenous communities, as this deficiency can affect data analysis, disease control, and the implementation of programs, processes, and policies targeted at Indigenous populations[43].

Despite the progress in vaccination nationwide, a decline in Covid-19 vaccination coverage was observed in the DSEIs of Pará. This led to increased fatality rates in most Districts, which may be related to the high health care demand in the villages and the lack of vaccine doses for immunization. In light of this, it is important to emphasize that more democratic access to health care units, diagnostic methods, and Covid-19 vaccination supports preventive and supportive care, which may reduce the risk of death among Indigenous residents in the DSEIs[14].

It is also notable that, during the pandemic, some health care units in the DSEIs received improvements, such as training for multidisciplinary teams to handle Covid-19 cases, increased supply stocks, and expanded infrastructure for better isolation of infected individuals. However, inadequate distribution and management of these resources, as well as a lack of effective measures for protection and treatment, affected the full operation of services, resulting in differences in infection and death rates across communities[14,44].

It is important to highlight that, within the context of the pandemic, there are multiple perspectives. It is understood that people's perceptions of scientific information are socially constructed, depending on political, socioeconomic, and cultural factors, and are shaped by risk communication during emergencies, such as the pandemic. This communication is integral to any emergency response, dealing with scientific uncertainties and bringing together different narratives to address specific interests. Thus, health information can influence individual perceptions and contribute to the spread of misconceptions about health, playing a crucial role in shaping individual and collective behavior[45].

Study limitations

The study's limitations stem from its reliance on secondary data, which may be subject to inconsistencies due to human error in data recording and entry. Moreover, the scientific literature lacks sufficient evidence to support result interpretation, making it challenging to explore and compare this study's findings with those of other studies in similar contexts.

The findings contribute to supporting nursing actions that address Covid-19 among Indigenous people residing in the DSEIs of Pará and the morbidity and mortality outcomes concerning vaccination against the disease. This enables the provision of comprehensive and quality care, respecting the unique characteristics of these traditional communities and facilitating the development of health services and policies that meet the specific needs of each DSEI. Thus, through appropriate care strategies, the most prevalent diseases among Indigenous populations can be reduced and/or prevented, promoting improved epidemiological indicators and the implementation of more targeted interventions.

CONCLUSION

The findings of this study allowed for the identification of the impacts of Covid-19 vaccination on Indigenous people in the DSEIs of the state of Pará, reflecting the cultural, political, and economic context in which these communities have historically existed. The results indicate low vaccination coverage against the disease compared to the general population,

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making them more susceptible to severe outcomes. This scenario highlights the challenges of vaccination and the limitations of PHC in providing qualified services tailored to the needs of the Indigenous population in these territories.

It is noteworthy that, despite using secondary data from the Ministry of Health, this is one of the first studies to investigate vaccination outcomes in the Indigenous population of Pará's Districts concerning morbidity and mortality. Thus, further studies in the northern region of the country and/or territories within the Brazilian Amazon are recommended, considering health incidents affecting Indigenous populations.

It is essential to train and encourage health care professionals to report Covid-19 cases and deaths, aiming for better analysis of the current state of the disease and the implementation of effective strategies. It is necessary to establish and strengthen socially committed health care practices and guidelines that respect and value Indigenous knowledge and practices, taking into account their beliefs and perspectives on the health-disease process.

The study can guide public authorities in building and strengthening measures to reduce barriers to health care access and increase Covid-19 vaccination coverage in Brazil, particularly in the northern region. Finally, recognizing the importance of collective immunization, it is essential to implement and reinforce measures that encourage vaccine adherence to prevent the spread of the virus and its multifactorial impacts, thereby supporting the life expectancy and quality of life of the Indigenous population.

REFERENCES

1. Moreira RS. Covid-19: intensive care units, mechanical ventilators, and latent mortality profiles associated with case-fatality in Brazil. Cad Saúde Pública. 2020 [cited 2023 July 03]; 36(5):e00080020. DOI: https://doi.org/10.1590/0102-311X00080020.
2. Silva GM, Sousa AAR, Almeida SMC, Sá IC, Barros FR, Sousa Filho JES, et al. Covid-19 vaccination challenges: from fake news to vaccine hesitancy. Cienc Saúde Coletiva. 2023 [cited 2023 July 03]; 28(3):739-48. DOI: https://doi.org/10.1590/1413-81232023283.09862022.
3. Silveira SCT, Ferreira Filho HR, Pontes AN, Lopes HS, Manfrini GC. The Covid-19 pandemic through the lens of humanitarian logistics. Ciênc Saúde Coletiva. 2023 [cited 2023 June 04]; 28(3):749-59. DOI: https://doi.org/10.1590/1413-81232023283.11762022.
4. Brasil. Painel Coronavírus [Site de Internet]. Brasília: Ministério da Saúde; 2023 [cited 2023 Nov 17]. Available from: https://covid.saude.gov.br/.
5. World Health Organization. Coronavirus disease (Covid-19) pandemic [Site de Internet]. Geneva: WHO; 2023 [cited 2023 Nov 17]. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019.
6. Daumas RP, Silva GA, Tasca R, Leite IC, Brasil P, Greco DB, et al. The role of primary care in the Brazilian healthcare system: limits and possibilities for fighting Covid-19. Cad Saúde Pública. 2020 [cited 2023 July 03]; 36(6):e00104120. DOI: https://doi.org/10.1590/0102-311X00104120.
7. Silva LLS, Lima AFR, Polli DA, Razia PFS, Pavão LFA, Cavalcanti MAFH, et al. Social distancing measures in the fight against Covid-19 in Brazil: description and epidemiological analysis by state. Cad Saúde Pública. 2020 [cited 2023 July 24]; 36(9):e00185020. DOI: https://doi.org/10.1590/0102-311X00185020.
8. Lana RM, Freitas LP, Codeço CT, Pacheco AG, Carvalho LMF, Villela DAM, et al. Identification of priority groups for Covid-19 vaccination in Brazil. Cad Saúde Pública. 2021 [cited 2023 July 03]; 37(10):e00049821. DOI: https://doi.org/10.1590/0102-311X00049821.
9. Brasil. Covid-19: situação epidemiológica do Brasil até a SE 28 de 2023 [Site de Internet]. Brasília: Ministério da Saúde; 2023 [cited 2023 Aug 07]. Available from: https://www.gov.br/saude/pt-br/coronavirus/informes-semanais-covid-19/covid-19-situacao-epidemiologica-do-brasil-ate-a-se-28-de-2023.
10. Albuquerque M, Ribeiro LHL. Inequality, geographic situation, and meanings of action in the Covid-19 pandemic in Brazil. Cad Saúde Pública. 2020 [cited 2023 July 04]; 36(12):e00208720. DOI: https://doi.org/10.1590/0102-311X00208720.
11. Borges MFS, Silva IF, Koifman R. Social, demographic, and health policies history of indigenous peoples from the state of Acre, Brazil. Ciênc Saúde Coletiva. 2020 [cited 2023 July 04]; 25(6):2237-46. DOI: https://doi.org/10.1590/1413-81232020256.12082018.
12. Orellana JDY, Cunha GM, Marrero L, Moreira RI, Leite IC, Horta BL. Excess deaths during the Covid-19 pandemic: underreporting and regional inequalities in Brazil. Cad Saúde Pública. 2021 [cited 2023 July 04]; 37(1):e00259120. DOI: https://doi.org/10.1590/0102-311X00259120.
13. Ministério dos Povos Indígenas (Br). Dados do censo 2022 revelam que o brasil tem 1,7 milhão de indígenas. Brasília: Ministério dos Povos Indígenas; 2023 [cited 2023 Aug 07]. Available from: https://www.gov.br/funai/pt-br/assuntos/noticias/2023/dados-do-censo-2022-revelam-que-o-brasil-tem-1-7-milhao-de-indigenas.
14. Cunha AA, Nazima MTST, Castilho-Martins EA. Covid-19 among the Brazilian Amazon indigenous people: factors associated with death. Saúde Soc. 2022 [cited 2023 July 04]; 31(2):e210368pt. DOI: https://doi.org/10.1590/S0104-12902022210368pt.
15. IBGE. Brasil tem 1,69 milhão de indígenas, aponta Censo 2022 [Site de Internet]. Brasília: IBGE; 2023 [cited 2023 Aug 07]. Available from: https://www.gov.br/secom/pt-br/assuntos/noticias/2023/08/brasil-tem-1-69-milhao-de-indigenas-aponta-censo-2022.
16. Estima NM, Alves SV. Maternal deaths and deaths of women of childbearing age in the indigenous population, Pernambuco, Brazil, 2006-2012. Epidemiol Serv Saúde. 2019 [cited 2023 July 04]; 28(2):e2018003. DOI: https://doi.org/10.5123/S1679-49742019000200010.

Research Article
Artigo de Pesquisa
Artículo de Investigación

DOI: https://doi.org/10.12957/reuerj.2024.83652

17. Machado FCG, Ferron MM, Barddal MTM, Nascimento LA, Rosalen J, Avelino-Silva VI. Covid-19 vaccination, incidence, and mortality rates among indigenous populations compared to the general population in Brazil: describing trends over time. Lancet Reg Health Am. 2022 [cited 2023 July 04]; 13:e100319. DOI: https://doi.org/10.1016/j.lana.2022.100319.
18. Organização Pan-Americana de Saúde. Alerta Epidemiológico: Covid-19 entre os povos indígenas nas Américas. Genebra: Organização Mundial da Saúde; 2020 [cited 2023 July 20]. Available from: https://iris.paho.org/handle/10665.2/53270.
19. Ahmadpour B, Turrini RNT, Camargo-Plazas P. Problem-solving in the Indigenous Health Care Subsystem (SASI-SUS): analysis in a reference service in Amazonas, Brazil. Cienc. saúde coletiva. 2023 [cited 2023 June 25]; 28(6):1757-66. DOI: https://doi.org/10.1590/1413-81232023286.13672022.
20. SESAI. Relatório resumido SESAI: Semana Epidemiológica - 44/2022 [Site de Internet]. Brasília: Ministério da Saúde; 2022 [cited 2023 Nov 17]. Available from: https://www.gov.br/saude/pt-br/assuntos/coronavirus/relatorios-covid-19/relatorio-de-acoes-sesai-se-44-22.pdf/view.
21. Procianoy GS, Rossini Junior F, Lied AF, Jung LFPP, Souza MCSC. Impact of the Covid-19 pandemic on the vaccination of children 12 months of age and under: an ecological study. Cienc. saúde coletiva. 2022 [cited 2023 July 04]; 27(3):969-78. DOI: https://doi.org/10.1590/1413-81232022273.20082021.
22. Santos EP, Souza AA, Dutra M, Vasconcelos ABM, Ramires VPM, Rocha ESC. Vacinação contra a Covid-19 em áreas remotas: experiências em saúde indígena. *In*: Silva TMR, Lima MG. Estratégias de vacinação contra a Covid-19 no Brasil: capacitação de profissionais e discentes de enfermagem [online]. Brasília: Editora ABen; 2021 [cited 2023 July 12]. p. 72-81. DOI: https://doi.org/10.51234/aben.21.e08.c08.
23. Silva TPR, Vimieiro AM, Gusmão JD, Souza JFA, Lachtim SAF, Vieira EWR, et al. Transmission risk classification for vaccine-preventable diseases in Minas Gerais, Brazil: two years since the onset of the Covid-19 pandemic. Cienc. saúde coletiva. 2023 [cited 2023 July 15]; 28(3):699-710. DOI: https://doi.org/10.1590/1413-81232023283.11192022.
24. Ministério da Saúde (Br). Distrito Sanitário Especial Indígena (DSEI). Brasília: Ministério da Saúde; 2022 [cited 2023 July 06]. Available from: https://www.gov.br/saude/pt-br/composicao/sesai/estrutura/dsei.
25. Ministério da Saúde (Br). População Indígena – SESAI [Site de Internet]. Brasília: Ministério da Saúde; 2024 [cited 2024 Feb 06]. Available from: https://infoms.saude.gov.br/extensions/sesai_pop_indigena/sesai_pop_indigena.html#.
26. Alatrany SSJ, Falaiyah AM, Zuhairawi RHM, Ogden R, ALdrraji HAS, Alatrany ASS, et al. A cross-sectional analysis of predictors of Covid-19 vaccine uptake and vaccine hesitancy in Iraq. PLoS One. 2023 [cited 2023 Aug 08]; 18(3):e0282523. DOI: https://doi.org/10.1371/journal.pone.0282523.
27. Pescarini JM, Cardoso AM, Santos RV, Scaff PF, Paixao ES, Ranzani OT, et al. Vaccine coverage and effectiveness against laboratory-confirmed symptomatic and severe Covid-19 in indigenous people in Brazil: a cohort study. BMC Public Health. 2023 [cited 2023 Aug 08]; 23:1267. DOI: https://doi.org/10.1186/s12889-023-16196-4.
28. Jacques N, Silveira MF, Hallal PC, Menezes AMB, Horta BL, Mesenburg MA, et al. Mask use during the Covid-19 pandemic in Brazil: results of the EPICovid19-BR study. Cad Saúde Pública. 2022 [cited 2023 Aug 10]; 38(6):e00271921. DOI: https://doi.org/10.1590/0102-311XPT271921.
29. Alves JD, Abade AS, Peres WP, Borges JE, Santos SM, Scholze AR. Impact of Covid-19 on the indigenous population of Brazil: a geo-epidemiological study. Epidemiol Infect. 2021 [cited 2023 Aug 07]; 149:e185. DOI: https://doi.org/10.1017/S0950268821001849.
30. Sansone NMS, Boschiero MN, Ortega MM, Ribeiro IA, Peixoto AO, Mendes RT. Severe acute respiratory syndrome by SARS-CoV-2 infection or other etiologic agents among brazilian indigenous population: an observational study from the first year of coronavirus disease (Covid)-19 pandemic. Lancet Reg Health Am. 2022 [cited 2023 Aug 07]; 8:e100177. DOI: https://doi.org/10.1016/j.lana.2021.100177.
31. Cupertino GA, Cupertino MC, Gomes AP, Braga LM, Siqueira-Batista L. Covid-19 and Brazilian indigenous populations. Am. J. Trop. Med. Hyg. 2020 [cited 2023 Aug 10]; 103(2):609-12. DOI: https://doi.org/10.4269/ajtmh.20-0563.
32. Souza CRS, Reis DA, Castro FF, Carreira L, Nascimento V. Prevenção da covid-19 na população idosa indígena. *In*: Santana RF. Enfermagem gerontológica no cuidado do idoso em tempos da Covid 19. 2.ed.rev. Brasília: Editora ABEn; 2020 [cited 2023 Aug 10]. p. 11-16. DOI: https://doi.org/10.51234/aben.20.e01.c02.
33. Pontes ALM, Cardoso AM, Bastos LS, Santos RV. Pandemia de Covid-19 e os povos indígenas no Brasil: cenários sociopolíticos e epidemiológicos. *In*: Matta GC, Rego S, Souto EP, Segata J. Os impactos sociais da Covid-19 no Brasil: populações vulnerabilizadas e respostas à pandemia [online]. Rio de Janeiro: Editora FIOCRUZ, 2021 [cited 2023 Aug 10]. p. 123-36. DOI: https://doi.org/10.7476/9786557080320.0010.
34. Passarelli-Araujo H, Pott-Junior H, Susuki AM, Olak AS, Pescim RR, Tomimatsu MFAI, et al. The impact of Covid-19 vaccination on case fatality rates in a city in Southern Brazil. Am J Infect Control. 2022 [cited 2023 Aug 08]; 50(5):491-6. DOI: https://doi.org/10.1016/j.ajic.2022.02.015.
35. Vicente RM, Moreira NF, Moreira CC, Simonelli CG, Luz VG. Working conditions of indigenous healthcare professionals in the largest Base Center in Brazil. Cad Saúde Pública. 2022 [cited 2023 Aug 08]; 38(12):e00110321. DOI: https://doi.org/10.1590/0102-311XPT110321.
36. Machado FCG, Ferron MM, Barddal MTM, Nascimento LA, Rosalen J, Avelino-Silva VI. Iniquidades na vacinação e taxa de mortalidade em populações indígenas comparadas com a população geral no brasil: uma análise de série temporal. Braz J Infect Dis. 2022 [cited 2023 June 26]; 26:102492. DOI: https://doi.org/10.1016/j.bjid.2022.102492.
37. Galhardi CP, Freire NP, Fagundes MCM, Minayo MC de S, Cunha ICKO. Fake News and vaccine hesitancy in the Covid-19 pandemic in Brazil. Cienc. saúde coletiva. 2022 [cited 2023 Aug 08]; 27(5):1849-58. DOI: https://doi.org/10.1590/1413-81232022275.24092021.

Research Article
Artigo de Pesquisa
Artículo de Investigación

DOI: https://doi.org/10.12957/reuerj.2024.83652

38. Pan-American Health Oganization. Immunization Newsletter [Site de Internet]. Institutional repository for Information Sharing; 2022 [cited 2023 July 08]; 44(1):1-8. Available from: https://iris.paho.org/handle/10665.2/56053?show=full.
39. Helnem M. Campanha Vacina Parente incentiva imunização de indígenas: fake news têm atrapalhado o engajamento para a vacinação [Site de Internet]. Agência Brasil; 2021 [cited 2023 Aug 13]. Available from: https://agenciabrasil.ebc.com.br/saude/noticia/2021-03/campanha-vacina-parente-incentiva-imunizacao-de-indigenas.
40. Ferreira, AG, Lima D, Rocha J. Infodemia e covid-19: a informação como instrumento contra os mitos. Artigo 19; 2021 [cited 2023 Aug 09]; 1(1):1-27. Available from: https://static.poder360.com.br/2021/05/infodemia-artigo-19.pdf.
41. Orellana JDY, Cunha GM, Marrero L, Leite IC, Domingues CMAS, Horta BL. Changes in the pattern of Covid-19 hospitalizations and deaths after substantial vaccination of the elderly in Manaus, Amazonas State, Brazil. Cad Saúde Pública. 2022 [cited 2023 July 04]; 38(5):e00192321. DOI: https://doi.org/10.1590/0102-311XPT192321.
42. Souza T. S. O enfrentamento da pandemia de Covid-19 no Estado da Bahia: possibilidades para o planejamento da auditoria do SUS/BA [Dissertação de Mestrado]. Salvador: Universidade Federal da Bahia; 2021 [cited 2023 Aug 11]. Available from: https://repositorio.ufba.br/bitstream/ri/35731/1/Thaienny%20Saback%20de%20Souza.pdf.
43. Prado MF, Antunes BBP, Bastos LSL, Peres IT, Silva AAB, Dantas LF, et al. Analysis of Covid-19 under-reporting in Brazil. Rev Bras Ter Intensiva. 2020 [cited 2023 Aug 11]; 32(2):224-8. DOI: https://doi.org/10.5935/0103-507X.20200030.
44. Silva LMVG, Lima BCS, Junqueira TLS. Indigenous population in pandemic times: reflections about health in a decolonial perspective. Saúde Soc. 2023 [cited 2023 Aug 13]; 32(2):e220092. DOI: https://doi.org/10.1590/S0104-12902023220092pt.
45. Massarani L, Mendes IM, Fagundes V, Polino C, Castelfranchi Y, Maakaroun B. Trust, attitudes, information: a study on the perception of the Covid-19 pandemic in 12 Brazilian cities Cienc. saúde coletiva. 2021 [cited 2023 Aug 09]; 26(8)3265-76. DOI: https://doi.org/10.1590/1413-81232021268.05572021.

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