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Factors associated with death among indigenous and non-indigenous pregnant and postpartum women hospitalized for COVID-19 in Brazil

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Abstract *The present article aimed to analyze the association between sociodemographic and hospitalization characteristics with the outcome of indigenous and non-indigenous pregnant and postpartum women, as well as factors associated with deaths among indigenous women hospitalized for Severe Acute Respiratory Syndrome (SARS) due to COVID-19 in Brazil. This is a cross-sectional and analytical study, with secondary data of pregnant and postpartum women of reproductive age, classified into race/skin color (indigenous and non-indigenous), extracted from the Obstetric Observatory, which uses data from the Influenza Epidemiological Surveillance Information System. The outcome variables were analyzed using the chi-square test or Fisher's exact test, and logistic regression was performed for the factors associated with the death of indigenous people. The highest proportion of deaths occurred among non-indigenous women who were in the 2nd trimester of pregnancy (99.7%), who lived in urban/peri-urban areas (99.8%), as well as in the South/Southeast (99.8%) and Northeast (99.5%) regions. Indigenous people who lived in rural areas and in the North and Midwest regions have a greater chance of death when compared to indigenous people who lived in urban areas and in the South/Southeast regions.*

Key words *Health of indigenous populations, Pregnant women, Postpartum Period, COVID-19*

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Introduction

Public policies for maternal and child health care are prominent on the Brazilian agenda, especially regarding prenatal care and childbirth, aimed at reducing maternal and child morbidity and mortality[1]. However, the COVID-19 pandemic had a direct and negative impact on maternal outcomes and, indirectly, on the interruption of prenatal services and difficulties in accessing intensive care for pregnant women with COVID-19[2,3]. A worsening of the social determinants of health affecting pregnant and postpartum women of different ethnic groups was also observed, exacerbating ethnic-racial disparities in the incidence of death and maternal complications associated with COVID-19[4].

These inequalities are evident in the differences in the evolution of deaths between ethnic-racial groups and in inequalities in the distribution of health services, such as the availability of beds in Intensive Care Units (ICUs), with direct repercussions on the fluctuations during critical periods of the disease within Brazilian regions[5].

It is important to note that, in June 2020, maternal mortality was higher than overall mortality in Brazil, showing that COVID-19 was not only the direct cause of death among pregnant and postpartum women, but also the indirect cause, by creating adversities for care during the pregnancy-puerperal cycle, such as inadequate prenatal care[6].

In 2021, the impact was even greater, with weekly deaths among pregnant and postpartum women more than doubling when compared to 2020, representing an increase of 151.0%, while the number of deaths within the general population increased by 60.5%[7].

In the field of indigenous health, social inequalities and deficiencies in the coverage and quality of prenatal care for women have a large impact on unfavorable outcomes and the high incidence of maternal deaths throughout the country[8,9].

Moreover, in the context of dealing with the COVID-19 pandemic, the indigenous population has experienced a heightening of invisibility and high severity in terms of mortality and lethality of the disease[10,11].

Although the number of deaths from COVID-19 within the indigenous population is worrisome, the high rate of transmission represents an even greater challenge. The communal lifestyle, characterized by multifamily housing, an intense sharing of objects, and limited access to health care, makes indigenous communities more vulnerable to the rapid spread of the virus. The occurrence of the pandemic has consequences for daily life in these communities, including impacts on economic activities in general[12].

The persistence of ethnic-racial inequalities that compromise the health of indigenous pregnant and postpartum women[8] and the relative scarcity of scientific studies on the outcome of maternal death due to COVID-19[3], reinforce the importance of this study.

In this sense, this study aims to analyze the connection of sociodemographic and hospitalization characteristics with the outcome of indigenous and non-indigenous pregnant and postpartum women, as well as factors associated with death among indigenous women hospitalized for Severe Acute Respiratory Syndrome (SARS) due to COVID-19 in Brazil.

Methods

This is an epidemiological and analytical study on the occurrence of indigenous and non-indigenous pregnant and postpartum women (white, yellow, black, and brown) hospitalized with SARS due to COVID-19, referring to the 9th week of 2020 (02/02/2020) and the 35th week of 2022 (03/09/2022), from the Epidemiological Calendar. Brazil has a population of 203,000,000 people, of which 1,693,535 are indigenous. Of these, 753,357 indigenous people live in the North Region; 528,800 in the Northeast Region; 199,912 in the Midwest Region; 123,369 in the Southeast Region; and 88,097 in the South Region[13].

Women in the 1st, 2nd, and 3rd pregnancy trimester or unknown gestational age, and postpartum women aged 10 to 49 years, according to indigenous and non-indigenous race/skin color, whose hospitalization outcome was cure or death, and with a laboratory confirmation of a SARS infection due to COVID-19, in public and private hospitals, residing in Brazil, were considered eligible for the study. For non-indigenous participants, the variable grouping of race/skin color as white, black, brown, and yellow was considered. This grouping was adopted in this study to identify racial disparities, especially those experienced by indigenous women, in the process of care during pregnancy, childbirth, and the postpartum period in the event of COVID-19.

The exclusion criteria were: pregnant women and postpartum women who did not have a record of race/skin color and those over 49 years of age, totaling 5,174 cases.

SARS is defined as a person of any age who is diagnosed with a flu-like syndrome, characterized by fever, cough, or sore throat, together with at least one of the following symptoms: headache, myalgia or arthralgia associated with dyspnea or oxygen saturation SpO2<95%[14].

Data collection was carried out in September 2022 and came from the Brazilian Obstetric Observatory for COVID-19 (*Observatório Obstétrico Brasileiro COVID-19* - OOBr COVID-19)[15], which collects data from the Influenza Epidemiological Surveillance Information System (*Sistema de Informação de Vigilância Epidemiológica da Gripe* - SIVEP-Gripe), including COVID-19 data, which are subsequently recorded in a Microsoft Excel 2016 spreadsheet.

The following sociodemographic variables were analyzed: age in years (10 to 19, 20 to 34, 35 to 49), education (none, elementary - elementary 1 and 2, high school, higher education), gestational period (1st trimester, 2nd trimester, 3rd trimester) and puerperium, region of residence (Southeast, Northeast, North, Midwest, South), and area of residence (rural and urban/peri-urban had their values grouped together). For comorbidities, the dichotomous variable (yes, no) was considered for the occurrence of: diabetes mellitus, cardiovascular disease, and lung disease.

For variables related to clinical data, the dichotomous variable (yes, no) was considered for dyspnea, respiratory distress, and O2 saturation <95%. The variables related to disease severity (yes, no) considered: the need for ICU admission and ventilatory support.

The analysis between the variables related to sociodemographic determinants, comorbidities, symptoms, and hospitalization characteristics, with the outcome of cure or death of indigenous and non-indigenous pregnant and postpartum women hospitalized for SARS due to COVID-19, was performed using the chi-square test or Fisher's exact test.

The odds ratio (OR) and 95% confidence interval (95% CI) were subsequently calculated using the logistic regression model, where the bivariate analysis and all variables that presented $p<0.25$ were inserted into the multiple model. Multicollinearity and goodness of fit were verified.

The adjusted model was considered only for indigenous women. Statistical analysis was performed using the R software, version 4.1.2, considering a significance level of 5%.

Pregnant and postpartum women who provided information on race/skin color and outcome (inclusion criteria), but who did not provide information (NA) on any other variable, had only this item excluded, that is, only the variable without information was not included in the analysis; however, the participant was kept in the study, as she presented other data on variables deemed important for this study.

This study used secondary data extracted from the OOBr COVID-19, which is available to the public, without identifying the research participants, and was exempt from assessment by the Research Ethics Committee, in accordance with Resolution No. 510[16].

Results

A total of 18,582 pregnant and postpartum women were hospitalized for SARS due to COVID-19 between the 9th week of 2020 and the 35th week of 2022. Of this total, 156 (0.8%) occurred among indigenous pregnant and postpartum women and 18,426 (99.2%) among non-indigenous women. Among indigenous women, 90.4% (141) were cured and 9.6% (15) died. In the case of non-indigenous women, 16,618 (90.2%) were cured and 1,808 (9.8%) died. It is important to note that the percentage difference in the absence of records regarding the hospitalization sector was 9.7% (1,790) for non-indigenous women and 25% (39) for indigenous women (Figure 1).

Table 1 shows that the highest number of pregnant and postpartum women hospitalized for SARS due to COVID-19 occurred in the age group of 20 to 34 years (66.1%), with a high school education (26.4%), non-indigenous (99.1%), in the 3rd trimester of pregnancy (51.1%), living in urban/peri-urban areas (85.5%), and in the Southeast region (38.1%). Most women had no comorbidities. Regarding symptoms, 47.3% of the women had an O2 saturation <95%, and 49.7% presented dyspnea.

Table 2 shows that the highest proportion of deaths occurred among non-indigenous women aged 35 to 49 years (99.5%), who had completed secondary/higher education (99.6%), were in the 2nd trimester of pregnancy (99.7%), lived in urban/peri-urban areas (99.8%), in the South/Southeast (99.8%) and Northeast (99.5%) regions, and had no comorbidities (98.1%).

The difference between the death rates was statistically significant for indigenous women aged 10 to 19 years, with an elementary education, postpartum women, who lived in rural areas, in the North region, and without comorbidities (Table 2).

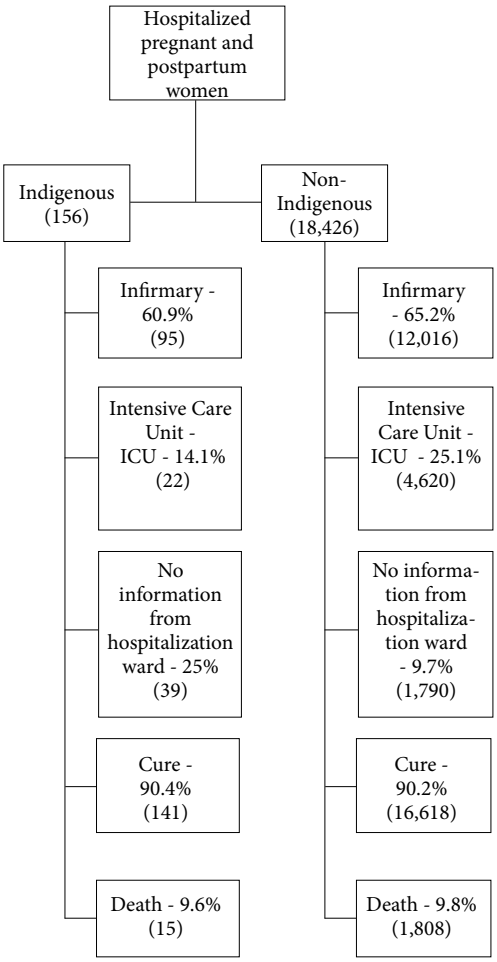

Figure 1. Flowchart of the outcome of hospitalizations for SARS due to COVID-19 among indigenous and non-indigenous pregnant and postpartum women, between the 9th Epidemiological Week of 2020 and the 35th Epidemiological Week of 2022, Brazil.

Source: Authors

Indigenous women who lived in rural areas had a 33.08-fold greater chance of death (95%CI 8.91-165.05), when compared to those who lived in urban/peri-urban areas and adjusted for other variables. Regarding the region of residence, indigenous women who lived in the Midwest region (OR 12.45; 95%CI 1.13-276.96) and in the North region (OR 10.83; 95%CI 1.85-206.55), had a greater chance of death when compared to indigenous women who lived in the Southeast/South regions, adjusted for other variables in the model (Table 3).

Discussion

The present study showed that indigenous pregnant and postpartum women who lived in rural areas and in the Midwest and North regions of Brazil had an increased chance of maternal death from COVID-19, showing that the spread of the COVID-19 pandemic among indigenous people has worsened health inequities in a population that already faces lower access to and quality of prenatal care and worse maternal mortality ratios (MMRs)[8,9].

The significant occurrence of deaths of indigenous and non-indigenous pregnant and postpartum women due to SARS due to COVID-19 recorded in the North and Northeast regions and in rural areas highlights historical social inequalities in health, characterized by the greater occurrence of maternal deaths in regions of Brazil that concentrate worse health indicators, fewer health resources, and greater socioeconomic inequalities[17].

It is also important to mention that, in these regions, there were numerous difficulties in reorganizing the health system to deal with cases of SARS caused by COVID-19, demonstrating that the regions lacked proper medical care that was not resolved by the implementation of new hospital beds for COVID-19, which characterized the violation of health rights in access to hospital care services[18-20].

In low- and middle-income countries, the increase in maternal mortality from COVID-19 is due to the disorganization of health services and the difficulties in reorganizing them in the face of the pandemic, characterized by numerous barriers faced by pregnant women in accessing prenatal and referral services for the treatment of COVID-19[21,22].

In Brazil, maternal deaths due to causes directly and indirectly related to COVID-19 in 2020 were higher among black women, who lived in rural areas and who were hospitalized in municipalities outside their residence, which demonstrates the synergistic effect of the inequalities already recorded in maternal mortality, regardless of the pandemic[23].

For indigenous pregnant and postpartum women, who live in rural areas and in regions of Brazil with greater socioeconomic vulnerability, this synergy also amplifies the difficulties in access to primary care services in indigenous territories, as well as to medium and high complexity services, which may result in a lack of care or in a delay in the provision of adequate and timely

Table 1. Distribution of sociodemographic variables, comorbidities, symptoms, and hospitalization characteristics, and association with the outcomes of cure and death of pregnant and postpartum women hospitalized for SARS due to COVID-19, between the 9th Epidemiological Week of 2020 and the 35th Epidemiological Week of 2022, Brazil.

Variables	Outcome		Total % (n=18,582)	p-value
	Cure % (n=16.759)	Death % (n=1,823)		
Age range (in years)				
10-19	94.3 (1,490)	5.7 (90)	8.5 (1,580)	**<0.001**
20-34	90.9 (11,158)	9.1 (1,121)	66.1 (12,279)	
35-49	87.0 (4,111)	13.0 (612)	25.4 (4,723)	
Educational level				
None	86.3 (63)	13.7 (10)	0.4 (73)	0.856
Elementary	89.1 (2,238)	10.9 (273)	13.5 (2,511)	
High School	89.4 (4,396)	10.6 (523)	26.4 (4,919)	
Higher Education	89.3 (1,499)	10.7 (180)	9.0 (1,679)	
Race/Skin color				
Non-indigenous	90.2 (16,618)	9.8 (1,808)	99.1 (18,426)	0.934
Indigenous	90.4 (141)	9.6 (15)	0.9 (156)	
Condition				
1st trimester of pregnancy	92.9 (1,262)	7.1 (96)	7.3 (1,358)	**<0.001**
2nd trimester of pregnancy	89.8 (3,284)	10.2 (372)	19.7 (3,656)	
3rd trimester of pregnancy	92.7 (8,807)	7.3 (692)	51.1 (9,499)	
Postpartum	82.4 (2,847)	17.6 (608)	18.6 (3,455)	
Zone of residence				
Urban/Periurban	90.5 (14,379)	9.5 (1,515)	85.5 (15,894)	**0.001**
Rural	87.6 (1,038)	12.4 (147)	6.4 (1,185)	
Region of residence				
South	93.5 (3,487)	6.5 (243)	20.1 (3,730)	**<0.001**
Southeast	90.1 (6,375)	9.9 (704)	38.1 (7,079)	
Midwest	91.7 (1,973)	8.3 (179)	11.6 (2,152)	
North	87.3 (1,963)	12.7 (286)	12.1 (2,249)	
Northeast	87.8 (2,961)	12.2 (411)	18.1 (3,372)	
Comorbidities				
Diabetes mellitus				
No	87.3 (5,118)	12.7 (743)	31.5 (5,861)	**0.024**
Yes	84.9 (1,012)	15.1 (180)	6.4 (1,192)	
Cardiovascular disease				
No	87.6 (5,215)	12.4 (738)	32.0 (5,953)	**<0.001**
Yes	82.7 (840)	17.3 (176)	5.4 (1,016)	
Pneumopathy				
No	87.1 (5,747)	12.9 (848)	35.5 (6,595)	**0.005**
Yes	78.3 (90)	21.7 (25)	0.6 (115)	

it continues

prenatal care, with negative implications and outcomes[8,11].

One of the strategies for preventing complications caused by COVID-19 in pregnant women is based on the assumption that vaccination in the first trimester of pregnancy is effective in protecting them in the following trimesters. However, studies indicate lower vaccination coverage against COVID-19 among pregnant women. The positive benefits of vaccination were only observed in the second half of 2021[18,24].

For the indigenous population, a lower vaccination coverage against COVID-19 was observed when compared to the non-indigenous

Table 1. Distribution of sociodemographic variables, comorbidities, symptoms, and hospitalization characteristics, and association with the outcomes of cure and death of pregnant and postpartum women hospitalized for SARS due to COVID-19, between the 9th Epidemiological Week of 2020 and the 35th Epidemiological Week of 2022, Brazil.

Variables	Outcome		Total % (n=18,582)	p-value
	Cure % (n=16.759)	Death % (n=1,823)		
Symptoms				
Saturation <95%				
No	96.2 (8,458)	3.8 (337)	47.3 (8,795)	**<0.001**
Yes	79.4 (4,880)	20.6 (1,269)	33.1 (6,149)	
Dyspnea				
No	96.7 (6,360)	3.3 (216)	38.3 (7,176)	**<0.001**
Yes	84.1 (7,778)	15.9 (1,468)	49.7 (9,246)	
Hospitalization Characteristics				
Hospitalization in ICU				
No	97.2 (11,767)	2.8 (344)	65.2 (12,111)	**<0.001**
Yes	70.8 (3,288)	29.2 (1,354)	25.0 (4,642)	
Use of Ventilatory Support				
Not used	98.6 (8,821)	1.4 (124)	48.1 (8,945)	**<0.001**
Non-invasive	92.8 (5,021)	7.2 (392)	29.1 (5,413)	
Invasive	48.3 (1,071)	51.7 (1,145)	12.0 (2,216)	

P-value in the chi-square or Fisher's exact test.

Source: Authors.

population, but with similar efficacy in both populations, highlighting barriers to access and the provision of primary health care, as aggravating factors for the occurrence of deaths[25].

It is also important to note that the investigation of the occurrence of deaths from COVID-19 among indigenous and non-indigenous people must be understood by inequalities related to situations of vulnerability, lower access to basic sanitation and water sources, which implies lower chances of adopting measures to prevent the spread of COVID-19[26].

Pregnant and postpartum indigenous and non-indigenous women with heart disease, O2 saturation <95%, ICU admission, and use of ventilatory support showed higher occurrences of maternal death. These findings are similar to those identified in other studies[27-29]. Similar results on the greater incidence of COVID-19 during the gestational period[21,29,30], as well as the presentation of the same symptoms and hospital complications[21,29,31], reaffirm the findings of the present study.

Maternal deaths due to SARS caused by COVID-19 suggest that young indigenous women, with an elementary education, in the postpartum period, who lived in rural areas and in the North region tend to have worse social determinants of health, making them more susceptible to a lack of health care during prenatal and childbirth, in addition to difficulties in receiving referrals to medium to high complexity services within the municipalities.

The First National Survey on the Health and Nutrition of Indigenous Peoples identified that the North region had the highest proportion of women who failed to receive prenatal care, only 30% of whom began prenatal care in the 1st trimester[8].

The COVID-19 pandemic highlights the health inequities and political, social, and environmental vulnerabilities experienced by the Brazilian indigenous population, characterized by the violation of the right to land, food security, as well as access to and quality of health care[32,33].

In this sense, it is necessary to advance social protection policies and strengthen primary care services provided by SASI-SUS in indigenous territories, so that they are culturally appropriate, along with the development of actions for the prevention, diagnosis, and treatment of COVID-19 for pregnant and postpartum women.

Table 2. Distribution of sociodemographic variables, comorbidities, symptoms, and hospitalization characteristics of indigenous and non-indigenous pregnant and postpartum women who died from SARS due to COVID-19, in Brazil, between the 9th Epidemiological Week of 2020 and the 35th Epidemiological Week of 2022, Brazil.

Variables	Outcome of death		Total % (n=1,823)	p-value
	Non-indigenous % (n=1,808)	Indigenous % (n=15)		
Age range (in years)				
10-19	95.6 (86)	4.4 (4)	4.9 (90)	
20-34	99.3 (1,113)	0.7 (8)	61.5 (1,121)	**<0.001**
35-49	99.5 (609)	0.5 (3)	33.6 (612)	
Educational level				
None	90.0 (9)	1.0 (1)	0.5 (10)	
Elementary	97.8 (267)	2.2 (6)	15.0 (273)	**<0.001**
High School/Higher Education	99.6 (520)	0.4 (3)	28.7 (523)	
Condition				
1st trimester of pregnancy	98.9 (95)	1.1 (1)	5.3 (96)	**<0.001**
2nd trimester of pregnancy	99.7 (371)	0.3 (1)	20.4 (372)	
3rd trimester of pregnancy	99.5 (689)	0.5 (3)	38.0 (692)	
Postpartum	98.4 (598)	1.6 (10)	33.3 (608)	
Zone of residence				
Urban/Periurban	99.8 (1,512)	0.2 (3)	83.1 (1,515)	**<0.001**
Rural	93.2 (137)	6.8 (10)	8.1 (147)	
Region of residence				
South/Southeast	99.8 (241)	0.2 (2)	13.3 (243)	**<0.001**
Midwest	98.9 (177)	1.1 (2)	9.8 (179)	
North	96.8 (277)	3.2 (9)	15.5 (286)	
Northeast	99.5 (409)	0.5 (2)	22.5 (411)	
Comorbidities				
No	98.1 (471)	1.9 (9)	26.3 (480)	**0.012**
Yes	99.7 (180)	0.3 (2)	10.0 (182)	
Symptoms				
Saturation of O2 <95%				
No	99.1 (334)	0.9 (3)	18.5 (337)	0.967
Yes	99.1 (1,258)	0.9 (11)	69.6 (1,269)	
Dyspnea				
No	98.6 (213)	1.4 (3)	11.8 (216)	0.333
Yes	99.3 (1,457)	0.7 (11)	80.5 (1,468)	
Hospitalization Characteristics				
Hospitalization in ICU				
No	99.7 (343)	0.3 (1)	18.9 (344)	0.257
Yes	99.1 (1,342)	0.9 (12)	74.2 (1,354)	
Use of Ventilatory Support				
No	99.2 (123)	0.8 (1)	6.8 (124)	0.908
Yes	99.3 (1,134)	0.7 (11)	62.8 (1,145)	

P-value in the chi-square or Fisher's exact test.

Source: Authors.

This study's limitations are inherent to the use of secondary databases due to the quality of the data, characterized by incompleteness and inconsistency, as well as to the fact that the analysis of cases of the reporting of pregnant and postpartum women with SARS due to COVID-19 only included hospitalizations. It is important to note that data from the Indigenous Health Care System (SIASI) was not used, as it is not a publicly accessible database, it does not have an interface

Table 3. Association of the characteristics of hospitalized indigenous pregnant and postpartum women, with the outcome of death from SARS due to COVID-19, between the 9th Epidemiological Week of 2020 and the 35th Epidemiological Week of 2022, Brazil.

Variables	Crude Odds ratio		Adjusted Odds ratio	
	OR	95%CI	OR	95%CI
Condition				
1st trimester of pregnancy	1.00	1.00		
2nd trimester of pregnancy	0.25	0.01-6.51		
3rd trimester of pregnancy	0.41	0.05-8.41		
Postpartum	1.59	0.30-29.32		
Age range (in years)				
10-19	1.00	1.00		
20-34	0.15	0.05-0.59		
35-49	0.10	0.02-0.49		
Educational level				
None	4.94	0.24-33.51		
Elementary	1.00	1.00		
High School/Higher Education	0.19	0.04-0.73		
Zone of residence				
Urban/Periurban	1.00	1.00	1.00	1.00
Rural	36.79	11.10-165.51	33.08	8.91-165.05
Region of residence				
South/Southeast	1.00	1.00	1.00	1.00
Midwest	5.34	0.63-44.73	12.45	1.13-276.96
North	15.52	3.97-102.95	10.83	1.85-206.55
Northeast	2.31	0.27-19.31	0.72	0.03-19.10
Comorbities				
No	1.00	1.00		
Yes	0.17	0.02-0.68		
Symptoms				
Saturation <95%				
No	1.00	1.00		
Yes	0.97	0.30-4.32		
Dyspnea				
No	1.00	1.00		
Yes	0.53	0.16-2.38		
Hospitalization Characteristics				
Hospitalization in ICU				
No	1.00	1.00		
Yes	3.07	0.60-55.97		
Use of Ventilatory Support				
No	1.00	1.00		
Yes	0.88	0.17-16.27		

Source: Authors.

with other national health information systems, and it only records data on indigenous people who inhabit territories demarcated and officially recognized by the Brazilian government.

However, it is important to emphasize that this study's findings highlight health inequities in the provision of care within regions with greater socioeconomic vulnerability, such as the North and Northeast, and the worsening of ethnic-racial inequities with the spread of the COVID-19 pandemic throughout the indigenous population, with serious maternal deaths among indigenous people living in rural areas and in the Midwest and North regions of the country.

The pandemic reinforces the need to strengthen public health policies so as to guarantee the right to health for indigenous pregnant and postpartum women so that they can gain access to prenatal care, as well as the need for proper diagnoses and the adequate management of COVID-19 cases within indigenous territories. In addition, there is a need for a greater integration of SASI-SUS with referral services so as to minimize obstacles in referring indigenous pregnant women with COVID-19 to referral services in order to provide adequate health care.

Collaborations

AKD Moura; GA Freitas and RP Pícoli: study design, analysis and interpretation of data. AKD Moura; GA Freitas and RP Pícoli: writing of the article or its critical review. GA Freitas and RP Pícoli: approval of the version to be published.

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