ACTA
AMAZONICA

http://dx.doi.org/10.1590/1809-4392202402511

HEALTH SCIENCES | ORIGINAL ARTICLE

Respiratory infection in indigenous population of the Amazon region, Brazil

Larissa Mendes da SILVA[1†], Linério Ribeiro de NOVAIS Júnior[1†], Pablo Michel Barcelos PEREIRA[1], Suelen de Souza RAMOS[1], Vicente MENEGUZZO[1], Guilherme Cabreira DAROS[1], Marina Goulart da SILVA[1], Williams Ferreira PORTELA[1], Mariana Pereira de Souza GOLDIM[1], Betine Pinto Moehlecke ISER[1], Rafael Mariano de BITENCOURT[1*]

[1]Laboratório de Neurociência Comportamental, Programa de Pós-Graduação em Ciências da Saúde, Universidade do Sul de Santa Catarina, Tubarão, Santa Catarina, Brasil.

[†]*These authors contributed equally to this work.*

*Corresponding author: rafael.bitencourt@ulife.com.br

ABSTRACT

Respiratory infections are considered the leading cause of mortality among communicable diseases in indigenous populations, becoming a public health issue. This case study was conducted in Amaturá municipality (Amazonas, Brazil) indigenous communities. On total 2.728 medical records for respiratory infections from the Alto Rio Solimões Special Indigenous Health District (DSEI) were analized. Of these, 52.7% were females, and 76.6% were under 18 years old. Acute nasopharyngitis was the most frequent diagnosis (91.5% of cases). The age group 1 to 4 years showed a higher frequency of some conditions. Females showed a significant likelihood ratio (LR) with unspecified acute tonsillitis, and males with acute laryngopharyngitis. The specific analysis of the village revealed LR for acute bronchitis caused by rhinovirus in Bom Pastor, and acute bronchitis caused by respiratory syncytial virus and *Streptococcus* in Nova Itália. This study highlights the high frequency of upper respiratory infections in the largest indigenous district of the Brazilian Amazon, especially affecting children aged 1 to 4 years. Though often self-limiting, these infections can lead to more severe lower respiratory issues. The findings stress the need for effective preventive measures, better healthcare access, and environmental policies to reduce the health impacts of pollution. The study also calls for more research with better representation of indigenous diversity and emphasizes the importance of strengthening health surveillance systems and social participation in healthcare planning.

KEYWORDS: Respiratory Tract Infections; Health of Ethnic Minorities; Health of Indigenous Peoples; Public Health.

Infecção respiratória na população indígena da região Amazônica, Brasil

RESUMO

As infecções respiratórias são consideradas a principal causa de mortalidade entre as doenças transmissíveis nos indígenas, tornando-se um problema de saúde pública. Este estudo de uma série de casos foi realizado em comunidades indígenas do município de Amaturá (Amazonas, Brasil). Foram analisados 2.728 prontuários de infecções respiratórias do Distrito Sanitário Especial Indígena (DSEI) Alto Rio Solimões. Destes, 52.7% eram do sexo feminino e 76.6% tinham menos de 18 anos. A nasofaringite aguda foi o diagnóstico mais frequente (91.5% dos casos). A faixa etária de 1 a 4 anos apresentou maior frequência de algumas condições. As mulheres apresentaram razão de verossimilhança (RV) significativa com amigdalite aguda não especificada e os homens com laringofaringite aguda. A análise específica da aldeia revelou RV para bronquite aguda por rinovírus em Bom Pastor e bronquite aguda por vírus sincicial respiratório e estreptococo em Nova Itália. Este estudo destaca a alta frequência de infecções respiratórias superiores no maior distrito indígena da Amazônia brasileira, afetando especialmente crianças de 1 a 4 anos. Embora muitas vezes autolimitadas, essas infecções podem levar a problemas respiratórios inferiores mais graves. As descobertas enfatizam a necessidade de medidas preventivas eficazes, melhor acesso à saúde e políticas ambientais para reduzir os impactos da poluição na saúde. O estudo também pede mais pesquisas com melhor representação da diversidade indígena e enfatiza a importância de fortalecer os sistemas de vigilância em saúde e a participação social no planejamento da saúde.

PALAVRAS-CHAVE: Infecções do Sistema Respiratório; Perfil Epidemiológico dos Grupos Étnicos; Saúde de Populações Indígenas; Saúde Pública.

CITE AS: Silva, L.M. da; Novais Jr., L.R. de; Pereira, P.M.B.; Ramos, S. de S.; Meneguzzo, V.; Daros, G.C.; Silva, M.G. da; Portela, W.F.; Goldim, M.P. de S.; Iser, B.P.M.; Bitencourt, R.M. de. 2025. Respiratory infection in indigenous population of the Amazon region, Brazil. *Acta Amazonica* 55: e55hs24251.

INTRODUCTION

In the sixteenth century, 5 million indigenous people lived in Brazil, but the consequences of colonialism, together with disease outbreaks in the Old World, led to a significant decline in this population (Lima et al. 2016; Valente 2017). Currently, according to the Brazilian Institute of Geography and Statistics (IBGE), about 1.7 million people live in the territory, representing 0.83% of the country's population, distributed among 305 indigenous ethnic groups that speak 274 languages (IBGE 2022). In Latin America, this figure is almost 45 million, which corresponds to 8.3% of the region's population (CEPAL 2015).

In order to rescue the fundamental rights that had been denied to this population for decades, the Subsystem of Health Care for Indigenous Peoples (SASISUS) was created in 1999 with Law No. 9.836/99, known as the Arouca Law. It consists of Special Indigenous Health Districts (DSEI) established in a network of services in indigenous territories to provide care to this population according to geographical, demographic and cultural criteria, following the principles of the Unified Health System (SUS) (Wenczenovicz 2018). Brazil currently has 34 DSEIs across the 27 Brazilian states. The states in the north are characterized by having the largest number of self-declared indigenous people (SESAI 2024). According to IBGE, around 868 thousand indigenous people live in the Brazilian Amazon, a region that includes all the states in the North and part of the Northeast and Midwest of the country (Amazonas, Acre, Amapá, Pará, Rondônia, Roraima, Tocantins, Mato Grosso and Maranhão), representing 51.2% of Brazil's Indigenous population. The communities of Alto Solimões have the largest Indigenous population in the Amazon region (IBGE 2022).

The DSEI Alto Rio Solimões (DSEI ARS) is located in the state of Amazonas, on the border between Brazil, Colombia and Peru. It serves the second largest indigenous population in Brazil with a total of 72.759 indigenous users who live in 240 villages spread across 13 base poles (Umariaçú I, Umariaçú II, Filadélfia, Feijoal, Belém do Solimões, Vendaval, Campo Alegre, São Paulo de Olivença, São Francisco do Canimari, Nova Itália, Betânia, São Sebastião and Vila Bitencourt) with complete multidisciplinary indigenous health teams located in 6 municipalities of Alto Rio Solimões (Tabatinga, Benjamin Constant, São Paulo de Olivença, Amaturá, Santo Antônio do Içá and Tonantins). This population is made up of 7 indigenous ethnic groups (Ticuna, Kocama, Kaixana, Kambeba, Kanamari, Witoto and Maku-Yuhup), with the Ticuna ethnic group being the largest indigenous group in the country (SESAI 2023).

According to data from the Information Technology Department of the Unified Health System (DATASUS), since the establishment of the Indigenous Health Care Information System (SIASI) in 2000 up to the most recent available year, 2023, the leading causes of mortality among the Indigenous population, in descending order, have been circulatory system diseases, external causes, ill-defined causes, respiratory system diseases, and infectious and parasitic diseases. Among communicable diseases, respiratory conditions emerged as the leading cause of death among Indigenous peoples, accounting for 11.3% of all mortality (DATASUS 2023). Due to the recent introduction of SASISUS and the even more recent introduction of SIASI, little data is available on the demographics, epidemiology and health profile of this population. Although research on these aspects has taken place, it is still in its infancy compared to that focusing on other population groups in the country. In addition, the enormous cultural, socioeconomic and linguistic diversity of this population leads to a health profile that can vary greatly from one group to another and often within the ethnic group itself, so that studies are needed that make it possible to ensure the specific characteristics of this heterogeneous group.

In order to generate more homogeneous data, this study aimed to identify the respiratory disease profile of part of the indigenous peoples of Brazil, here represented by the territory of Alto Rio Solimões DSEI, belonging to the municipality of Amaturá, in the period from May 2017 to July 2021, in order to help in the elaboration and implementation of specific and differentiated public policies in the indigenous districts.

MATERIAL AND METHODS

This is a case-study of a data series on respiratory diseases of indigenous Amazonian communities in the municipality of Amaturá, Amazonas state, northern Brazil. Thirteen semi-isolated villages with a population of 2,896 indigenous people (SIASI 2020) were served by the Special Indigenous Health District of the Alto Rio Solimões, which is part of the Nova Itália base pole.

The information was collected from the medical records of indigenous patients who reported to the DSEI of the Alto Rio Solimões for respiratory-related complaints. These data were collected anonymously without checking for duplications. People from the Ticuna, Witoto, Kambeba and Kocama ethnic groups who were diagnosed with respiratory infections between May 2017 and July 2021 participated in the study.

The diagnosis of respiratory diseases followed the International Classification of Diseases, Edition Nº10 (ICD-10). The ICDs included were: Acute nasopharyngitis [common cold] (J00); Pharyngitis to *Streptococcus* (J02); Acute tonsillitis (J03); Unspecified acute tonsillitis (J03.9); Acute laryngopharyngitis (J06.0); Influenza [flu] due to unidentified virus (J11); Viral pneumonia, not elsewhere classified (J12); Other viral pneumonia (J12.8); Pneumonia due to *Streptococcus pneumoniae* (J13); Pneumonia due to *Haemophilus infuenzae* (J14); Acute bronchitis (J20); Acute bronchitis due to *Streptococcus* (J20.2); Acute bronchitis due to respiratory syncytial virus (J20.5); Acute bronchitis due to

rhinovirus (J20.6); Acute bronchitis unspecified (J20.9); Acute bronchiolitis due to respiratory syncytial virus (J21.0); Acute bronchiolitis due to other specified microorganisms (J21.8). Patients whose data did not contain the minimum information required to fulfill the study objectives were excluded. The collection started before the COVID-19 pandemic and the diagnosis of infection with this virus when confirmed by the rapid antigen test for COVID-19 was excluded.

To determine the epidemiologic profile of respiratory disease in the population of interest, data on the disease and associated conditions were extracted from the individuals' medical records. The descriptive variables used were: Gender, age, ethnicity, village and diagnosis according to ICD-10. Based on the identification of the different respiratory diseases, the distribution of cases was evaluated according to the descriptive variables indicated above.

It is worth noting that the DSEIs (Special Indigenous Health Districts) are composed of Multidisciplinary Indigenous Health Teams, including doctors, nurses, dentists, psychologists, pharmacists/biochemists, nutritionists, laboratory technicians, nursing technicians, oral health technicians, oral health assistants, indigenous health agents, indigenous sanitation agents, and river drivers. They have land vehicles, boats, and aircraft for transporting professionals and patients. Their services include multi-vaccination, rapid tests for Sexually Transmitted Infections (HIV, syphilis, hepatitis B and C), tests for COVID-19, influenza, and tuberculosis, as well as basic laboratory tests such as blood counts, liver enzyme analysis, and kidney and inflammatory assessments. For the identification of specific pathogens, cultures were performed.

Statistical Analysis

The data analysis was carried out using SPSS software, version 21.0. Qualitative variables were described as absolute (n) and relative (%) frequencies. Comparisons of frequency rates between subgroups of the population studied according to sociodemographic and clinical characteristics were made using the likelihood ratio (LR) with a confidence interval (CI) of 95% and a significance level of 5%.

Ethical Considerations

The study was approved by the National Research Ethics Committee under 4.265.105 and received permission from the Alto Rio Solimões DSEI general coordinator. Data collection and processing was only carried out after approval by the ethics committee.

RESULTS

In this study, a total of 2,728 medical records of respiratory infections according to ICD-10 of indigenous patients who were members of the DSEI Alto Rio Solimões, Polo Base Nova Itália, municipality of Amaturá, in the period from May 2017 to July 2021 were analyzed.

Among the 2,728 cases, 52.7% of the patients were female, 76.6% of the patients were under 18 years old, 94.9% belonged to the Tikúna ethnic group and 62.8% were from the village of Nova Itália (Supplementary Table S1). Acute nasopharyngitis was the most common diagnose according to ICD-10, accounting for 91.5% of cases (Table 1).

Respiratory infections were significantly more frequent (LR = 290.674; df = 112; $p < 0.05$) in individuals aged 1 to 4 years (Table 2). Cases of acute bronchitis due to streptococci, acute bronchitis due to respiratory syncytial viruses, acute bronchiolitis due to respiratory syncytial viruses and acute bronchiolitis due to other specific microorganisms occurred exclusively in the population of this age group.

Women were more frequently diagnosed with unspecified acute tonsillitis and Influenza (Flu), while in men prevailed acute laryngopharyngitis, *Haemophilus influenzae* pneumonia, acute streptococcal bronchitis, acute respiratory syncytial virus bronchitis, acute rhinovirus bronchitis and acute bronchiolitis caused by other specified microorganisms (Table 3).

The frequency of respiratory infections differed among villages (LR=292.796; df=192; $p<0.05$): The Bom Pastor village was the only one to present cases of acute bronchitis caused by rhinovirus and the isolated case of pneumonia caused by Haemophilus influenzae recorded in the study; meanwhile, the residents of Nova Itália village were the only ones diagnosed with acute bronchitis caused by Streptococcus and acute bronchitis caused by respiratory syncytial virus (Table 4). On the other hand, there was no statistical difference on the frequency of respiratory infections by ethnicity, although among the Witoto there were only cases of acute nasopharyngitis and acute tonsillitis, and 90% of Influenza (Flu) cases occurred among Ticuna (Table 5).

Table 1. Frequency of respiratory infections among the indigenous population of the Special Indigenous Health District of Alto Rio Solimões from May 2017 to July 2021 (N=2,728)

ICD-10	Diagnosis of respiratory disease	n	(%)
J00	Acute nasopharyngitis [common cold]	2,497	91.5
J02	Streptococcal pharyingitis	8	0.3
J03	Acute tonsillitis	44	1.6
J03.9	Unspecified acute tonsillitis	2	0.1
J06.0	Acute laryngopharyngitis	4	0.1
J11	Influenza (flu) due to unspecified virus	29	1.1
J12	Viral pneumonia not classified elsewhere	2	0.1
J12.8	Other viral pneumonia	10	0.4
J13	Pneumonia due to *Streptococcus pneumoniae*	5	0.2
J14	Pneumonia due to *Haemophilus influenzae*	1	0.0
J20	Acute bronchitis	5	0.2
J20.2	Acute bronchitis due to *Streptococcus*	1	0.0
J20.5	Acute bronchitis due to respiratory syncytial virus	1	0.0
J20.6	Acute bronchitis due to rhinovirus	7	0.3
J20.9	Unspecified acute bronchitis	32	1.2
J21.0	Acute bronchiolitis due to respiratory syncytial virus	56	2.1
J21.8	Acute bronchiolitis due to other microorganisms	24	0.9

Table 2. Distribution of respiratory infection by age group (N=2,728).

Age group and ICD-10	n	Proportion (%)
0-11 months	**123**	**4.5**
J00	117	95.1
J20.6	2	1.6
J20.9	4	3.3
1-4 years	**1323**	**48.5**
J00*	1196	90.4
J03	1	0.1
J06.0*	1	0.1
J11*	13	1.0
J12*	1	0.1
J12.8*	4	0.3
J13	2	0.2
J20.2*	1	0.1
J20.5*	1	0.1
J20.6*	3	0.2
J20.9*	20	1.5
J21.0*	56	4.2
J21.8*	24	1.8
5-11 years	**552**	**20.2**
J00	520	94.2
J02	1	0.2
J03	6	1.1
J06.0*	1	0.2
J11	6	1.1
J12*	1	0.2
J12.8*	4	0.7
J13	1	0.2
J20*	3	0.5
J20.6	1	0.2
J20.9	8	1.4
12-17 years	**92**	**3.4**
J00	86	93.5
J02	1	1.1
J03	3	3.3
J11	1	1.1
J20	1	1.1
18-29 years	**246**	**9.0**
J00	218	88.6
J02*	4	1.6
J03*	15	6.1
J06.0	2	0.8
J11	4	1.6
J12.8	1	0.4
J14	1	0.4
J20.6	1	0.4
30-49 years	**248**	**9.1**
J00	228	91.9
J02	1	0.4
J03	13	5.2
J03.9*	1	0.4
J11	2	0.8
J13	2	0.8
J20	1	0.4

Table 2. Continued.

Age group and ICD-10	n	Proportion (%)
50-69 years	**109**	**4.0**
J00	100	91.7
J02	1	0.9
J03	4	3.7
J03.9*	1	0.9
J11	2	1.8
J12.8	1	0.9
70 or more years	**35**	**1.3**
J00	32	91.4
J03	2	5.7
J11	1	2.9

*Significantly different among age groups at 5% level (p<0,05)

Table 3. Distribution of respiratory infection by sex (N=2728).

Sex and ICD-10	n	Proportion (%)
Female	**1,439**	**52.7**
J00*	1326	92.1
J02	4	0.3
J03*	29	2.0
J03.9*	2	0.1
J06.0	0	0.0
J11*	20	1.4
J12	1	0.1
J12.8	2	0.1
J13*	3	0.2
J14	0	0.0
J20*	4	0.3
J20.2	0	0.0
J20.5	0	0.0
J20.6	0	0.0
J20.9*	24	1.7
J21.0	24	1.7
J21.8	0	0.0
Male	**1289**	**47.3**
J00	1171	90.8
J02	4	0.3
J03	15	1.2
J03.9	0	0.0
J06.0*	4	0.3
J11	9	0.7
J12	1	0.1
J12.8*	8	0.6
J13	2	0.2
J14*	1	0.1
J20	1	0.1
J20.2*	1	0.1
J20.5*	1	0.1
J20.6*	7	0.5
J20.9	8	0.6
J21.0*	32	2.5
J21.8*	24	1.9

*Significantly different among sex groups at 5% level (p<0,05)

Table 4. Distribution of respiratory infection by village (N=2728).

Village and ICD-10	n	Proportion (%)
Bom Pastor	**393**	**14.4**
J00	330	84.0
J02	2	0.5
J03	6	1.5
J03.9*	1	0.3
J06.0*	3	0.8
J11	8	2.0
J12.8	2	0.5
J14*	1	0.3
J20	1	0.3
J20.6*	7	1.8
J20.9*	16	4.1
J21.0	8	2.0
J21.8*	8	2.0
Canimaru	**279**	**10.2**
J00	252	90.3
J02	1	0.4
J03	6	2.2
J03.9*	1	0.4
J11	2	0.7
J12.8	1	0.4
J21.0*	16	5.7
Cordeiro de Deus	**56**	**2.1**
J00	56	100
Nova Alegria	**70**	**2.6**
J00	53	75.7
J03	1	1.4
J20.9*	16	22.9
Nova Galileia	**20**	**0.7**
J00	18	90.0
J12*	1	5.0
J13	1	5.0
Nova Itália	**1714**	**62.8**
J00*	1606	93.7
J02*	5	0.3
J03*	23	1.3
J06.0	1	0.1
J11*	16	0.9
J12*	1	0.1
J12.8*	5	0.3
J13*	4	0.2
J20*	3	0.2
J20.2*	1	0.1
J20.5*	1	0.1
J21.0*	32	1.9
J21.8*	16	0.9
Porto Caldas	**24**	**0.9**
J00	20	83.3
J03	2	8.3
J12.8	2	8.3
Porto Gama	**26**	**1.0**
J00	24	92.3
J03	2	7.7
Santo Inácio	**11**	**0.4**
J00	11	100
São Domingos	**18**	**0.7**
J00	16	88.9
J03	1	5.6
J11	1	5.6
São Pedro	**32**	**1.2**
J00	30	93.8
J03	1	3.1
J11	1	3.1
Tambaqui	**79**	**2.9**
J00	76	96.2
J03	2	2.5
J20	1	1.3
Vargem Grande	**6**	**0.2**
J00	5	83.3
J11	1	16.7

*Significantly different among villages at 5% level (p<0,05)

Table 5. Distribution of respiratory infection by ethnicity (N=2,728).

Ethnicity and ICD-10	n	Proportion (%)
Kambeba	**16**	**0.6**
J00	14	87.5
J03	1	6.3
J11	1	6.3
Kocama	**97**	**3.6**
J00	90	92.8
J03	4	4.1
J11	2	2.1
J12.8	1	1.0
Ticuna	**2588**	**94.9**
J00	2367	91.5
J02	8	0.3
J03	38	1.5
J03.9	2	0.1
J06.0	4	0.2
J11	26	1.0
J12	2	0.1
J12.8	9	0.3
J13	5	0.2
J14	1	0.0
J20	5	0.2
J20.2	1	0.0
J20.5	1	0.0
J20.6	7	0.3
J20.9	32	1.2
J21.0	56	2.2
J21.8	24	0.9
Witoto	**27**	**1.0**
J00	26	96.3
J03	1	3.7

*Significantly different among ethnical groups at 5% level (p<0,05)

DISCUSSION

We observed in this study that 94.7% of the respiratory conditions affecting the studied population involve the upper respiratory tract, the majority being of viral etiology. Acute nasopharyngitis, commonly known as the common cold, was the most frequent diagnosis. These diseases are generally self-limiting, requiring only symptomatic treatment, including the use of antipyretics and analgesics, along with non-pharmacological measures such as nasal irrigation and oral hydration.

However, it is known that these types of conditions can predispose individuals to more severe secondary infections, affecting the lower respiratory tract, which increases mortality risk and healthcare costs. In the analyzed population, this scenario was present in only 5.3% of the patients (n=144), who were affected by pneumonia, acute bronchitis, and acute bronchiolitis. Generally, the course of these diseases tends to be benign, but in Brazil, pneumonia is the leading cause of mortality among indigenous populations, accounting for nearly 7% of all causes of death, with 5,650 cases recorded between 2000 and 2023 (DATASUS 2023). In the present study, pneumonia was recorded in only 0.7% of the population, which can be explained by the limited contact of the Alto Rio Solimões peoples with urban centers and the rest of society, a factor that helps prevent villages from contracting a higher number of diseases. Social and geographical isolation may also explain the absence of tuberculosis cases in this population, which is nationally considered a high-incidence disease among indigenous peoples (Vaz et al. 2023). Regarding the COVID-19 pandemic, the semi-isolated villages of Amaturá were not spared, with approximately 3% (89 patients) of their population affected in 2020. However, all cases showed a favorable outcome, with no reported deaths (Silva et al. 2022).

It is well known that it is crucial to combat the possibility of such infections with effective preventive measures, such as immunization, adequate conditions for isolation of sick individuals, greater access to healthcare services, food security, and improvements in housing and sanitation conditions. However, the outcome of respiratory diseases depends on several other more complex factors, including the effects of environmental degradation and territorial invasions, which worsen each year in indigenous regions (Souza et al. 2020). During the COVID-19 pandemic, there was a season of intense fires in the Amazon (INPE 2024), raising serious concerns about the health of the local population. After the pandemic, a decrease in respiratory disease rates was expected, but according to DATASUS data, the mortality rate from these conditions in the indigenous population in 2022 and 2023 was the highest in decades (DATASUS 2023), coinciding with the worsening of forest fires in 2022 and 2024, which saw the largest outbreaks recorded since 2010 (INPE 2024). The Brazilian North and Midwest regions were the most affected by respiratory diseases in the indigenous population up to 2023 (DATASUS 2023), and these were also the regions with the highest deforestation rates (INPE 2024). This perpetuates a correlation between air pollution and respiratory diseases.

In the present study, a higher frequency of respiratory infections was observed in children, especially in the 1 to 4-year-old age group, which represented nearly 50% of the total medical records analyzed, in line with previous studies (Requia et al. 2021; Souza et al. 2020). It serves as a warning to focus attention on this demographic group, as they are more susceptible to contracting lower respiratory tract infections, such as bronchiolitis and bronchitis, due to the fact that at this stage, the respiratory tract is still developing (SBP 2017). It is important to highlight that the adverse effects of repeated exposure to pollutant particles occur both in the short and long term, potentially leading to the onset of diseases that may only be discovered years later (Coelho 2023). Due to the fact that the current trend of environmental destruction may gradually impact the profiles of respiratory diseases in the general population (Requia 2021), it is suggested that the same may be occurring among the indigenous population, including those in semi-isolated villages.

It is important to highlight that there are currently few studies characterizing the epidemiological profile of respiratory infections in indigenous populations in Brazil, especially in semi-isolated villages, despite the relevance of this topic for public health in general. Regarding the limitations of the present study, it is noted that some data were collected during the COVID-19 pandemic, which may have introduced some biases into the study, although confirmed diagnoses of such infections by swab tests were not considered when recorded in the medical records. Furthermore, it should be emphasized that the evaluated medical records did not include patient identification, which may have increased the frequency count if a patient was assessed more than once during the data collection period. In this study, certain disease trends were observed in some villages, such as Bom Pastor and Nova Itália. However, only isolated cases were recorded, making it difficult to establish any correlations, as well as due to the limitations of the nature of this study. Thus, further research is needed to validate these findings.

Therefore, high-quality studies with improved representation of indigenous diversity are needed to support evidence-based public policies (Cardoso et al. 2022). Official indigenous health surveillance and monitoring systems must be strengthened to improve social participation in the planning of public health policies and to increase access to and the quality of healthcare for indigenous populations. All these aspects require a national pact and political and social commitment (Cardoso et al. 2022). Primary Healthcare must expand its preventive efforts, as these are more cost-effective compared to the economic costs of respiratory hospitalizations for the SUS. Furthermore, stronger control measures and penalties for illegal deforestation and burning must be implemented, along with environmental policies for the conservation of natural ecosystems within indigenous

territories, in order to prevent the deterioration of social and living conditions that has been affecting this population.

CONCLUSIONS

This study highlights a high frequency of upper respiratory infections in the largest indigenous district of the Brazilian Amazon, with children aged 1 to 4 years being the most affected. These infections, while often self-limiting, can progress to severe lower respiratory tract conditions, a major cause of mortality in these populations.

The findings emphasize the need for preventive measures, better healthcare access, and stronger environmental policies. Further research is crucial to understanding respiratory infections in indigenous communities and informing public health policies.

ACKNOWLEDGMENTS

The authors declare that the study was carried out without third-party funding and without specific institutional support. The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

REFERENCES

Cardoso, A.M.; Tavares, I.N.; Werneck, G.L. 2022. Indigenous health in Brazil: from vulnerable to protagonists. *The Lancet* 400: 2011-2014.

Coelho, T.F.C.; Souza, A.R.; Souza, J.A.P.L.L.; Petrosa, M.M. 2023. Impactos dos poluentes resultantes das queimadas na saúde humana. *Revista de Engenharia e Tecnologia* 15: 1-15.

CEPAL. 2015. Comisión Económica para América Latina. *Os Povos Indígenas na América Latina: Avanços na última década e desafios pendentes para a garantia de seus direitos. Síntese*. (https://repositorio.cepal.org/entities/publication/fd1b61e8-fdcf-45b6-aee9-0243f3fa11ac). Accessed on 10 Dec. 2024.

DATASUS. 2023. Departamento de Tecnologia da Informação do Sistema Único de Saúde. *Sistema de Informações sobre Mortalidade sobre Causa-CID-BR-10 nos indígenas no período de 2000 a 2023*. (http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sim/cnv/obt10uf.def). Acessed on 10 Dec. 2024.

DATASUS. 2023. Departamento de Tecnologia da Informação do Sistema Único de Saúde. *Sistema de Informações sobre Mortalidade sobre Causa-CID-BR-10 sobre Ano do óbito nos indígenas no período de 2000 a 2023*. (http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sim/cnv/obt10uf.def). Acessed on 10 Dec. 2024.

DATASUS. 2023. Departamento de Tecnologia da Informação do Sistema Único de Saúde. *Sistema de Informações sobre Mortalidade sobre Causa-CID-BR-10 sobre Região nos indígenas no período de 2000 a 2023*. (http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sim/cnv/obt10uf.def). Acessed on 10 Dec. 2024.

IBGE. 2022. Instituto Brasileiro de Geografia e Estatística. Informações sobre a população indígena (https://censo2022.ibge.gov.br/panorama/indicadores.html?localidade=BR). Acessed on 10 Dec. 2024.

INPE. 2024. Instituto Nacional de Pesquisas Espaciais. *Monitoramento dos Focos Ativos por Estado, Região ou Bioma - Programa Queimadas*. (https://terrabrasilis.dpi.inpe.br/queimadas/situacao-atual/estatisticas/estatisticas_estados/). Accessed on 10 Dec. 2024.

Lima, A.P.; Marques, B.; Ramos, D. 2016. Violações de direitos de povos indígenas de recente contato: o caso da região de Hupdäh e Yuhupdëh, no Alto Rio Negro (AM). *Revista Aracê* 3: 1-12.

Requia, W.J.; Amini, H.; Mukherjee, R.; Gold, D.R.; Schwartz, J.D. 2021. Health impacts of wildfire-related air pollution in Brazil: a nationwide study of more than 2 million hospital admissions between 2008 and 2018. *Nature Communications*. 12: 6555.

SBP. 2017. Sociedade Brasileira de Pediatria. *Diretrizes para o manejo da infecção causada pelo vírus sincicial respiratório (VSR)*. Departamentos científicos de cardiologia, imunizações, infectologia, neonatologia e pneumologia. (https://www.sbp.com.br/fileadmin/user_upload/Diretrizes_manejo_infeccao_causada_VSR2017.pdf). Acessed on 10 Dec. 2024.

SESAI. 2023. Secretaria de Saúde Indígena. *Relatório situacional do distrito sanitário especial de saúde indígena - Alto Rio Solimões*. Ministério da Saúde, Brasil. (https://www.gov.br/saude/pt-br/acesso-a-informacao/participacao-social/chamamentos-publicos/2023/chamamento-publico-sesai-ms-no-01-2023/anexo-xxix-relatorio-situacional-dsei-alto-rio-solimoes.pdf). Acessed on 10 Dec. 2024.

SESAI. 2024. Secretaria de Saúde Indígena. *Ministério da Saúde - População Indígena.* (https://infoms.saude.gov.br/extensions/sesai_pop_indigena/sesai_pop_indigena.html). Accessed on 10 Dec. 2024.

SIASI. 2020. Sistema de Informação da Atenção à Saúde Indígena. *Mostra Saúde Indígena-Respeito e Cuidados.* (http://www.ccms.saude.gov.br/saudeindigena/asesai/sistemasdeinformacao.html). Accessed on 10 Dec. 2024.

Silva, MG; Pereira, PMB; Portela, WF; Daros, GC; Barbosa, CRA, Vanassi, BM; et al. 2022. Epidemiology of COVID-19 Among Indigenous Populations in Brazil. *Journal of Racial and Ethnic Health Disparities* 9: 960–966.

Souza, A.A.; Oviedo, A.F.P.; Santos, T.M. 2020. Impact of deforestation-related fires on air quality and indigenous health in the Brazilian Legal Amazon. *Instituto Socioambiental*. (https://acervo.socioambiental.org/sites/default/files/documents/i1d00039_i.pdf)

Valente, R. 2017. *Os fuzis e as flechas: história de sangue e resistência indígena na ditadura*. 1ª ed. Companhia das Letras, São Paulo.

Vaz, I.F.; Paiva, N.S.; Viana, P.V.S. 2023. Spatial-temporal evolution of tuberculosis incidence rates in indigenous and non-indigenous people of Brazil, from 2011 to 2022. *Revista Brasileira de Epidemiologia* 26: e230055.

Wenczenovicz, J. T. 2018. Saúde Indígena: Reflexões Comtemporâneas. *Cadernos Ibero-Americanos de Direito Sanitário* 7: 63-82.

RECEIVED: 11/07/2024
ACCEPTED: 04/12/2024
ASSOCIATE EDITOR: Carlos José Souza Passos
DATA AVAILABILITY: The data that support the findings of this study are available, upon reasonable request, from the corresponding author Rafael Mariano de Bitencourt.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

SUPPLEMENTARY MATERIAL

Silva *et al*. Respiratory infection in indigenous population of the Amazon region, Brazil

Table S1. Sociodemographic data of the indigenous population of the Special Indigenous Health District of Alto Rio Solimões (N=2,728)

Sociodemographic Data	n	%
Sex		
Female	1,439	52.7
Male	1,289	47.3
Age group		
0-11 months	123	4.5
1-4 years	1,323	48.5
5-11 years	552	20.2
12-17 years	92	3.4
18-29 years	246	9.0
30-49 years	248	9.1
50-69 years	109	4.0
70 years or more	35	1.3
Ethnicity		
Kambeba	16	0.6
Kocama	97	3.6
Ticuna	2,588	94.9
Witoto	27	1.0
Village		
Bom Pastor	393	14.4
Canimaru	279	10.2
Cordeiro de Deus	56	2.1
Nova Alegria	70	2.6
Nova Galiléia	20	0.7
Nova Itália	1,714	62.8
Porto Caldas	24	0.9
Porto Gama	26	1.0
São Inácio	11	0.4
São Domingos	18	0.7
São Pedro	32	1.2
Tambaqui	79	2.9
Vargem Grande	6	0.2