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Original Article

Epidemiological scenario of Acute Chagas Disease in Brazil (2007-2022)

Cenário epidemiológico da Doença de Chagas Aguda no Brasil (2007-2022)
Escenario epidemiológico de la Enfermedad de Chagas Aguda en Brasil (2007-2022)

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ABSTRACT

Background and Objectives: Describe the epidemiology of Acute Chagas Disease (ACD) in Brazil through sociodemographic and clinical variables between 2007 and 2022. **Methods:** Epidemiological study using secondary data from SINAN/DATASUS, covering the period from 2007 to 2022. The variables included were outcome, confirmation criterion, age group, probable place of infection, region of residence, year/month/region of notification, sex, education level, probable mode of infection, race, pregnancy status, and Federative Unit (state) of residence. Population estimates were obtained from DATASUS. **Results:** There were 4,019 cases of Acute Chagas Disease (ACD), of which 3,791 were confirmed by laboratory tests, and the national prevalence was 0.124 per 100,000 population. The North and Northeast regions accounted for 98.28% of the cases. Most cases occurred in males, and the most affected age group was 20–39 years. In the North and Northeast, oral transmission was the most common mode of infection. Regarding race, most cases occurred in individuals identified as mixed-race (pardo). In 3,134 cases, the home was the probable place of infection. The period with the highest number of reported cases was between the months of August and December, as well as in the years 2018, 2019, and 2022. Infection during pregnancy was reported in all trimesters. Most patients survived. **Conclusion:** ACD continues to be a serious public health concern, mainly because of its chronic phase, during which patients experience most of the fatal complications.

Keywords: *DATASUS. Trypanosoma cruzi. Brazil. SINAN.*

RESUMO

Justificativa e Objetivos: Descrever a epidemiologia da Doença de Chagas Aguda (DCA) no Brasil por meio das variáveis sociodemográficas/clínicas entre 2007 e 2022. **Métodos:** Estudo epidemiológico com dados secundários do SINAN/DATASUS, no período de 2007 a 2022. As variáveis foram evolução, critério de confirmação, faixa etária, local provável de infecção, região de residência, ano/mês/região de notificação, sexo, escolaridade, provável modo de infecção, raça, gestante e Unidade Federativa de residência. As estimativas da população foram coletadas a partir do DATASUS. **Resultados:** Houve 4.019 casos de DCA, sendo n= 3.791 confirmados por exames laboratoriais, e a prevalência nacional foi de 0,124/100.000 habitantes. As regiões Norte e Nordeste totalizaram 98,28% dos casos. A maioria dos casos ocorreu em indivíduos do sexo masculino, e a faixa etária mais afetada foi 20-39 anos. No Norte e Nordeste, a via oral foi o modo de infecção mais comum. Quanto à raça, predominaram os casos em indivíduos pardos. Em 3.134 casos o domicílio foi o local provável de infecção. O período com maior número de registros foi entre os meses de agosto e dezembro, bem como nos anos de 2018, 2019 e 2022. Quanto à infecção durante a gravidez, houve registros em todos os trimestres. A maioria dos pacientes sobreviveram. **Conclusão:** A DCA continua sendo uma grave preocupação para a saúde púbica, principalmente devido a sua fase crônica, durante a qual os pacientes apresentam a maioria das complicações fatais.

Descritores: *DATASUS. Trypanosoma cruzi. Brasil. SINAN.*

RESUMEN

Justificación y Objetivos: Describir la epidemiología de la Enfermedad de Chagas Aguda (ECA) en Brasil mediante las variables sociodemográficas y clínicas entre 2007 y 2022. **Método:** Estudio epidemiológico con datos secundarios del SINAN/DATASUS, en el período de 2007 a 2022. Las variables fueron evolución, criterio de confirmación, grupo de edad, lugar probable de infección, región de residencia, año/mes/región de notificación, sexo, nivel educativo, probable modo de infección, raza, gestante y Unidad Federativa (estado) de residencia. Las estimaciones de la población se obtuvieron a partir de DATASUS. **Resultados:** Hubo 4.019 casos de ECA, de los cuales n= 3.791 fueron confirmados mediante pruebas de laboratorio, y la prevalencia nacional fue de 0,124 por 100.000 habitantes. Las regiones Norte y Nordeste totalizaron el 98,28% de los casos. La mayoría de los casos ocurrieron en individuos de sexo masculino, y el grupo etario más afectado fue de 20 a 39 años. En el Norte y Nordeste, la vía oral fue el modo de infección más común. En cuanto a la raza, la mayoría de los casos se presentó en individuos mestizos (pardo). En 3.134 casos, el domicilio fue el lugar probable de infección. El período con el mayor número de registros fue entre los meses de agosto y diciembre, así como en los años 2018, 2019 y 2022. En cuanto a la infección durante el embarazo, se registraron casos en todos los trimestres. La mayoría de los pacientes sobrevivieron. **Conclusión:** La ECA continúa siendo una grave preocupación para la salud pública, principalmente debido a su fase crónica, durante la cual los pacientes presentan la mayoría de las complicaciones fatales.

Palabras Clave: *DATASUS. Trypanosoma cruzi. Brasil. SINAN.*

INTRODUCTION

The parasite *Trypanosoma cruzi*, which causes Acute Chagas Disease (ACD), is a unicellular hemoflagellate protozoan belonging to the family Trypanosomatidae. Its life cycle is heteroxenous, involving a definitive host and an intermediate host, with hematophagous triatomines, commonly known as "kissing bugs," responsible for transmitting the disease to humans and other vertebrates through the vectorial route.[1,2]

Nearly a century after its discovery, ACD continues to be an important social and public health issue. According to the World Health Organization (WHO), an estimated 6–7 million people worldwide are infected with *T. cruzi*, most of whom live in endemic areas across 21 countries in Latin America.[3]

The main route of ACD transmission over the years has been vectorial, through the blood-feeding of the "kissing bug" and contamination from the vector's feces infected with *T. cruzi* coming into contact with the host's mucous membranes or skin wounds. However, the disease can also be transmitted through blood transfusions, organ transplants, laboratory accidents, and vertical transmission from mother to fetus. In addition, the consumption of contaminated foods such as açaí berry fruit, meat from infected animals, sugarcane juice, and unpasteurized milk can also lead to infection, particularly in the Amazon region. Thus, foodborne transmission has become increasingly relevant, currently accounting for up to 70% of cases in Brazil. [4,5,6]

Chagas disease initially presents an acute phase, characterized by a high presence of the protozoan in the blood, and an incubation period ranging from 4 to 14 days after inoculation of *Trypanosoma cruzi*, with an estimated duration of 2 to 4 months. This phase is predominantly asymptomatic, affecting about 95% of cases, or it may present with nonspecific signs similar to those of a mild flu-like syndrome. In approximately 5% of individuals, more evident clinical manifestations may be observed, such as inflammatory signs at the site of parasite entry or systemic symptoms.[4]

When transmission is vectorial, some signs and symptoms may appear, such as a chagoma (nodule at the bite site), and when near the eye region, the Romaña sign may occur (palpebral edema and conjunctivitis). In more severe cases, particularly when the infection is acquired orally, manifestations such as myocarditis, pericardial effusion, and In the chronic phase, serious complications may arise, including chronic myocarditis and cardiomegaly, which can lead to heart failure and sudden death, as well as digestive problems such as megacolon and megaesophagus, which pose significant life-threatening risks.[4] Thus, the present study aims to outline the epidemiology of Acute Chagas Disease in Brazil through sociodemographic and clinical variables between 2007 and 2022.

METHODS

This is a retrospective, observational, and descriptive ecological epidemiological study using secondary data from the Notifiable Diseases Information System (SINAN), with information stored in the Department of Informatics of the Unified Health System (DATASUS), which is publicly available. Records of confirmed cases of Acute Chagas Disease in Brazil for the period from 2007 to 2022 were collected.

The variables studied were: outcome (unknown/blank, alive, death due to the reported condition, and death due to another cause), confirmation criterion (unknown/blank, laboratory, clinical-epidemiological, and under investigation), age group (<1 year, 1–4 years, 5–9 years, 10–14 years, 15–19 years, 20–39 years, 40–59 years, 60–64 years, 65–69 years, 70–79 years, and 80+), probable place of infection (unknown/blank, blood transfusion unit, home, laboratory, and other), region of residence (North, Northeast, Southeast, South, and Central-West), and year of first symptom (2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, and 2022), month of 1st symptom (January, February, March, April, May, June, July, August, September, October, November, and December), region of notification (North, Northeast, Southeast, South, and Central-West), sex (female and male), education level (unknown/blank, illiterate, incomplete 1st to 4th grade of elementary school, complete 4th grade of elementary school, incomplete 5th to 8th grade of elementary school, incomplete elementary school, complete elementary school, incomplete higher education, complete higher education, and not applicable), probable mode of infection (unknown/blank, vectorial, oral, and other), race (unknown/blank, white, black, yellow, mixed-race, and indigenous), pregnancy status (unknown/blank, 1st trimester, 2nd trimester, 3rd trimester, gestational age unknown, no, and not applicable), and Federative Unit (state) of residence.

The information was collected on July 7, 2024, and the population estimates of the resident population were obtained from the DATASUS platform, with the stored data sourced from the Brazilian Institute of Geography and Statistics (IBGE). Data outside the established period were excluded.

The data were organized into spreadsheets and processed using the computer program Microsoft Excel 2019. A descriptive statistical analysis was performed, and the results were expressed in absolute numbers and percentages. The prevalence rate (P) was calculated based on the number of ACD cases divided by the resident population in the location and year, according

to IBGE data, and then multiplied by 100,000 population.

Because the data is available in a publicly accessible database, the study in question did not require review by the Research Ethics Committee (REC). Moreover, the ethical guidelines established in Resolution 466/12 of the National Health Council (CNS) were followed.

RESULTS

The results obtained were organized and presented according to the variables analyzed, in order to provide a clearer and more coherent visualization of the proposed study design. This structure made it possible to highlight the main findings, as well as to establish relationships among the different parameters evaluated. The information was presented in tables and figures to facilitate data interpretation and highlight trends observed throughout the study. In addition, the comparative analysis among the investigated groups or categories made it possible to identify consistent patterns and relevant variations, contributing to a deeper understanding of the observed phenomena.

Region of notification and Federative Unit (state) of residence

In Brazil, 4,019 cases of Acute Chagas Disease (ACD) were confirmed between 2007 and 2022. The North (n = 3,800) and Northeast (n = 150) regions had the highest number of notifications in the country, together accounting for 98.28% of the records. The national prevalence for the period from 2007 to 2022 was 0.124 per 100,000 population.

The North region, with the highest prevalence among Brazilian regions (1.383 per 100,000 population), accounted for 3,800 cases. Pará (n = 3,149) and Amapá (n = 206) were the states with the highest absolute numbers of confirmed cases. In the Northeast (n = 150), Maranhão (n = 66) and Pernambuco (n = 43) led in confirmed cases, while Ceará (n = 2) and Sergipe (n = 2) had the lowest numbers of reported cases.

In the other regions of the country, confirmed cases of ACD were scarce. The leading states in the Central-West were Goiás (n = 28) and Mato Grosso (n = 7); in the Southeast, Rio de Janeiro (n = 9) and São Paulo (n = 7); and in the South, Rio Grande do Sul (n = 6) and Paraná (n = 4) (Table 1).

Table 1. Confirmed cases of Acute Chagas Disease (ACD) in Brazil by region and Federative Unit (n = 4,016).

Region/FU of residence	Total (%)	Prevalence
North Region	3,800	1.38
Rondônia	7 (0.18)	0.02
Acre	79 (2.07)	0.62
Amazonas	207 (5.44)	0.33
Roraima	5 (0.13)	0.06
Pará	3,193 (84.02)	2.42
Amapá	252 (6.63)	2.43
Tocantins	57 (1.41)	0.24
Northeast Region	150	0.01
Maranhão	66 (44)	0.06
Piauí	8 (5.33)	0.01
Ceará	2 (1.33)	0.01
Rio Grande do Norte	12 (8)	0.02
Paraíba	15 (10)	0.02
Pernambuco	43 (28.66)	0.03
Sergipe	2 (1.33)	0.00
Bahia	2 (1.33)	<0.01
Southeast Region	19	<0.01
Minas Gerais	2 (10.52)	<0.01
Espírito Santo	1 (5.26)	<0.01
Rio de Janeiro	9 (47.36)	<0.01
São Paulo	7 (36.84)	<0.01
South Region	10	<0.01
Paraná	4 (40)	<0.01
Rio Grande do Sul	6 (60)	<0.01
Central-West Region	40	0.01
Mato Grosso do Sul	4 (10)	0.01
Mato Grosso	7 (17.5)	0.01
Goiás	28 (70)	0.02
Distrito Federal	1 (2.5)	0.01

Sociodemographic Variables

Of the confirmed ACD cases, 53.4% (n = 2,146) occurred in male individuals. The most affected age group was 20–39 years, accounting for 33.78% (n = 1,357) of cases, followed by 40–59 years (24.60%, n = 988) and 10–14 years (8.74%, n = 351). The least affected age groups were 80 years or older, under 1 year of age, and 65–69 years (n = 118). Individuals identified as mixed race (pardo) represented 78.33% (n = 3,146) of the total cases. Regarding affected pregnant women, 20 cases occurred during the third trimester of pregnancy. The North region recorded the highest number of infected pregnant women in the 1st, 2nd, and 3rd trimesters, as well as cases with unknown gestational age, totaling 63 cases. Regarding education level, 3,673 records were classified as unknown/blank (Table 2).

Table 2. Confirmed cases of ACD in Brazil between 2007 and 2022 by sex, age group, race, pregnancy, and education level.

Variables	Total (%)
Sex	
Male	2,146 (53.40)
Female	1,873 (46.60)
Age Group	
Blank/Ignored	1 (0.02)
<1 year	60 (1.49)
1-4	181 (4.50)
5-9	297 (7.39)
10-14	351 (8.74)
15-19	327 (8.14)
20-39	1.357 (33.78)
40-59	988 (24.60)
60-64	153 (3.80)
65-69	118 (2.93)
70-79	145 (3.61)
80+	41 (1.02)
Race	
Ignored/Blank	213 (5.30)
White	409 (10.18)
Black	186 (4.63)
Asian (Yellow)	16 (0.39)
Mixed (Pardo)	3,146 (78.33)
Indigenous	49 (1.22)

continue

Variables	Total (%)
Pregnancy	
Ignored/Blank	65 (1.61)
1st Trimester	9 (0.22)
2nd Trimester	18 (0.44)
3rd Trimester	20 (0.49)
Gestational age Ignored	8 (0.19)
No	1,222 (30.42)
Does not apply	2,677 (66.65)
Schooling	
Ignored/Blank	3,673 (91.39)
None	346 (8.60)

Clinical Variables

Oral transmission (77.97% - n = 3,134) and vectorial transmission (7.38% - n = 297) are the most frequent modes of infection in Brazil. In the North region, oral transmission was the most common, accounting for 75.83% (n = 3,048), with the municipalities reporting the highest numbers of cases being Abaetetuba (11.86%, n = 477), Belém (10.42%, n = 419), and Breves (9%, n = 362).

In the Northeast, oral transmission is also the most common (n = 84), followed by vectorial transmission (n = 25). In the Central-West, vector-borne infection predominates (n = 18) over the other modes of transmission. In contrast, in the Southeast, vertical transmission is the most prevalent mode of infection in the region (n = 7). The South region has few reported cases of infection. Regarding the confirmation criteria, 94.32% (n = 3,791) of the cases were confirmed through laboratory testing. Regarding the outcome of the cases analyzed, 87% (n = 3,499) survived. Regarding the probable place of infection, 63.79% (n = 2,564) occurred at home (Table 3).

Table 3. Region/Federative Unit and the probable mode of infection of ACD cases in Brazil between 2007 and 2022.

Region/FU of residence	Ignored/Blank	Vectorial	Vertical	Accidental	Oral	Other
North Region	**488**	**251**	**5**	**5**	**3,048**	**3**
Rondônia	1	4	-	-	1	1
Acre	4	18	-	-	57	-
Amazonas	20	29	1	1	156	-
Roraima	3	1	-	-	1	-
Pará	416	190	4	3	2,578	2
Amapá	37	3	-	1	211	-
Tocantins	7	6	-	-	44	-
Northeast Region	**38**	**25**	**-**	**2**	**84**	**1**
Maranhão	9	11	-	1	45	-
Piauí	2	6	-	-	-	-
Ceará	1	1	-	-	-	-
Rio Grande do Norte	3	-	-	-	9	-
Paraíba	8	5	-	1	1	-
Pernambuco	14	-	-	-	29	-
Sergipe	1	1	-	-	-	-
Bahia	-	1	-	-	-	1
Southeast Region	**6**	**2**	**7**	**2**	**-**	**2**
Minas Gerais	-	1	-	1	-	-
Espírito Santo	-	-	-	-	-	1
Rio de Janeiro	6	1	-	1	-	1
São Paulo	-	-	7	-	-	-
South Region	**2**	**1**	**3**	**1**	**2**	**1**
Paraná	2	1	-	1	-	-
Rio Grande do Sul	-	-	3	-	2	1
Central-West Region	**20**	**18**	**1**	**-**	**-**	**1**
Mato Grosso do Sul	2	2	-	-	-	-
Mato Grosso	3	4	-	-	-	-
Goiás	14	12	1	-	-	1
Distrito Federal	1	-	-	-	-	-

Month of first symptom

The months with the highest number of confirmed cases were October (n = 601), September (n = 589), and August (n = 499) (Figure 1).

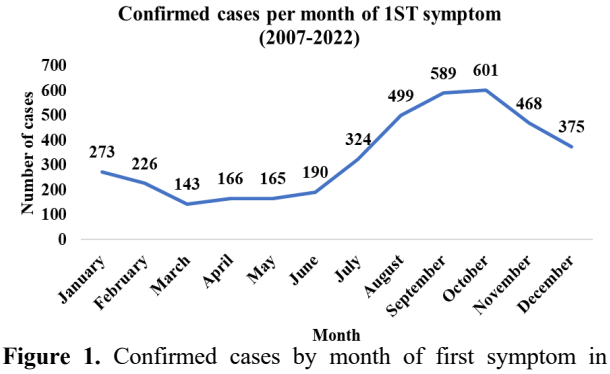

Figure 1. Confirmed cases by month of first symptom in Brazil between 2007 and 2022.

Year of first symptom

The years 2022 (n = 390), 2019 (n = 385), and 2018 (n = 384) had the highest number of confirmed cases (Figure 2).

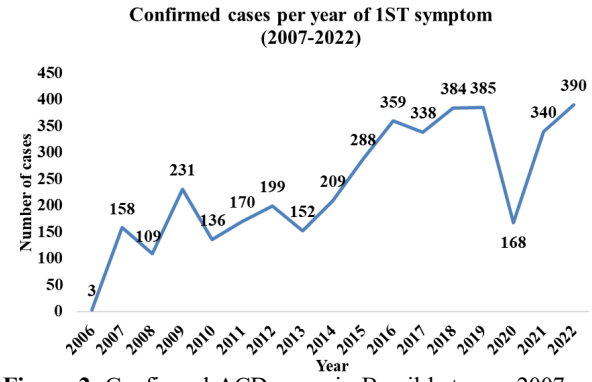

Figure 2. Confirmed ACD cases in Brazil between 2007 and 2022 by year of first symptom.

DISCUSSION

Based on the data collected from SINAN, it was observed that in Brazil the geographic distribution of ACD is heterogeneous, with the North region showing the highest prevalence. This pattern has also been observed in other studies, which reported prevalences of 91.1% and 92.1% in the same location.[8,9]

The high prevalence in the North region is primarily due to oral contamination through açaí berry juice, a traditional beverage associated with the regional culture, with the highest number of cases occurring in the second half of the year, especially in September and October, which is the harvesting season. This regional pattern corroborates the results obtained in the present study, in which the highest numbers of confirmed ACD cases occurred between August and December, with October being the most critical month of the year.[10]

Foodborne contamination results from improper handling of the fruit, which can be exposed to triatomine insects. In this regard, the results obtained in this study are consistent with those reported in the current literature, which indicate that, although vector-borne infection has historically been the most prevalent form, foodborne transmission is currently responsible for up to 70% of cases in Brazil. This shift has altered the epidemiological profile of the disease, with more frequent outbreaks, especially in the Amazon Basin region.[6]

There are reports in the literature of ACD outbreaks in humans associated with oral transmission in Latin America, both in endemic and non-endemic areas. In Brazil, especially in the Amazon region, and in Latin America, studies point to the consumption of açaí and bacaba, fruit juices, sugarcane, guava, babaçu, prickly pear, and açaí pulp, as well as meat from wild animals contaminated with triatomine feces, as the main vehicles of contamination. Other foods can also be sources of transmission, such as peach, banana, and potato.[4, 11-16]

Vector control is the most commonly used strategy for the prevention of ACD, especially in endemic areas. Programs developed in Brazil and other countries in the Americas have contributed to a 70% reduction in new cases in the region, due to the interruption of vector-borne and blood transfusion transmissions. These measures have made vector-borne transmission less common in Brazil, demonstrating the success of this preventive strategy. [17]

On the other hand, as long as foods such as açaí are not properly treated beforehand, oral transmission will remain very high, since proper handling is a protective factor. Research highlights the resilience of triatomines even with various heat treatments and different incubation periods, but emphasizes the importance of refrigerating açaí, as individuals who consumed refrigerated açaí did not develop ACD.[18]

Males were the most affected, representing approximately 53.3% of the cases in the present study. his fact reinforces findings reported in the literature, such as a study conducted in Brazil between 2013 and 2023, which observed approximately 54.47% of confirmed cases in male individuals.[19] The predominance of cases in the male population is likely associated with occupational activities performed by these individuals, who are often exposed to the vector while working in forested areas, such as hunting and agriculture—activities generally carried out by the male segment of the population.[20]

Regarding race, 78.3% of Brazilian cases occurred in the mixed-race (pardo) population, a pattern also reported in other studies, which found 84.68% and 77.62% of cases in the pardo population.[12] The high number of ACD cases affecting this group can be explained by the fact that, in both the North and Northeast regions, the mixed-race (pardo) population represents the largest population group, accounting for 67.2% and 59.6%, respectively, according to the Brazilian Institute of Geography and Statistics (IBGE) 2022 census.[4] It is important to note that in Brazil, race on the notification form is self-reported, and the understanding of the term “pardo” varies among Brazilians. Furthermore, other factors such as income level, education, and phenotypes are considered to complement self-reported race, which helps contextualize the individual within their social reality.[21]

The 20–39-year age group has the highest number of reported cases, accounting for 33.78% of the total. Next, the 40–59-year age group accounts for 24.6% of the cases. Similar results were found in two analyzed studies, in which the predominance of the 20–39-year age group was observed, with prevalences of 34.44% and 33.39%, respectively. For the 40–59-year age group, the percentages were 23.66% and 23.52% in the same studies.[4,7]

Therefore, it is possible to observe that the most affected age group is the one that falls within the working-age portion of the population, which reaffirms the influence of occupational activities on the spread of the disease.[19]

The SINAN data available on DATASUS refer only to ACD, limiting the understanding of the epidemiology related to chronic cases. Although ACD is a notifiable disease, the forms have often been filled out incompletely, with a lack of data in categories such as pregnancy, race, education, and confirmation criteria, which compromises the accuracy of the information.

In light of this, based on the results found regarding the disease during the study period (2007 to 2022), it is clear that prevention of oral contamination is necessary through measures related to basic sanitation,

epidemiological surveillance, and food monitoring (such as the proper processing of the main fruits/foods involved), especially in endemic areas, such as the northern region of the country. Furthermore, the seasonality of the disease requires intensified monitoring and preventive measures, especially between August and December, in order to enable early and rapid diagnosis of ACD cases, thereby preventing disease-related complications. These measures indirectly aim to ultimately reduce the burden on the Brazilian Unified Health System (SUS), as they would decrease the number of severe cases of the disease and, consequently, the demand for hospital services.

We emphasize that, since the data comes from a secondary database, underreporting is a possibility, representing a limitation of the study. However, the research made it possible to present a new epidemiological aspect associated with the risk factors of ACD over the past 16 years, identifying that the disease continues to be neglected in endemic areas. Based on the data collected and analyzed, it is expected that the results of this study will contribute to new epidemiological investigations of the disease in Brazil.

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AUTHORS' CONTRIBUTIONS

Gisele Marques de Carvalho contributed to the literature review, writing of the abstract, introduction, methodology, discussion, interpretation and description of the results, preparation of tables, conclusions, review, and statistical analysis. **Júlia da Silva Brito** contributed to the literature review, writing of the abstract, introduction, methodology, and discussion, interpretation and description of the results, preparation of tables, conclusions, review, and statistical analysis. **Juliane Cristine Ferreira Pires** contributed to the literature review, writing of the abstract, introduction, methodology, and discussion, interpretation and description of the results, preparation of tables, conclusions, review, and statistical analysis. **Rafaela Macedo Assis** contributed to the literature review, writing of the abstract, introduction, methodology, and discussion, interpretation and description of the results, preparation of tables, conclusions, review, and statistical analysis. **Lucas Araújo Ferreira** contributed to project management, literature review, writing of the abstract, introduction, methodology, and discussion, interpretation and description of the results, conclusions, review, and statistical analysis.

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