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TUBERCULOSIS IN CHILDREN UNDER 5 YEARS OF AGE IN THE STATE OF GOIÁS: EPIDEMIOLOGICAL ANALYSIS AND IMPACT OF BCG VACCINATION COVERAGE

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ABSTRACT

Tuberculosis (TB) is one of the world's leading infectious diseases, responsible for high morbidity and mortality, especially in children under 5 years of age, a vulnerable population due to the immaturity of the immune system and the difficulty of early diagnosis. The disease, caused by Mycobacterium tuberculosis, predominantly affects the lungs but can affect other organs, especially in children, in whom extrapulmonary forms are more common and severe. According to the World Health Organization, in 2022, approximately 1.3 million cases of TB occurred in children under 14 years of age, highlighting the severity of the problem in this population. In this sense, this study aims to analyze the epidemiological profile of individuals under 5 years of age affected by tuberculosis in the state of Goiás in the last 10 years and to evaluate the impact of BCG vaccination coverage on the incidence of these cases. This descriptive, quantitative, and retrospective study uses secondary data collected from the Notifiable Diseases Information System (SINAN) and the National Immunization Program Information System (SI-PNI), made available by DATASUS. The results indicate a significant increase in childhood TB cases during the period, with growth of over 300% between 2014 and 2023. At the same time, BCG vaccination coverage showed a significant decrease, from 115.49% in 2014 to 70.67% in 2023. Among the cases analyzed, 70.64% were of the pulmonary form of the disease, predominating in male children (55.05%) and brown children (59.63%). The Central-West macro-region concentrated most of the notifications (51%), reflecting possible regional inequalities in access to vaccination and health care. This inversely proportional relationship between vaccination coverage and the incidence of TB in children reinforces vaccination's crucial role in preventing the disease. The drop in immunization compromises protection against severe forms of TB, especially in this population. In addition, socioeconomic and regional factors and the impact of events such as COVID-19 may have contributed to the reduction in vaccination coverage and the consequent increase in childhood vulnerability. Thus, low vaccination coverage is a determining factor for the increase in cases of childhood TB in Goiás. To face this challenge, it is essential to strengthen public policies aimed at raising awareness about the importance of vaccination, in addition to implementing educational campaigns and preventive strategies. Improving access to health services, prioritizing early diagnosis, and intensifying epidemiological

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surveillance actions are crucial measures to reverse the increase in TB in children and reduce its morbidity and mortality.

Keywords: Vaccination Coverage. Child. Epidemiology. Tuberculosis.

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INTRODUCTION

Tuberculosis (TB) is a highly relevant communicable disease worldwide, being one of the main causes of morbidity and mortality, with special attention to the most vulnerable populations. Given this, in 2018, for the first time, TB was a central theme at the high-level meeting of the United Nations (UN), to outline strategies for the elimination of the disease by 2030. This meeting highlighted the need to improve prevention, diagnosis, and treatment measures for this disease, with special attention to children and adolescents, due to the high rate of undiagnosed cases, requiring advances in specific diagnostic tools for this age group (TAHAN; GABARDO; ROSSONI, 2020).

According to the global tuberculosis report carried out by the World Health Organization, in 2022, 10.6 million cases of tuberculosis were registered worldwide, of which 12% (approximately 1.3 million) occurred in the age group from 0 to 14 years. The emphasis on children under 5 years of age is because tuberculosis presents high morbidity and mortality, in addition to considerable early diagnostic complexity due to nonspecific symptoms in this age group and the absence of a test that can be considered the gold standard in children (GUO et al., 2022).

TB is caused by the bacillus Mycobacterium tuberculosis, which spreads through the air through the inhalation of aerosols, when a person with the disease in its active form speaks, coughs, or sneezes. The disease usually affects the lungs (pulmonary TB), but it can also affect other systems (GUPTA et al., 2022). The subsequent evolution of active tuberculosis depends on the balance of host and pathogen immunity (CARVALHO et al., 2018). In this context, the clinical manifestations of TB result from the host's immune responses to mycobacteria, with the initial activation of neutrophils, attracted and replaced by macrophages that phagocytose and seek to eliminate the microorganisms, which remain unharmed due to their serous coating. The immune response involves delayed hypersensitivity mediated by T cells, which release lymphokines, attracting and maintaining macrophages around the focus of infection (SILVA et al., 2018).

Although tuberculosis has treatment and leads to a cure for the patient, it is still characterized as a serious public health problem, requiring the development of strategies aimed at its proper control. In this sense, the BCG vaccine, a component of the National Immunization Program (PNI), is made available by the Unified Health System (SUS) in Brazil and administered shortly after birth.

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However, despite its wide distribution, the incidence of TB in children remains a challenge to be faced. In Goiás, inconsistencies in vaccination coverage are of great importance and are related to the increase in the tuberculosis infection rate in children under 5 years of age, and their analysis is crucial for a better understanding and improvement in the effectiveness of the Vaccination Program.

Therefore, understanding the epidemiological situation of TB in children under 5 years of age in the state of Goiás is essential for identifying gaps in disease control, such as failures in preventive, diagnostic, and treatment strategies. Furthermore, analyzing the impact of BCG vaccination on the number of TB cases in this age group can support more effective public policies.

Given the above, the objective of this study was to analyze the epidemiological profile of children under 5 years of age affected by tuberculosis in the state of Goiás over the last 10 years and to evaluate the impact of BCG vaccination coverage on the incidence of these cases.

METHODOLOGY

A descriptive, quantitative, and retrospective study was conducted using secondary data collected via the Notifiable Diseases Information System (SINAN) and the National Immunization Program Information System (SI-PNI), made available electronically by the Health Surveillance Secretariat of the Ministry of Health (SVS/MS) in the DATASUS public database, corresponding to the incidence of tuberculosis cases in children and BCG vaccination coverage.

According to the Ministry of Health, BCG can be administered to children up to 4 years, 11 months, and 29 days. Therefore, this study was divided into categories for analysis, considering only tuberculosis cases in children under 5 years of age.

The data obtained correspond to notifications of confirmed tuberculosis cases in the state of Goiás between 2014 and 2023. The following selections were used: year of diagnosis, form, health macro-region of notification, race, and sex.

Furthermore, information was obtained on BCG vaccination coverage in Goiás during these 10 years.

The data were tabulated in Excel spreadsheets and manipulated with descriptive statistics, with variables from the notification form and the immunization information system available on TabNet, a tool developed by DATASUS.

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Since these are non-nominal data, this study does not require the use of approval of a Research Ethics Committee (REC) involving human beings, since secondary data are publicly accessible and the information is aggregated, with no possibility of individual identification.

RESULTS

The epidemiological characteristics of childhood tuberculosis are described in Table 1. Pulmonary tuberculosis (70.64%) was the most frequently recorded form in children under 5 years of age. Furthermore, a predominance of involvement in the mixed race (59.63%) and in males was observed(55,05%).

Table 1. Epidemiological Profile of Tuberculosis Cases in Children Under 5 Years Old in the State of Goiás, 2014-2023

Category	Number of Cases	Percentage Representation
FORM		
Pulmonary	77	70.64%
Extrapulmonary	19	17.43%
Pulmonary + Extrapulmonary	13	11.93%
RACE		
White	24	22.02%
Black	3	2.75%
Mixed race	65	59.63%
Indigenous	8	7.34%
Unspecified	9	8.26%
SEX		
Male	60	55.05%
Female	49	44.95%
TOTAL	109	100%

Source: Author's analysis based on data from SINAN.

Regarding location, tuberculosis cases were most prevalent in the Central-West macro-region (51%), followed by the Central-Southeast (24%) and Northeast (16%) regions, as represented in Figure 1.

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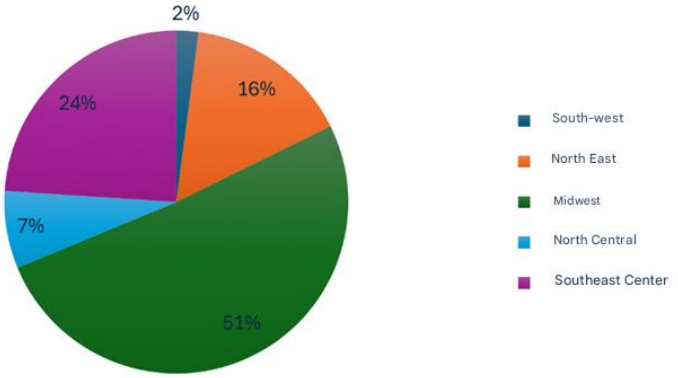
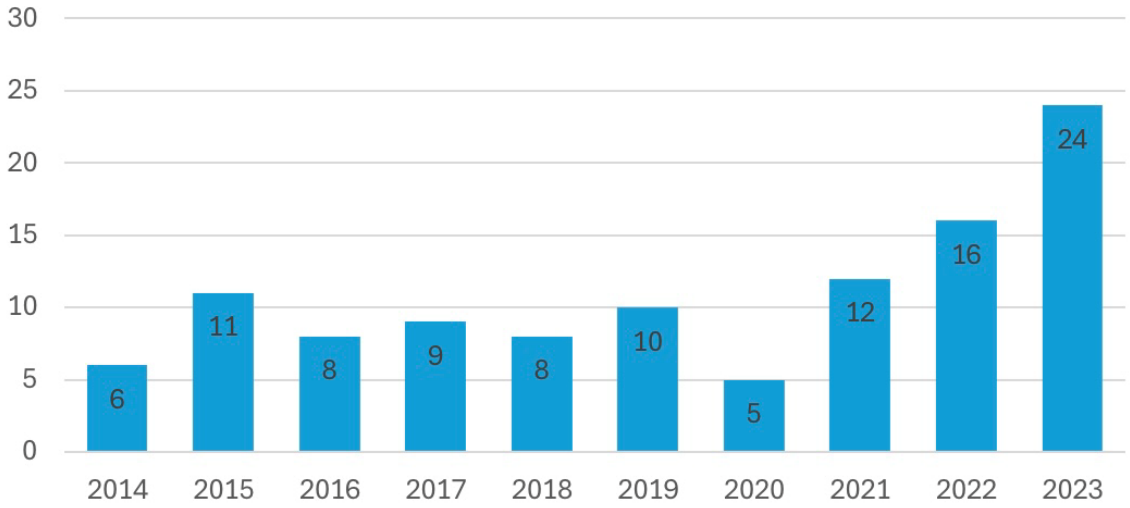
Figure 1. Distribution of tuberculosis cases in children under 5 years of age in the notification health macro-regions of the state of Goiás, 2014-2023.



Source: Authorial with data taken from SINAN

Between 2014 and 2023, 109 cases of tuberculosis were recorded in children up to 5 years of age in the state of Goiás. Figure 2 shows the absolute number of cases distributed by year of notification. An upward trend was observed throughout the period analyzed, with 2023 exceeding the tuberculosis records of 2014 by 300%.

Figure 2. Confirmed cases of tuberculosis in children up to 5 years old in Goiás, 2014-2023.



Source: Authorial with data taken from SINAN

Figure 3 shows the evolution of BCG vaccination coverage in Goiás over the period evaluated. Given this, there is a tendency for a decrease between 2014 and 2023, with the highest rate of childhood immunization against tuberculosis being found in 2014 (115.49) and the lowest in 2023. (70,67).

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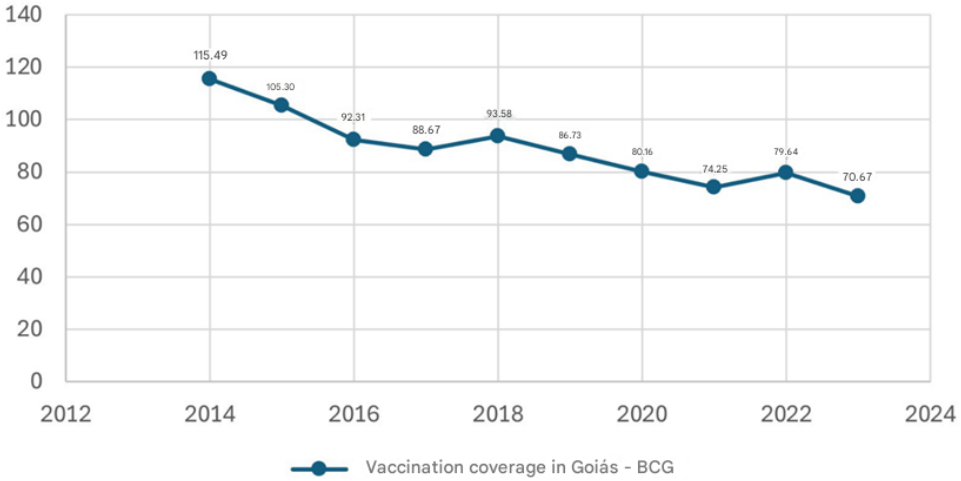
Figure 3. BCG vaccination coverage in the state of Goiás, 2014-2023.



Source: Authorial with data taken from SI-PNI.

Finally, it is crucial to highlight that, concomitantly with the increase in the number of tuberculosis notifications in children under 5 years of age, a reduction in BCG vaccination coverage was observed in this age group. Thus, an inversely proportional relationship between these variables is evident.

DISCUSSION

The results reveal important characteristics about the distribution and development of tuberculosis in this population. The predominance of pulmonary tuberculosis, with 70.64% of cases, reflects the most common and transmissible clinical form of the disease previously documented (Sant'Anna, 2012). In a dissertation presented by Julio (2019), it was observed that tuberculosis in children has characteristics that are distinct from the adult form, such as nonspecific symptoms and the difficulty in producing sputum for smear microscopy, which increases the risk of developing extrapulmonary forms of the disease, which represent the second most common form, with 17.43% of cases. In demographic terms, a higher incidence was observed in male children (55.05%) and children of mixed race (59.63%), in line with the national epidemiological profile, similar to that described in the literature (Macêdo et al., 2024; Gondim et al., 2019; Santos et al., 2020), which may reflect the population distribution and social determinants of health that impact exposure and susceptibility to tuberculosis infection. The geographic distribution of cases also showed a predominance of occurrences in the central-west macro-region of the state (51%), followed by the central, southeast (24%), and northeast (16%) regions, which is justified both by the population difference and by a possible discrepancy in vaccination

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coverage between the regions. In addition, the results elucidated a significant increase in tuberculosis cases in the age group studied, accompanied by a reduction in BCG vaccination coverage over the period. These findings are consistent with the observations of Procianoy (2024), who highlighted a decline in BCG vaccination coverage in several regions of Brazil after the onset of the COVID-19 pandemic, which negatively impacted the incidence of childhood tuberculosis. The inverse association between vaccination coverage and tuberculosis cases, evidenced both in the present study and by Procianoy (2024), reinforces the importance of maintaining high levels of vaccination coverage for the control of tuberculosis in childhood. Outside Brazil, the inverse relationship between VC and new TB cases remains present, as pointed out in the study by Jackson (2024), who analyzed the cessation of the universal BCG vaccination program in Ireland, showing that the interruption of vaccination resulted in a non-significant but notable increase in the age-specific incidence rate in children up to six years of age. The systematic review conducted by Dias (2024) highlights TB as a significant cause of childhood morbidity and mortality. In the context of Goiás, the overall increase in the incidence of TB in children under five years of age highlights the vulnerability of this group and reinforces the need for targeted interventions. Dias notes that “despite the efforts of recent decades, the outcomes of childhood TB treatment are still worrying” (DIAS, 2024), suggesting that, in addition to existing practices, it is necessary to intensify health policies that address the specific risks of this population. Barreira (2018) also emphasizes the need for an integrated political and social response to address TB, noting that the disease is deeply linked to socioeconomic factors that aggravate the vulnerability of certain populations. The World Health Organization’s “End TB Strategy,” as discussed by Barreira, proposes a comprehensive approach to eradicating TB, including “rapid diagnosis, appropriate treatment, and prevention, such as vaccination and treatment of latent TB” (BARREIRA, 2018). In Goiás, where data indicate an inverse relationship between BCG CV and the incidence of childhood TB, the implementation of policies that ensure high vaccination coverage and reinforce early diagnosis and treatment of TB in children is essential to control the disease.

CONCLUSION

The study showed a continuous increase in the number of cases - especially in 2022 and 2023 - of tuberculosis in individuals under 5 years of age over a decade, with a concentration of these occurrences in children of mixed race, male, from the Central-West

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macro-region, and predominantly in the pulmonary form of the disease. This increase in the incidence of TB coincides with a significant drop in BCG vaccination coverage, which indicates a possible correlation between the reduction in immunization and the increased vulnerability to this serious infection. This scenario highlights the urgent need to strengthen public policies aimed at child health, especially tuberculosis prevention. It is essential to implement effective strategies that raise awareness of the risks of the disease. And the importance of vaccination, with educational campaigns that encourage adherence to immunization, ensuring that all children are protected against one of the main causes of preventable morbidity and mortality. The creation of programs aimed at promoting health and improving vaccination coverage can be a decisive step toward reversing this growing situation and reducing the impact of tuberculosis on the pediatric population.

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REFERENCES

1. Almeida, C. C., Quinderé, J. A., & Schmitt, I. A. M. (2023). Perfil epidemiológico de tuberculose infantil no Brasil – um estudo retrospectivo. Brazilian Journal of Health Review, 6(5), 25708–25722.

2. Barreira, D. (2018). Os desafios para a eliminação da tuberculose no Brasil. Epidemiologia e Serviços de Saúde, 27(1).

3. Brasil, Ministério da Saúde. (2023). Boletim Epidemiológico de Tuberculose: Número Especial - Março de 2023. Brasília, DF: Ministério da Saúde.

4. Brasil, Ministério da Saúde, Secretaria de Vigilância em Saúde e Ambiente, & Departamento do Programa Nacional de Imunização. (2024). Calendário nacional de vacinação da criança. Brasília: Ministério da Saúde.

5. Costa, R. S. L. da, et al. (2019). Análise de casos notificados de tuberculose em crianças e adolescentes. Revista Enfermagem Contemporânea, 8(2).

6. Crispim, L. C., & Abreu, A. M. O. W. (2014). Perfil epidemiológico de crianças e adolescentes diagnosticados com tuberculose no Centro de Referência Augusto Guimarães no período de 2008 a 2012. Revista Científica da FMC, 9(1).

7. Dias, J. V., et al. (2024). Outcomes of childhood TB in countries with a universal BCG vaccination policy. The International Journal of Tuberculosis and Lung Disease, 28(6), 273–277.

8. Goiás, Secretaria de Estado da Saúde. (2024). Baixa cobertura vacinal favorece surgimento de casos de tuberculose em crianças. Available at: https://goias.gov.br/casacivil/baixa-cobertura-vacinal-favorece-surgimento-de-casos-de-tuberculose-em-criancas/. Accessed on: November 4, 2024.

9. Goiás, Secretaria de Estado da Saúde. (2024). Situação Epidemiológica e Operacional da Tuberculose no Estado de Goiás. Goiânia: Secretaria de Estado da Saúde.

10. Gondim, C. B., et al. (2019). Avaliação de tuberculose em crianças e adolescentes no Pará. Revista Eletrônica Acervo Saúde, 11(18), e1822.

11. Jackson, S., Kabir, Z., & Comiskey, C. (2024). Retrospective cohort study exploring the impact of universal Tuberculosis (TB) vaccination cessation on the epidemiology of pediatric TB in Ireland, 2011–2021. Vaccine, 42(8), 2099–2105.

12. Julio, M. E. C. (2019). Desenvolvimento de aplicativo de apoio à decisão na tuberculose pulmonar na criança (Master's thesis). Universidade do Estado do Rio de Janeiro, Rio de Janeiro.

13. Khandelia, P., Yadav, S., & Singh, P. (2023). An overview of the BCG vaccine and its future scope. Indian Journal of Tuberculosis, 70(suppl. 1), S14–S23.

Revista ARACÊ
ISSN: 2358-2472

14. Macêdo, M. F. L. de, et al. (2024). Perfil epidemiológico da tuberculose em menores de 15 anos: um retrato dos últimos 10 anos no Brasil. Revista Eletrônica Acervo Médico, 24, e15846.

15. Procianoy, G. S., et al. (2024). Impact of BCG Vaccination Disruptions During the COVID-19 Pandemic on Tuberculosis Incidence in Infants: A Nationwide Study in Brazil. Journal of the Pediatric Infectious Diseases Society, 13(3), 186–188, February 8.

16. Procianoy, G. S., Procianoy, R. S., & Silveira, R. C. (2024). Regional disparities in BCG vaccination coverage and tuberculosis incidence in infants among Brazilian states. Journal of Tropical Pediatrics, 70(4).

17. Sant'Anna, C. C. (2012). Diagnóstico da Tuberculose na Infância e na Adolescência. Pulmão RJ, 21(1), 60–64.

18. Santos, B. A., et al. (2020). Tuberculose em crianças e adolescentes: uma análise epidemiológica e espacial no estado de Sergipe, Brasil, 2001-2017. Ciência & Saúde Coletiva, 25(8), 2939–2948, August.

19. Silva, M. E. N. da, et al. (2018). Aspectos gerais da tuberculose: uma atualização sobre o agente etiológico e o tratamento. Revista Brasileira de Análises Clínicas, 50(3), 228–232.

20. Tahan, T. T., Gabardo, B. M. A., & Rossoni, A. M. O. (2020). Tuberculosis in childhood and adolescence: a view from different perspectives. Jornal de Pediatria, 96, 99–110, March.

21. Unicamp, Hospital de Clínicas. (2024). Boletim Epidemiológico de Tuberculose: Número Especial - Março de 2024. Campinas: Hospital de Clínicas da Unicamp.

22. Unki, P., et al. (2024). TB prevention and immunization in pediatrics. Indian Journal of Tuberculosis, 71(4), 444–452.

23. World Health Organization. (2023). Global tuberculosis report 2023. Geneva: WHO.