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Tuberculosis and cash transfer programs in the indigenous social context of the Amazon in Pará

Tuberculose e os programas de transferência de renda no contexto social indígena da Amazônia paraense

Tuberculosis y programas de transferencia de ingresos en el contexto social indígena de la región amazónica de Pará

Jaqueline Ferreira de Oliveira[I]; *Tais Oliveira da Silva*[I]; *Ingrid Bentes Lima*[I]; *Ivaneide Leal Ataíde Rodrigues*[I]; *Camilla Cristina Lisboa do Nascimento*[I]; *Raquel Gomes da Silva*[I]; *Lucinéia Ferreira Ferreira*[I]; *Laura Maria Vidal Nogueira*[I]

[I]*Universidade do Estado do Pará. Belém, PA, Brasil*

ABSTRACT

Objective: to analyze the association between tuberculosis among indigenous individuals who are beneficiaries of cash transfer programs and the social determinants of health. **Methods:** a cross-sectional, analytical study with a quantitative approach, conducted with 548 tuberculosis cases among indigenous individuals in the state of Pará from 2014 to 2023. Socio-environmental data were collected and subjected to descriptive and inferential analysis. The research protocol was approved by the Research Ethics Committee. **Results:** among the 548 cases, 161 were beneficiaries of cash transfer programs. There was an association between being a beneficiary and conditions such as being literate, having access to the public sewer system, having a septic tank, and having a bathroom in the household. **Conclusions:** the association between unfavorable social determinants of health and tuberculosis cases among beneficiaries of cash transfer programs reinforces the context of indigenous vulnerability and the need for integrated health, education, and social assistance policies to reduce inequalities.
Descriptors: Indigenous Culture; Tuberculosis; Social Determinants of Health; Government Programs; Social Vulnerability.

RESUMO

Objetivo: analisar a associação da tuberculose entre indígenas beneficiários de programas de transferência de renda e os determinantes sociais da saúde. **Métodos:** estudo transversal, analítico de abordagem quantitativa, realizado com 548 casos de tuberculose entre indígenas do estado do Pará, no período de 2014 a 2023, coletando dados socioambientais, submetidos a análise descritiva e inferencial. Protocolo de pesquisa aprovado pelo Comitê de Ética. **Resultados:** entre 548 casos, 161 eram beneficiários de programas de transferência de renda. Houve associação entre ser beneficiário e condições como ser alfabetizado, ter acesso à rede geral de abastecimento de água, possuir fossa séptica e banheiro no domicílio. **Conclusões:** a associação de determinantes sociais da saúde desfavoráveis com os casos de tuberculose entre os beneficiários de programas de transferência de renda reforça o contexto de vulnerabilidade indígena e a necessidade de políticas integradas de saúde, educação e assistência social para minimizar as desigualdades.
Descritores: Povos Indígenas; Tuberculose; Determinantes Sociais da Saúde; Programas Governamentais; Vulnerabilidade Social.

RESUMEN

Objetivo: analizar la asociación entre la tuberculosis en beneficiarios indígenas de programas de transferencia de ingresos y los determinantes sociales de la salud. **Métodos:** se realizó un estudio transversal analítico con un enfoque cuantitativo con 548 casos de tuberculosis en personas indígenas del estado de Pará, entre 2014 y 2023, recolectando datos socioambientales, los cuales fueron sometidos a análisis descriptivo e inferencial. El protocolo de investigación fue aprobado por el Comité de Ética. **Resultados:** de los 548 casos, 161 eran beneficiarios de programas de transferencia de ingresos. Se encontró una asociación entre ser beneficiario y condiciones como alfabetización, acceso a la red de alcantarillado y contar con fosa séptica y baño en el hogar. **Conclusiones:** la asociación de determinantes sociales desfavorables de la salud con casos de tuberculosis en beneficiarios de programas de transferencia de ingresos refuerza el contexto de vulnerabilidad indígena y la necesidad de políticas integradas de salud, educación y asistencia social para minimizar las desigualdades.
Descriptores: Povos Indígenas; Tuberculosis; Determinantes Sociales de la Salud; Programas de Gobierno; Vulnerabilidad Social.

INTRODUCTION

The persistence of tuberculosis (TB) is strongly associated with conditions of social vulnerability, such as poverty and overcrowding[1]. The main challenges in controlling the disease are related to economic and social barriers, the infrastructure of the health system, underreporting of cases, and the disproportionate incidence observed in populations at higher risk of illness, such as indigenous peoples, which is 1.7 times higher compared to non-indigenous populations[2,3].

Corresponding author: Ingrid Bentes Lima. E-mail: ingridbentes@outlook.com
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In 2024, 84,308 new TB cases were reported in Brazil, with an incidence rate of 39.7 per 100,000 inhabitants and 6,025 deaths in 2023, corresponding to 2.8 deaths per 100,000 inhabitants. In the Northern region, there were 11,712 cases, with an incidence rate of 62.7 per 100,000 inhabitants and 649 deaths. In the state of Pará, there were 5,356 new cases and an incidence rate of 61.8 per 100,000 inhabitants[2]. Among indigenous populations, in the same year (2024), incidence rates were 52.13 cases per 100,000 in Brazil, 64.07 per 100,000 in the Northern region, and 155.59 per 100,000 in the state of Pará[2,4].

Data of this magnitude are concerning for public healthcare professionals and policymakers and have driven the development of global policies and strategies aimed at better disease control in society, such as the "End TB" Strategy, which aims to reduce mortality by 90% and incidence by 80% by 2030. The Brazilian National Tuberculosis Control Plan was proposed, with the goal of reducing incidence to fewer than ten cases per 100,000 inhabitants and the number of deaths to fewer than one case per 100,000 inhabitants by 2035[5].

Additionally, the World Health Organization proposes social protection strategies for people with TB, including government policies aimed at reducing poverty, such as cash transfer programs. These measures are essential both for preventing illness and for treating cases, given the catastrophic economic costs generated by the disease[6].

In this context, Brazil established a Family Allowance (PBF - *Programa Bolsa Família*) and the Continuous Benefit Payment, social programs widely accessed by socially vulnerable populations, including those undergoing TB treatment[7]. Scientific evidence has shown the importance of increasing investments to impact both the epidemiology of the disease and the social context, as demonstrated in a study conducted in Brazil, which found increased cure rates and reduced TB mortality associated with receiving PBF, especially among individuals in extreme poverty and belonging to ethnic-racial groups such as indigenous populations, who historically experience greater social vulnerability[8].

Another study conducted in Pará showed high TB rates among indigenous populations in territories with fewer beneficiaries of social programs[9]. These findings reinforce the close relationship between social protection and health, highlighting that such socioeconomic programs influence TB outcomes and, consequently, contribute to either increasing or reducing vulnerability and poverty.

Despite TB control strategies strengthened by social protection, the disease continues to have a higher number of cases among socially vulnerable populations due to socioeconomic barriers, which hinder treatment adherence and increase unfavorable outcomes, such as higher incidence, treatment abandonment, and mortality[8,10,11]. This scenario reflects the influence of living conditions on disease control, particularly emphasizing unsatisfactory social, economic, and environmental determinants.

The association between social determinants and TB has been demonstrated in studies showing higher incidence among individuals with limited access to sanitation, precarious housing, lower Gross Domestic Product *per capita*, inadequate working conditions, and limited access to education[12,13]. In addition, individual factors such as age and sex are determinants of mortality risk among indigenous peoples[13]. Furthermore, the health-disease process among indigenous populations is directly influenced by their living context, as they are embedded in a specific historical and social environment that shapes their health conditions[14].

Other studies have highlighted limitations in accessing healthcare services, despite legal guarantees and the existence of a structured healthcare network designed to meet the specific needs of this population, implemented through the National Policy for the Health Care of Indigenous Peoples[12,15].

Given the above, TB is recognized as an indicator of inequality and social exclusion, as it primarily affects the most socially vulnerable groups. Furthermore, the search for scientific evidence on this topic highlights the need to deepen studies relating TB illness among indigenous populations to social protection policies.

This study aimed to analyze the association between TB among indigenous beneficiaries of cash transfer programs and the social determinants of health (SDH).

METHOD

A cross-sectional and analytical study with a quantitative approach, guided by STrengthening the Reporting of OBservational studies in Epidemiology[16] guidelines, was conducted using TB notifications among indigenous populations in the state of Pará between 2014 and 2023. The state has 80,980 indigenous inhabitants. The territorial unit considered was the Special Indigenous Health Districts (DSEIs - *Distritos Sanitários Especiais Indígenas*), organizational structures defined according to indigenous territories, regardless of official geographic boundaries of states and municipalities. In

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Brazil, there are 34 DSEIs, four of which are headquartered in Pará: DSEI Guamá-Tocantins; DSEI Rio Tapajós; DSEI Altamira; and DSEI Kayapó do Pará (Figure 1).

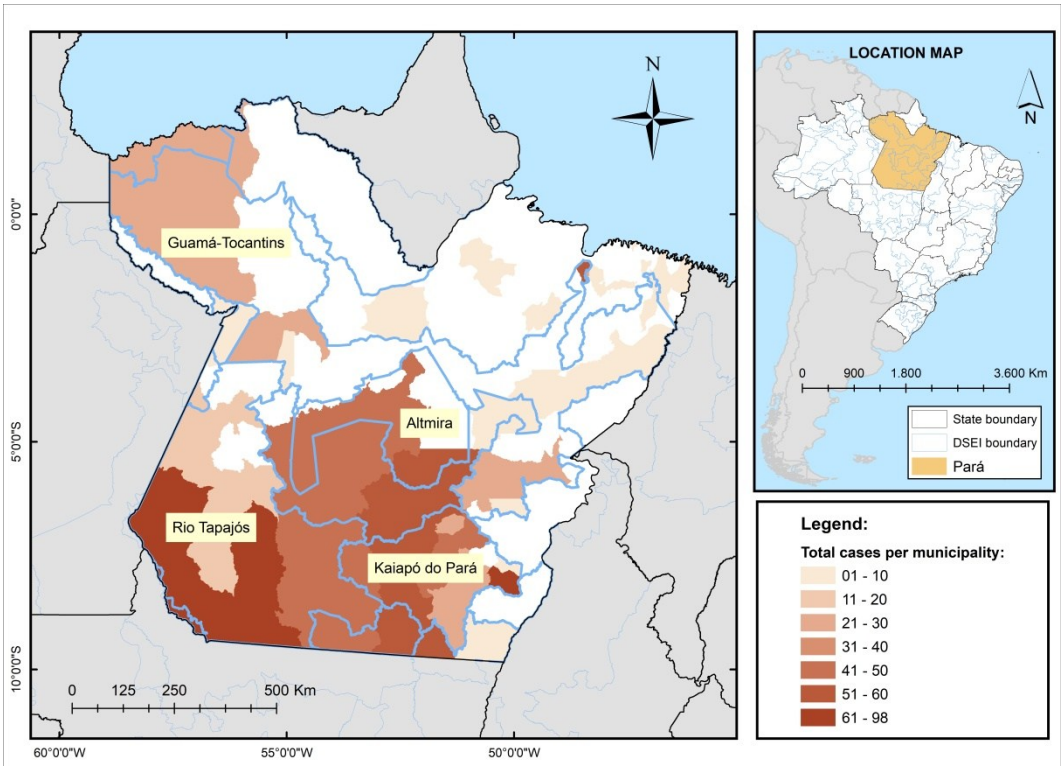

Figure 1: Spatial distribution of tuberculosis cases in indigenous populations in the state of Pará between 2014 and 2023

From a total of 702 identified TB cases, 548 were included in the study and 154 were excluded. To minimize bias related to secondary data, 58 cases were excluded due to missing or blank information for the variable "Beneficiary of cash transfer program"; 47 cases from municipalities without DSEI (as they do not include indigenous territories); and 51 cases with inconsistent and/or incomplete variables.

Data were obtained from the Pará State Department of Public Health, made available on December 19, 2024, and originated from the Notifiable Diseases Information System. Social variables were extracted from the IBGE Automatic Recovery System (SIDRA - *Sistema IBGE de Recuperação Automática*) on November 30, 2024, corresponding to data from the 2022 demographic census (SIDRA).

The dependent variable consisted of TB cases among indigenous individuals who were beneficiaries of federal government cash transfer programs. Independent variables included epidemiological data such as sex, age, education level, year of notification, DSEI, incarcerated population, and homeless population. Clinical data included type of case entry in the system, chest X-ray information, sputum culture, HIV serology, sputum smear microscopy (at diagnosis), clinical form, and treatment outcome. Social variables (SDH) included the presence of a bathroom in the household, type of sanitation, water supply source, and literacy of the household head (ability to read and write).

Considering the sanitation and education variables, missing data accounted for 8.3% (n=54) and 8.8% (n=62), respectively—both below 10%—and were therefore not included in the analysis, being treated as omitted.

Data were organized in spreadsheets using Microsoft Office Excel® 2010 and analyzed using absolute and relative frequencies for categorical variables and mean and standard deviation for numerical variables. Association analysis was performed using hypothesis testing, specifically Fisher's exact test for categorical variables and the Mann–Whitney U test for numerical variables.

Variables with a significance level below 0.05 were included in simple logistic regression, and only those that remained statistically significant ($p<0.05$) were included in the multiple model. In the bivariate logistic regression model, DSEI Altamira was selected as the reference category due to having the lowest number of cases. Additionally, a normality

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test was performed for SDH data, and Spearman's correlation was used for association analysis. The IBM SPSS and R software were used.

This study complied with ethical standards and had its research protocol approved by the Research Ethics Committee of the proposing institution.

RESULTS

A total of 548 cases were analyzed, corresponding to areas with an incidence rate of 676.71 per 100,000 inhabitants, distributed as shown in Figure 1. Tables 1 and 2 present data related to the sociodemographic and clinical variables of the studied cases.

Table 1: Sociodemographic variables of tuberculosis cases among indigenous people according to access to benefits from Brazilian government cash transfer programs (n=548). Belém, PA, Brazil, 2025

	Receipt of social benefits					Total	
	Yes		No				
Variables	**(n=161)**	**f (%)**	**(n=387)**	**f (%)**	***p-value****	**(n=548)**	**f (%)**
Education							
No education	90	60.8	134	38.4		224	45.1
Complete 4th grade of elementary school	16	10.8	58	16.6		74	14.9
Complete elementary school	4	2.7	26	7.4		30	6.0
Complete high school	3	2.0	23	6.6		26	5.2
Complete higher education	0	0.0	5	1.4		5	1.0
Ignored	15	10.1	61	1.5		76	15.3
Not applicable	20	13.5	42	12.0		62	12.5
Sex at birth							
Female	92	57.1	188	48.6	0.075	280	51.1
Male	69	42.9	199	51.4		268	48.9
Population deprived of liberty							
Yes	9	5.7	5	1.3	**0.007**	14	2.6
No	150	94.3	372	98.7		522	97.4
Homeless population							
Yes	2	1.3	11	2.9	0.363	13	2.4
No	156	98.7	367	97.1		523	97.6
Special Indigenous Health District							
Altamira	6	3.9	27	7.6	**<0.001**	33	6.5
Guamá-Tocantins	21	13.8	101	28.5		122	24.1
Kayapó do Pará	86	56.6	100	28.2		186	36.7
Rio Tapajós	39	25.7	127	35.8		166	32.7

Notes: *Significance according to Fisher's exact test for categorical variables and the Kruskal-Wallis test for numerical variables.

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Table 2: Clinical variables of tuberculosis cases among indigenous people according to access to benefits from Brazilian government cash transfer programs (n=548). Belém, PA, Brazil, 2025

	Receipt of social benefits					Total	
	Yes		No				
Variables	**(n=161)**	**f (%)**	**(n=387)**	**f (%)**	***p-value****	**(n=548)**	**f (%)**
Type of entrance							
New case	160	99.4	386	99.7	0.502	546	99.6
Unknown	1	0.6	1	0.3		2	0.4
Clinical form							
Pulmonary	156	96.9	351	90.7	**0.019**	507	92.5
Extrapulmonary	5	3.1	25	6.5		30	5.5
Pulmonary + extrapulmonary	0	0.0	11	2.8		11	2.0
Sputum smear microscopy (diagnosis)							
Positive	86	53.4	189	48.8	0.728	275	50.2
Negative	30	18.6	84	21.7		114	20.8
Not performed	40	24.8	97	25.1		137	25.0
Not applicable	5	3.1	17	4.4		22	4.0
Chest X-ray							
Suspected	129	82.2	312	80.8	0.942	441	81.2
Normal	5	3.2	16	4.1		21	3.9
Other pathology	1	0.6	5	1.3		6	1.1
Not performed	22	14.0	53	13.7		75	13.8
Culture							
Positive	10	6.2	25	6.5	0.940	35	6.4
Negative	4	2.5	9	2.3		13	2.4
In progress	3	1.9	5	1.3		8	1.5
Not performed	144	89.4	348	89.9		492	89.8
HIV							
Positive	0	0.0	7	1.8	0.143	7	1.3
Negative	121	75.2	290	74.9		411	75.0
In progress	1	0.6	10	2.6		11	2.0
Not performed	39	24.2	80	20.7		119	21.7
Treatment termination status							
Cure	121	93.1	293	93.9	0.709	414	93.7
Abandonment	5	3.8	13	4.2		18	4.1
Death for tuberculosis	4	3.1	6	1.9		10	2.3

Notes: *Significance according to Fisher's exact test for categorical variables and the Kruskal-Wallis test for numerical variables.

Among the cases, 161 (29.4%) were beneficiaries of cash transfer programs, with an educational profile in which 60.8% (n=90) had no formal education. Regarding sex, 57.1% were female (n=92; p=0.075), and the mean age was 30 (±20) years (p=0.8). In this group, 5.7% were individuals deprived of liberty (n=9; p=0.007), 1.3% were experiencing homelessness (n=2; p=0.363), and 3.2% were immigrants (n=5; p=0.149).

Regarding distribution by DSEI, beneficiaries were predominantly from DSEI Kayapó do Pará (n=86; 56.6%; p<0.001). In terms of clinical profile, 99.4% were new cases (n=160; p=0.502), of which 96.9% presented the pulmonary form of the disease (n=156; p=0.019). Additionally, 53.4% were diagnosed through positive sputum smear microscopy (n=86; p=0.728), and 82.2% had chest X-rays suggestive of TB (n=129; p=0.942). None of the beneficiaries tested positive for HIV. Regarding treatment outcomes, 93.1% were discharged as cured (n=121; p=0.709).

Among non-beneficiaries (n=387), there was a predominance of males (51.4%; n=199), with a mean age of 32 (±26) years. Most had no formal education (n=134; 38.4%), 1.3% were deprived of liberty (n=5), and 2.9% were experiencing homelessness (n=11). The highest proportion of cases was recorded in DSEI Rio Tapajós (n=127; 35.8%). From a clinical perspective, 99.7% were new cases (n=386), similar to beneficiaries. The pulmonary form was observed in 90.7% (n=351), and sputum smear microscopy was positive in 48.8% (n=189). Chest X-ray findings suggestive of TB were present in 80.8% (n=312), and 6.5% had positive culture results (n=25). Regarding HIV testing, 1.8% tested positive (n=7), and 93.9% achieved cure as the treatment outcome (n=293).

Table 3 presents the results of the association analysis for TB occurrence in the sample studied.

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Table 3: Factors associated with tuberculosis illness among indigenous beneficiaries of a Brazilian government cash transfer program, according to the logistic regression model (n=248). Belém, PA, Brazil, 2025

			Adjustment model			
		Comparison category			*Comparison category*	
DSEI	**Unadjusted OR**	**95%CI***	***p-value****	**Adjusted OR**	**95%CI***	***p****
Altamira						
Guamá-Tocantins	0.936	0.344 – 2.548	0.896	0.893	0.326 – 2.446	0.826
Kayapó do Pará	3.870	1.526 – 9.812	**0.004**	3.718	1.460 – 9.468	**0.006**
Rio Tapajós	1.382	0.532 – 3.590	0.507	1.404	0.540 – 3.648	0.486
Population deprived of liberty						
Yes						
No	0.224	0.074 – 0.679	**0.008**	0.237	0.061 – 0.928	**0.039**

Notes: *95%CI - Confidence Interval; **logistic model bivariate; ***logistic model multivariate.

In the bivariate logistic regression model, individuals belonging to DSEI Kayapó do Pará had a higher likelihood of not being beneficiaries of cash transfer programs compared to those from DSEI Altamira (OR=3.870; 95%CI: 1.526–9.812; p=0.004). This association remained significant after adjustment in the multivariate model (adjusted OR=3.718; 95%CI: 1.460–9.468; p=0.006). No statistically significant associations were observed for being a beneficiary among residents of DSEIs Guamá-Tocantins (adjusted OR=0.893; 95%CI: 0.326–2.446; p=0.826) and Rio Tapajós (adjusted OR=1.404; 95%CI: 0.540–3.648; p=0.486), compared to DSEI Altamira.

Individuals not deprived of liberty had a higher likelihood of not being beneficiaries compared to those deprived of liberty, both in the bivariate model (OR=0.224; 95%CI: 0.074–0.679; p=0.008) and in the adjusted model (adjusted OR=0.237; 95%CI: 0.061–0.928; p=0.039). In other words, indigenous individuals deprived of liberty were more likely to be beneficiaries of cash transfer programs. Table 4 presents the results of the association between TB and SDH.

Table 4: Tuberculosis among indigenous beneficiaries of Brazilian government cash transfer programs is associated with the social determinants of health (n=548). Belém, PA, Brazil, 2025

Social determinants of health	**Spearman's rho**	**p-value**
Has a connection to the public sewer system and uses it as its primary method	-0.214	**<0.001**
Has a connection to the public sewer system, but primarily uses another method	-0.161	**<0.001**
└ Deep or artesian well	0.222	**<0.001**
└ Shallow well, water table or cistern	-0.261	**<0.001**
└ Spring, source or mine	-0.200	**<0.001**
└ Stored rainwater	-0.099	**0.026**
└ Rivers, reservoirs, streams, lakes, and creeks	-0.213	**<0.001**
└ Other	-0.099	**0.026**
Does not have a connection to the public sewer system	0.200	**<0.001**
└ Deep or artesian well	0.161	**<0.001**
└ Shallow well, water table or cistern	-0.262	**<0.001**
└ Spring, source or mine	-0.018	0.692
└ Stored rainwater	0.044	0.328
└ Rivers, reservoirs, streams, lakes, and creeks	0.045	0.315
└ Other	-0.013	0.765
Public sewer system, storm drain or septic tank connected to the sewer system	-0.262	**<0.001**
Public sewer system or storm drain	-0.261	**<0.001**
Septic tank or filter tank connected to the sewer system	-0.253	**<0.001**
Septic tank or filter tank not connected to the sewer system	-0.200	**<0.001**
Rudimentary pit or hole	-0.214	**<0.001**
Ditch	0.018	0.692
River, lake, stream or sea	0.222	**<0.001**
Other form	0.018	0.692
Literate	-0.213	**<0.001**
Illiterate	0.214	**<0.001**
Had a bathroom for the exclusive use of the household	-0.273	**<0.001**
└ 1 bathroom	-0.273	**<0.001**
└ 2 bathrooms	-0.273	**<0.001**
└ 3 bathrooms	-0.037	0.402
└ 4 bathrooms or more	0.204	**<0.001**
Only a bathroom shared by more than one household	-0.204	**<0.001**
Only a toilet or hole for defecation, including those located on the property	-0.207	**<0.001**
Had neither a bathroom nor a toilet	0.273	**<0.001**

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According to the findings, literacy was correlated with receiving social benefits (ρ=-0.213; p<0.001). Thus, indigenous individuals without formal education showed a positive correlation (ρ=0.214; p<0.001), whereas literate individuals showed a negative correlation (ρ=-0.213; p<0.001).

Regarding sanitation, indigenous individuals living in villages and undergoing TB treatment who were beneficiaries of social programs used the public sewer system less frequently as their primary source of domestic water (ρ=-0.214; p<0.001). This pattern was also observed for alternative sources connected to the public sewer system, including shallow wells or dug wells (ρ=-0.261; p<0.001). On the other hand, not using water from the public sewer system showed a positive correlation with receiving benefits (ρ=0.200; p<0.001), especially when the main source was a "deep/artesian well" (ρ=0.161; p<0.001). Regarding sanitation systems, the use of precarious solutions such as rivers, lakes, or the sea was identified (ρ=0.222; p<0.001). The reduced use of widely recommended sanitation alternatives reflects the living conditions in indigenous villages (variation of ρ=-0.200 to -0.262; p<0.001).

In relation to the number and type of bathroom, a negative correlation was identified with the use of an "exclusive bathroom in the home" (ρ=-0.273; p<0.001), regardless of the number of bathrooms in the home. The presence of "four or more bathrooms" showed a positive correlation with not receiving the benefit (ρ=0.204; p<0.001), while "common use of a bathroom" (ρ=-0.204; p<0.001) or the exclusive use of a "toilet/hole in the ground" (ρ=-0.207; p<0.001) were negatively correlated. The total absence of a bathroom or toilet reinforced the positive association with receiving the benefit (ρ=0.273; p<0.001).

DISCUSSION

The results revealed sociodemographic, clinical, and behavioral differences between beneficiaries and non-beneficiaries of cash transfer programs, highlighting the complexity of the relationships between poverty, social policies, and indigenous health. These findings are consistent with studies emphasizing that vulnerabilities among indigenous peoples are directly related to TB illness[9,14, 17-19].

There was a statistically significant association with the variables deprivation of liberty, DSEI of origin, and clinical form of the disease. However, treatment outcomes, including cure and treatment abandonment, did not show significant differences between the groups.

Among the social variables, low educational level stands out as a major challenge to be addressed. In 2022, the literacy rate among indigenous individuals aged 15 years or older reached 84.9% (equivalent to 1.0 million people) out of a total of 1.2 million. This represents an improvement compared to 2010[20], when the rate was 76.6%. Despite this improvement, the proportion of literacy remains below the national average, which was 93% in the same period[21]. Consequently, low educational levels limit access to information, increasing the vulnerability of these populations to illness and negatively affecting treatment adherence and prevention practice [22].

Evidence from this study indicates that indigenous women who are beneficiaries of government social programs are more affected by TB compared to men. Several studies report that TB is more prevalent among men, which is explained by differences in exposure to risk factors and lifestyle habits, as well as lower healthcare-seeking behavior[2,23,24]. In the case of indigenous women, this pattern may be associated with cultural and social factors, such as gender inequality in traditional communities[25].

Another relevant aspect is the higher proportion of beneficiaries among women, which may reflect the prioritization of women in public policies such as PBF, which is often granted to female heads of household[7]. PBF is the largest cash transfer and anti-hunger program in Brazil, expanding access to rights and promoting development and social protection through conditionalities such as school attendance, up-to-date vaccination records, prenatal care for pregnant women, and nutritional monitoring for children[7]. Additionally, concentrating benefits in the hands of women increases the likelihood that resources are allocated to household care, children's education, and family nutrition, positively impacting the family unit[7].

Considering geographic distribution, the highest proportion of TB cases among beneficiaries was observed in DSEI Kayapó do Pará (56.6%), while among non-beneficiaries it was in DSEI Rio Tapajós (35.8%). It is recognized that in DSEI Rio Tapajós there are significant geographic barriers that hinder access to both healthcare services and social protection programs. Furthermore, this district covers a large territorial area, with 14,884 indigenous individuals from nine different ethnic groups, making it the most populous DSEI among the four located in Pará. In contrast, DSEI Kayapó do Pará assists 6,726 indigenous individuals from two ethnic groups: Kayapó and Atikum [26]. In this context, the study suggests that cultural barriers, lack of infrastructure, and administrative challenges compromise the monitoring of program conditionalities, directly affecting access to cash transfer programs [27].

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When analyzing the dynamics of TB illness and access to social benefits across DSEIs, there is a higher likelihood that cases from DSEI Kayapó do Pará are not beneficiaries compared to those from DSEI Altamira. This may be related to the fact that DSEI Altamira encompasses a larger proportion of indigenous territories located in areas with lower Human Development Index in Pará[28].

Social vulnerability in the DSEI Altamira territory is intensified by historical and structural processes, such as the construction of the Trans-Amazonian Highway (BR-230) and the Belo Monte Hydroelectric Plant, which resulted in deforestation, invasion of indigenous lands, illegal mining, and unregulated exploitation of natural resources[29]. These factors have profoundly impacted indigenous ways of life and sanitary conditions, leading to cultural and socioeconomic losses, food insecurity, increased violence, discrimination, and social exclusion[29-31].

An important finding relates to individuals deprived of liberty. TB among incarcerated populations is a major concern, as they are 26 times more likely to develop the disease compared to the general population[2]. According to the 2024 Penal Information Report, 1,581 indigenous individuals were registered in the prison system, representing a 23.4% increase compared to the previous year[32]. The criminalization of indigenous peoples reflects broader social transformations, such as migration to urban areas and conflicts related to land defense[33], as well as changes in social relations.

In this context, Brazilian social security legislation provides the Prisoner's Family Allowance benefit to dependents of low-income incarcerated individuals who contributed to *Instituto Nacional do Seguro Social*[34]. Although it is not a direct federal cash transfer program, it adopts eligibility criteria similar to the PBF and ensures family subsistence during incarceration. Thus, this may explain the higher likelihood of incarcerated indigenous individuals with TB being beneficiaries compared to those who are not deprived of liberty.

Beyond these associations, it is important to highlight that inequalities and social vulnerabilities are intrinsically linked to SDH, particularly social, economic, environmental, and sanitary factors[14,15,35]. Regarding sanitation, the sixth Sustainable Development Goal aims to ensure the availability and sustainable management of water and sanitation for all by 2030[36]. Data from IBGE indicate progress in the implementation of basic sanitation services in both urban and rural areas, estimating that in 2022, 98% of the population had access to piped water and 98.2% of households had exclusive-use bathrooms, while 69.5% of sewage disposal occurred through the public sewer system or septic tanks connected to it[21]. However, surveys show that indigenous populations have lower access to basic sanitation services in both urban and rural areas, reinforcing the findings of this study[37].

A comparative study between the 2000 and 2010 censuses showed that water supply remained one of the most deficient services in indigenous villages in both periods[37]. A study conducted in an indigenous territory revealed that the consumed water had inadequate physicochemical conditions, with total and thermotolerant coliforms present in more than 70% of samples. All assessed groundwater sources, such as deep tubular wells, were contaminated, confirming that the water was unfit for consumption[38]. Studies indicate that households with high population density, lack of adequate water supply, and absence of sewage systems or use of rudimentary pits are at higher risk of diseases such as TB[37-39].

From an economic perspective, a study concluded that TB illness exacerbates financial difficulties among individuals with limited economic resources due to direct healthcare costs, as well as expenses related to transportation, food, and nutritional supplements associated with TB treatment. These costs may compromise up to 20% of the annual income of low-income families[6]. Therefore, this reality reinforces the importance of cash transfer programs and public policies that consider the social and economic specificities of indigenous populations to mitigate inequalities and reduce the impact of TB on their lives.

Study limitations

The limitations of this study are related to the use of secondary data sources, which may lead to underreporting and inconsistencies in the completion of notification forms, resulting from human error during data entry into the system.

CONCLUSION

This study highlights how structural and historical inequalities—such as poverty, low educational levels, inadequate sanitation, water supply conditions, and geographic distance—directly influence the risk of TB illness, treatment adherence, and clinical outcomes. Thus, it provides support for the implementation of strategies in

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indigenous communities aimed at reducing social exclusion, involving the education, health, and social protection sectors. Cash transfer programs do not eliminate vulnerability, but they can contribute positively to reducing TB transmission. Additionally, this study contributes to the advancement of knowledge on the topic, enabling reflection on TB in indigenous populations, with a focus on SDH and the importance of cash transfer programs in improving treatment outcomes.

Hence, when comparing indigenous beneficiaries and non-beneficiaries of cash transfer programs, it was found that access to benefits is a fundamental tool for reducing inequalities, as it promotes access to essential services such as healthcare, food, and education. Cash transfer policies should be integrated with strategies for productive inclusion, expanded access to healthcare and education, and the reduction of structural inequalities.

In the indigenous context, recognizing the impact of structural, geographic, cultural, and financial barriers is essential for addressing TB. Therefore, public policies that integrate health and social protection are fundamental to promoting universal and equitable access to healthcare, contributing to better clinical outcomes and reducing the impact of TB in this population.

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Authors contributions

Conceptualization, J.F.O, T.O.S, I.B.L. and L.M.V.N.; methodology, J.F.O, T.O.S, I.B.L. and L.M.V.N.; software, J.F.O, T.O.S, I.B.L. and L.M.V.N.; validation, J.F.O, T.O.S, I.B.L., I.L.A.R, C.C.L.N, R.G.S, L.F.F e L.M.V.N.; formal analysis, J.F.O, T.O.S, I.B.L., I.L.A.R, C.C.L.N, R.G.S, L.F.F e L.M.V.N..; investigation, J.F.O e T.O.S.; resources, J.F.O, T.O.S, I.B.L. and L.M.V.N.; data curation, J.F.O, T.O.S, I.B.L. and L.M.V.N.; manuscript writing, J.F.O, T.O.S, I.B.L. and L.M.V.N.; review and editing, J.F.O, T.O.S, I.B.L., I.L.A.R, C.C.L.N e L.M.V.N.; visualization, J.F.O, T.O.S, I.B.L., I.L.A.R, C.C.L.N, R.G.S, L.F.F e L.M.V.N.; supervision, I.B.L. and L.M.V.N.; project administration, I.B.L. and L.M.V.N.; financing acquisition, L.M.V.N. All authors read and agreed with the published version of the manuscript.

Use of artificial intelligence tools

Authors declare that no artificial intelligence tools were used in the composition of the manuscript "*Tuberculosis and cash transfer programs in the indigenous social context of the Amazon in Pará*".