

Original Research Article

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Syphilis in a Mining Region of the Brazilian Amazon: Prevalence and Characteristics

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ABSTRACT

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Syphilis is a chronic bacterial infection, being one of the main determinants of sexually transmitted infections (STIs). It is endemic in low-income countries, it is important for both individual and public health because, besides its direct morbidity, it increases the risk of other STIs. The prevalence and characteristics associated with syphilis in a mining region of the Brazilian Amazon was investigated. A cross-sectional study, with 908 individuals from the mining region of Tapajós, was carried out at the Municipal Hospital of Itaituba-Pará. A structured epidemiological questionnaire and collection of venous blood for the performance of the rapid test and VDRL was performed. The majority of men (58.15%), aged 21 - 30 years (31.83%), with incomplete elementary education (51.65%), with mining as their main activity (42.84). The prevalence of active syphilis was 8.15%. The characteristics associated with syphilis in the rapid test were schooling and income. As for occupation being "professional of sex" it presented an increased frequency for syphilis. The prevalence of active syphilis in this study was high compared to other vulnerable populations, low schooling, and low-income influence the prevalence of the disease in this public.

Introduction

Syphilis is a chronic sexually transmitted infection (STI) caused by *Treponema pallidum*, subspecies *pallidum*, being endemic in low-income countries and important for both individual and global public health due to reemergence of outbreaks in several countries from America, Africa and Asia, leading to increasing morbidity and risk for other STIs (Rowley *et al.*, 2019; Hook, 2017; Kitayama *et al.*, 2017).

The World Health Organization (WHO), based on prevalence data from 2009 to 2016, estimated 376.4 million cases of treatable STIs worldwide, including 6.3 million of syphilis cases. The estimated global prevalence of syphilis was 0.5%, with regional values ranging from 0.1 to 1.6% (Rowley *et al.*, 2019). In the Americas, WHO estimated that approximately 2 million adolescents and adults had syphilis, including 1 million new reinfections annually. In addition, significant variations in the impact of syphilis highlighted that specific groups are disproportionately affected by the disease, with seroprevalence of 10.3% among men who have sex with men (MSM), 2.3% among sex workers and 0.4% in the general population (OPAS, 2019). In the last decade in the European Union, a growing trend of syphilis has been observed, with MSM and pregnant women as the most affected populations (ECDC, 2019).

In Brazil the increasing prevalence of syphilis is similar to other countries worldwide and considered a critical national health problem with urgent need of control (Garbin *et al.*, 2019). In 2018, according to the data from the Aggravates Notification Information System (SINAN), 158,051 cases of acquired syphilis were registered, reflecting in an increase of 28.3% in the detection rate compared to 2017. In the Brazilian Northern region and in the

State of Pará, 9,890 and 2,625 cases of acquired syphilis were registered in the same year, respectively (Brasil, 2019). Worryingly, previous study highlights the scarcity of epidemiological information on STIs, specially of syphilis in Northern Brazil, as an indirect reflection of the poor healthcare and socioeconomic attention (SEMSA, 2020).

The city of Itaituba is located in southwestern region of Pará State, having 97,493 inhabitants in a territory of 62,040.705 km². Access to the city can be made by air, land, or waterway. The city presents the Human Development Index (HDI) in the value of 0.640, below the Brazilian average (0.727) and similar to the Pará average (0.646). It is considered the 14th most populated municipality in the state, being one of the main economic centers of western Pará and the 13th largest gross domestic product in the state. The economy stands out in the industrial, agricultural, and specially, in the mining sectors, with intense gold mining activity in the Tapajós River Valley (Cavalcante *et al.*, 2019).

Previously, Santos *et al.*, (1995) reported the poor healthcare conditions, in addition to frequent risk behavior for STIs occurrence such as drug use, alcohol abuse, unsafe sexual practices, prostitution, and promiscuity; and high a prevalence of syphilis, reaching 41.6% in the city. In 2019, however, data from the Municipal Health Secretary of the city of Itaituba, registered only 85 cases of acquired syphilis (Ueno *et al.*, 2020), suggesting that syphilis cases among this population are underreported and do not portray the real epidemiological scenario. Furthermore, the existing mining operations throughout the city contribute to high population mobility, due to the constant presence of individuals looking for work, which generates disorderly growth in the city (Ueno *et al.*, 2020; Nascimento *et al.*, 2019; Brasil, 2014).

The mining activity increases the population's vulnerability situation, since it narrows down sickening situations, mainly due to the non-adoption of preventive measures, and justified by the ineffective public policy directed at this population that does not guarantee living conditions, health, and access to public services, thus increasing the vulnerability of these individuals (Brasil, 2014; Souza *et al.*, 2020). Considering the importance and need of clinical and epidemiological data on syphilis, specially from vulnerable settings such as observed in Itaituba city, the present study aimed to investigate the prevalence and characteristics associated with syphilis in the mining region of the Brazilian Amazon.

Materials and Methods

Study design and inclusion criteria

A cross-sectional study was conducted including individuals from the city of Itaituba (04° 16' 34" latitude south of the equator and 55° 59' 01" longitude west of Greenwich) (Figure 1), a mining region in the Brazilian Amazon, from March to December 2019. The participants were recruited from the endemic sector of the Municipal Hospital of Itaituba. Participants who were or live in areas of mining, 10 years old or older, and who agreed to participate in the research were included. All individuals included signed the informed consent form and responded to a structured epidemiological questionnaire on sociodemographic characteristics (Santos *et al.*, 2018). Individuals not living in mining areas and unable to respond to interviews were excluded from the study.

Sample collection and STI testing

After the interview, 5 ml of blood were collected by venipuncture to perform the rapid treponemic test in loco and the non-treponemic Venereal Disease Research

Laboratory (VDRL) at the Evandro Chagas Institute. Individuals who tested positive on the rapid treponemic test were also tested for HIV, hepatitis B, and hepatitis C in the Test and Counseling Center (TCC) of the city and forwarded for treatment at the Basic Health Unit (BHU) closer to their residence. All participants received pre-test and post-test counseling, condoms and health education guidance on good practices.

Statistical analysis

The Chi-square and G tests were applied according to the distribution of the data. Values of $P \leq 0.05$ were considered statistically significant. All analyzes were performed using the Statistical Package for Social Sciences (SPSS), version 17.0.

Ethics considerations

The present study was conducted in accordance with Helsinki Declaration and the Brazilian National Health Council and approved by the Ethics Committee of the State University of Pará (N° 2,852,618 – 29. August. 2018). Consent was obtained from all participants.

Results and Discussion

Sociodemographic and risk behaviors characteristics of participants

The present study included 908 individuals from the mining region and the endemic sector of the Municipal Hospital of Itaituba. The majority were male, 58.15% (528/908), married 58.92% (535/908), with an average income of 1 to 3 minimum monthly wages 37.88% (344/908), natural born in Pará State 94.05% (854/908) and with mining 42.84% (389/908) as the main labor activity. Table 1 summarizes the data related to the sociodemographic characteristics of the 908

participants, with age, education level and income statistically associated with syphilis (P <0.05).

The use of psychoactive substances in the last 12 months was reported by 67.51% (613/908) of individuals, including alcohol consumption 61.23% (556/908), cigarette 20.59% (187/908) and marijuana 7.49% (68/908), as the most frequent, mainly with frequency of use twice a week. As for the presence of other STIs in the last 12 months, only 10.68% (97/908) reported a picture suggestive of some infection, of these only 0.44% (4/908) reported having confirmed the diagnosis of the disease. When asked about the treatment,

3.74% (34/908) were not treated, 3.63% (33/908) reported self-medication and 3.30% (30/908) sought health service. The majority of participants (57.38% - 521/908) had one sexual partner in the last 30 days, followed by 30.18% (276/908) reported having between 2 and 8 partners in the same period. Exposure among heterosexual 94.49% (858/908) was the most reported. As for the use of condoms with a fixed partner 61.12% (555/908) said not to use, and with an eventual partner, 26.21% (238/908) revealed to use every time in the last 12 months. Sex activity with multiple partners and absence of condom use were risk behaviors associated with syphilis (P <0.05) (Table 2).

Table.1 Socioeconomic characteristics and frequency of syphilis among a mining population in the Brazilian Amazon

	Total		Quick Test positive N (%)	p-value	VDRL positive N (%)	p-value
	N	%				
Gender						
Male	528	58.15	59 (11,17)	0,8367	42 (7,95)	0,8962
Female	380	41.85	45 (11,84)		32 (8,42)	
Age group						
<= 20	81	8.92	3 (3,70)	0,0574	2 (2,47)	0,0075
21 – 30	289	31.83	43 (14,88)		36 (12,46)	
31 – 40	241	26.54	27 (11,20)		13 (5,39)	
41 – 50	156	17.18	14 (8,97)		10 (6,41)	
>=51	141	15.53	17 (12,06)		13 (9,22)	
Marital status						
Married	535	58.92	52 (9,72)	0,2640	38 (7,10)	0,6197
Separate	51	5.62	7 (13,73)		5 (9,80)	
Single	310	34.14	44 (14,19)		30 (9,68)	
Widower	12	1.32	1 (8,33)		1 (8,33)	
Income						
<that 1 wage	114	12.56	13 (11,40)	< 0.0001	9 (7,89)	0,0668
1 - 3 Wages	344	37.89	36 (10,47)		23 (6,69)	
4 - 6 Wages	70	7.71	19 (27,14)		13 (18,57)	

> 6 Wages	47	5.18	6 (12,77)		3 (6,38)	
Uninformed	333	36.67	30 (9,01)		26 (7,81)	
Schooling						
Illiterate	23	2.53	1 (4,35)	0,0007	1 (4,35)	0,3136
Incomplete Elementary School	469	51.65	60 (12,79)		44 (9,38)	
Complete Elementary School	86	9.47	13 (15,12)		7 (8,14)	
Incomplete High School	123	13.55	13 (10,57)		10 (8,13)	
Complete High School	173	19.05	16 (9,25)		12 (6,94)	
Incomplete Higher Education	23	2.53	1 (4,35)		0	
Complete Higher Education	11	1.21	0		0	
Occupation						
Farmer	33	3.63	2 (6,06)	0,0979	2 (6,06)	0,2816
Autonomous	147	16.19	17 (11,56)		11 (7,48)	
Cook	274	30.18	32 (11,68)		22 (8,03)	
Mining	389	42.84	46 (11,83)		33 (8,48)	
Sex professional	16	1.76	5 (31,25)		4 (25,00)	
Health Professional	20	2.20	0		0	
Other	29	3.19	2 (6,90)		2 (6,90)	

Source: Authors' Research. P values were calculated using the G-test of independence

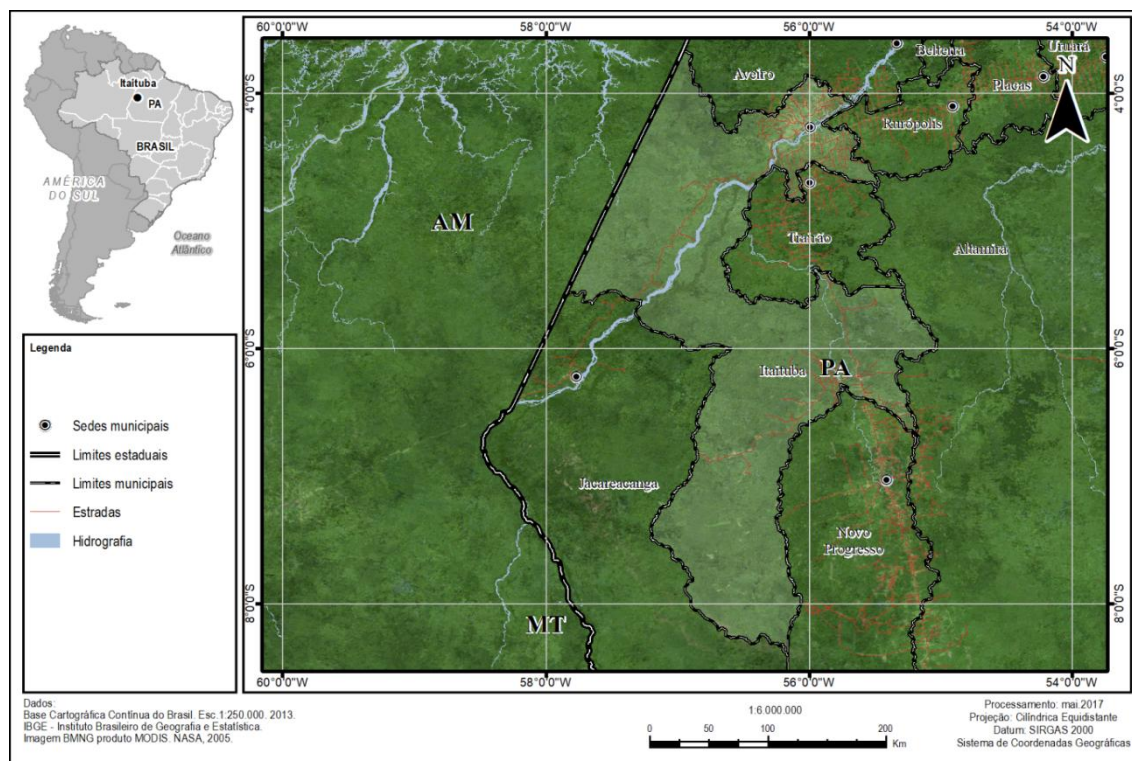
Table.2 Risk behaviors associated with syphilis among a mining population in the Brazilian Amazon

	Total		Quick Test	p-value	VDRL positive	p-value
	N	%	positive		N (%)	
	N	%	N (%)		N (%)	
Use of psychoactive substances						
Yes	613	67.51%	76 (12.40)	0.2393	54 (8.81)	0.3590
No	295	32.49%	28 (9.49)		20 (6.78)	
Use of Psychoactive Substances						
Alcohol	556	61.23%	70 (12.59)	0.3580	52 (9.35)	0.8627
Smoking	187	20.59%	26 (13.90)		19 (10.16)	
Marijuana	68	7.49%	13 (19.12)		4 (5.88)	
Crack	18	1.98%	5 (27.78)		2 (11.11)	
Aspirated Cocaine	14	1.54%	2 (14.29)		1 (7.14)	
Reported to have STIs in 12 months						
Yes	97	10.68%	17 (17.53)	0.0690	7 (7.22)	0.8736

No	811	89.32%	87 (10.73)		67 (8.26)	
Conduct for informed IST						
Not-treated	34	3.74%	9 (26.47)	0.1142	4 (11.76)	0.0796
Self-medication	33	3.63%	6 (18.18)		3 (9.09)	
Sought Health Service	30	3.30%	2 (6.67)		0 (0.00)	
HIV test						
He has	474	52.20%	51 (10.76)	0.5604	40 (8.44)	0.8327
Never performed	434	47.80%	53 (12.21)		34 (7.83)	
Number of Sexual Partners 30 days						
1	521	57.38%	49 (9.40)	0.0044	34 (6.53)	0.0316
2 to 8	276	30.40%	41 (14.86)		32 (11.59)	
More than 8	67	7.38%	13 (19.40)		7 (10.45)	
Uninformed	44	4.85%	1 (2.27)		1 (2.27)	
Sexual Orientation						
Heterosexual	858	94.49%	100 (11.66)	0.1704	71 (8.28)	0.4864
Uninformed	38	4.19%	1 (2.63)		1 (2.63)	
Multiple Sexual Partnerships	7	0.77%	2 (28.57)		1 (14.29)	
Homosexual MSM	5	0.55%	1 (20.00)		1 (20.00)	
Condom Use in the Last 12 Months						
Always	140	15.42%	5 (3.57)	0.0014	1 (0.71)	0.0006
Never	722	79.52%	98 (13.57)		72 (9.97)	
Not informed	46	5.07%	1 (2.17)		1 (2.17)	
Use of Condom with FixedPartner						
Always	61	6.72%	3 (4.92)	0.1373	1 (1.64)	0.0842
Never	674	74.23%	82 (12.17)		60 (8.90)	
It has only any potential partner	127	13.99%	18 (14.17)		12 (9.45)	
Not informed	46	5.07%	1 (2.17)		1 (2.17)	
Use of Condom with random partner						
Always	240	26.43%	17 (7.14)	<0.0001	12 (5.04)	<0.0001
Never	121	13.33%	36 (29.75)		27 (22.31)	
Has only Fixed Partner	501	55.18%	50 (9.98)		34 (6.79)	
Not informed	46	5.07%	1 (2.08)		1 (2.08)	

Source: Authors' Research.P values were calculated using the G-test of independence

Fig.1 Location map of the city of Itaituba, Pará, Brazil



Source: Geoprocessing Laboratory, Evandro Chagas Institute- LABGEO/IEC

Prevalence of syphilis

In general, 104 subjects (11.45%) were reactive in the rapid test, suggesting current or past infection (exposure to syphilis), 74 (8.15%) presented VDRL positive, characterizing active syphilis, of which 22 (2.42%) presented titration above 1:8. Two subjects with VDRL positive were not detected in the rapid test.

Considering the result of the rapid test, variables income of 4 - 6 Wages and Complete Elementary School showed significant differences. In the occupation variable, the report of being a sex professional showed an increased frequency of syphilis, compared to the others, without showing significant difference. Considering the result of the VDRL, the age group variable highlighted a higher frequency of infection among subjects from 21 to 30 years of age.

The present study investigated the prevalence and risk factors associated with syphilis in a mining population in the Brazilian Amazon. We identified that social and behavioral vulnerability conditions were associated with syphilis in the population living in mining area, highlighting that infection control is still a public health challenge and that syphilis circulation must not be ignored (Liu *et al.*, 2019; Peeling *et al.*, 2017; Barros *et al.*, 2018).

The prevalence of syphilis was higher than that notified in the whole municipality in the year 2019 (85 cases) (Santos *et al.*, 1995). It was also higher than the prevalence found in the street population of the central west of Brazil (5.4%) (Barros *et al.*, 2018), among MSM (5.23%) (Motta *et al.*, 2018); but lower when compared to the study with sex workers conducted in the State of Pará (14.1%)¹⁴. Nevertheless, the findings confirm the

vulnerability of the mining population to this infection.

The low level of education and low income influenced positively the occurrence of syphilis cases in this population, as previously evidenced by other studies (Barros *et al.*, 2018; Motta *et al.*, 2018; Macêdo *et al.*, 2017; Weng *et al.*, 2019; Smock *et al.*, 2017). Given that low schooling is associated with less knowledge and consequently related to poverty, these two variables are used to measure the social inequality of a population, and also highlight the need for public policy actions aimed at this public, which is more vulnerable (Motta *et al.*, 2018; Macêdo *et al.*, 2017; Smock *et al.*, 2017).

Regarding the occupation, sex workers presented an increased frequency of syphilis, in line with data obtained in other studies (Cavalcante *et al.*, 2019; Halatoko *et al.*, 2017; Kakchapati *et al.*, 2017). In other cities in Pará State, the prevalence of syphilis among sex workers is also high (8.5%), fifteen times higher than that observed in the general population (Souza *et al.*, 2020). Also, individuals with age between 21 and 30 years were associated with the increased frequency of syphilis, in comparison to other studies. This age group often engages in risky practices, including unprotected sex and psychoactive substance use (Halatoko *et al.*, 2017; Gomes *et al.*, 2017; Azevedo *et al.*, 2017). Furthermore, 67.51% of the participants reported the use of psychoactive substances, such findings corroborate other researches that report the use of licit (alcohol) and illicit drugs as associated factors for syphilis (Barros *et al.*, 2018; Gomes *et al.*, 2017; Castro *et al.*, 2018).

The history of STIs and the multiplicity of partners were described infrequently in the present study, which differentiates from the findings reported in other studies (Macêdo *et*

al., 2017; Aguilar *et al.*, 2019; Chen *et al.*, 2019). Such results may be related to the partially inadequate environment of data collection, since it is a small room in a mixed care unit (primary care and tertiary care) in a city where social relations are very close and familiar between health professionals and the user of the system, this fact may have caused an omission in these data, besides, most of the participants declare themselves married and/or stable union. It was also evidenced that 47.80% of the universe of this study never carried out an HIV test, this data is worrisome because syphilis increases the risk of HIV infection, as evidenced by a survey conducted in São Paulo (Brazil) in which HIV/Syphilis co-infection was 56.6% (Luppi *et al.*, 2018).

Other evidence from this study is associated with the non-use of condoms with the fixed partner (61.12%), whose reason for non-use is anchored in trust, these results are similar to the study conducted in Recife, Brazil, where it is evident that the high frequency of stable relationships contributes to unprotected sex, besides, the condom is still seen as a symbol of distrust and/or infidelity (Macêdo *et al.*, 2017). However, it is known that mining areas, the mining company and/or other workers in the region leave the city in search of jobs in the legal and/or illegal mining around the city, most of them difficult to access and with a high transfer value, so they are isolated for months from their respective companions. Also, at the mining headquarters, there is always the presence of licit and illicit drugs and prostitution houses, a favorable environment for unsafe sexual practice and infidelity. Moreover, although many women identify themselves as cooks or other professionals, it is known that most of these women not only perform domestic work during the day, but many of them prostitute themselves at night as a way to supplement their income.

In conclusion the present study demonstrated a high prevalence of syphilis in the mining population compared to other vulnerable populations (street population and MSM). Socioeconomic and behavioral factors are related to the occurrence of syphilis in a mining population of the Brazilian Amazon, including: low level of schooling, low income, younger age, use of licit and illicit drugs, and no use of condoms with a fixed partner. Thus, this high prevalence related to risk behaviors points to the need for public policies and health and education actions aimed at this population, it is also evident the need for health campaigns on-site (in mining) periodically to perform tests for STIs, since many never perform them. It is fundamental to guarantee this population access to public health services.

The need for prevention measures (individual and group orientation, condom distribution, among others) is evident in this scenario. It is also worth mentioning that syphilis, despite an old disease, with simple and inexpensive diagnostic test and treatment, is a present infection and a health problem for this population, whose circulation should not be disregarded. Finally, studies providing data on STIs subsidizes public health and direct intervention strategies, and help to reduce the burden of STIs.

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Conflict of interest

The authors have no conflicts of interest to declare.

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