Prevalence of syphilis and associated factors in the adult population treated at healthcare facilities in Vitória (ES), Brazil

Prevalência e fatores associados à sífilis em adultos atendidos em unidades de saúde de Vitória (ES), Brasil

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ABSTRACT

Introduction: There are few population-sampling studies on the prevalence of syphilis in Brazil. **Objectives**: We aim to determine the seroprevalence of syphilis and identify factors associated with the infection in adult patients observed at six regional healthcare facilities in Vitória city, state of Espírito Santo, Brazil. **Methods:** A cross-sectional study was conducted between September 2010 and December 2011. For individuals included in the study, a Venereal Disease Research Laboratory (VDRL) test and two treponemal tests (immunochromatographic and IgG ELISA assays) were performed. Demographic data, history of sexually transmitted infections, and behavioral data were collected. **Results:** Of the 1,502 subjects included in the study, 47% were men and 53% were women. The mean age was 41.63±14.57 years. The prevalence of syphilis was (0.9%; 95%CI 0.4–1.3) when a diagnosis of syphilis was considered with VDRL titers equal to or greater than 1:8. However, the prevalence was higher (2.8%) when a positive VDRL test, regardless of the titer, was considered. A multivariate analysis showed a significant association between syphilis and homosexual or bisexual behavior [OR=6.80; 95%CI 1.00–46.20], prior history of sexually transmitted infection [OR=16.30; 95%CI 3.61–73.41], the presence of a tattoo [OR=6.21; 95%CI 1.49–25.84], and cocaine use [OR=6.80; 95%CI 1.15–40.30]. The prevalence of positive treponemal test was 10.4%. **Conclusion:** The seroprevalence of active syphilis in this population was similar to that observed in other populational studies in Brazil. The high prevalence of positive treponemal tests may be due to the positive serological memory of a cured infection, but the results may also be due to cases of early or late syphilis that were not detected by the VDRL test.
Keywords: syphilis; serology; prevalence; Brazil.

RESUMO

Introdução: Existem poucos estudos em amostras populacionais sobre a prevalência da sífilis no Brasil. **Objetivos:** Determinar a soroprevalência de sífilis e identificar fatores associados à infecção em pacientes adultos atendidos nas unidades das seis regiões de saúde do Município de Vitória, Estado do Espírito Santo. **Métodos:** Foi realizado um estudo transversal entre setembro de 2010 e dezembro de 2011. Para os indivíduos incluídos no estudo, foram realizados o teste *Venereal Disease Research Laboratory* (VDRL) e dois testes treponêmicos (imunocromatográfico e IgG ELISA). Foram coletados dados demográficos, histórico de infecções sexualmente transmissíveis e dados comportamentais. **Resultados:** Dos 1.502 indivíduos incluídos no estudo, 47% eram homens e 53% eram mulheres. A média de idade foi de 41,63±14,57 anos. A prevalência de sífilis foi de 0,9% (IC95% 0,4–1,3) quando considerado diagnóstico de sífilis com títulos de VDRL iguais ou superiores a 1:8. Porém, a prevalência foi maior (2,8%) quando considerado VDRL positivo, independente do título. Análise multivariada mostrou associação significativa da sífilis com comportamento homo ou bissexual [OR=6,80; IC95% 1,00–46,20], história prévia de infecções sexualmente transmissíveis [OR=16,30; IC95% 3,61–73,41], tatuagem [OR=6,21; IC95% 1,49–25,84] e uso de cocaína [OR=6,80; IC95% 1,15–40,30]. A prevalência de teste treponêmico positivo foi de 10,4%. **Conclusão:** A soroprevalência de sífilis ativa nesta população foi semelhante à observada em outros estudos populacionais no Brasil. A alta prevalência nos testes treponêmicos positivos pode ser devida a cicatriz sorológica de infecção curada, mas pode também estar associada a casos de sífilis primária ou tardia, que não foram detectados pelo teste de VDRL.
Palavras-chave: sífilis; sorologia; prevalência; Brasil.

INTRODUCTION

Syphilis is a sexually transmitted infection (STI) that dates to the fifteenth century; while it was described more than 100 years ago, it remains a challenge and a major global public health problem[1-4]. According to the World Health Organization (WHO), syphilis infects more than 6.3 million people aged 15–49 years worldwide annually.

In 2016, the global prevalence estimates in women and men were 0.5%[5]. In Brazil, syphilis is a disease of compulsory notification since 2010[6], and the scenario is also worrisome, with a detection rate of acquired syphilis of 72.8 cases per 100,000 inhabitants in 2019. These rates are more than 200% higher compared to 2015[7].

Thus, knowing the prevalence of syphilis is an important tool for monitoring this STI and is also useful for public health policies, both when planning and implementing programs and providing appropriate guidance on prevention, control, and care[5,7-9]. Studies of the prevalence of syphilis using nationwide representative samples have been performed in specific population groups. Among the studies conducted in Brazil between 2004 and 2005, the prevalence rates of syphilis ranged from 0.85 to 0.53% among the military force, 1.90% among industrial workers, 2.6% among pregnant women, 3.3%

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among men seeking help at STI clinics, and 3.4% among women in the same situation[8,10,11].

Also, it is important to discuss the use of diagnosis tests for syphilis screening. For syphilis investigation, there are two types of tests available: direct tests that detect the pathogen; and immunological tests that detect antibodies produced against syphilis infections, called treponemal and non-treponemal tests. The immunological tests, usually called serological diagnosis, are the most used in clinical practice and there are two different approaches that combine those testes: the classic algorithm, which stars with a non-treponemal test and, when positive, continues the investigation with a treponemal test; and the reverse algorithm, which starts with a treponemal test and then a non-treponemal test after positive results on the first one[2,12].

It is important to note that treponemal tests become positive before the non-treponemal tests, a great advantage to investigate new infections[2,3,13]. But, in the other hand, treponemal tests remains positive in around 85% of the infections, regardless of syphilis treatment[1]. Then, the reverse approach for syphilis screening may increase the number of diagnosed cases, but it poses the risk of incorrectly diagnosing patients with prior infections, leading to unnecessary treatment[2,3,12,13]. Although screening with non-treponemal tests may not identify some early- and late-phase cases, it can produce results that are most strongly associated with the active disease, which is the reason why these tests were widely recommended by healthcare authorities in the past[14,15]. Clearly, whatever screening strategy is adopted, the serological diagnosis of syphilis has limitations, and there will still be failures in detecting some cases. Therefore, additional information about the patient's clinical history, epidemiological assessments (risk factors associated with the infection), and periodic retesting are important in this context and result in more appropriate clinical decisions[4].

OBJECTIVE

Because there are few population-based studies approaching the general population and with the additional goal of gathering more available data, this study was designed to investigate the seroprevalence of and the risk factors associated with syphilis in a representative sample of the adult population in the municipality of Vitória, Espírito Santo, Brazil.

METHODS

This was a population-based and cross-sectional study on patients treated at regional healthcare facilities in the municipality of Vitória, Espírito Santo, Brazil. The study encompassed both male and female subjects aged 18 years or older living in Vitória who were admitted to a municipal healthcare facility from September 2010 to December 2011. Patients who agreed to participate in the study signed an informed consent form and were interviewed. Then, a blood sample was collected.

The city of Vitória is divided into six administrative healthcare regions. The sample size was calculated based on the average prevalence of syphilis according to previous studies, which is 0.84% with a variation of ±0.48% (0.53%[10]; 0.40%[16]; 1.60%[11]). According to the Brazilian Institute of Geography and Statistics (Instituto Brasileiro

de Geografia e Estatística — IBGE), in 2006, the municipality of Vitória had 317,085 inhabitants. Based on estimates prepared by the Municipal Secretary of Health (Secretaria Municipal de Saúde — SEMUS) using project data from the United Nations Population Fund (UNFPA/IBGE) (BRA/4/P31A), the municipality of Vitória had a population of 320,153 inhabitants in 2009. The sample size required for a statistical power of 80% (β error=0.20) and a level of significance of 95% (α error=0.05) was considered. We, therefore, planned to enroll 1,633 people, which would allow for a loss of up to 15%.

To calculate the number of individuals per region/municipal healthcare facility, the estimated 2009 population was used, and a simple proportion of cases was calculated. Individuals observed at the 27 regional healthcare facilities of the municipality of Vitória were randomly approached, and those who met the study's inclusion criteria were invited to participate. To maximize sample population heterogeneity and include representatives from each healthcare region, sample selection took into consideration the address of the patient so that only one individual per household was included in the study.

After agreeing to participate and signing the informed consent form, the patients were interviewed in person for approximately 20 minutes using a modified version of the questionnaire used in the survey "Markers of Hepatitis B Virus in young women seen by the Family Health Program in Vitória, ES, 2008" (Marcadores do Vírus da Hepatite B em mulheres jovens atendidas pelo programa de saúde da família em Vitória-ES, 2008)[17]. Based on this questionnaire, sociodemographic data (age, gender, race/color, education level, marital status, monthly family income, and healthcare region) and epidemiological data (sexual activity, number of sexual partners over the last year, condom use, use of injectable drugs and other drugs, alcohol use, and history of STIs) were collected.

After the interview, blood was collected from the patients using a vacuum collection system or sterile disposable syringe. In total, 5 to 10 mL of blood from each patient were collected in a sterile tube without anticoagulants. The tubes containing the samples were placed in an isothermal box and sent to the Center for Infectious Diseases laboratory at Universidade Federal do Espírito Santo (NDI/UFES).

The tests conducted included a VDRL antigen suspension test® (Wiener Lab), and samples that were considered reactive in the semi-qualitative test were serially diluted (dilutions 1:2. 1:4, 1:8, 1:16, etc.) in a sterile saline solution and analyzed. Antibody titers were determined for the highest dilution with reactivity. The samples were also submitted to an immunochromatographic assay, which is a qualitative, highly-sensitive and specific treponemal test that detects specific *T. Pallidum* IgM and IgG antibodies (SyphilisRapid Check Sífilis® at NDI/UFES), and to a recombinant ELISA assay (enzyme-linked immunosorbent assay) v.4.0® (Wiener Lab).

Any non-treponemal titer has to be investigated as active syphilis, and low titers can be observed especially in the early and late stages of syphilis[2,3,12]. In this study, we considered samples with VDRL titers greater than or equal to 1:8 and one positive treponemal test as serological diagnostic criteria for syphilis. However, those with VDRL titers <1:8 were included in another analysis and also received standard of care treatment for syphilis according to national guidelines[4].

The statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) software, version 17.0. A descriptive analysis was performed to determine the distribution of syphilis across

the different qualitative variables and calculate the mean and standard deviation (SD) of the quantitative variables. The prevalence of syphilis was estimated by the number of cases diagnosed in relation to the total number of samples tested. The corresponding 95% confidence interval was also calculated (individuals whose samples had reactive VDRL titers greater than or equal to 1:8 and were positive using one of the treponemal tests were considered positive for syphilis). Possible associations between the occurrence of syphilis and risk factors or demographic variables were tested using a chi-square test with Yates' or Fischer's correction, when appropriate. The odds ratios (ORs) and confidence intervals (CIs) were calculated using bivariate analyses to estimate the degree of association between syphilis and potential risk factors. A multivariate logistic regression analysis was used to estimate the effect of a given variable, while controlling for the effect of the other variables, in predicting the probability of a diagnosis of syphilis. The variables with a significance level (p) less than or equal to 0.150 were considered in the model, and variables with a $p<0.05$ were considered significant.

This research was conducted in accordance with the provisions of Resolution No. 196, October 10, 1996, and the National Board of Health for scientific research in humans and is part of the research project entitled: "Prevalence of human T-cell lymphotropic virus (HTLV 1 and 2) infection in the healthcare regions of the municipality of Vitória, ES", which was approved by the Committee for Ethics in Research at the Center for Health Sciences, Universidade Federal do Espírito Santo under protocol No. 089/10. Patients who were diagnosed with syphilis were referred to follow-up visits and appropriate treatment.

RESULTS

Of the 1,633 individuals surveyed, a total of 1,502 (92%) were interviewed and consented to give blood samples. These individuals were distributed proportionally across the facilities belonging to the six healthcare regions of the municipality of Vitória, ES. Of the 1,502 subjects enrolled in the study, 712 (47.4%) were male and 790 (52.6%) were female. The age of the group ranged from 18 to 86 years, with a mean age of 41.63 years (SD=14.57).

The results of the three serologic tests performed are summarized in **Table 1**. The positivity of treponemal tests was higher than the positivity of VDRL tests at any titer. Of the 42 cases with positive VDRL tests, 13 had titers greater than or equal to 1:8 and at least one positive treponemal test. Thus, the prevalence rate for syphilis was 0.9% (95%CI 0.40–1.30), when the diagnosis of syphilis was considered with VDRL titers equal to or greater than 1:8. However, if any VDRL titer were considered, the prevalence would be 2.8% (2.0–3.6).

Table 2 shows the sociodemographic characteristics of the study subjects. The 13 subjects who met the serological diagnostic criteria for syphilis were positive by both treponemal tests. The proportion of positive men (10 or 76.9%) was significantly higher (p=0.030) than that of women (3 or 23.1%). For the age and marital status criteria, subjects aged 18 to 39 years (10 or 76.9%) and subjects who were single (8 or 61.5%) had significantly higher frequencies of syphilis (p=0.039 and 0.003, respectively).

For individuals with VDRL results greater than or equal to 1:8, the results of the two treponemal tests employed were in agreement.

Table 1 – Results of the serological diagnosis test for syphilis performed on 1,502 adults living in the municipality of Vitória, ES.

VDRL titers (n)		Treponemal tests	
		ELISA IgG (%*)	Immunochromatographic (%*)
<1:8	29	27 (93.1)	25 (86.2)
≥1:8	13	13 (100)	13 (100)
Total	42	40 (95.2)	38 (90.5)

*According VDRL results.

For the 29 cases in which the VDRL titers were less than 1:8, the ELISA and Rapid Test treponemal tests were positive for 27 and 25 individuals, respectively. Two positive VDRL samples were not positive for either the treponemal test and were considered false positives for syphilis. Among the VDRL seronegative subjects, the treponemal tests detected 117 positive cases by ELISA and 105 using the Rapid Test.

Table 3 describes the relationship between the behavioral variables and the presence or absence of syphilis. Except for the variable "blood transfusion", the other variables were significantly associated with having syphilis.

The final logistic regression model (**Table 4**) showed an association between syphilis cases and homosexual or bisexual behavior [OR=6.80 (95%CI 1.00–46.20)], report of a history of STI [OR=16.30 (95%CI 3.61–73.41)], the presence of tattoos [OR=6.21 (95%CI 1.49–25.84)], and cocaine use [OR=6.80 (95%CI 1.15–40.30)].

DISCUSSION

The data from this study indicate that there was a low prevalence (0.9%) of syphilis, when considering VDRL titers equal to or greater than 1:8 in the adult population who sought care at regional healthcare facilities in Vitória. This prevalence is similar to that reported in other studies conducted in Brazil using different sample populations[8,9,18]. These results are similar to previous reports of the prevalence for syphilis in other sample populations studied in Vitória and its metropolitan area among young women (1.2%) and pregnant women (0.4%) treated at healthcare clinics in the Brazilian public healthcare system[8,16]. Some studies conducted in other Brazilian states have also showed similar prevalence, such as the reports including pregnant women in the state of Mato Grosso do Sul (0.8%)[19], Sergipe (0.9%)[9], and São Paulo (0.9%)[20].

It is important to highlight that, if a positive VDRL, regardless of the titer, had been considered, the prevalence in this study would be higher (2.8%; 2.0–3.6). Thus, this prevalence would be similar to that reported in the another study conducted in six state capitals that included data from industry workers (1.9%), pregnant women (2.6%), and men and women being observed at STI clinics (3.3% and 3.4%, respectively)[11]. Higher syphilis prevalence was also reported in African-descendant women in maroon communities (4.3%)[21], women living with HIV (10.0%)[22], and women deprived of liberty (15.5%)[23].

Similarly, if only the results of the treponemal tests had been considered, the prevalence of infection throughout life would have been at least ten times higher. These data suggest that the prevalence can be underestimated when low-sensitivity methods for the early and late stages of the disease, such as VDRL, are used as the first test in

Table 2 – Sociodemographic characteristics of adults living in the municipality of Vitória who were screened for syphilis (n=1,502).

Variable	N (%)	Syphilis		OR (95%CI)	P-value
		present	absent		
Gender					0.030
Male	712 (47)	10 (76.9)	702 (47.1)	3.70 (1.02–1.37)	
Female	790 (53)	3 (23.1)	787 (52.9)	1	
Race / Color (Self-reported)					0.486
Non-white	1095 (72.9)	9 (69.2)	1086 (72.9)	1.20 (0.37–3.91)	
White	407 (27.1)	4 (30.8)	403 (27.1)	1	
Age (years)					0.039
18–39	736 (49.0)	10 (76.9)	726 (48.8)	3.50 (0.96–12.78)	
>40	766 (51.0)	3 (23.1)	763 (51.2)	1	
Education (years)					0.779
Up to 4	218 (14.5)	1 (7.7)	217 (14.6)	1	
5–8	334 (22.2)	3 (23.1)	331 (22.2)	1.06 (0.28–3.92)	
>8	950 (63.3)	9 (69.2)	941 (63.2)	2.07 (0.26–16.47)	
Marital status					0.003
Single	343 (22.8)	8 (61.5)	335 (22.5)	5.51 (1.79–16.96)	
Married	1159 (77.2)	5 (38.5)	1154 (77.5)	1	
Family Income					0.411
Up to 3 MW	1047 (60.7)	10 (76.9)	1037 (69.7)	1.45 (0.40–5.30)	
>3 MW	455 (30.3)	3 (23.1)	452 (30.4)	1	
Healthcare Region					nc	nc
Continental	477 (31.8)	4 (30.8)	473 (31.8)		
Maruípe	290 (19.3)	2 (15.4)	288 (19.3)		
Centro	133 (8.8)	0 (0)	133 (8.9)		
Santo Antônio	145 (9.6)	0 (0)	145 (9.7)		
São Pedro	130 (8.7)	1 (7.7)	129 (8.7)		
Forte São João	327 (21.8)	6 (46.1)	321 (21.6)		

MW: minimum wage; nc: not calculated; OR: odds ratio; 95%IC: interval of confidence of 95%.

syphilis algorithms testing. On the other hand, the prevalence can be overestimated when methods that cannot discriminate between the active disease and a past infection are used alone, as treponemal tests. These tests usually remain positive (85%) throughout the patient's lifetime, regardless of treatment[1].

Traditionally, following screening by non-treponemal tests, reactive samples are tested using treponemal tests to confirm the result. Although this approach has the advantage of being cost-effective, it is limited because it depends on a screening method that has low sensitivity for the early and late stages of syphilis, requires manual operation, and can be affected by the subjectivity of the operator performing the interpretation[2,24]. After the introduction of automated and rapid treponemal tests, the healthcare services and laboratories implemented treponemal tests as first tests in syphilis algorithm, and positive cases are subsequently tested with a non-treponemal method such as VDRL or RPR. Known as reverse screening, this approach has several advantages over traditional screening: the use of specific antibodies, the possibility of automating routine screening, eliminating subjective interpretation of the results, and improved sensitivity and specificity[2,12,14,25-27].

Reverse screening increases the chance of detecting more syphilis cases because treponemal tests become positive before non-treponemal tests, but this strategy can lead to conflicting results (i.e. positive treponemal test and negative non-treponemal test). In these situations, the sample must undergo a third test with a different treponemal methodology from one previously used. Discrepancy results

between treponemal and nontreponemal tests may happen in prior syphilis cases that have been cured following treatment or cured spontaneously, in which case treponemal antibodies can remain positive. Conflicting results may also be due to the identification of patients with early or late stage syphilis for which the sensitivity of non-treponemal tests is low. Therefore, for defining syphilis cases, it is important to consider clinical data, results from diagnosis tests, past infection history, recent treatment records, and investigation of risk exposure[2,3,12,26].

In this study, syphilis was prevalent among males and in the 18-to 39-year-old age group, which is consistent with other studies[28]. In the United States, there was an increase in the number of cases among males since 2000, and during 2017-2018, the rate among men increased 11.3%[29]. In Europe, the overall male-to-female ratio has increased continuously from 1.4:1 in 2000 to a maximum of 8.5:1 in 2017 and 2018[30].

Moreover, this result is consistent with the reported trend of a higher frequency of syphilis cases among men, especially given the involvement of the group that includes men who have sex with men (MSM)[29-32]. According to some studies, young individuals are more susceptible to acquiring a STI, likely due to the need for having new sexual experiences, which leads to high-risk sexual behavior[33,34]. Fenton and Lowndes[35] showed that, in developed countries, there was a higher incidence of syphilis in MSM, with an even higher frequency among young people. Although lower educational levels have been shown to be a variable associated with susceptibility to

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Table 3 – Analysis of the relationship between behavioral data and positive status for syphilis for 1,502 adults living in the municipality of Vitória, Espírito Santo, Brazil, 2010. (N=1,502).

Variable	N (%)	Syphilis		OR (95%CI)	P-value
		present	absent		
Sexual Behavior					0.001
Heterosexual	1,483 (98.7)	10 (76.9)	1,473 (98.9)	1	
Homo/bisexual	19 (1.3)	3 (23.1)	16 (1.1)	27.62 (6.94–109.90)	
Condom use					0.032
Regular	305 (20.3)	6 (46.2)	299 (20.1)	0.29 (0.10–0.88)	
Rarely/Never	1,197 (79.7)	7 (53.8)	1,190 (79.9)	1	
Drug Use					
Marijuana					
No	1,282 (85.2)	4 (30.8)	1,278 (85.8)	1	0.000
Yes	220 (14.6)	9 (69.2)	211 (14.2)	13.63 (4.16–44.65)	
Crack					0.000
No	1,466 (97.6)	8 (61.5)	1,458 (97.9)	1	
Yes	36 (2.4)	5 (38.5)	31 (21.1)	29.39 (9.10–94.60)	
Cocaine					0.000
No	1,377 (91.7)	4 (30.8)	1,373 (92.2)	1	
Yes	125 (8.3)	9 (69.2)	116 (7.8)	26.63 (8.08–87.80)	
Tattoo					0.002
No	1,249 (83.2)	6 (46.2)	1,243 (83.5)	1	
Yes	253 (16.8)	7 (53.8)	246 (16.5)	5.90 (1.96–17.70)	
No. of sexual partners over the last year					0.000
0 to 1	1,273 (84.8)	6 (46.1)	1,267 (85.1)	1	
2 to 5	190 (12.6)	4 (30.8)	186 (12.5)	3.88 (0.83–18.06)	
≥6	39 (2.6)	3 (23.1)	36 (2.4)	17.60 (4.23–73.16)	
History of STIs					0.000
No	1241 (82.6)	4 (30.8)	1237 (83.1)	1	
Yes	261 (17.4)	9 (69.2)	252 (16.9)	11.04 (3.40–36.14)	
Blood transfusion					0.902
No	1336 (88.9)	12 (92.3)	1324 (88.9)	nc	
Yes	166 (11.1)	1 (7.7)	165 (11.1)		

nc: not calculated; STI: sexually transmitted infections.

Table 4 – Multivariate analysis of factors associated with syphilis in the population treated in the municipality of Vitória, Espírito Santo, 2010.

Variable	OR	(95%CI)	P-value
Age in Years (18–39 vs. >40)	3.24	0.66–15.22	0.146
Gender (female vs. male)	0.62	0.12–3.35	0.582
Marital Status (Married vs. Single)	0.75	0.38–1.47	0.408
Sexual Behavior (Homo/bisexual vs. heterosexual)	**6.80**	**1.00–46.20**	**0.050**
No. Partners per Year (>1 vs. 1)	2.25	0.50–10.10	0.288
Condom Use (Regular vs. Rarely/Never)	0.70	0.16–3.03	0.633
Previous STIs (Yes vs. No)	**16.30**	**3.61–73.41**	**0.000**
Tattoo (Yes vs. No)	**6.21**	**1.49–25.84**	**0.012**
Marijuana (Yes vs. No)	1.35	0.24–7.54	0.731
Crack (Yes vs. No)	2.14	0.42–10.88	0.360
Cocaine (Yes vs. No)	**6.80**	**1.15–40.30**	**0.035**

OR: odds ratio; 95%IC: interval of confidence of 95%.

STI[10], this association was not observed in this study. This effect is likely due to the sample population studied, in which 63.3% of the individuals had eight or more years of education.

Risk factor associations for syphilis infection found in this study were consistent with those reported in the literature. The risk factors significantly associated with syphilis included cocaine use, history of STI, tattoos and homo- or bisexual behavior, all of which are risk factors observed in several studies that have targeted different populations[10,35,36]. Individuals who self-reported being homosexual or bisexual had a higher risk of infection. These data are consistent with

studies conducted in other countries, such as in the United States, where over 50% of syphilis cases are in men who have sex with men (MSM)[29]. In China, a study[37] also observed a higher prevalence in the same group. Brazilian studies have also found an association between syphilis and MSM among blood donors in São Paulo[38] and in the HIV-infected population[39,40].

Strengths

This is a population-based study, of great importance for understanding the disease in Brazil, where very few studies have been published. This study showed the importance to use reverse algorithm for syphilis screening, which starts with a treponemal test and, then, a non-treponemal test after positive results on the first one. When the study was performed in 2010 and 2011, the national protocol recommended the classical algorithm for syphilis screening, which could miss some cases, especially in the early and late stages of syphilis.

Limitation

The sample population studied included subjects assisted at public health clinics only, in the municipality of Vitória. This may limit extrapolation to the entire population. In addition, there may be the possibility of a response bias because of the tendency to provide answers that are socially acceptable and/or a recall bias regarding information on the number of partners, condom use, drug use, and history of STI. However, in this study, we believe that there was no selection bias in the sample population because subjects from all six healthcare regions of the municipality were proportionately included, and there was an appropriate sample size and high acceptance rate, which are important to accurately represent the occurrence of syphilis in this study population.

CONCLUSION

This study shows the influence of serological test interpretation on diagnosing acquired syphilis infection and, consequently, the impact of these tests on determining the prevalence of syphilis in the adult population in Vitória. The criteria for defining the diagnosis of syphilis (isolated treponemal test, non-treponemal reagent test, or treponemal test with titers equal to or greater than 1:8) impact the prevalence determined. Furthermore, as we have shown, the choice of the screening method in routine clinical practice should take into account its limitations so that the information provided by a particular method is translated into the true condition of the person being screened. Knowing the prevalence of syphilis and identifying factors associated with the infection represent key elements for implementing public health policies aimed at controlling transmission and preventing the emergence of new cases, as well as avoiding complications as the most severe outcome, like congenital syphilis.

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Participation of each author

All authors contributed to the article's conception and design, Joaquim B Ferreira-Filho and Fausto EL Pereira wrote the first version of the manuscript. Pâmela C Gaspar, Alisson Bigolin, Maria PS Orletti, Fausto EL Pereira, and Angélica E Miranda critically reviewed it. All authors approved the final version and are responsible for all aspects, including for ensuring accuracy and integrity.

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Conflict of interests

The authors declare no conflict of interest.

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