Factors associated with non-use of condoms and prevalence of HIV, viral hepatitis B and C and syphilis: a cross-sectional study in rural communities in Ouro Preto, Minas Gerais, Brazil, 2014-2016*

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Abstract

Objective: to investigate socio-demographic factors associated with non-use of condoms, and to describe the prevalence of sexually transmitted infections (STI) in rural communities of Ouro Preto, Minas Gerais, Brazil, 2014 to 2016. **Methods:** data were gathered from individual interviews and rapid tests were performed; associations were tested using Poisson regression, with a 95% confidence interval (95%CI). **Results:** we detected 3.8 cases/10,000 inhabitants for hepatitis B and syphilis, and 1.3 cases/10,000 inhabitants for hepatitis C; no HIV cases were detected; in the multivariate analysis we found higher prevalence rates of condom non-use among the group of individuals who were married, had common law partners or were widowed (PR=1.20 – 95%CI 1.06;1.36). **Conclusion:** individuals in a stable relationship formed the group with the highest prevalence rate of condom non-use; new syphilis and viral hepatitis cases were detected using rapid tests during the survey.

Keywords: HIV Seroprevalence; Hepatitis B; Hepatitis C; Syphilis; Sexual Behavior; Cross-Sectional Studies.

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Introduction

Sexually transmitted infections (STI) can occur through sexual contact, including among individuals who are asymptomatic or have not been diagnosed. HIV, syphilis and hepatitis B and C can develop without symptoms. Apart from the sexual route, contact with contaminated blood can be an important source of hepatitis C transmission.[1] Condom use is a first-line STI prevention strategy on the individual level. However, in Brazil the low rates of condom use in 2013 contradicted the high percentage of people (98%) who stated being aware of the importance of condom use in relation to the risk of infection transmission.[2]

Recorded HIV/AIDS cases in Brazil are frequently concentrated in the country's state capitals and their metropolitan regions, where there is greater sociodemographic and economic diversity.[1,3] The same trend can be seen for other asymptomatic STI, hepatitis B and C, and acquired syphilis.[4,5] Heterogeneous geographic distribution is perceptible in the large variation in case detection rates between Brazil's five regions.[1]

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The main source of data on STI is the Notifiable Diseases Information System (SINAN). However, underreporting is frequent. Complementary data, obtained from the Mortality Information System (SIM), the Laboratory Examination Information System (SISCEL) and the Logistic Medication Control System (SICLOM), currently account for around 30% of known HIV/AIDS cases in Brazil.[1]

In Brazil 982,129 HIV/AIDS cases have been recorded since 1980. The average detection rate in 2017 was 1.8 case per 10,000 inhabitants.[1] Between 1999 and 2017, 218,257 hepatitis B cases and 331,855 hepatitis C cases were recorded, with an average detection rate in 2017 of 0.6 and 1.2 case per 10,000 inhab., respectively.[4] In 2017, 119,800 new acquired syphilis case were reported, with a detection rate of 5.8 cases per 10,000 inhabitants that year.[5]

Despite underreporting, national epidemiological studies using SINAN data have been used to describe the HIV/AIDS epidemic and the situation of other STI.[2,3] However, those studies do not reflect local and regional particularities of the epidemics, especially in relation to cultural and behavioral aspects.[6-8]

The highest number of HIV/AIDs cases reported on SINAN in the last ten years in Ouro Preto, Minas Gerais, occurred in 2016: 19 cases among 74,000 inhab., or 2.6 cases per 10,000 inhab. This fact may be related to the creation in Ouro Preto of the Communicable and Parasitic Diseases Outpatients Department at the Federal University of Ouro Preto in 2010, the Specialized HIV/AIDS and Viral Hepatitis Care Service in 2014, and the Antiretroviral Medication Dispensing Unit in 2016. Also according to SINAN data, between 2011 and 2015, Ouro Preto recorded 8 cases of hepatitis B (1.1/10,000 inhab.) and 5 hepatitis C cases (0.7/10,000 inhab.). In 2017, 34 acquired syphilis cases (4.6/10,000 inhab.) were recorded.

The Lavras Novas, Antônio Pereira and Santo Antônio do Salto districts (henceforth the latter district will be referred to as Salto) are rural communities within the municipality of Ouro Preto. They have in common their historical origin in mining activities and the later decline of these when the gold deposits ran out still in the colonial period, apart from their inhabitants predominantly being descendants of African slaves. With effect from the 1990s, the main economic activity of Lavras Novas has been tourism; Antônio Pereira, one of the first mining centers of Minas Gerais state, continues to have mining as its main economic activity, although now it is iron ore that is mined; while in Salto, productive activities are basically characterized by subsistence farming and livestock rearing.[9,10]

Given that detailed information on local epidemics is capable of identifying appropriate interventions and priority populations for prevention and control actions, the purpose of this study was to analyze prevalence rates of sexually transmitted infections and sociodemographic factors related to non-use of condoms during sexual intercourse in rural communities in the municipality of Ouro Preto, Minas Gerais, Brazil, between 2014 and 2016.

Methods

A prevalence survey was conducted in the rural communities of Antônio Pereira, Lavras Novas and

Salto, in the municipality of Ouro Preto, between December 2014 and April 2016.

The population aged 18 or over registered on the Primary Care Information System (SIAB) in 2015 and used for the sample calculation, was comprised of 762 individuals in Lavras Novas, 747 in Salto and 3,712 in Antônio Pereira (data provided by the SIAB data processing sector of the Ouro Preto Municipal Health Department). The sample size of 819 individuals was calculated using Epi Info V7.0 (Centers for Disease Control and Prevention [CDC], Atlanta, USA) based on the following assumptions: estimated hepatitis C prevalence of 2.2% in Southeast Brazil, this being the lowest prevalence expected among the diseases included in this study, with an acceptable error margin of 1%, a 5% confidence limit and possible losses of 20%.

All households were visited in Lavras Novas and Salto. In Antônio Pereira, 390 out of a total of 1,170, households were selected by means of a 1:3 systematic sampling process. In the event of refusal, the next house on the right was selected. If there was no house on the right, the house on the left was selected. In each household, one individual among those present took part in the study on a convenience basis. The eligibility criteria were: living in one of the districts, being 18 years old or over, giving written consent after being informed, and understanding and answering the interview questions.

The following data were studied.

a) Demographic data
- sex (female; male);
- age (in years: 18-39 or 40 or over);
- self-reported race/skin color (not Black or Black);
- marital status (single or divorced; married, common law relationship or widowed);
- place of residence (Antônio Pereira, Lavras Novas or Salto);

b) Socioeconomic data
- schooling (illiterate; elementary education; high school education and higher education);
- family income (in minimum wages: up to 3; 4 or more);

c) Data on past STI history
- Previous STI (yes or no);

d) Behavioral data
- alcohol use (yes or no);
- illicit drug use (yes or no);

e) Sex-related data
- stable partners (yes or no);
- frequency of sexual intercourse (once a week or more; less than once a week)
- sexual orientation (heterosexual or homo/bisexual).

The information was collected by means of face-to-face individual interviews using a semi-structured questionnaire. The interviews were conducted on working days and also at weekends in order to enable greater participation of males.

Blood samples (10ml) were collected via venipuncture in tubes without anticoagulants, respecting universal biosafety standards for the performance of rapid tests. We opted to collect samples via venipuncture so that serum samples of positive initial test results would be available for confirmatory tests. The samples were kept on ice until being processed at the laboratory on the same day. After being centrifuged at 2000 rpm/15 min., the serum samples were stored at -20ºC until the rapid tests were performed. All tests were performed using serum, as per the manufacturer's recommendation and Ministry of Health guidelines.[4-6]

Rapid tests are immunochromatographic assays which detect antigens of the agent or antibodies present in biological samples, blood, serum or oral fluid. The advantages of rapid tests are their high sensitivity and specificity (sensitivity varying between 98.6% and 100%, and specificity varying between 98.9% and 99.8%), being easy to use regardless of the place where care is provided and being ready in up to 30 minutes.[11-13]

For hepatitis we used rapid tests to detect the HBsAg antigen (VIKIA–HBV, Biomérieux, Brazil) and to detect anti-HCV antibodies (Imunorápido-HCV, Wama Diagnóstica, São Paulo, Brazil). The Rapidcheck-HIV rapid test (Núcleo de Doenças Infecciosas [NDI], Espírito Santo, Brazil) was used as test 1 to detect anti-HIV 1 and 2 antibodies; while the Bioeasy test (Standard Diagnostic Inc., Korea) or the Dual Path Platform (DPP)/HIV test (Biomanguinhos, Rio de Janeiro, Brazil), were used as test 2. If the result of test 1 was positive, test 2 was performed as the confirmatory test in accordance with Ministry of Health Ordinance SVS/MS No. 29, dated December 17th 2013.[3] The Rapidcheck-Syphilis test (NDI, Espírito Santo, Brazil) or the DPP-Syphilis test (Biomanguinhos, Rio de Janeiro, Brazil) were used to detect the anti-treponema antibody. The tests were performed in accordance with the guidelines of each manufacturer.

Rapid test samples with positive results were sent for confirmatory tests at a Brazilian National Health System (SUS) outsourced laboratory. The confirmatory tests for hepatitis B and C were, respectively, HBsAg and anti-HCV chemiluminescence immunoassays. For syphilis we used the Venereal Disease Research Laboratory (VDRL) nontreponemal test. To confirm diagnosis, another indirect immunofluorescence treponemal assay (Fluorescent Treponemal Antibody Absorption [FTAABS]) was used. The enzyme-linked immunosorbent assay (ELISA) was used in cases of HIV rapid tests with indeterminate results.

The data were stored using Epi Info V7.0 and analyzed using Stata/SE version 12.1 (StataCorp LP).

Data from Antônio Pereira were analyzed separately because this district has a floating population, differently to the other two districts. The Lavras Novas and Salto districts were grouped together for the purposes of analysis as they have traditional rural populations in common. Detection rates were calculated based on the population aged 18 or over, out of a total of 7,468 people, to obtain a 10,000 inhabitant basis. Condom use was assumed to be a dependent variable. The qualitative independent variables were expressed in absolute and relative frequencies. Bivariate analysis was used to assess association between condom use and demographic, socioeconomic, behavioral, sex-related and past STI history variables, and to generate prevalence ratios (PR) with a 95% confidence interval (95%CI).

Following bivariate analysis, variables statistically associated with the outcome (condom use) with p<0.20, with biological plausibility and epidemiological relevance, were included simultaneously, initially in three blocks ([i] demographic variables [sex, age range and marital status], [ii] socio-economic variables [schooling and family income] and [iii] sex-related variables [stable partners and frequency of sexual intercourse]), using the Poisson multivariate regression model with estimated robust variance. Only participants who had had blood samples collected were considered in the regression estimates. Variables associated with the outcome with a level of significance defined as p<0.05 were kept in the final model.[14]

The study project was approved by the Research Ethics Committee of the Federal University of Ouro Preto (CEP/UFOP): Certification of Submission for Ethical Appraisal (CAAE) No. 07952412.0.0000.5150; Opinion CEP/UFOP 018/2013. All study participants signed a Free and Informed Consent form. Cases with positive results were referred for diagnosis and treatment at a specialized service.

Results

We interviewed 800 people, 757 (94.6%) of whom came forward to have their blood samples collected. In Lavras Novas there were 320 participants aged between 18 and 93 years old. In Salto, there were 290 aged between 18 and 91, while in Antônio Pereira there were 147 aged 19 to 80. The majority of participants in Lavras Novas and Salto were female (n=416; 63.7%) and people aged 40 or over (n=435; 66.6%). In Antônio Pereira, the sex ratio was similar, as was the predominance of people aged 40 or more (n=80; 54.4%) (Table 1).

Table 2 shows the comparison between condom use and non use in the last six months, according to the participants' demographic, clinical and lifestyle characteristics. In the bivariate analysis, not using a condom was significantly associated with married/common law relationship/widowed marital status (PR=1.23 − 95%CI 1.10;1.36) and with stable partners (PR=1.21 − 95%CI 1.07;1.38). Frequency of condom non use was similar among the communities and no association was found with sex, age, schooling, race/skin color, income, frequency of sexual intercourse, sexual orientation, the habit of consuming alcoholic drinks or illicit drugs, or prior history of STI.

The final multivariate model adjusted for sex, age and schooling, identified that married/common law relationship/widowed marital status (PR=1.20 − 95%CI 1.06;1.36) was a factor associated with not using condoms (Table 3).

The test results are shown in Table 4. No new HIV cases were detected. In Antônio Pereira, one individual had positive RT and VDRL results for syphilis, and another had a positive RT result for hepatitis B. In Lavras Novas, three new hepatitis C cases were detected. In Salto, two RTs were positive for syphilis and the VDRL result was also positive.

Table 1 – Characteristics of the study participants living in rural communities in Ouro Preto, Minas Gerais, 2014-2016

Characteristics	Antônio Pereira n (%)	Santo Antônio do Salto and Lavras Novas n (%)
Sex		
Male	74 (50.3)	237 (36.3)
Female	73 (49.7)	416 (63.7)
Age range (in years)		
18-39	67 (45.6)	218 (33.4)
≥40	80 (54.4)	435 (66.6)
Schooling		
Illiterate and elementary education	81 (55.1)	363 (55.6)
High school education and higher education	66 (44.9)	289 (44.3)
No information	–	1 (0.2)
Family income (in minimum wages)[a]		
Up to 3	119 (81.0)	530 (81.2)
4 or more	18 (12.2)	93 (14.2)
No information	10 (6.8)	30 (4.6)
Marital status		
Single/divorced	43 (29.3)	221 (33.8)
Married/common law relationship/widowed	104 (70.7)	431 (66.0)
No information	–	1 (0.2)
Self-reported race/skin color		
Not Black	118 (80.3)	489 (74.9)
Black	29 (19.7)	160 (24.5)
No information	–	4 (0.6)
Previous STI[b]		
Yes	6 (4.1)	41 (6.3)
No	141 (95.9)	600 (91.9)
No information	–	12 (1.8)
Alcohol use		
Yes	44 (29.9)	169 (25.9)
No	103 (70.1)	466 (71.4)
No information	–	18 (2.8)
Illicit drug use		
Yes	9 (6.1)	28 (4.3)
No	138 (93.9)	617 (94.5)
No information	–	8 (1.2)
Stable partners		
Yes	101 (68.7)	421 (64.5)
No	38 (25.9)	146 (22.4)
Does not have sexual intercourse	8 (5.4)	84 (12.9)
No information	–	2 (0.3)

a) Minimum wage in 2015: R$ 788.00
b) STI: sexually transmitted infections
Notes: Total (N= 800); Antônio Pereira (N=147); Santo Antônio do Salto and Lavras Novas (N=653).

Table 1 – Characteristics of the study participants living in rural communities in Ouro Preto, Minas Gerais, 2014-2016

Characteristics	Antônio Pereira n (%)	Santo Antônio do Salto and Lavras Novas n (%)
Frequency of sexual intercourse		
Once a week or more	93 (63.3)	324 (49.6)
Less than once a week	34 (23.1)	139 (21.3)
Does not have sexual intercourse	20 (13.6)	182 (27.9)
No information	0 (0.0)	8 (1.2)
Sexual orientation		
Heterosexual	145 (98.6)	630 (96.5)
Homo/bisexual	2 (1.4)	7 (1.1)
Does not have sexual intercourse	–	13 (2.0)
No information	–	3 (0.5)
Condom use in the last 6 months		
Yes	20 (13.6)	86 (13.2)
No	97 (66.0)	345 (52.8)
Does not have sexual intercourse	30 (20.4)	216 (33.1)
No information	–	6 (0.9)
Had blood sample collected		
Yes	147 (100.0)	610 (93.4)
No	–	43 (6.6)

Notes: Total (N= 800); Antônio Pereira (N=147); Santo Antônio do Salto and Lavras Novas (N=653).

Discussion

This study found that in rural communities of the municipality of Ouro Preto with predominantly Afro-Brazilian populations, there were lower condom use prevalence rates among those with stable marital status. The serological survey detected three new syphilis cases, three hepatitis C cases and one hepatitis B case. The infected people were mainly females aged ≥40 years, with a long-term partner, married /in a common law relationship/widows, having sexual intercourse less than once a week, with elementary education and family income of up to 3 minimum wages (data not shown in tables).

Although the majority of females were aware of the protection afforded by condoms, some studies report that nearly three quarters of them (72.7%) do not use condoms to prevent infection.[15,16] It is known that for a long time condom use was associated with prostitution, multiple partners and extramarital sex.[17] Several circumstances may hinder agreement on condom use, even between partners aware that condoms can prevent STI. In heterosexual relationships, within the context of a patriarchal society, the decision as to whether to use a condom often lies with men, whereby females need to be empowered to negotiate this matter.[16] A study conducted in Brazil's Federal District concluded that married females represent the group most vulnerable to condoms not being used.[17] Among Brazilian women, between 2007 and 2017, 96.8% of reported HIV/AIDS cases were due to unprotected sexual intercourse with males.[1]

Some authors describe significant increase in condom use following behavioral interventions involving sexual health education, aimed at promoting correct and consistent condom use.[18-20] A randomized study conducted in Washington, United States, indicated that participants of the 'Safe sex for females' program used condoms less frequently in sexual intercourse with their stable partners, when compared to their casual partners.[21] The main reasons for not using condoms are male partner refusal to use them[22] and the false perception of safety given by affection between partners.[23] These findings point to the importance of understanding that one is naturally exposed to STI if one does not use a condom. Failure to understand

Table 2 – Non-use of condoms in the last 6 months by residents in rural communities, according to demographic, clinical and lifestyle characteristics, Ouro Preto, Minas Gerais, 2014-2016

Characteristics	N (%)	Condom use in the last 6 months[a]			P value[b]
		Yes	No	Prevalence ratio	
		n (%)	n (%)	(95%CI[c])	
Sex					
Female	289 (55.3)	40 (13.8)	249 (86.2)	1.15 (0.95;1.34)	0.151
Male	234 (44.7)	59 (25.2)	175 (74.8)	1.00	
Age range (in years)					
≥40	315 (60.2)	43 (13.7)	272 (86.3)	1.18 (0.97;1.44)	0.099
18-39	208 (39.8)	56 (26.9)	152 (73.1)	1.00	
Schooling					
Illiterate and elementary education	258 (49.3)	32 (12.4)	226 (87.6)	1.17 (0.97;1.42)	0.102
High school education and higher education	265 (50.7)	67 (25.3)	198 (74.7)	1.00	
Marital status					
Married/common law relationship/widowed	392 (75.1)	32 (8.2)	360 (91.8)	1.23 (1.10;1.36)	<0.001
Single/divorced	130 (24.9)	67 (51.5)	63 (48.5)	1.00	
Family income (in minimum wages)[d]					
Up to 3	406 (82.4)	64 (15.8)	343 (84.2)	0.96 (0.91;1.02)	0.185
4 or more	87 (17.6)	22 (25.3)	65 (74.7)	1.00	
Self-reported race/skin color					
Not Black	391 (75.3)	71 (18.2)	320 (81.8)	1.03 (0.93;1.14)	0.569
Black	128 (24.7)	28 (21.9)	100 (78.1)	1.00	
Previous STI[e]					
Yes	35 (6.8)	6 (17.1)	29 (82.9)	1.02 (0.94;1.12)	0.593
No	482 (93.2)	93 (19.3)	389 (80.7)	1.00	
Alcohol use					
Yes	166 (32.4)	30 (18.1)	136 (81.9)	0.99 (0.91;1.07)	0.745
No	347 (67.6)	66 (19.0)	281 (81.0)	1.00	
Illicit drug use					
Yes	31 (6.0)	3 (9.7)	28 (90.3)	1.03 (0.93;1.14)	0.564
No	488 (94.0)	96 (19.7)	392 (80.3)	1.00	
Stable partners					
Yes	448 (86.0)	56 (12.5)	392 (87.5)	1.21 (1.07;1.38)	0.003
No	73 (14.0)	43 (58.9)	30 (41.1)	1.00	
Frequency of sexual intercourse					
Once a week or more	399 (80.1)	58 (14.5)	341 (85.5)	1.01 (0.94;1.08)	0.792
Less than once a week	99 (19.9)	35 (35.4)	64 (64.6)	1.00	
Sexual orientation					
Heterosexual	512 (99.0)	97 (18.9)	415 (81.1)	1.04 (0.92;1.17)	0.561
Homo/bisexual	5 (1.0)	2 (40.0)	3 (60)	1.00	
Place of residence					
Antônio Pereira	117 (22.4)	20 (17.1)	97 (82.9)	1.03 (0.82;1.29)	0.802
Santo Antônio Salto and Lavras Novas	406 (77.6)	79 (19.5)	327 (80.5)	1.00	

a) Took part in blood collection.
b) Poisson regression with estimated robust variance.
c) 95%CI: 95% confidence interval.
d) Minimum wage in 2015: R$ 788.00.
e) STI: sexually transmitted infections.
Note: Used a condom (N=99); Did not use a condom (N=424).

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Table 3 – Multivariate analysis of factors associated with not using condoms in rural communities, Ouro Preto, Minas Gerais, 2014-2016

Variable	Crude PR[a] (95%CI[c])	Adjusted PR[b] (95%CI[c])	P value[d]
Married/common law relationship/widowed	1.23 (1.10;1.36)	1.20 (1.06;1.36)	0.003
Stable partner	1.21 (1.07;1.38)	1.15 (1.00;1.33)	0.048

a) Crude prevalence ratio (PR).
b) Prevalence ratio (PR) adjusted for sex, age and schooling.
c) 95%CI: 95% confidence interval.
d) Poisson regression with estimated robust variance.

Table 4 – Positive results of rapid tests, nontreponemal test for syphilis and confirmatory tests for viral hepatitis B and C in rural communities, Ouro Preto, Minas Gerais, 2014-2016

Location	Syphilis[a] N (%)	VDRL[b] N (%)	Hepatitis C[a] N (%)	Anti-HCV[c] N (%)	Hepatitis B[a] N (%)	HBsAg[d] N (%)
Antônio Pereira	11 (7.5)	1 (0.7)	–	–	1 (0.7)	1 (0.7)
Lavras Novas	19 (5.9)	–	3 (0.9)	3 (0.9)	–	–
Santo Antônio do Salto	10 (3.5)	2 (0.7)	–	–	1 (0.3)	–
Total	40 (5.3)	3 (0.4)	3 (0.4)	3 (0.4)	2 (0.3)	1 (0.1)

a) Rapid test.
b) VDRL: Venereal Diseases Research Laboratory, or nontreponemal test for syphilis diagnosis.
c) Serological test using the chemiluminescence method to confirm hepatitis C (anti-HCV) and hepatitis B.
d) HBsAg: hepatitis B virus surface antigen assay.
Note: Total (N= 757); Antônio Pereira (N=147); Lavras Novas (N=653) and Santo Antônio do Salto (N=290).

one's own vulnerability can lead to unprotected sex as a natural habit. Other explanations may be associated with idiosyncratic factors or the surrounding social and economic environment.[16,24]

The number of confirmed syphilis and hepatitis cases found in this survey was higher than that available on SINAN for Ouro Preto in the study period. This suggests possible shortcomings in the municipality's epidemiological surveillance and the need for greater coverage of testing. An additional contribution of this study to scaling up the new case detection network in Ouro Preto was the training given for Primary Health Care medical and nursing staff in performing rapid HIV tests, by one of the authors of this study, Barbosa KF, at the request of the Municipal Health Department.

An increase of approximately 10% in HIV/ AIDS case detection between 2010 and 2015 was found in Minas Gerais state, reaching 2.0 cases per 10,000 inhab. in 2015. Analysis of HIV/AIDS cases by municipality found higher incidence in densely urbanized areas.[1] Ouro Preto reported 0.1 HIV/ AIDS case per 10,000 inhab. in 2014, this rate being considerably below the mean detection rate for Minas Gerais state. In keeping with this data, our

study did not detect new cases of HIV infection in the area studied. This also corroborates the finding that cases tend to be concentrated in areas with greater population density. A possible explanation for this finding could be the frequent migration of people with a variety of health conditions requiring and receiving diagnosis and treatment in more urbanized areas.[6]

Data on acquired syphilis began to become known when mandatory notification came into effect in 2010. Minas Gerais had 5,245 notified cases in 2016.[25] There was also an increase in the number of cases in Ouro Preto, from 19 notifications in 2015 to 31 in 2016. The trend already mentioned above of cases being concentrated in urban areas leads to the assumption that the majority of cases recorded were detected in the town itself rather than in its outlying districts. Rapid testing takes place primarily in Primary Care, during antenatal care and to meet local demand, in the maternity hospital and, periodically, during STI prevention campaigns. The fact that our study found three syphilis cases in the rural area of the municipality confirms the need to scale up detection and treatment efforts among populations at risk of contracting STI. The same recommendation applies to hepatitis.

Forty participants had a positive RT result for syphilis. All of them were tested using the nontreponemal VDRL method, as well as using FTAABS in order to increase the reliability of diagnosis. Three cases were positive in at least two tests and were referred for treatment. In primary syphilis, VDRL and FTAABS tests are reactive with 85% sensitivity after the onset of chancre; in secondary syphilis, the sensitivity of these tests increases to 99%; while in tertiary syphilis, VDRL sensitivity is 70% and that of FTAABS is 98%.[13] Around 1% of the population has reactive treponemal test results without being infected or following treatment.[5,13] A reactive result indicates that the patient has had contact with *Treponema pallidum* and developed specific antibodies. Nontreponemal VDRL tests tend to give a negative result after treatment. For these reasons, syphilis is considered to be active when both VDRL and FTAABS tests give positive results for syphilis infection.

In our study the results of the two treponemal methods were discordant: 10 of the 40 cases with positive syphilis RT results had negative FTAABS results. There are some factors that might explain this discordance. The FTAABS method depends on the experience of the examiner, the preparation and quality of the reagents and, in view of these conditions, some of the results obtained may have been false negative owing to flaws in performing the test.[26] Moreover, test accuracy varies between syphilis stages and some participants with negative test results might have been in stages with lower sensitivity. The results of a study conducted in Hong Kong with 801 serum samples using immunoassay and FTAABS treponemal tests were concordant.[26] In another studying assessing the performance of the *T. pallidum* Passive Particle Agglutination Test (TPPA) and FTAABS treponemal tests, discordance was 2.9 times more frequent in populations with low syphilis prevalence compared to those with high prevalence.[27] It is difficult to affirm whether (i) the discordance detected by our study resulted from low expected syphilis prevalence, whether (ii) cases with positive RT results were a consequence of the detection of previous infection and false negative using FTAABS, or (iii) whether they were false positive RT results.

The trend of the HIV/AIDS epidemic spreading away from urban regions, affecting poorer people and females[28-30] was not confirmed in our study. No new cases of HIV infection were found in the population we studied, which was rural, and mostly low-income and with low schooling. Moreover, although more females than males took part in the study, no HIV/AIDS cases were detected among females. An explanation for this result could be that in the districts studied the majority (84%) of the population forming the sample belonged to traditional and stable family units, possibly with a low number of sex partners.

One of the limitations of the survey lies precisely in a possible selection bias resulting from the participation of a higher proportion of females (61.7%). The survey was conducted in households, initially on working days, when males are usually are at work and not at home. Due to the low schooling level of the population studied, face-to-face interviews were a necessary choice. This technique may have introduced information bias into the study, namely that the respondents may have been embarrassed by questions of a sexual nature. Another limitation to be considered was the use of a sample determined by the interest of the participants, capable of causing information under-recording and, as a consequence, capable of causing inaccuracy in the measurement of association with the increase in the confidence interval.

Finally, in Ouro Preto's rural communities, prevalence of not using condoms was greater among people in long-term relationships. The frequency of sexually transmitted infections detected in the places studied not only corresponds to expected frequency, but was also higher than the frequency of cases recorded on SINAN, thus indicating problems in case detection or reporting in the region. Identification of new viral hepatitis and syphilis cases in these communities will enable early care to be provided as well as interruption of the transmission chain. In turn, knowledge of local particularities will enable targeting of prevention and education actions regarding condom use among this population.

Authors' contributions

All the authors conceived and designed the study, took part in the statistical analysis and interpretation of the results, writing and critical revision of the manuscript. All the authors approved the final version of the manuscript and take on responsibility for all aspects of the study, including ensuring its accuracy and integrity.

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