Published in final edited form as:

AIDS Behav. 2008 July ; 12(4 Suppl): S25–S31. doi:10.1007/s10461-008-9378-0.

A Population-based survey of the prevalence of HIV, syphilis, hepatitis B and hepatitis C infections and associated risk factors among young women in Vitória, Brazil

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Abstract

Objective—To estimate the prevalence of HIV, hepatitis B (HBV) and C (HCV) and syphilis infections and associated risk exposures in a population-based sample of young women in Vitória, Brazil.

Methods—From March to December 2006, a cross-sectional sample of women aged 18 to 29 years was recruited into a single stage, population-based study. Serological markers of HIV, HBV, HCV, and syphilis infections and associated risk exposures were assessed.

Results—Of 1,200 eligible women, 1,029 (85.8%) enrolled. Median age was 23 (interquartile range [IQR] 20, 26) years; 32.2% had 8 years of education. The survey weighted prevalence estimates were: HIV, 0.6% (95% CI, 0.1%, 1.1%); anti-HBc, 4.2% (3.0%, 5.4%); HBsAg, 0.9% (0.4%, 1.6%); anti-HCV, 0.6% (0.1%, 1.1%) and syphilis 1.2% (0.5%, 1.9%). Overall, 6.1% had at least one positive serological marker for any of the tested infection. A majority (87.9%) was sexually active, of whom 12.1% reported a previously diagnosed sexually transmitted infection (STI) and 1.4% a history of commercial sex work. Variables independently associated with any positive serological test included: older age (≥ 25 vs. <25 years), low monthly income (< 4× vs. ≥ 4× minimum wage), previously diagnosed STI, ≥ 1 sexual partner, and any illicit drug use.

Conclusions—These are the first population-based estimates of the prevalence of exposure to these infectious diseases and related risks in young women, a population for whom there is a scarcity of data in Brazil.

Keywords

HIV; syphilis; HBV; HCV; prevalence; young women; Brazil

INTRODUCTION

Prevalence assessment and monitoring of sexually transmitted infections (STI) are important components of public health surveillance that can be performed for defined populations. Population-based data, which are wider in scope, are especially valuable as they provide generalizable unbiased estimates of health and disease outcomes in the community as a whole. Such data on HIV and STI are not the norm and most public health entities rely principally on data from sentinel or targeted populations for public planning purposes. Comparing both can be beneficial and help to reduce uncertainties. Estimates of disease prevalence from targeted surveillance may differ significantly when contrasted with population-based data, and conversely, they may converge (Dandona 2006; Fylkesnes 1998; Fylkesnes 2001). Both targeted surveillance and population-based data provide essential information that can be used for planning, implementing and evaluating public health interventions and programs.

Sexually transmitted and bloodborne infections, including HIV, hepatitis B virus (HBV), and hepatitis C virus (HCV) remain a major public health challenge in Brazil. While substantial progress has been made in preventing, diagnosing, and treating STI in recent years, the Brazilian Health Ministry estimates that 10 million new curable STIs occur each year, almost half of them among young people (Brasil, 2002). In addition to the physical and psychological consequences of these infections, they also exact an economic toll both on young women and children born to infected mothers (Zierler and Krieger, 1997).

The benefits of testing young women for HIV are increasingly ensured, particularly in terms of reducing vertical transmission (Postma et al., 1999). Syphilis remains all too common despite the availability of cheap, accurate diagnostic tests and treatments (Watts and Brunham, 1998). Screening for HBV offers an opportunity to assess the impact of HBV vaccination programs (Brasil, 2003; Ribeiro and Azevedo, 2006). HCV infection is not well characterized in the general population in Brazil, or among women of childbearing age, despite the potential for vertical transmission. Since carriers of HBV and HCV often are asymptomatic, screening for these infections offers opportunities for case management as well as treatment.

Previous studies, conducted in other populations in the Vitória metropolitan area, reported prevalence estimates of HIV among women ranging from 0.5% among child-bearing women to 9.9% among female prisoners (Lima and Tanure, 2003; Miranda et al., 2000). Studies of syphilis infection have found 1.2% of pregnant women have markers for latent infection, and up to 16.0% of female prisoners have these markers (Costa et al., 2007; Miranda et al. 2000). Chronic HBV has been identified in 1.1% of women presenting for antenatal care (Miranda et al., 2001; Lima and Tanure, 2003), 5.4% of women attending an STI clinic (Miranda et al., 1999), 7.4% among female prisoners (Miranda et al., 2000) and 3.8% of female HIV-infected patients (Zago et al., 2007). Anti-HCV has been detected among 1.4% of pregnant

women tested, and 19.0% of female prisoners (Lima, 2003; Miranda et al., 2000). As most of these data are from convenience or other non-generalizable samples, there is a lack of information regarding exposures and the burden of disease in the general population. The primary objective of this study was to estimate the prevalence of HIV infection and exposures to HBV, HCV and syphilis, and describe associated risk behaviors in a population-based sample of young women in Vitória, Brazil. These data will be used to develop prevention and care programs for these infections, all of which are preventable and are associated with significant morbidity among women in Vitória, Brazil.

METHODS

General Study Design

We conducted a single stage, population-based, door-to-door, cross-sectional survey designed to measure the prevalence of HIV, syphilis, markers of HBV and HCV infections and related risk behavior in young women (18–29 years) in the Vitória island metropolitan area, in the Espírito Santo State, in the Southeast region of Brazil. This area includes the city of Vitória (including 400,000 inhabitants and the port) and three adjacent municipalities that together include about 1.5 million inhabitants. These linked municipalities comprise the Vitória metropolitan area.

The study benefited from a recently completed, comprehensive census of the target population. The census provided a representative sampling frame for the Vitória metropolitan area and facilitated the contact and recruitment of subjects for participation.

Subject Selection and eligibility criteria

The target population was young women residing in Vitória, Brazil. The Municipal Health Department of Vitória is divided administratively into six regions. Of these regions, Health Region I, II, and VI were selected as the target area because the Family Health Program (FHP) in this area had previously enumerated the population for programmatic implementation of primary health care. The three regions were defined by 2000 Census data, which have median-high, median and median-low household income, respectively. In this target area, the total population was 117,056, of whom 10,660 (9.1%) were females aged 18–29.

We planned to sample eligible women proportional to their population size in the three regions: 30.7% for Region I, 51.0% for Region II, and 18.3% for Region VI. The sample therefore was self-weighting with respect to the number of eligible women in the three regions. Sampled households with eligible women were randomly selected from the HFP census available for each target area. Study recruitment occurred by door-to-door contact; at each residence after contact was made with a resident, we invited young eligible women residing at each household to participate in the study. Recruitment occurred from March to December 2006.

Eligibility criteria include female gender, age 18 to 29 years, and residency in the targeted health regions in Vitória, Brazil. Residency was defined as staying at a dwelling during the previous six months and having no other home.

Total Number/Number Per Group

Based on *a priori* power calculations, we planned to enroll 1,200 women to provide 80% power to estimate a point prevalence of HIV at 0.5% with a 95% confidence interval of (0.2–1.1). All women sampled who met the eligibility criteria were invited to participate. To weight the sample according to the relative proportion of eligible women in the three regions, the enrollment goals were 368 women from Region I, 612 from Region II and 220 from Region VI. The number of households targeted for contact anticipated an 80% participation rate.

Subject Recruitment

Community health outreach workers (CHOWs) visited selected women and invited them to participate in the project. CHOWs used an enumeration form for each participant to record and monitor household contact attempts, successes, resident eligibility, enrollment, and refusals. CHOWs made at least six attempts to contact a resident of each dwelling. Study eligibility was established through a face-to-face interview. Eligible women were invited to participate and be enrolled immediately, or, later on an alternatively arranged date and/or location. The option of completing the survey and blood draw at a neutral location, rather than at the house, was offered.

Consent Process and Documentation

The Ethics Committees from the Federal University of Espírito Santo and from University of California, San Francisco approved the protocol for the study. Informed consent procedures were conducted at recruitment time and before participation in any activity of the study. After the Consent Form had been read and discussed with the participant, and after any questions posed by the participant had been answered, she was asked to sign the Consent Form. All women with diagnosed infections were offered counseling and treatment according to national guidelines (Brasil, 2006) and referrals to care as necessary or requested.

Study Procedures

A 30-minute face-to-face interview was conducted with the use of a standardized questionnaire; trained field staff from the local health department conducted the interview. The questionnaire included questions on participants' socio-demographic conditions, HIV testing history, and exposures and behaviors associated with risk of sexually transmitted (STI) or bloodborne infections. Sexual exposures assessed included history of sexual activity, number of sexual partners, condom use, commercial sex, having been previously diagnosed with an STI, and if ever forced to have sex against their will. Participants were asked about alcohol use, use of illicit drugs including marijuana, cocaine, amphetamine, barbiturates, ecstasy, and crack, whether they had ever injected illicit drugs, or used illicit drugs prior to or during sex. Prior to phlebotomy for blood samples, the study staff conducted pre-test counseling addressing risks for the infections being tested. This session also covered the purpose, meaning and interpretation of results from the tests for HIV, syphilis, HBV, and HCV, and an appointment was made for participants to receive test results in 10 days.

Venous blood samples were collected by trained phlebotomists and the following tests were performed using approved commercial assays: anti-HIV (HIV-1 Microelisa, Organon Laboratories, Boxtel, Holland, with confirmation by immunofluorescence assay [IFI], HIV-1 IFA, FIOCRUZ, Rio de Janeiro, Brazil); HBV panel including antibody to HBV core antigen (anti-HBc), HBV surface antigen (HBsAg), and HBV surface antibody (anti-HBs) (Corzyme EIA, Ausab EIA, Auszyme Monoclonal Enzyme Immunoassay [EIA], respectively, Abbott Laboratories, Rio de Janeiro, Brazil), anti-HCV (MEIA, Abbott Laboratories, Rio de Janeiro, Brazil), and VDRL for syphilis (Laborclin Laboratories, São Paulo, Brazil) and Microhemagglutinin – *Treponema pallidum* (MHA-TP - Abbott Laboratories, Rio de Janeiro, Brazil). Women positive for syphilis were referred to the local public STD clinic for further evaluation and treatment.

Data Analyses

The primary outcome analyzed was an aggregate variable of exposure to any sexually transmitted or bloodborne infection tested. This variable was derived from results of serological testing as follows: any positive marker for HIV infection (positive ELISA and IFI), prior HBV infection (presence of either antibody to hepatitis B core antigen (anti-HBc) or hepatitis B surface antigen (HBsAg), or HCV exposure (positive anti-HCV), or syphilis exposure (positive VDRL and positive microhemagglutination). Point prevalence rates, 95% confidence intervals (CI), and odds ratios (OR) were estimated accounting for the single-stage survey design using Stata software version 9.0 SVY procedures (STATA Corp, College Station, Tx).

Multiple logistic regression, adjusted for survey design, was conducted to assess exposures independently associated with the “any” infection outcome. Variables which were significant at $p < 0.15$ in the bivariate analyses, and additional variables based on known *a priori* associations (for instance, age and number of sexual partners) were considered in the multivariate analysis. Main risk factors were assessed through a forward stepwise process, with 15% as the critical p-value for variable entry and 10% as the criterion for variable elimination. Parsimonious models were finalized based on variables found to be significantly associated with p-value of 0.05.

RESULTS

Within contacted dwellings, 1,200 eligible women were identified and 1,029 enrolled (85.75%). The median age of the participants was 23 (interquartile range [IQR] 20–26) years; 32.2% had up to eight years of education and 42.7% were married or living with a partner. Median monthly family income in U.S dollars was \$310 (IQR \$174 – \$652).

Weighted estimates for prevalence of serological markers of the infections tested for are shown on Table 1: HIV infection, 0.6% (95% CI, 0.1%, 1.1%); anti-HBc, 4.2% (3.0%, 5.4%); HBsAg, 0.9% (0.4%, 1.6%); anti-HCV, 0.6% (0.1%, 1.1%); syphilis, 1.2% (0.5%, 1.9%). Regarding HBV, almost half - 45.3% (42.2%, 48.4%) of women showed anti-HBs, 2% in the context of prior or latent infection (anti-HBc and anti-HBs), 40.5% demonstrated isolated anti-HBs consistent with vaccine induced immunity, and 2.1% had isolated anti-HBc which may indicate false positive result, acute or remote HBV infection. A total of 6.1%

(4.7%, 7.8%) of participants had at least one positive serological marker for exposure to any infection, the aggregate outcome (Table 1).

The majority (87.9%) of women had a history of sexual activity, of whom 36.6% reported condom use during last intercourse, 1.5% reported history of commercial sex, and 12.3% reported history of STI. Table 2 shows prevalence of self-reported use of alcohol and illicit drugs among participants, including lifetime use, use in the last six months (recent), and recent use in association with sexual activity. Any alcohol use was widely (72.7%) reported; 41% reported recent use, and 19.6% reported drinking before or during sex in the past six months. Prevalence of any use of illicit drugs ranged from 1.1% for ecstasy to 12.45% for marijuana. Very few women (0.5%) reported any history of injection drug use (IDU).

Table 3 shows demographic characteristics, blood and sexual risk exposures and associations with any positive serological marker among the participating women. Being 25 to 29 years old, lower education (up to eight years), monthly income of up to 4 times the minimum wage, history of any illicit drug use, IDU, reporting more than one (>1) sexual partner within the last six months, ever having forced sex against will, history of commercial sex work, use of any illicit drug before sex, and history of previous STI were associated with infections of interest in bivariate analysis.

Age (25–29), low income (up to 4×MW), previous STI, reporting of more than one partner and use of any illicit drug were identified as being independently associated with any infection in the final multiple logistic model (Table 4).

DISCUSSION

This study sought to investigate prevalence of HIV, exposure to HBV, HCV and syphilis and assess associated risk exposures in a well-defined and representative population of young women in Vitória, Brazil. Results show that 6.1% of young women have been exposed to at least one infection; the most prevalent was HBV (4.2%), and HIV and HCV both the lowest (0.6%). Results from this study are in agreement with other recent studies of infection prevalence among women in other Brazilian locales. The last national sentinel study among pregnant women found 0.4% HIV prevalence, and 1.3% syphilis (Szwarcwald, 2005). A cross-sectional study performed to investigate the factors associated with positive syphilis serology results in puerperal women who were receiving care at 24 health centers accredited by Brazil's National Program on Sexually Transmitted Diseases and AIDS found 1.7% of syphilis (Rodrigues et al., 2004). A recent study performed in Campo Grande, MS, in the central-western region, to estimate the frequency of infections during pregnancy found 0.2% of HIV-1, 0.8% of syphilis, 0.3% of HBsAg, and 0.1% of hepatitis C (Figueiro-Filho, 2007). In a general population study conducted in the city of São Paulo, Focaccia et al. (Focaccia et al., 1998) found a prevalence of anti-HBc of 5.9% (4.5%, 7.4%) and anti-HCV prevalence of 1.4% (0.7%, 2.1%), with similar proportions in males and females.

Behaviors and exposures independently associated with the principal outcome were: any positive serological marker, included: older age (≥ 25 vs. <25 years), low monthly income (4× vs. > 4× minimum wage), reporting a previously diagnosed STI, one or more lifetime

sexual partner, and reporting any illicit drug use. These exposures are common in this population and are similar to finding by others in Brazil (Focaccia et al., 1998; Clemens et al., 2000; Rossini et al., 2003).

Among all women, up to 4% had results consistent with prior, latent or remote HBV infection, and 40.5% demonstrated isolated antiHBs consistent with vaccine induced immunity; thus, over half demonstrated susceptibility to HBV infection. At present, there are enhanced efforts to vaccinate infants and children in Brazil. Since 1994, HBV vaccination has become a routine program for children in the first year of life in Vitória and, in 2000, the program was expanded to reach adolescents up to 19 years of age. However, coverage remains imperfect principally due to unreliable vaccine supply and, as a result, many women of childbearing age are at risk for infection or are chronically infected and at risk for transmission to their infants and partners. This study succeeded in raising some awareness of HBV vaccination; among participants, the counseling conducted with the HBV testing included information on HBV vaccine. And, with the study results, suggestions were forwarded to the FHP program to extend HBV vaccination for women up to 29 years old.

Limitations of this study include the modest sample size. However, response rate was high, and the data are highly relevant and generalizable to women in the metropolitan area of Vitória. Nevertheless, the Brazilian population is highly heterogeneous, and inferences from this may be limited with respect to women attending private health care and/or from other parts of the country. The possibility of response bias, due to the tendency to provide socially acceptable responses, cannot be excluded. In addition, underreporting due to recall regarding condom use and/or number of sexual partners may have occurred. A strength of the study was the high participation rate, which was accomplished by means of an effective collaboration with the FHP program in Vitória, which provides substantive public health services locally.

This report draws attention to the importance of women's health surveillance and points to some of the ways in which women's health and women's lives can be improved with well planned research and community health collaborations. By working closely with the FHP this research achieved numerous goals, gathered highly relevant and generalizable health data relevant for health planning, reached and counseled a large number of women for HIV and other sexually and blood transmitted infection, and facilitated prevention and direct assistance for young women's health.

Acknowledgments

We wish to thank the University of California, San Francisco, Center for AIDS Prevention Studies (P30 MH062246) for technical support of this research, as well as the Fogarty International Center's International, Operational and Health Services Research Training Award, Brazilian Scientists Program (D43 TW005799) & the AIDS International Training in Research Program (D43 TW00003).

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Table 1

Prevalence of markers for infectious diseases among young women in three health regions in Vitória, 2006

Infection markers	N	%	95% CI
HIV *	6	0.6	0.1%–1.1%
Syphilis [#]	12	1.2	0.5%–1.9%
Hepatitis B core antibody (anti-HBc)	43	4.2	3.0%–5.4%
Hepatitis B surface antigen (HbsAg)	9	0.9	0.4%–1.6%
Hepatitis C antibody	6	0.6	0.1%–1.1%
Any positive infection marker ^{**}	63	6.1	4.7–7.8%

* HIV (confirmed serologic diagnosis by ELISA and IFI)

[#] Syphilis infection (confirmed by positive VDRL and microhemagglutination tests)

^{**} Any positive marker for HIV (positive ELISA and IFI), or HBV exposure or chronic infection (positive anti-HBc or positive HBsAg), or HCV exposure (positive anti-HCV), or syphilis exposure (positive VDRL and positive microhemagglutination).

Table 2

Prevalence of drug use among young women in three health regions in Vitória, 2006

Drug	Ever used	In last six months	
		Use	Use before or during sex
Alcohol	748 (72.7%)	422 (41.0%)	202 (19.6%)
Marijuana	128 (12.4%)	30 (2.9%)	16 (1.6%)
Cocaine	53 (5.2%)	11 (1.1%)	7 (0.7%)
Amphetamine	31 (3.0%)	13 (1.3%)	5 (0.5%)
Barbiturate	40 (3.9%)	15 (1.5%)	7 (0.7%)
Ecstasy	11 (1.1%)	4 (0.4%)	4 (0.4%)
Crack	23 (2.2%)	3 (0.4%)	2 (0.2%)
Injection drug use (IDU)	5 (0.5%)	2 (0.2%)	-
Other	5 (0.5%)	1 (0.1%)	1 (0.1%)

Table 3

Demographic characteristics, blood and sexual risk exposures and associations with any infection with among young women in three health regions in Vitória, 2006

Variables	% (CI 95%)	OR (CI 95%) ^I	P value
<u>Age</u>			
25 to 29 years	36.2 (33.2, 39.2)	2.70 (1.59, 4.54)	0.000
18 to 24 years	63.8 (60.8, 66.8)	1	
<u>Education</u>			
Up to 8 years	31.6 (28.8–34.5)	2.07 (1.24, 3.45)	0.007
9 or more years	68.4 (65.5–71.2)	1	
<u>Marital status</u>			
Married/living together	41.3 (38.3, 44.4)	1.00 (0.60, 1.68)	1.000
Not married	58.7 (56.6, 61.7)	1	
<u>Monthly income</u>			
4× Minimum Wage ²	68.0 (65.1, 70.9)	2.61 (1.3, 15.20)	0.005
> 4× Minimum Wage	32.0 (29.1, 34.9)	1	
<u>Previous HIV test</u>			
Yes	59.3 (56.2, 62.3)	1.30 (0.76, 2.22)	0.357
No	40.7 (37.7, 43.8)	1	
<u>Previous Blood transfusion</u>			
Yes	2.9 (1.9, 4.1)	0.52 (0.07, 3.89)	1.000
No	97.1 (95.9, 98.0)	1	
<u>History of any illicit drug use³</u>			
Yes	17.8 (15.5, 20.3)	3.29 (1.99, 5.45)	0.000
No	82.2 (79.7, 84.5)	1	
<u>History of injection drug use IDU</u>			
Yes	0.5 (0.2, 1.1)	10.53 (1.73, 64.17)	0.033
No	99.5 (98.7, 99.8)	1	
<u>Number of Lifetime sexual partners⁴</u>			
>1	67.4 (64.2, 70.4)	1.39 (0.82, 2.35)	0.21
1	32.6 (29.6, 35.8)	1	
<u>Number of sex partners in last 6 months⁴</u>			
>1	15.6 (13.3, 18.1)	1.61 (0.86, 2.99)	0.15
1	84.4 (81.9, 86.7)	1	
<u>Condom use at last intercourse⁴</u>			
No	63.5 (60.3, 66.6)	1.16 (0.69, 1.95)	
Yes	36.5 (33.4, 39.7)	1	0.59
<u>History of commercial sex work⁴</u>			
Yes	1.4 (0.9, 2.6)	4.62 (1.22, 17.52)	0.045
No	98.6 (97.4, 99.2)	1	

Variables	% (CI 95%)	OR (CI 95%) ¹	P value
<u>Previously diagnosed with STI</u> ⁴			
Yes	12.1 (10.0, 14.4)	3.01 (1.66, 5.47)	0.001
No	87.9 (85.6, 89.9)	1	
<u>Ever been forced sex against your will</u> ⁴			
Yes	8.1 (6.5, 9.9)	2.62 (1.31, 5.24)	0.013
No	91.9 (89.8, 93.3)	1	
<u>Use of illicit drugs before sex</u> ⁴			
Yes	3.8	6.9 (2.4, 19.5)	0.002
No	96.2	1	

¹ OR (CI 95%): Odds ratio (confidence interval 95%).

² MW: minimum wage; 1×MW = US \$159

³ Reported any use of marijuana, cocaine, amphetamine, barbiturates, ecstasy, or crack

⁴ Among 904 women who reported any history of sexually activity.

Table 4

Multivariate analysis of independent factors associated with at least one infection among young women in three health regions in Vitória, 2006 (N=904)

Factors	OR	95% CI	P value
Age: 25–29 vs. <25 years	1.75	1.01, 3.03	0.048
Income: 4 × minimum wage vs. >4 × minimum wage	1.91	1.00, 3.65	0.050
Previous diagnosed with STI (yes vs. no)	2.37	1.18, 4.77	0.016
Number of lifetime sexual partners: 1 partner compared to 0 sexual partners	2.88	1.54, 5.38	0.001
Use of any illicit drug (yes vs. no)	3.25	1.70, 6.21	0.000