Risk Factors Associated With HIV Prevalence Among Female Sex Workers in 10 Brazilian Cities

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Background: HIV prevalence is 15 times higher among female sex workers (FSWs) than in the overall Brazilian female population. In this article, we investigated factors associated to HIV infection among FSW, recruited by Respondent-driven sampling (RDS), in 10 Brazilian cities in 2008–2009.

Method: The total sampling was 2523 FSWs. The variables considered in the study included sociodemographic characteristics and those related to profession, knowledge, and source of information on sexually transmitted infection/AIDS, access to condoms, sexual behavior, health care and sexually transmitted infection signs, discrimination and violence, and the use of alcohol and drugs. Sampling weights were proportional to the inverse of network size and for the generation of global results for the 10 cities, data were calibrated by the population size. Multivariate logistic regression models were used, taking into account the dependency structure of observations.

Results: The longest period of prostitution (odds ratio [OR], 1.040; 95% confidence interval [CI], 1.013–1.067), the lowest price charged for sex (OR, 0.713; 95% CI, 0.522–0.970), the association with other sexually transmitted infections such as syphilis (OR, 2.186; 95% CI, 1.064–4.488), and the fact of would waive the use of condom on client's request (OR, 3.735; 95% CI, 1.449–9.661) were the most important associated risk factors to HIV infection among FSWs. Purchase of condoms (OR, 0.503; 95% CI, 0.304–0.833) was a relevant preventive factor.

Conclusions: The use of RDS proved to be appropriate for the recruitment of FSWs as long as the statistical analysis takes into account the dependency structure of observations. The HIV infection predictors here depicted can support public health policies focused on this population group in Brazil.

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INTRODUCTION

The AIDS epidemic broke out in Brazil in the early 1980s. After three decades, the epidemic is still concentrated according to UNAIDS definition with a low HIV prevalence in the general population, lower than 1%,[1] and a high prevalence in the most-at-risk populations[2] such as men who have sex with men, drug users and female sex workers (FSWs). Among pregnant women, the HIV prevalence is 0.4%, much lower than 1%.

In Brazil, it is estimated that the FSWs represent 1% of the female population from 15 to 49 years of age, accounting for more than a half million women.[3] Studies indicate that the HIV prevalence is 15 times higher among FSWs than that found in the overall Brazilian female porpulation.[4] In Santos, a Brazilian municipality with a busy harbor and located in the state of São Paulo, the HIV prevalence among FSWs was 8% in 1998.[5] From 2000 to 2001, in some state capitals in Brazil, the prevalence of HIV among these women was estimated in 6.1%.[6] In international literature, studies attest to an increased risk of HIV infection among FSWs.[7–9]

The study in Santos showed that the prevalence of HIV infection among FSWs was influenced by drug use, low level of education, and unsafe sex.[10] Another study carried out in three different regions of Brazil showed that HIV infection was associated with age, time as a FSW, educational level, and monthly income.[5] International studies show that the increased risk of HIV infection among FSWs is associated with factors connected to professional activity, multiplicity of sexual partners,[8,9,11] little access to health care,[12,13] and social vulnerability.[4] Illicit drug use[7,14] and the history of sexually transmitted infections (STIs) also stand out in the literature as being factors associated to HIV infection in this population.[5,7,14]

In Brazil, studies on the risk of HIV infection among FSWs are scarce and use convenience samples that allow no statistical inference, hindering the parameter estima tion for monitoring the HIV epidemic in this population group.[15] Besides, population-based studies that use traditional sampling techniques among FSWs would not be appropriate given that this is a small-sized and hard-to-reach population group.[16]

Respondent-driven sampling (RDS)[17] is a chain recruitment sampling method that has been used in several countries to achieve representative results on hard-to-reach populations such as HIV most-at-risk populations, including FSWs.[18,19]

In this article, we investigated factors associated to HIV infection among FSWs recruited by RDS in 10 Brazilian cities in 2008–2009.

METHODS

RDS was proposed by Douglas Heckathorn in 1997[17] for estimating disease prevalence in hard-to-reach populations. RDS data are collected through a snowball mechanism, also called chain-referral sampling, in which current participants recruit future participants. An RDS study begins with the recruitment of a small number of people in the target population, the seeds of the process. After participating, the seeds receive a fixed number of numerated coupons and are asked to recruit people that they know from the target population. The eligible participants with valid coupons constitute the first wave of the study. These participants receive new numerated coupons and are asked to recruit people that they know from the target population. The sampling continues in this way until the desired sample size is reached.

The original recruitment procedure recommends an incentive for participation (primary incentive) and a secondary incentive (usually financial) for each recruited participant. The recruitment method increases the possibility of reaching the most hidden individuals in the target population. Additionally, the study is generally carried out in health services, stimulating access and use of health services among HIV most-at-risk populations.

The data used in this article come from a research study entitled Health Chain "Corrente da Saúde." The total sample was 2523 FSWs recruited by RDS in 10 Brazilian cities from August 2008 to July 2009. The Brazilian cities were chosen by the Brazilian Department of STD, AIDS and Viral Hepatitis to their HIV/AIDS epidemic magnitude.

Eighteen-year-old FSWs, or older, who had at least one sexual intercourse in exchange for money in the 4 months before the research in the municipalities chosen were included. In each one of those cities, sampling was distributed proportionally to the city population, although a minimum sample size of 100 women was set. Figure 1 shows the foreseen and collected sample in the 10 cities studied.

Tests for HIV[20] and syphilis were conducted using rapid tests (capillary blood collection), according to the protocols recommended by the Brazilian Department of STD, AIDS and Viral Hepatitis. Pre- and posttest counseling was carried out by a qualified professional.

The Audio Computer-Assisted Self-Interview software was used for data collection. The questionnaire included the following topics: sociodemographic data; knowledge of HIV and other STI transmission; sexual behavior; previous HIV testing—during lifetime and in the previous year; history of STI; alcohol and illicit drug use; access to health care and prevention activities; discrimination; and violence.

Details on the Health Chain research and RDS technique have been published previously.[21] The research was submitted to and approved by the Ethic in Research Committee of Oswaldo Cruz Foundation.

Statistical Analysis

The measurement of the network size of each FSW was based on the question: "How many female sex workers do you know who work in this town?," and sample weights proportional to the inverse of the participants' network size were used.[22, 23] Furthermore, for global data estimation, the sample was weighted by the relative population size of women 18 to 59 years of age in each city assuming the same proportion of FSW in all cities.[24]

Considering the dependency of observations generated by the recruitment pattern,[24] the multivariate analysis was carried out taking into account the recruiter's HIV tests results. For such, multivariate logistic regression models were used, controlling, for each participant, the effects of the recruiter's HIV results. Moreover, as each participant recruited, on average, 2.15 FSWs, to take the intraclass correlation effects into account, in the multivariate analysis, the "Complex Sample" appendix of the Statistical Package for the Social Sciences software (SPSS, Version 17.0; SPSS Inc, Chicago, IL) was used considering the participants recruited by the same person as a cluster.

For the bivariate analyses, the logistic regression models had the HIV test result as the dependent variable, and the odds ratio (OR) was used to test the association of the independent variables with HIV infection after controlling for the recruiter's HIV test result. For the multivariate logistic model, the Backward procedure was used for variable selection.

The following variables were considered in the study: sociodemographic data (age, education level, race/color, marital status); professional characteristics (workplace, time as a sex worker, price charged for sex, average number of paid sexual encounters per day); knowledge and source of information on STI/AIDS and access to condoms (degree of knowledge of STI/AIDS, knowledge of some nongovernment organization that promotes sex worker citizenship and civil rights defense, purchased or received condoms in the previous 12 months); discrimination and violence (was discriminated in the previous 12 months as a result of her professional activity, was ever physically forced to sexual intercourse against her will); and alcohol consumption and drug use (marijuana, crack or cocaine) just before or during sexual intercourse.

In relation to sexual behavior, we summarized the questions in the following indicators: regular condom use with steady partners (always uses condom during sexual intercourses with steady partners in vaginal sex, anal sex, and oral sex); and regular condom use with clients (always uses condom during sexual intercourses with clients in vaginal sex, anal sex, and oral sex). Indirect questions about possible situations in which the participants could waive the use of condoms resulted in the following indicators: "would waive the use of condom when knowing the client" (yes/no); "would waive the use of condom when in much need of cash" (yes/no); "would waive the use of condom when having many sexual
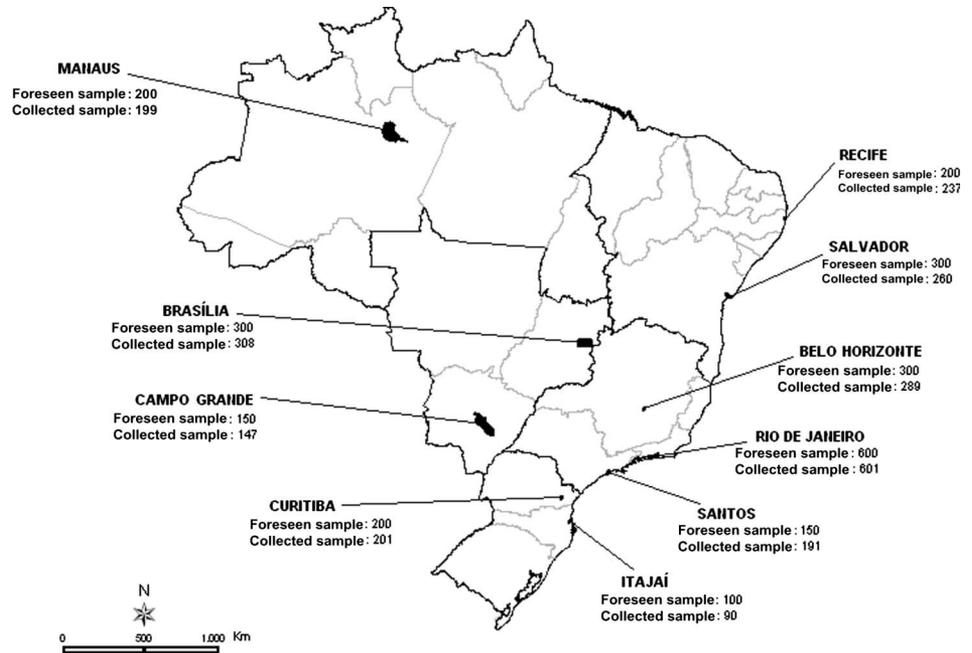
FIGURE 1. Location of the 10 cities studied and foreseen and collected sample, Health Chain, Brazil, 2009.

intercourses per day" (yes/no); and would waive the use of condom on client's request (yes/no).

Regarding health care, we considered the variable gynecologic examination in the previous 3 years and in relation to STI we considered the occurrence of lesions, blisters, and warts on the vagina or anus in the previous 12 months besides a positive syphilis testing result.

RESULTS

The majority of women who participated in this research were aged 25 to 39 years old, classified their race/color as being "pardo" (brown), stated being single and never been married, and not having completed primary school. The modal class of monthly income was from R $300.00 ($130 US) to R $599.00 ($260 US). As for work conditions, 39% of the women interviewed worked on the streets, the majority of them having from 1 to 3 years of profession, charging from R $30.00 to R $99.00 per paid sexual encounter, and having from two to five paid sexual encounters a day (Table 1).

The estimation of HIV prevalence was object of a previous work, which included a proposition of variance calculation, design effect, and confidence interval.[24] The prevalence was estimated in 4.8% (95% confidence interval, 3.4–6.1%; design effect equal to 2.63; standard error 0.69%).

The association between the recruiter's and the recruit's HIV estimate showed that the OR of an HIV-positive recruiter choosing an HIV-positive recruit is nearly six times higher than that of an HIV-negative recruiter choosing an HIV-positive recruit (Table 2).

In the bivariate analyses, many of the studied variables were significantly associated to HIV infection, even after being controlled by the HIV recruiter's result. Of the sociodemographic characteristics, age was positively correlated and educational level was inversely correlated to HIV infection. As for professional characteristics, HIV prevalence was directly associated with time as a FSW and inversely associated with the amount charged for sexual encounter. The purchase of condoms during the 12 months before the research was a protective factor to HIV infection. As for sexual behavior, the OR was higher among those FSWs who would waive the use of condom when in much need of cash or when having many sexual intercourses per day. The OR was four times higher among those FSWs who would waive the use of condom on client's request (Table 2).

In regard to the occurrence of STI signs during the 12 months before the research, the report of lesions or warts on the vagina or anus indicated an OR four times higher. The OR was higher among FSWs who were also syphilis-positive as well as among those who had been exposed to syphilis at some point in their lifetime (Table 2).

The OR among FSWs who had been physically forced to have sex against their will was close to 2; among those who used illicit drugs, the OR was 1.4 and 2.2 women who used illicit drugs just before or during sexual intercourse (Table 2).

In the multivariate analysis, STI signs such as lesions or warts on the vagina or anus in the previous year were important predictors of HIV infection. As for risky sexual practices, the adjusted OR was 3.7 among women who stated that they would waive the use of condom on the client's request. The time spent as a sex worker and the fact of having ever been exposed to syphilis at some point in their lifetime were also factors associated with HIV infection. In relation to work conditions, the price charged for sex was the most relevant factor in the multivariate analysis, inversely associated with HIV infection (Table 3).

TABLE 1. Characterization of Female Sex Workers, Health Chain, Brazil, 2009

Variables		No.	Percent	(95% confidence interval)
	18–24	856	33.96	(31.20–36.82)
Age group	25–39	1200	47.61	(44.72–50.52)
	40–59	435	17.25	(15.15–19.56)
(n = 2521)	60 or older	30	1.19	(0.72–1.96)
Color or race	White	604	23.94	(21.62–26.42)
	Afro-American	717	28.42	(25.80–31.20)
(n = 2523)	Pardo (brown)	962	38.15	(35.48–40.89)
	Other	240	9.49	(7.78–11.54)
	Single/never been married	1333	52.81	(49.88–55.73)
Marital status	Married or lives with a partner	513	20.34	(18.04–22.85)
	Separated/divorced	546	21.62	(19.48–23.94)
(n = 2523)	Widow	132	5.22	(4.03–6.75)
	Illiterate or having less than 1-year instruction	126	5.01	(3.79–6.58)
	Elementary incomplete (first–third grade)	367	14.53	(12.59–16.71)
Education level	Elementary complete and middle school incomplete (fourth–seventh grade)	1000	39.65	(36.81–42.57)
(n = 2523)	Middle school complete and high school incomplete	599	23.73	(21.33–26.31)
	High school complete and higher education incomplete	400	15.84	(13.86–18.05)
	Higher education complete and beyond	31	1.24	(0.69–2.23)
	Bar/nightclub	951	37.67	(34.76–40.68)
Workplace	Hotel	529	20.95	(18.60–23.51)
(n = 2523)	Street	983	38.96	(36.08–41.92)
	Other	61	2.41	(1.71–3.40)
	Less than 1 year	185	7.39	(5.64–9.63)
	1–3 years	755	30.07	(27.33–32.97)
Time as a female sex worker	4–6 years	458	18.26	(16.18–20.55)
	7–9 years	304	12.13	(10.31–14.23)
	10–19 years	492	19.62	(17.52–21.89)
(n = 2510)	20–29 years	207	8.25	(6.89–9.85)
	30 years or more	107	4.28	(3.28–5.57)
	R $1.00–% $10.00	97	3.84	(2.95–5.00)
Price charged for sex	R $11.00–R $29.00	414	16.42	(14.42–18.65)
	R $30.00–R $49.00	524	20.77	(18.43–23.33)
(n=2,523)	R $50.00–R $299.00	1364	54.06	(51.05–57.04)
	R $300.00 or more	124	4.90	(3.73–6.41)
Average number of paid sexual encounters per day	1	193	7.64	(6.10–9.54)
	2–3	998	39.56	(36.75–42.44)
	4–5	758	30.03	(27.54–32.66)
(n = 2523)	6–10	406	16.09	(14.08–18.32)
	11–20	114	4.52	(3.51–5.80)
	21–30	54	2.16	(1.46–3.18)

DISCUSSION

RDS is a method of sampling hard-to-reach populations. It was applied for the first time in Brazil in 10 cities and made possible the recruitment of a large sample of FSWs in the country.

However, the statistical analysis of the data collected by RDS is still limited and under development. The software Respondent-Driven Sampling Analysis Tool (RDSAT) evaluates and adjusts the data according to recruitment standards observed during the study, taking into account the homophily effect and the size of each participant's network size. Nevertheless, it is not possible to do multivariate

statistical analyses by means of this software. In the international literature, authors have been using traditional multivariate statistical techniques considering independent observations,[25,26] and only few studies have taken into account the dependency structure of observations in the data analysis.[27,28]

In the present study, besides considering the size of each participant's network size, we worked out a multivariate analysis method taking into account the dependency structure between observations by means of two effects: the recruiter–recruit effect and the effect of the intraclass correlation among those FSWs who were recruited by the same participant.

TABLE 2. Bivariate Analysis of the Association Between the Study Variables and the HIV Prevalence Controlled by the Recruiters HIV Status, Health Chain, Brazil, 2009

Control Variable	OR*	95% CI	*P*
Recruiter's HIV status			
Positive	5.821	(3.060–11.071)	0.000
Negative	1.000	—	—
Covariable			
Sociodemographic			
Age	1.040	(1.021–1.058)	0.000
Level of education	0.741	(0.573–0.958)	0.022
Race/color			
White	2.045	(0.639–6.542)	0.228
Afro-American	1.447	(0.474–4.416)	0.516
Pardo (brown)	1.404	(0.496–3.977)	0.523
Other	1.000	—	—
Marital status			
Single (never been married)	0.593	(0.301–1.171)	0.132
Separated or divorced	0.461	(0.206–1.032)	0.060
Widow	1.214	(0.439–3.355)	0.708
Married/lives with partner	1.000	—	—
Characteristics related to profession			
Workplace			
Bar/nightclub	0.581	(0.291–1.160)	0.124
Hotel	0.595	(0.305–1.161)	0.128
Other	0.791	(0.187–3.347)	0.750
Street	1.000	—	—
Time as a female sex worker	1.055	(1.036–1.075)	0.000
Price charged for sex	0.602	(0.449–0.808)	0.001
Average number of paid sexual encounters per day	0.909	(0.618–1.335)	0.625
Knowledge of and source of information on sexually transmitted disease/AIDS and access to condoms			
Degree of knowledge of sexually transmitted disease/AIDS	1.003	(0.987–1.018)	0.744
Knows some nongovernment organization that promotes the sex workers' citizenship and civil rights defense			
Yes	1.484	(0.729–3.020)	0.276
No	1.000	—	—
Purchase of condoms in the previous 12 months			
Yes	0.503	(0.304–0.833)	0.008
No	1.000	—	—
Receipt of condoms in the previous 12 months			
Yes	0.747	(0.389–1.433)	0.380
No	1.000	—	—
Sexual behavior			
Always use condoms during sexual intercourses with partners			
Yes	1.304	(0.784–2.168)	0.306
No	1.000	—	—
Always use condoms during sexual intercourses with clients			
Yes	0.720	(0.415–1.250)	0.243
No	1.000	—	—
Would waive the use of condom when knowing the client			
Yes	1.704	(0.913–3.182)	0.094
No	1.000	—	—
Would waive the use of condom when in much need of cash			
Yes	2.206	(1.236–3.940)	0.008
No	1.000	—	—
Would waive the use of condom when having many sexual intercourses per day			
Yes	3.295	(1.367–7.940)	0.008
No	1.000	—	—

TABLE 2. (*continued*) Bivariate Analysis of the Association Between the Study Variables and the HIV Prevalence Controlled by the Recruiters HIV Status, Health Chain, Brazil, 2009

Control Variable	OR*	95% CI	*P*
Would waive the use of condom on client's request			
Yes	4.012	(1.616–9.960)	0.003
No	1.000	—	—
Health care and sexually transmitted infection signs			
Gynecologic examination in the previous 3 years and prevention			
Yes	0.615	(0.361–1.047)	0.073
No	1.000	—	—
Occurrence of lesions on the vagina or anus in the previous 12 months			
Yes	4.329	(2.197–8.531)	0.000
No	1.000	—	—
Occurrence of blisters on the vagina or anus in the previous 12 months			
Yes	2.531	(1.235–5.188)	0.011
No	1.000	—	—
Occurrence of warts on the vagina or anus in the previous 12 months			
Yes	4.659	(1.956–11.097)	0.001
No	1.000	—	—
Active syphilis			
Yes	2.901	(0.994–8.468)	0.051
No	1.000	—	—
Syphilis Scar			
Yes	3.305	(1.855–5.887)	0.000
No	1.000	—	—
Discrimination and violence			
Was discriminated in the previous 12 months as a result of her profession			
Yes	1.079	(0.630–1.849)	0.781
No	1.000	—	—
Was ever physically forced into having sexual intercourse against her will			
Yes	1.743	(1.002–3.030)	0.049
No	1.000	—	—
Alcohol and drug use			
Alcohol consumption			
Yes	0.787	(0.462–1.342)	0.379
No	1.000	—	—
Drug use			
Yes	1.439	(1.057–1.961)	0.021
No	1.000	—	—
Use of drugs just before or during sexual intercourse			
Yes	2.235	(1.267–3.943)	0.006
No	1.000	—	—

*OR estimated by logistic regression.
OR, odds ratio; CI, confidence interval.

Our results corroborate results of other FSW studies showing the increase of the HIV prevalence as age increases and level of education decreases.[29,30]

Besides the longer period of exposure, older women charged less for their services, had a lower level of education and a lower condom use rate, and the majority worked in the streets. These findings confirm those of Ghys et al,[29] which evidenced lower HIV prevalence associated with women with a shorter period of professional practice who charged higher amounts for their services and made frequent use of condoms.

The purchase of condoms in the previous 12 months proved to be a protective factor against HIV infection. Because the majority of participants stated not having received a sufficient number of condoms to be used with all their customers, this finding takes on significant importance for public prevention policies given that FSWs who cannot afford to buy condoms and do not receive condoms for free are more likely to practice unsafe sex.

The association between STI signs and symptoms and HIV infection is known[5,7,14] and reinforces the need to facilitate

TABLE 3. Multivariate Analysis of the Association Between the Study Variables and the HIV Prevalence Controlled by the Recruiter's HIV Status, Health Chain, Brazil, 2009

Variables*	Multivariate Analysis		
	Odds Ratio†	(95% confidence interval)	*P*
The recruiter's HIV results			
Yes	4.596	(2.299–9.189)	0.000
No	1.000	—	—
Time as a female sex worker	1.040	(1.013–1.067)	0.004
Price charged for sex	0.713	(0.522–0.970)	0.034
Occurrence of lesions on the vagina or anus in the previous 12 months			
Yes	3.041	(1.504–6.148)	0.002
No	1.000	—	—
Occurrence of warts on the vagina or anus in the previous 12 months			
Yes	4.567	(1.770–11.786)	0.002
No	1.000	—	—
Syphilis scar (positive rapid test)			
Yes	2.186	(1.064–4.488)	0.033
No	1.000	—	—
Would waive the use of condom on client's request			
Yes	3.735	(1.449–9.661)	0.007
No	1.000	—	—

* Variables selected by step-by-step procedure.
†Odds ratio estimated by multivariate logistic regression.

the FSWs' access to the healthcare system. We noted that STI signs and symptoms, especially lesions and/or warts on the vagina or anus as well as the presence of active syphilis and scar, stood out as factors that are associated with HIV infection among FSWs, corroborating previous work in Santos, Brazil, on factors associated with HIV incident infection.[31] Among those FSWs who had STI signs, 61.6% sought health care, 8.3% took counsel with a nonprofessional, 18.6% went to the pharmacy, and 11.5% did nothing.

On the other hand, the finding that concurrent STI is associated with HIV may be indicating that the real predictors of HIV—sexual risk behaviors—were not successfully measured, allowing the confounder (STI) to reach significance. The hypothesis that STIs are merely markers of sexual risk has been broadly accepted, because a large number of randomized clinical trials did not found an impact of treating other STIs on HIV infection.[32–34] In this study, gynecologic examination in the past 3 years showed a borderline significant effect but lost significance after controlling for other variables.

Moreover, it is noteworthy that the variables related to direct questions on the use of condoms with customers or steady partners were not significantly associated with HIV infection, confirming the limitations of some measures of risky sexual practices adopted in this study. However, indirect questions about the conditions under which FSWs would waive the use of condoms such as "when in much need of cash" or "when having many sexual intercourses per day" were associated with an increased risk of HIV infection, evidencing that the indirect questions worked better at identifying unsafe sex practices.

The increased risk of being infected by HIV among FSWs who would waive the use of condom on client's request

(OR, 4.012; 95% confidence interval, 1.616–9.960) indicates the difficulty in negotiating safe sex. In China, it was evidenced that the customers' refusal was one of the main obstacles for the use of condoms by FSW.[35] Likewise, Szwarcwald et al[4] showed the relevant role played by the need of money for the purchase of illicit drugs and the lack of bargaining power when negotiating the use of condoms with customers.

According to the World Health Organization,[36] violence has a direct impact on the FSW's ability to adopt safe sexual practices. In the present study, the fact of having been physically forced into having sexual intercourse against their will at some point of their lives increased the OR of being infected by HIV, although the effect was not statistically significant after controlling for other variables that could be causing the effect of confusion, for example, poor women with less education may be more likely to experience sexual violence.

Violence is a manifestation of the stigma and discrimination experienced female sex workers who, in the aggressors' eyes, are to be subject to violent sexual practices, even against their own will.[36] Farley and Barkan[37] showed, in a study carried out in San Francisco with 130 FSWs, that 82% had been physically assaulted, 83% had been threatened with a gun, and 68% had been raped during work. In a study carried out in three large British cities,[38] both FSWs who worked in the streets and those who worked indoors reported having sustained some sort of violence from customers. Physical threats, customers' coercion, absence of legal protection for street workers, isolation, and the lack of community support combined with youth, poverty, and drug use are factors that increase FSWs' vulnerability to violence or potential risk of STI.[39] Miller and Schwartz[40] reinforced that FSWs are

particularly susceptible to sexual coercion as a result of the profession's stigmatized character.

The use of drugs in general and, mainly, the use of some kind of illicit drug just before or during the sexual intercourse were also factors associated with HIV infection, corroborating the study carried out in 32 cities in nine countries in South America.[7] Likewise, Szwarcwald et al[4] showed, in a study carried out in Santos, that FSWs' vulnerability increases with the use of drugs.

The multivariate model results showed that the association of some variables with HIV infection persisted such as the presence of lesions or warts on the vagina or anus in the previous year; time as a FSW; the exposure to syphilis at some point of their lifetime; would waive the use of condom on client's request; and the price charged for sex service, the most relevant variable in the analysis, which was inversely associated to HIV infection. It is worth pointing out that the use of multivariate models on data collected by complex samples often results in loosing statistical significance on account of the design effect.[41]

As to RDS application, this type of sampling proved to be appropriate for recruitment in this population subgroup. The statistical analysis proposed in this study, considering the homophily effect and the intraclass correlation of participants recruited by the same FSW, allowed the use of logistic regression models. The results here depicted may substantiate public health care policies focused on this population group in Brazil.

REFERENCES

1. Szwarcwald CL, Souza PRB Jr. Estimativa da prevalência de HIV na população brasileira de 15 a 49 anos, 2004. *Bol Epidemiol AIDS*. 2006;1: 11–15.
2. Barbosa A Jr, Szwarcwald CL, Pascom ARP, et al. Tendências da epidemia de AIDS entre subgrupos sob maior risco no Brasil, 1980–2004. *Cad Saude Publica*. 2009;25:727–737.
3. Ministério da Saúde–Programa Nacional de DST e Aids (Brasil). *PCAP Pesquisa de conhecimento atitudes e práticas na população brasileira 2004*. Brasília: Ministério da Saúde; 2006.
4. Szwarcwald CL, Barbosa A Jr, Souza PRB Jr, et al. HIV testing during pregnancy: use of secondary data to estimate 2006 test coverage and prevalence in Brazil. *Braz J Infect Dis*. 2008;12:167–172.
5. Szwarcwald CL, Bastos FI, Gravato N, et al. The relationship of illicit drug use to HIV infection among commercial sex workers in the city of Santos, São Paulo, Brazil. *Int J Drug Policy*. 1998;9:427–436.
6. Ministério da Saúde–Coordenação Nacional de DST e Aids (Brasil). *Avaliação da efetividade das ações de prevenção dirigidas às trabalhadoras do sexo, em três regiões brasileiras. Coleção DST/aids–Série Estudos, Pesquisas e Avaliação n° 7*. Brasília: Ministério da Saúde; 2004.
7. Bautista CT, Sanchez JL, Montano SM, et al. Seroprevalence of and risk factors for HIV-1 infection among female commercial sex workers in South America. *Sex Transm Infect*. 2006;82:311–316.
8. Allen CF, Edwards M, Williamson LM, et al. Sexually transmitted infection service use and risk factors for HIV infection among female sex workers in Georgetown, Guyana. *J Acquir Immune Defic Syndr*. 2006;43: 96–101.
9. Reyes MCB, Rivera LR, Valdez AC, et al. Prevalencia de infecciones de transmisión sexual y factores de riesgo concomitantes en sexo servidoras de Cuautla, Morelos. *Ginecol Obstet Mex*. 2005;73:36–47.
10. Silva NG. Fatores associados à infecção pelo HIV em trabalhadoras do sexo de Santos, São Paulo [dissertação de Mestrado]. São Paulo: Universidade Federal de São Paulo; 2004.
11. Ministério da Saúde–Coordenação Nacional de DST e Aids (Brasil). *Profissionais do sexo: documento referencial para ações de prevenção das DST e da aids. Série Manuais n° 47*. Brasília: Ministério da Saúde; 2002.
12. Thuong NV, Nhung VT, Nghia KV, et al. HIV in female sex workers in five border provinces of Vietnam. *Sex Transm Infect*. 2005;81: 477–479.
13. Wong WCJ, Holroyd EA, Gray A, et al. Female street sex workers in Hong Kong: moving beyond sexual health. *J Womens Health*. 2006;15: 390–399.
14. Nguyen TV, Khuu NV, Truong PH, et al. Correlation between HIV and sexual behavior, drug use, trichomoniasis and candidiasis among female sex workers in a Mekong Delta province of Vietnam. *AIDS Behav*. 2009; 13:873–880.
15. Semaan S, Lauby J, Liebman J. Street and network sampling in evaluation studies of HIV risk-reduction interventions. *AIDS*. 2002;4: 213–223.
16. Magnani R, Sabin K, Saidel T, et al. Review of sampling hard-to-reach and hidden populations for HIV surveillance. *AIDS*. 2005;19(suppl 2): S67–S72.
17. Heckathorn DD. Respondent-driven sampling: a new approach to the study of hidden populations. *Soc Probl*. 1997;44:174–199.
18. Johnston L, Sabin K, Hien MT, et al. Assessment of respondent driven sampling for recruiting female sex workers in two Vietnamese cities: reaching the unseen sex worker. *J Urban Health*. 2006;83:16–28.
19. Simic M, Johnston LG, Platt L, et al. Exploring barriers to 'respondent driven sampling' in sex worker and drug-injecting sex worker populations in eastern Europe. *J Urban Health*. 2006;83(suppl 1):6–15.
20. Ferreira OC Jr, Ferreira C, Riedel M, et al. Evaluation of rapid tests for anti-HIV detection in Brazil for the HIV Rapid Test Study Group. *AIDS*. 2005;19(suppl 4):S70–S75.
21. Damacena GN, Szwarcwald CL. Implementação do método de amostragem Respondent-Driven Sampling entre mulheres profissionais do sexo no Brasil, 2009. *Cad Saude Publica*. 2010;27(suppl1):S45–S55.
22. Salganik MJ, Heckathorn DD. Sampling and estimation in hidden populations using respondent-driven sampling. *Sociol Methodol*. 2004; 34:193–240.
23. Volz E, Heckathorn DD. Probability-based estimation theory for respondent-driven sampling. *J Off Stat*. 2008;24:79–97.
24. Szwarcwald CL, Souza PRB Jr, Damacena GN, et al. Analysis of data collected by RDS among sex workers in 10 Brazilian cities, 2009: Estimation of the prevalence of HIV, variance, and design effect. *J Acquir Immune Defic Syndr*. 2011;57(suppl 3):S129–S135.
25. Bobashev GV, Zule WA, Osilla KC, et al. Transactional sex among men and women in the south at high risk for HIV and other STIs. *J Urban Health*. 2009;86(suppl 1):32–47.
26. Shahmanesh M, Wayal S, Copas A, et al. A study comparing sexually transmitted infections and HIV among ex-red-light district and non-red-light district sex workers after the demolition of Baina Red-Light District. *J Acquir Immune Defic Syndr*. 2009;52:253–257.
27. Strathdee SA, Lozada R, Pollini RA, et al. Individual, social, and environmental influences associated with HIV infection among injection drug users in Tijuana, México. *J Acquir Immune Defic Syndr*. 2008;47: 369–376.
28. Frost SD, Brouwer KC, Cruz MF, et al. Respondent driven sampling of injection drug users in two US–Mexico border cities: recruitment dynamics and impact on estimates of HIV and syphilis prevalence. *J Urban Health*. 2006;83(suppl 1):83–97.
29. Ghys PD, Diallo MO, Ettiègne-Traoré V, et al. Increase in condom use and decline in HIV and sexually transmitted diseases among female sex workers in Abidjan, Côte d'Ivoire, 1991–1998. *AIDS*. 2002;16: 251–258.
30. Tran TN, Detels R, Long HT, et al. HIV infection and risk characteristics among female sex workers in Hanoi, Vietnam. *J Acquir Immune Defic Syndr*. 2005;39:581–586.
31. Alves K, Shafer KP, Caseiro M, et al. Risk factors for incident HIV infection among anonymous HIV testing site clients in Santos, Brazil: 1996–1999. *AIDS*. 2003;32:551–559.
32. Gray RH, Wawer MJ. Reassessing the hypothesis on STI control for HIV prevention. *Lancet*. 2088;371:2064–2065.
33. Potts M, Halperin DT, Kirby D, et al. Reassessing HIV prevention. *Science*. 2008;320:749–750.
34. Ward H, Rönn M. The contribution of STIs to the sexual transmission of HIV. *Curr Opin HIV AIDS*. 2010;5:305–310.

35. Lau JT, Tsui HY, Siah PC, et al. A study on female sex workers in southern China (Shenzhen): HIV-related knowledge, condom use and STD history. *AIDS Care*. 2002;14:219–233.

36. World Health Organization (WHO). Violence against sex workers and HIV prevention. In: Violence Against Women and HIV/AIDS: Critical Intersections. Available at: http://www.who.int/gender/violence/en/vawinformationbrief.pdf. Accessed May 20, 2010.

37. Farley M, Barkan H. Prostitution, violence, and post–traumatic stress disorder. *Women Health*. 1998;27:37–49.

38. Church S, Henderson M, Barnard M, et al. Violence by clients towards female prostitutes in different work settings: questionnaire survey. *BMJ*. 2001;322:524–525.

39. Pyett PM, Warr DJ. Vulnerability on the streets: female sex workers and HIV risk. *AIDS Care*. 1997;9:539–547.

40. Miller J, Schwartz MD. Rape myths and violence against street prostitutes. *Deviant Behav*. 1995;16:1–23.

41. Cochran WG. *Sampling Techniques*, 3rd ed. New York: John Wiley & Sons; 1977.