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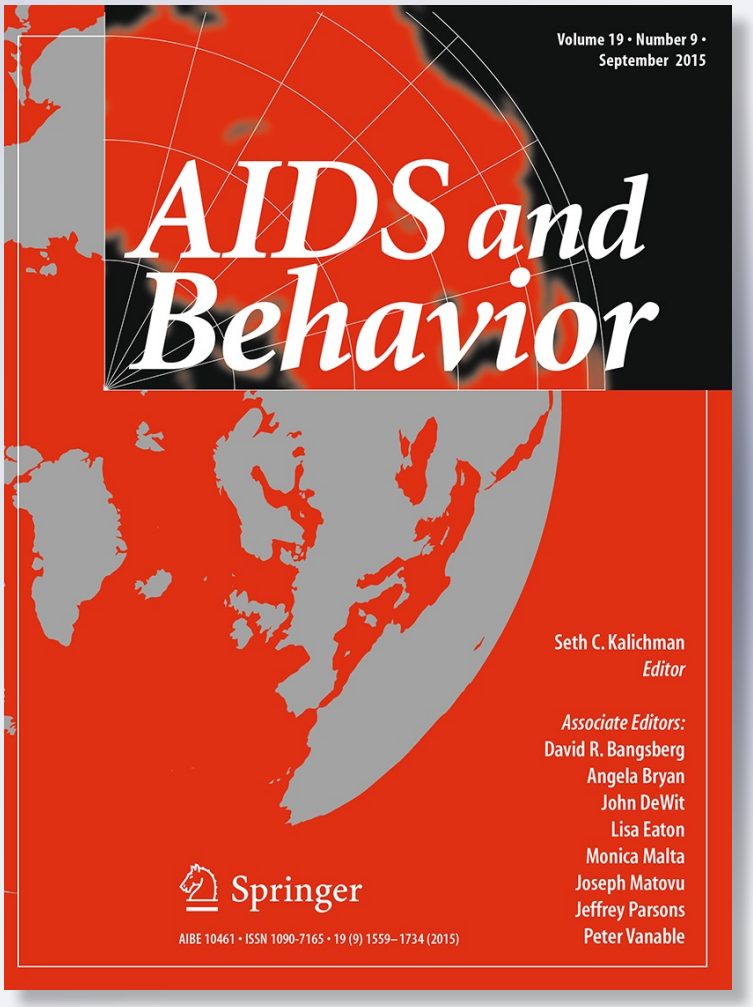

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ORIGINAL PAPER

HIV, STI and Behavioral Risk Among Men Who have Sex with Men in a Setting of Elevated HIV Prevalence Along Ecuador's Pacific Coast

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Abstract We assessed HIV and STI prevalence, risk behaviors and factors associated with HIV infection in men who have sex with men (MSM) in Guayaquil, Ecuador. Respondent-driven sampling was used to recruit 400 MSM in 2011–2012. Participants completed a computer-assisted self-interview and provided blood samples. Statistical analysis accounted for differential probability of selection and for recruitment patterns. HIV prevalence was 11.3 %, HSV-2 30.2 %, active syphilis 6.9 % and hepatitis B 1.2 %. In the previous 12 months, 84 % of MSM reported casual male sex partners and 25 % sex work. Only 48 % of MSM consistently used condoms with male partners and 54 % had ever been tested for HIV. Of 17 % of MSM reporting a female partner, consistent condom use was 6 %. HIV infection was associated with age 25 or older, active syphilis and homosexual self-identification. Findings suggest continuing HIV risk and a need to strengthen prevention and testing among MSM.

Resumen Este estudio evaluó la prevalencia del VIH y otras ITS, los comportamientos de riesgo y los factores asociados a la infección por VIH en la población de hombres que tienen sexo con hombres (HSH) en Guayaquil, Ecuador. Se empleó el muestreo dirigido por participantes para reclutar a 400 HSH en 2011–2012. Los participantes completaron una entrevista auto-administrada asistida por computadora y aportaron muestras de sangre. El análisis estadístico tuvo en cuenta la probabilidad diferencial de selección y los patrones de reclutamiento. La prevalencia del VIH fue 11,3 %, VHS-2 30,2 %, sífilis activa 6,9 % y hepatitis B 1,2 %. En los últimos 12 meses, 84 % de los HSH refirieron parejas ocasionales hombres y 25 % haber ejercido trabajo sexual. Solo el 48 % usó el condón de manera consistente con sus parejas masculinas y el 54 % se había realizado la prueba del VIH alguna vez en la vida. Del 17 % que refirió haber tenido una pareja mujer, el uso consistente del condón fue del 6 %. La infección por el VIH se asoció con edad igual o mayor a 25 años, sífilis activa y autoidentificación como homosexual. Los resultados sugieren un riesgo continuado y la necesidad de fortalecer la prevención y el testeo entre HSH en la costa pacífica de Ecuador.

Keywords Men who have sex with men · Sexually transmitted infections · HIV · Ecuador

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Introduction

HIV has disproportionately affected men who have sex with men (MSM) since the beginning of the epidemic [1]. While declining trends in new infections and in AIDS morbidity and mortality have been observed globally [2], HIV epidemics among MSM in many low-, middle- and high-income countries continue to expand [1, 3].

In Latin America, MSM, represent between 6 and 20 % of all adult men across nations [4]. Around 50 % of all Latin America's HIV infections are assumed to result from unprotected sex between men [5], with the median national prevalence among MSM estimated at 12 % [2]. Male-to-female transgender individuals—transgender women (TW)—in particular face the highest levels of HIV prevalence in the region (15.5–31.9 %) [6]. Other key populations that have been identified globally, such as female sex workers and people who inject drugs, are also at higher risk of infection relative to the general population in Latin America, although HIV burden in these populations is generally far lower relative to MSM and TW and is lowest in the Andean area (0.0–2.0 %) [7–9].

In Ecuador, the provinces along the Pacific coast are viewed as the epicenter of the country's epidemic. In 2010, the Pacific provinces accounted for 74 % of all HIV and AIDS cases nationally [10]. A recent study found a prevalence of HIV infection of 1.1 % among pregnant women attending antenatal clinics in the Pacific provinces, relative to 0.6 % nationally [11]. Guayas province in particular, where the country's largest city of Guayaquil is located, accounted for 52 % of HIV cases and the nation's highest incidence rate (58.2 cases per 1,000 inhabitants) [12]. Largely due to upward trends in Guayas and other Pacific provinces, HIV case reports nationally increased from 1,070 in 2005 to 3,966 in 2010, with a similar increase in reported AIDS cases [12]. However, data on key populations in the Pacific provinces is limited to a 1991–2001 study that reported a HIV prevalence of 27.8 % among a convenience sample of MSM in Guayaquil [13].

The principle objective of this study was to determine the current HIV burden, risk behaviors and prevention needs among MSM in Guayaquil.

Methods

Recruitment

Methods used in the present study are as in a previous study conducted in Quito, Ecuador, which are described elsewhere [14]. In brief, participants were recruited from August 11th, 2011 to May 31st, 2012 using respondent-driven sampling (RDS). Study eligibility criteria included male sex at birth, ≥15 years of age, anal intercourse with a man in the past 12 months, residence or employment in Guayaquil and possession of a valid recruitment coupon (not applicable to the "seeds", or first participants, who initiated recruitment). Eligibility criteria did not limit participation based on gender and therefore TW were not excluded from study participation. The study protocol was approved by the research ethics committees of the Pan American Health Organization and *Universidad Central de Ecuador*. Parental permission for minors to participate was waived by the ethics committee.

Formative research was conducted prior to the study implementation, including 35 interviews with MSM which explored social networks and aimed to determine the most suitable operating hours, profile of study staff and incentive levels. Based on the formative interviews, eight seeds were selected based on leadership in the MSM community and to achieve diversity with respect to age, socioeconomic status, area of residence and occupation.

Data Collection

Data collection for the formative research and main study were carried out by *Fundación Ecuatoriana Equidad*, a community based GLBTI organization, whose head office served as the study site. Participants presenting to *Equidad* underwent eligibility screening, an informed consent process, a computer-assisted self-interview (CASI), pre-test counseling, blood specimen collection, medical consultation and delivery of the results with post-test counseling. The CASI explored socio-demographic characteristics, access to health services, sexual and drug risk behaviors, recent symptoms of STI, HIV and STI knowledge, HIV testing and experiences of MSM-related stigma and discrimination. Participants could consent to complete the survey without testing for HIV and STIs. Participants received a primary incentive of US $5; secondary incentives for each of up to three referrals recruited were a fanny pack, a hat and a thermos.

Laboratory Procedures

Diagnostic algorithms followed national regulations. Initial testing performed at *Equidad* consisted of a rapid test (Determine®) for HIV infection and RPR (Wama Diagnostica®) for syphilis infection. The national reference laboratory in Guayaquil, *Instituto Nacional de Higiene y Medicine Tropical* (*INHMT*), conducted confirmatory testing by Western Blot and fluorescent treponemal antibody absorption (FTA-ABS) for HIV and syphilis, respectively, as well as external quality control of the study site.

HIV rapid test and rapid plasma reagin (RPR) results were provided during the initial visit. Participants were asked to return after 2 weeks for confirmatory results.

Measures

Binge drinking was defined as having consumed >4 alcoholic beverages on the same occasion in the past 30 days [15]. Sex work was defined as the exchange of money for sexual services. Self-reported STI symptoms was defined as having experienced odorous or non-odorous genital discharge, pain or burning upon urinating, genital ulcers, warts or condylomata in the past 12 months. Participants who correctly identified all the previous symptoms and did not select other unrelated items (e.g., fatigue, dizziness) were considered as having knowledge of STI symptoms. HIV-related knowledge was assessed by the UNGASS composite indicator, defined as correct responses to five questions on HIV prevention, transmission and rejection of major misconceptions [16]. Sexual role was defined as their usual role during anal MSM. Consistent condom use with a partner was defined as reporting "always" (as opposed to "most of the time", "sometimes" or "never") using condoms during sexual intercourse. Sex work was defined as having received money in exchange for sex. Participants' personal network size, required for RDS analyses to adjust for differential probability of selection [17], was defined as the number of MSM aged 15 years and older living or working in Guayaquil with whom the participant had seen in the past week.

Statistical Analysis

We attempted to correct very low reported network sizes ("degree"), as in earlier analysis [14] as low degree values can lead to disproportionately large RDS sampling weights. Degree was set to the greater of (1) the reported degree and (2) the number of individuals the participant referred to the study plus one (for the participant's recruiter) [14]. This correction was applied for 24 participants. Unreported degree values for a further 44 participants were imputed at the mean, exclusive of seeds.

Univariate estimates were calculated using the RDS-1 estimator [18, 19] and 95 % bootstrap confidence intervals using Stata's *rds* package [20]. Logistic regression was used to analyze risk factors for HIV infection. The regression models were specified to account for the RDS study design, building upon methods in [21, 22]. Specifically, models were weighted by inverse degree, with weights scaled to sum to the sample size. Systematic bias in recruitment patterns was assessed by examining the bivariate relationship between participant's HIV status and recruiter-level variables, while controlling for the participant's value of the same variable. An inverse association between HIV and the recruiter's report of past-year STI symptoms was identified [odds ratio (OR) = 0.30, $P = 0.015$], but due to the large number of missing observations on this variable ($N = 64$, 16 %), it was not controlled in bivariate or multivariate analysis. To account for potential intra-class correlations, we tested whether adding random effects at the level of recruiter and recruitment chain improved the final multivariate model using likelihood-ratio tests [23]. The recruiter-level random effect improved goodness of fit ($\chi^2 = 9.6, P = 0.0025$). We therefore included a Huber-White adjustment for clustering by recruiter in the bivariate and multivariate models.

Multivariate models with inverse-degree weights were initially estimated by including all variables with a significant bivariate association ($P \leq 10$ %) with HIV infection. Quadratic and log transformations of continuous variables and interactions between significant main effects were then evaluated. The final models retained variables with associations significant at the 10 % level. We considered strong associations as those with $P \leq 5$ % and moderate associations as those with $P \leq 10$ %. Variance inflation factors from linear specifications of the models were below two, so that multicollinearity problems were not present. Equilibrium was attained on all variables reported [18].

Eleven participants who reported having previously received a positive HIV test result were excluded from the analysis of risk factors. All analyses were conducted in Stata 12.0 (College Station, TX).

Results

A total of 400 MSM were recruited between August, 2011 and May, 2012 from eight seeds (four initial seeds plus four seeds added during the course of the study to accelerate recruitment). One seed accounted for half of the sample, yielding a recruitment chain of 19 waves. Five seeds recruited smaller proportions of the sample, less than 5 % each (Table 1). Although all participants passed eligibility screening, six provided CASI survey responses indicating ineligibility on age or MSM criteria and were excluded from the analysis, resulting in a final sample of 394 non-seed participants.

Socio-Demographic Characteristics and Risk Behaviors

The majority of MSM were under 25 years old (71.5 %, 95 % CI 64.1–78.2) (Table 2). Most had completed post-secondary education (61.8 %, 95 % CI 54.5–69.1). More than a third (35.1 %, 95 % CI 28.1–42.7) were students while 43.2 % (95 % CI 36.2–50.2) were employed.

Table 1 RDS recruitment chains, Guayaquil, Ecuador, 2011–2012

Seed ID	No. referrals (%)	Cumulative (%)	No. waves
1	214 (53.5)	53.5	19
2	87 (21.8)	75.3	12
3	48 (12.0)	87.3	11
4	16 (4.0)	91.3	9
5	14 (3.5)	94.8	5
6	12 (3.0)	97.8	5
7	5 (1.3)	99.0	2
8	4 (1.0)	100.0	3

Approximately half of the participants identified themselves as either heterosexual or bisexual. However, far fewer reported present or past unions with women (7.2 %, 95 % CI 3.9–11.2) or a female sexual partner in the past 12 months (17.1 %, 95 % CI 11.1–24.1). When asked about their gender identity, an estimated 9.0 % (95 % CI 5.0–14.5) identified as female or transgender.

Most (82.5 %, 95 % CI 75.5–88.6) experienced sexual debut prior to 18 years of age. Recent casual male partners were very common (84.4 %, 95 % CI 79.3–88.9). 39.9 % (95 % CI 33.0–47.2) had ever engaged in commercial sex and 24.5 % (95 % CI 18.6–30.9) had in the past 12 months, while past-year purchasing of sex was less frequent (15.5 %, 95 % CI 10.3–21.6). Consistent condom use was higher with casual compared with stable male partners, and was particularly low (6.1 %, 95 % CI 4.2–31.0) with female partners. A diversity of anal sex roles was identified, with "versatile" (both insertive and receptive) being the most prevalent. MSM met casual male partners more frequently at bars or clubs (20.0 %, 95 % CI 15.5–24.7) followed by public venues (15.8 %, 95 % CI 11.4–21.1).

Alcohol was the most commonly used substance, with 77.4 % (95 % CI 70.5–83.7) reporting having consumed >4 alcoholic beverages on the same occasion in the past 30 days. Among other substances, crack or cocaine use was the most frequently reported (8.4 %, 95 % CI 4.8–12.7). Four participants reported injecting cocaine, crack or heroin in the past 12 months.

Low levels of comprehensive HIV knowledge (29.7 %, 95 % CI 23.1–36.5) and recent access to HIV information or prevention activities (24.2 %, 95 % CI 18.4–30.5) were found. Knowledge of STI symptoms was even lower than for HIV (15.7 %, 95 % CI 10.9–21.1), although almost a quarter of MSM had experienced an STI symptom in the past 12 months (24.1 %, 95 % CI 17.5–31.4). Levels of utilization of HIV testing were 53.6 %, 95 % CI 46.5–61.0 (lifetime) and 40.9 %, 95 % CI 33.9–48.0 (past 12 months).

Table 2 Characteristics of MSM, Guayaquil, Ecuador, 2011–2012

Variable	n/N	Percent	95 % CI
Demographics			
Age			
15–17	53/394	13.0	(8.2–19.0)
18–24	215/394	58.5	(50.7–65.5)
≥25	126/394	28.6	(21.9–35.9)
Education			
Secondary or lower	159/394	38.2	(30.9–45.5)
Vocational/university	235/394	61.8	(54.5–69.1)
Residence in Guayaquil			
Northern	138/394	39.4	(31.9–46.9)
Southern	52/394	13.0	(8.4–18.1)
Center	165/394	40.3	(32.9–47.9)
Other	39/394	7.3	(4.6–10.5)
Employed	178/394	43.2	(36.2–50.2)
Student	133/394	35.1	(28.1–42.7)
Marital status			
Single	293/394	76.1	(70.1–81.9)
Union with a man/trans	74/394	16.6	(11.7–22.2)
Married/union/separated/divorced with a woman	27/394	7.2	(3.9–11.2)
Sexual orientation			
Homosexual	177/374	48.0	(40.1–55.7)
Heterosexual	49/374	16.4	(10.6–23.2)
Bisexual	148/374	35.5	(28.7–42.7)
Gender identity			
Male	345/380	91.0	(85.4–94.9)
Female/transgender	35/380	9.0	(5.0–14.5)
Sexual relationships			
Age of sexual debut			
<18	272/330	82.5	(75.5–88.6)
≥18	58/330	17.5	(11.4–24.5)
No. male sex partners[a]			
1–2	79/308	25.1	(17.2–33.8)
3–5	139/308	46.7	(38.0–56.0)
>5	90/308	28.1	(20.5–36.1)
Any casual, male anal sex partners[a]	325/387	84.4	(79.3–88.9)
No. female sex partners[a]			
0	250/308	82.9	(75.9–88.9)
≥1	58/308	17.1	(11.1–24.1)
Paid for sex ever	59/393	15.5	(10.3–21.6)
Sex work ever	144/393	39.9	(33.0–47.2)
Sex work past 12 months	86/393	24.5	(18.6–30.9)

Table 2 continued

Variable	n/N	Percent	95 % CI
Consistent condom use[a]			
Stable male partners	64/215	22.8	(14.8–31.5)
Casual male partners	128/294	48.3	(39.5–57.4)
Female partners	6/73	6.1	(4.2–31.0)
Sexual role in anal intercourse			
Insertive	113/356	34.7	(27.0–42.6)
Receptive	87/356	24.4	(18.0–31.4)
Versatile	156/356	41.0	(33.4–48.8)
Met casual male partners via[a]			
Bars or dance clubs	105/394	20.0	(15.5–24.7)
Public transport/ parks/street	76/394	15.8	(11.4–21.1)
Internet web pages	50/394	14.7	(9.8–20.3)
Internet *cabinas*	61/394	12.9	(8.5–18.0)
Saunas	35/394	6.2	(3.4–10.0)
Alcohol and drug use			
Binge drinking[b]	239/304	77.4	(70.5–83.7)
Illicit drug use[a]			
Marijuana	27/351	7.2	(3.3–12.1)
Crack/cocaine	35/350	8.4	(4.8–12.7)
Other	5/349	2.6	(0.2–6.4)
HIV knowledge and testing			
Has heard of HIV/AIDS	369/393	91.2	(85.6–95.6)
UNGASS HIV knowledge indicator	122/393	29.7	(23.1–36.5)
Received HIV information/ education[a]	119/381	24.2	(18.4–30.5)
Tested for HIV ever	228/393	53.6	(46.5–61.0)
Tested for HIV past 12 months	165/372	40.9	(33.9–48.0)
STI knowledge			
Has heard of STI	319/393	80.2	(73.9–85.6)
Correctly identifies STI symptoms	68/377	15.7	(10.9–21.1)
Experienced STI symptoms[a]	75/329	24.1	(17.5–31.4)
Infection prevalence			
HIV	50/369	11.3	(7.3–16.1)
HSV-2 seropositivity	107/348	30.2	(23.3–37.3)
Active syphilis[c]	25/370	6.9	(3.3–11.3)
Hepatitis B	8/369	1.2	(0.4–2.3)

Percentages and 95 % confidence intervals (CI) are from the RDS I estimator

[a] Past 12 months

[b] Past 30 days

[c] RPR titer greater or equal than 1:8 dilutions

HIV and STI

Samples for HIV and other STI testing were provided by 93.7 and 94.0 %, respectively, of enrolled MSM. Overall HIV prevalence among MSM in Guayaquil was estimated at 11.3 % (95 % CI 7.3–16.1). Herpes simplex virus (HSV-2) infection was present in 30.2 % (95 % CI 23.3–37.3) of the population, while active syphilis (6.9 %, 95 % CI 3.3–11.3) and hepatitis B infection (1.2 %, 95 % CI 0.4–2.3) were less prevalent. Of the 50 eligible, non-seed participants with HIV infection, 20 (weighted estimate 45 %) were co-infected with HSV-2, 10 (23 %) with active syphilis infection, 2 (3 %) with hepatitis B and 32 (60 %) had any of these STIs.

Factors Associated with HIV

Bivariate analysis is shown in Table 3. Estimated HIV prevalence was highest among MSM with active syphilis (32.7 %) (OR 5.6, 95 % CI 1.6–19.4; $P = 0.006$) and in those self-identified as female or transgender (24.4 %) (OR 3.5, 95 % CI 1.0–11.4; $P = 0.042$). An increased risk of HIV infection was also associated with more than five male sex partners in the past 12 months (OR 6.0, 95 % CI 1.1–31.8; $P = 0.036$), age 25 or older (OR 2.7, 95 % CI 1.0–7.1; $P = 0.043$), self-identification as homosexual (OR 3.5, 95 % CI 1.4–8.3; $P = 0.006$), receptive (OR 5.0, 95 % CI 1.3–19.2; $P = 0.018$) or versatile (OR 4.1, 95 % CI 1.3–12.7; $P = 0.015$) anal sex roles and female sex partners in the past 12 months (OR 0.2, 95 % CI 0.0–0.8; $P = 0.027$). Unexpectedly, HIV infection was negatively associated with having consumed crack or cocaine (OR 0.2, 95 % CI 0.0–1.0; $P = 0.057$) or marijuana in the past 12 months (OR 0.1, 95 % CI 0.0–0.8; $P = 0.028$). However, this association did not persist after adjustment in multivariable analysis.

Multivariable analysis showed increased odds of HIV infection independently associated with active syphilis [adjusted odds ratio (AOR) 4.6, 95 % CI 1.2–17.9; $P = 0.029$] and moderate associations with age 25 or older (AOR 2.6, 95 % CI 0.9–7.2; $P = 0.066$) and homosexual self-identification (AOR 2.6, 95 % CI 1.0–7.0; $P = 0.053$) (Table 4).

Discussion

Results from this study confirm that MSM remain highly affected by HIV in Guayaquil, with a prevalence similar to the median estimated across Latin American countries [2], and nearly identical to the prevalence recently found among MSM in Ecuador's second largest city, Quito (11.0 %, 95 % CI 7.3–15.5) [14]. Although we estimate

HIV prevalence among MSM in Guayaquil at less than half the level reported a decade ago [13], differences in sampling methods compared to the earlier venue-based convenience sample hinder assessment of trends.

Risks for HIV acquisition that have been well-documented globally in MSM [1] were present in our study population, such as high frequency of male sex partners along with low condom use, especially with stable male partners (77.2 %). This is particularly relevant, as results from modeling studies suggest that up to 68 % of HIV transmissions among MSM come from main sex partners [24]. A versatile role during anal intercourse was found to be the most prevalent in our study; which has been previously cited as a rising practice among Latin American MSM [25] and may play a role in enhancing the efficiency of HIV spread [26, 27]. Sex work was highly prevalent and more frequently reported than among MSM in Quito [24.5 % in the past 12 months (95 % CI 18.6–30.9) versus 8.3 % (95 % CI 4.8–12.4)] [14]. Potentially related to unprotected sex [28, 29], binge drinking was highly prevalent and recent consumption of illicit drugs was above estimated national levels [30, 31]. Injection drug use is rare in Ecuador [9], yet was reported by 1.1 % of MSM.

Our findings highlight inadequate coverage of targeted prevention activities. Less than a third of MSM had correct knowledge of HIV, a percentage below the estimated median for MSM among Latin American countries (65 %) [32]. Although HIV testing is a central component of the Ecuadorian national multi-sectoral strategic plan [33], we find that at present, testing reaches only 53.6 % of MSM. Our findings also suggest unawareness of HIV infection status among most MSM who were HIV positive (only 11 of 50 MSM living with HIV reported having previously received a positive test result), which can increase the likelihood of onward transmission [34].

Among other STIs, HSV-2 was found to be particularly prevalent in our study (30.2 %), reaching similarly elevated levels as those recently reported in Peru [35] and El Salvador [36]. At approximately 8 %, the prevalence of active syphilis is currently below the median in Latin America countries [37], while still considerably higher relative to prevalence in the general population in Ecuador (0.25 %) [11]. A strong association was found between HIV infection and active syphilis, which may be due to the increased risk of HIV acquisition associated with primary syphilis [38], although more complex behavioral mechanisms of interaction among both infections have also been suggested [39].

We found that HIV was more prevalent among MSM who identified as gay or homosexual, similar to findings in Peru [35]. Previous research in other settings has suggested that MSM and women have lower rates of HIV infection than men who only report sex with men [40], as they might

Table 3 Bivariate associations with HIV infection in MSM in Guayaquil, Ecuador, 2011–2012

Variable	n/N	HIV prevalence	OR	95 % CI	*P*
Demographics					
Age					
15–24	19/248	6.8	1.0	–	–
≥25	20/110	16.6	2.7	(1.0–7.1)	0.043
Education					
Secondary or lower	15/143	7.3	1.0	–	–
Vocational/ university	24/215	11.2	1.6	(0.6-4.2)	0.333
Residence in Guayaquil					
Northern	12/124	7.9	1.0	–	–
Southern	5/45	11.3	1.5	(0.3-7.0)	0.614
Center	17/154	9.8	1.3	(0.4-4.0)	0.684
Other	5/35	15.7	2.2	(0.5-8.9)	0.285
Employed	19/161	10.1	1.1	(0.4-2.8)	0.896
Marital status					
Single	29/265	9.4	1.0	–	–
Union with a man/trans	8/69	13.2	1.5	(0.5–4.5)	0.509
Married/ union/ separated/ divorced with a woman	2/24	4.5	0.5	(0.1–2.4)	0.360
Sexual orientation					
Bisexual or heterosexual	13/182	5.0	1.0	–	–
Gay/ homosexual	26/158	15.5	3.5	(1.4–8.3)	**0.006**
Gender identity					
Male	31/312	8.5	1.0	–	–
Female/ transgender	7/33	24.4	3.5	(1.0–11.4)	**0.042**
Sexual relationships					
Age of sexual debut					
<18	28/250	10.3	1.0	–	–
≥18	6/50	7.9	0.7	(0.2–2.7)	0.654
No. male sex partners[a]					
1–2	3/74	3.3	1.0	–	–
3–5	15/121	10.0	3.2	(0.7–15.4)	0.138
>5	13/84	17.0	6.0	(1.1–31.8)	**0.036**

Table 3 continued

Variable	n/N	HIV prevalence	OR	95 % CI	*P*
Any casual, male anal sex partners[a]	32/296	9.2	0.9	(0.3–2.6)	0.818
No. female sex partners[a]					
0	28/225	11.6	1.0	–	–
≥1	3/54	2.5	0.2	(0.0–0.8)	**0.027**
Paid for sex ever	3/50	3.5	0.3	(0.1–1.2)	0.081
Sex work ever	15/125	10.3	1.1	(0.4–3.1)	0.830
Sex work past 12 months	11/78	13.3	1.6	(0.5–5.2)	0.401
Consistent condom use[a]					
Stable male partners	7/51	7.5	0.5	(0.2–1.7)	0.281
Casual male partners	9/110	6.9	0.6	(0.1–2.6)	0.480
Female partners	0/4	0.0	1.0	(1.0–1.0)	–
Sexual role in anal intercourse					
Insertive	6/98	3.6	1.0	–	–
Receptive	11/80	15.7	5.0	(1.3–19.2)	**0.018**
Versatile	21/144	13.2	4.1	(1.3–12.7)	**0.015**
Met casual male partners via[a]					
Bars or dance clubs	13/97	13.1	1.5	(0.6–4.3)	0.403
Public transport/ parks/ street	11/67	9.7	1.0	(0.4–2.6)	0.992
Internet web pages	3/47	13.8	1.6	(0.3–7.6)	0.547
Internet *cabinas*	7/59	5.0	0.4	(0.2–1.3)	0.139
Saunas	6/30	12.7	1.4	(0.4–4.9)	0.612
Alcohol and drug use					
Binge drinking[b]	25/219	8.8	0.7	(0.1–3.5)	0.665
Illicit drug use[a]					
Marijuana	1/24	1.1	0.1	(0.0–0.8)	**0.028**
Crack/ cocaine	3/32	2.5	0.2	(0.0–1.0)	**0.057**
Other	0/4	0.0	1.0	(1.0–1.0)	–
HIV knowledge and testing					
Has heard of HIV/AIDS	36/335	9.3	0.6	(0.1–2.9)	0.557
UNGASS HIV knowledge indicator	14/106	7.3	0.7	(0.2–1.7)	0.393
Received HIV information/ education[a]	12/106	8.0	0.9	(0.3–2.5)	0.777
Tested for HIV ever	20/204	7.1	0.5	(0.2–1.4)	0.181
Tested for HIV past 12 months	11/152	5.5	0.4	(0.1–1.3)	0.139
STI knowledge					
Has heard of STI	29/291	8.4	0.5	(0.2–1.4)	0.178
Correctly identifies STI symptoms	6/63	6.3	0.6	(0.2–2.1)	0.409
Experienced STI symptoms[a]	9/69	6.7	0.6	(0.2–1.7)	0.315
STI infections					
HSV-2 seropositive	20/100	14.0	1.7	(0.7–4.2)	0.252
Active syphilis[c]	8/23	32.7	5.6	(1.6–19.4)	**0.006**
Hepatitis B	2/8	23.0	2.8	(0.3–25.3)	0.354

Significant bivariate associations ($P \leq 10$ %) are given in bold

Odds ratios are from logistic models with inverse degree weighting

[a] Past 12 months

[b] Past 30 days

[c] RPR titer greater or equal than 1:8 dilutions

Table 4 Multivariate logistic model predicting HIV infection in MSM in Guayaquil, Ecuador, 2011–2012 (N = 319)

Variable	AOR	95 % CI	*P*
Age			
15–24	1.0	–	–
≥25	2.6	0.9–7.2	0.066
Sexual orientation			
Bisexual or heterosexual	1.0	–	–
Gay/homosexual	2.6	1.0–7.0	0.053
STI infections			
Active syphilis[a]	4.6	1.2–17.9	0.029

Table includes predictors significant at the 10 % level

[a] RPR titer greater or equal than 1:8 dilutions

be more likely to use condoms with male partners or less likely to engage in receptive anal intercourse [41]. HIV prevalence was higher among older MSM in this study and in the Quito sample, which, together with the high levels of HIV prevalence reported a decade ago, point to a mature epidemic in Ecuadorian MSM [13]. We also estimate HIV prevalence at 24.4 % among individuals who self-identified as female or transgender, which is more than double relative to other natal MSM. This finding is consistent with findings elsewhere in Latin America [6]. Targeted biological and behavioral studies of TW in Ecuador are needed to provide a more comprehensive understanding of the HIV epidemic and to address their specific prevention needs.

Our study is subject to a number of limitations. Our definition of sex work did not capture sex in exchange for non-monetary favors or gifts, although this practice has been evidenced in MSM in neighboring settings such as Peru [42]. The CASI survey administration method was intended to reduce under-reporting of socially undesirability risk behaviors and computer-assisted interview has been shown to do so in evaluations versus face-to-face interview in other settings [43, 44]. However, as behaviors were self-reported some degree of social undesirability bias may be present [45]. RDS is also subject to important limitations. A recent assessment of RDS suggests that standard errors—and consequently, confidence intervals—are currently under-estimated [46]. In some settings, estimates produced using RDS have been shown to differ from known underlying population values [47, 48]. In our study, most of recruited MSM (71.5 %) were younger than 25 years old and 61.8 % had completed at least secondary education, compared with 27.8 and 24.5 %, respectively, of the general population of men in Guayas within the age range of participants in our study (15–67 years old) [49]. It is unknown whether these characteristics are similarly distributed among MSM and overall men or not; however, if so, our study would be less representative of older and less educated MSM. Considering the association between age and HIV infection, this could have led to an underestimation of HIV prevalence. The structure of the recruitment chains may also reflect problems of limited connection or segmentation patterns [50]. In our study, five out of eight seeds produced relatively short recruitment chains. While longer recruitment chains generally favor equilibrium [18], equilibrium was attained for all variables presented here. Moreover, HIV prevalence did not differ between the five shortest recruitment chains (11.8 %) and the longest one (11.9 %). Although some authors have reported limited efficiency of RDS [50], we achieved a rate of 42 participants recruited per month, which is similar or even higher than the speed reported by prior studies using RDS in Latin America [51, 52].

This report contributes to the understanding of the role of MSM populations in a context of high HIV prevalence among the general population, a scenario seldom seen in the Latin American region. Targeting interventions to key populations at higher risk as well as geographic targeting to areas where more new infections are occurring can improve the impact and efficiency of prevention efforts [53]. In this sense, enhancing prevention among MSM in Guayaquil should be a priority within Ecuadorian's national HIV strategy. Scale-up of HIV and STI testing is urgently needed, as a means of MSM with undiagnosed infections to access to behavioral and biomedical interventions, as well as the gateway to timely treatment, which is now known to reduce the likelihood of HIV transmission [1].

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Conflicts of interest None

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