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A Continuing HIV Epidemic and Differential Patterns of HIV-STI Risk among MSM in Quito, Ecuador: An Urgent Need to Scale Up HIV Testing and Prevention

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Abstract This study characterized the HIV epidemic among men who have sex with men (MSM) in Quito, Ecuador and contrasted risk patterns with other STI's. 416 MSM ages 15 years and older were recruited using respondent-driven sampling in 2010–2011. Biological testing and a self-interview survey assessed HIV and STI infections and risk behaviors. Analysis incorporated recruiter-level variables and clustering adjustments to control for recruitment patterns. We identify high levels of HIV (11 %), HSV-2 (14 %) and active syphilis (5.5 %) infections, low levels of lifetime HIV testing (57 %), limited knowledge of HIV and STI's (<48 %) and limited consistent condom use independent of partner type (<40 %). Sex work was associated with all infections while associations with residential location, how casual partners are met and other variables, varied. Scale-up of behavioral prevention and HIV testing is urgently needed. Interventions should target male sex workers and exploit differential patterns of HIV-STI risk to stay ahead of the epidemic.

Resumen Este estudio caracteriza la epidemia de VIH en hombres que tienen sexo con hombres (HSH) en Quito, Ecuador y contrasta los patrones de riesgo con otras ITS. En 2010–2011, se reclutaron 416 HSH mayores de 14 años utilizando muestreo dirigido por participantes. Se evaluó la prevalencia de VIH e ITS y los comportamientos de riesgo a través de serología y entrevista auto-administrada. Para controlar los patrones de reclutamiento se incorporaron variables a nivel del reclutador y ajustes por conglomerados. Se identificaron niveles elevados de VIH (11 %), VHS-2 (14 %) y sífilis activa (5.5 %) y niveles bajos de uso de la prueba del VIH (57 %), conocimiento de VIH-ITS (<48 %) y uso consistente del condón independientemente del tipo de pareja (<40 %). El trabajo sexual se asoció con todas las infecciones, mientras que variaron las asociaciones con lugar de residencia, manera de conocer parejas ocasionales y otras variables. Ampliar las estrategias de prevención y testeo son medidas urgentemente necesarias. Las intervenciones deben dirigirse a los trabajadores sexuales masculinos y aprovechar los patrones diferenciales de riego de VIH-ITS para mantenerse al frente de la epidemia.

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

Palabras clave Hombres que tienen sexo con hombres · Infecciones de transmisión sexual · VIH · Ecuador

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Introduction

Men who have sex with men (MSM) are at elevated risk for HIV infection globally [1, 2] and in Latin America are increasingly recognized as the predominant core group with respect to HIV burden and transmission [3–5].

In Ecuador, studies conducted a decade ago in 1999–2001 identified high levels of HIV prevalence among MSM: 27.8 % in Guayaquil, the country's largest city, and 14.5 % in Quito, the second largest city and political capital [6, 7]. Since then, high male–female ratios with respect to registered AIDS deaths and reported HIV/AIDS cases have persisted (6.7 and 2.6, respectively, in 2010) [8–10], suggesting a continuing elevated disease burden among men. Recent years have also seen a marked rise in HIV case reports nationally from 1070 in 2005 to 4041 in 2010 and a similar increase in reported AIDS cases. AIDS-related mortality in Ecuador has also continued to increase steadily since the mid-1990s, despite commencement of state-provided treatment in 2003 and in contrast to dramatic declines observed in most other Latin American nations [8]. The current state of the HIV epidemic among MSM in Ecuador, however, is unknown.

We present prevalence estimates for HIV, herpes simplex virus type 2 (HSV-2), syphilis and hepatitis B infections from a recent bio-behavioral surveillance study among MSM in Quito. We also provide the first descriptive analysis of demographics, risk behaviors and HIV knowledge and testing utilization in this population. Finally, we present evidence of differential patterns of HIV and STI risk among MSM subgroups to inform prevention and control efforts.

Methods

Sampling and Recruitment

Participants were recruited from November, 2010 to April, 2011 using respondent-driven sampling (RDS), a chain referral method designed for stigmatized populations [11] that has been widely applied for HIV surveillance in international settings [12]. While similar to snowball sampling in that it uses chain referral, RDS limits the number of recruits from any one study participant and includes statistical adjustments to correct for differences in selection probability due to differences in personal network size (degree) and biases in recruitment patterns (homophily) [11].

The study was preceded by a formative stage comprising 52 interviews with MSM heterogeneous with respect to age, socioeconomic status, area of residence and diagnosed HIV infection. Information was gathered about social networks and connectivity among MSM, feasibility of chain-referral and operational aspects of the study, including study location and hours, profile of study personnel, incentives and questionnaire wording. Six initial participants ("seeds") were also identified, based on leadership in the community and diversification along the same characteristics used to select participants for the formative interviews.

Study participants received 3 recruitment coupons to be offered to peers whom they believed likely to meet eligibility criteria. Coupons listed a coupon code to track recruitment and the address and operating hours of the study site, located at EQUIDAD (a community-based GLBTI organization) in Quito's central *mariscal* neighborhood, which is located at the intersection of the larger and socioeconomically distinct northern and southern areas. Participants received a primary incentive of US $5, sexual health promotion information and condoms, and could also receive a telephone calling card, hat or backpack valued at US $5 for each of up to 3 referrals who completed study procedures.

Study eligibility criteria included male sex at birth, $\geq$15 years of age, anal intercourse with a man in the past 12 months, residence or employment in Quito and possession of a valid recruitment coupon (not applicable to seeds). We planned for a sample size of 400 MSM. The study protocol was approved by the research ethics committees of the Pan American Health Organization and *Universidad Central de Ecuador*.

Data Collection

Following eligibility screening and a written informed consent process, MSM presenting at EQUIDAD with a valid coupon completed a face-to-face interview to ascertain personal network size. Participants then completed a computer-assisted self-interview (CASI) adapted from standard HIV behavioral surveillance instruments [13], which explored socio-demographic characteristics, access to health services, sexual and drug risk behaviors, recent symptoms of sexually transmitted infection (STI), HIV and STI knowledge and HIV testing and experiences of MSM-related stigma and discrimination. Following pre-test counseling, participants then provided blood specimens, urine and pharyngeal and rectal swab samples.

Laboratory Procedures

HIV rapid tests (Determine®) and rapid plasma reagin (RPR) tests for syphilis infection were conducted at EQUIDAD. Reactive samples were sent to the *Instituto Nacional de Higiene y Medicine Tropical* (INHMT) in Quito for confirmatory testing with Western Blot and

fluorescent treponemal antibody absorption (FTA-ABS) for HIV and syphilis, respectively, following national diagnostic algorithms. Active syphilis was defined as a RPR titer $\geq$1:8 dilutions and a reactive FTA-ABS result. 10 % of samples non-reactive for HIV and syphilis were re-tested at INHMT for external quality control. Genital herpes (HSV-2) antibody status was determined by type-specific enzyme immunoassay (ELISA) IgG. Hepatitis B infection was screened using ELISA for hepatitis B surface antigen (HBsAg). Post-test counseling and HIV rapid test and RPR results were provided during the initial visit. Participants were asked to return after 2 weeks for remaining results and additional post-test counseling. A medical consultation, including STI syndromic management and treatment, was offered at the study site. Participants with confirmed infection were referred to Ecuador's free HIV care and treatment program and/or to specialized STI treatment facilities.

Measures

A measure of the size of the participant's personal network—the number of other MSM who, had they received a study coupon, could conceivably have recruited the participant—is required for analyses of RDS data to adjust for differential probability of selection [14]. We defined personal network size as the number of MSM ages 15 years and older living or working in Quito with whom the participant had been in contact (either sexual or social) in the past 6 months, who the participant believed would have been likely to recruit him if provided with a coupon. The term "MSM" was defined to participants using local terminology as including gay, homosexual and bisexual men, as well as male-to-female transgender persons.

Sexual and illicit drug use risk variables referred to the past 12 months while binge drinking was defined as having consumed >4 alcoholic beverages on the same occasion in the past 30 days [15]. 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. STI knowledge was defined as correctly identifying all of these symptoms as potential indicators of an STI, from a multiple choice list that also included unrelated items (e.g., fatigue, dizziness). For HIV knowledge, we used the UNAIDS definition of correct responses to all in a series of 5 questions on HIV transmission and AIDS disease [16]. Consistent condom use was defined as reporting "always" (as opposed to "most of the time", "sometimes" or "never") using condoms during intercourse with male and female stable and casual partners, respectively. Exposure to HIV prevention was defined as having participated in informational or educational HIV/AIDS activities in the past 12 months.

Statistical Analysis

Because sampling weights used in RDS analysis are proportional to the inverse of personal network size ("degree") [11], very low reported degree values can lead to disproportionately large weights. We therefore attempted to correct very low degree values that appeared inconsistent with the number of individuals the participant referred to the study. Specifically, degree was set to the greater of (1) the reported degree and (2) the number of individuals the participant referred to the study plus 1 (for the participant's recruiter). Network sizes reported as 0 were imputed at the mean, calculated exclusive of seeds. All analyses were conducted in Stata 12.0 (College Station, TX).

Characteristics of the sample were described by univariate proportions using the RDS-1 estimator [11, 17] and 95 % bootstrap confidence intervals estimated by Stata's *rds* package [18].

Odds ratios from logistic regression models identified risk factors for HIV, HSV-2 and active syphilis infections. Models were specified to account for the RDS study design, building upon methods in [19, 20]. Specifically, bivariate models were weighted by inverse degree to account for differences in probability of selection, with weights scaled to sum to the sample size. To account for dependencies due to homophily, we identified recruiter-level variables significantly associated with each outcome at the 5 % level while controlling for the participant's value of the same variable. Recruiter-level variables identified included syphilis and HSV-2 for the syphilis outcome and HIV and past 12-month sex work for the HSV-2 outcome. Of these, only the HIV recruiter control persisted in the final HSV-2 multivariate model, and thus was retained in both bivariate and multivariate analyses. No recruiter-level variables were identified for the HIV outcome. Finally, Huber-White clustering adjustments [21, 22] were included if likelihood-ratio tests indicated an improved model fit [23] to account for intraclass correlations within recruitment trees (i.e., participants in the same recruitment chain) and among participants recruited by the same individual (i.e., shared recruiter group). The clustering adjustment for shared recruiter group improved the fit of the final HSV-2 model and was therefore retained in bivariate and multivariate analyses.

Multivariate models were initially estimated with inverse degree weighting on all variables with a significant bivariate association ($P \leq 10$ %) with the respective outcome. Quadratic and log transformations of continuous variables and interactions between significant main effects were evaluated. Final models retained covariates with $P \leq 10$ %. We considered strong associations as those with $P \leq 5$ % and marginal associations as those with $P \leq 10$ %. Variance inflation factors from linear

specifications of the models were all under 4, indicating the absence of multicolinearity problems. Equilibrium [11] was attained on all variables reported.

Eight participants who reported having previously received a positive HIV test result were excluded from the analysis of risk factors.

Results

Sample and Demographic Characteristics

Six initial seeds attained recruitment trees ranging from 1 to 14 waves comprising a total of 420 participants, with 3 seeds accounting for nearly all of the sample (97.9 %) and 3 others largely unproductive (Table 1). Although all participants passed eligibility screening, 4 provided CASI survey responses indicating ineligibility on age or MSM criteria and were excluded from the analysis, resulting in a final sample of 416 non-seed participants. The estimated proportion of MSM aged 25 years or older was 50.7 and 4.5 % aged 15–17 (Table 2). Most had completed post-secondary education (69.4 %) and were employed (63.5 %).

Sexual Identity and Risk Behaviors

An estimated 70.1 % self-identified as gay or homosexual and 27.4 % as bisexual. In terms of gender, 6.7 % identified as female or transgender/transsexual/transvestite (henceforth, "trans"), including all 5 of the heterosexual-identified participants. Most (63.0 %) experienced sexual debut prior to 18 years of age and 12.9 % prior to age 12. 31.8 % were circumcised. Most (84.4 %) were single. Recent sexual relationships (9.6 %) or unions (6.2 %) with women were uncommon despite a higher percentage identifying as bisexual. Having a recent casual male anal sex partner (88.4 %) or multiple male partners (79.0 %) was very common and 39.9 % had had $\geq$5 recent male anal sex partners in the past 12 months. Consistent condom use was low (<40 %), independent of partner type. Fewer than 1 in 10 had sold (8.3 %) or purchased (1.9 %) sex recently, while more than twice as many had done so during their lifetimes (18.9 and 13.7 %, respectively). Exclusively insertive (24.5 %) or receptive (13.9 %) anal sex roles were less common than a versatile role (i.e., both) (61.6 %). The most common form of meeting casual male partners was the Internet (44.3 %) followed by nocturnal venues (30.6 %). Recent binge drinking was very common (75.6 %). Past-year illicit drug use was largely limited to marijuana (19.6 %) and crack or cocaine (13.8 %).

Table 1 RDS recruitment chains for MSM in Quito, Ecuador, 2010–2011

Recruitment chain (seed ID)	No. referrals (%)	Cumulative %	No. waves
1	254 (60.5)	60.5	14
2	113 (26.9)	87.4	13
3	44 (10.5)	97.9	8
4	8 (1.9)	99.8	4
5	1 (0.2)	100.0	1
6	0	–	–

HIV and STI's

Comprehensive knowledge of HIV (47.8 %) and correct identification of STI symptoms (31.8 %) were low. Just over half of MSM had ever been tested for HIV and 38.9 % within the past year. A similar percentage (29.4 %) had recently been reached by HIV/AIDS prevention. Nearly all participants (99.5 %) provided biological samples. Estimated population prevalence of HSV-2 and HIV were 14.0 and 11.0 %, respectively, while active syphilis (5.5 %) and hepatitis B (1.9 %) were lower. Of 53 participants who tested positive for HIV, 3 were co-infected with hepatitis B (weighted estimate 3.4 %), 7 (12.3 %) with active syphilis, 17 (27.3 %) with HSV-2 and 22 (35.9 %) with any of these STI's.

Factors Associated with HIV and Other STI's

Bivariate analyses identified risk factors associated with HIV and STI infections, and excluded 8 participants previously diagnosed with HIV (Table 3). In this subgroup, estimated HIV prevalence was 9.5 % overall, but reached $\geq$20 % among MSM who met casual partners in public places [odds ratio (OR) 3.5, 95 % confidence interval (CI) 1.2–9.8] or adult theatres (2.7, 1.0–7.2), had a history of sex work (3.1, 1.3–7.6) or HSV-2 infection (3.2, 1.2–8.2). HIV was marginally higher among older MSM (10.9 %; OR 7.0, 95 % CI 0.8–57.8) and those reporting a versatile sex role (12.4 %; 4.0, 1.3–12.2).

Some of these factors were also associated with elevated levels of active syphilis infection (OR's from 3.9 to 8.0): older age, being versatile and, in particular, sex work; syphilis was also higher among MSM who had purchased sex (OR 4.6, 95 % CI 1.2–17.9), had a recent casual male partner (6.5, 1.3–32.9), residing in Northern or Central Quito (8.9 %; OR 4.1, 95 % CI 1.3–13.2) compared to all other areas (2.3 %, $P < 5$ %, not shown in table), and those identifying as heterosexual, although the latter estimate was unstable.

HSV-2 infection was strongly related to sex work (OR 2.8, 95 % CI 1.0–7.3) (similar to both other infections),

Table 2 Characteristics of MSM in Quito, Ecuador, 2010–2011

Variable	*n*/*N*	Percent[a]	95 % CI
Demographics			
Age			
15–17	23/416	4.5	(2.1–7.5)
18–24	223/416	44.9	(37.3–52.7)
≥25	170/416	50.7	(42.5–58.5)
Education			
Secondary or lower	127/416	30.6	(23.9–38.0)
Vocational/university	289/416	69.4	(62.0–76.1)
Residence in Quito			
Northern	196/416	46.1	(38.7–53.5)
Central	64/416	15.3	(10.7–20.4)
Southern	112/416	27.7	(20.6–35.5)
Valleys/*Mitad del Mundo*	44/416	10.9	(7.2–15.2)
Employed	247/415	63.5	(56.1–70.6)
Marital status			
Single	345/416	84.4	(79.7–88.8)
Cohabitating with a man	50/416	9.4	(6.3–12.8)
Married or cohabitating with a woman, separated or divorced[b]	21/416	6.2	(3.2–9.8)
Circumcised	122/397	31.8	(25.1–38.7)
Sexual orientation			
Gay/homosexual	269/396	70.1	(62.6–76.7)
Heterosexual	5/396	2.5	(0.3–5.9)
Bisexual	122/396	27.4	(21.1–34.3)
Gender identity			
Male	382/403	93.3	(88.5–97.2)
Female/transgender	21/403	6.7	(2.8–11.5)
Sexual relationships			
Age of sexual debut			
<12	49/405	12.9	(8.8–17.8)
12–17	223/405	50.1	(43.0–57.3)
≥18	133/405	36.9	(29.6–44.6)
Any casual, male anal sex partners[d]	359/412	88.4	(84.0–92.8)
No. male anal sex partners[d]			
1	61/375	21.0	(13.8–28.1)
2–4	153/375	39.1	(31.5–46.7)
≥5	161/375	39.9	(32.4–47.4)
No. female sex partners[d]			
0	336/384	90.4	(86.2–94.1)
≥1	48/384	9.6	(5.9–13.8)
Solicited sex ever	50/414	13.7	(8.8–19.5)
Solicited sex past 12 months	6/372	1.9	(0.1–5.1)
Sex work ever	76/414	18.9	(13.3–25.2)
Sex work past 12 months	34/414	8.3	(4.8–12.4)
Consistent condom use[d]			
Stable male partners	74/263	33.9	(24.2–44.5)
Casual male partners	146/351	41.1	(33.3–49.3)
Female partners	21/57	36.8[c]	–
Sexual role in anal intercourse			
Insertive	87/409	24.5	(18.1–31.0)
Receptive	68/409	13.9	(9.5–19.0)
Both ("versatile")	254/409	61.6	(54.6–68.6)
Met casual male partners via[d]			
Internet	182/414	44.3	(37.5–51.3)
Bars or dance clubs	148/414	30.6	(24.4–36.9)
Saunas	55/414	14.3	(9.3–20.1)
Public transport/parks/street	41/414	10.7	(6.8–15.0)
Adult theatres	39/414	10.2	(6.2–14.7)
Alcohol and drug use			
Binge drinking[e]	302/388	75.7	(69.0–82.0)
Illicit drug use[d]			
Marijuana	89/400	19.6	(14.4–25.4)
Crack/cocaine	61/403	13.8	(9.3–19.0)
Other	29/402	4.4	(2.3–6.9)
HIV knowledge and testing			
Has heard of HIV/AIDS	401/413	98.3	(96.9–99.4)
UNGASS HIV knowledge index	206/413	47.8	(40.8–54.9)
Received HIV information/ education[d]	131/400	29.4	(23.1–36.2)
Tested for HIV ever	240/413	56.6	(49.0–63.7)
Tested for HIV past 12 months	161/413	38.9	(32.1–45.9)
STI knowledge			
Has heard of STI's	371/414	90.5	(85.8–94.5)
Correctly identifies STI symptoms	126/387	31.8	(25.0–39.1)
Experienced STI symptoms[d]	126/370	34.5	(27.4–41.9)
Infection prevalence			
HIV	53/414	11.0	(7.3–15.5)
HSV-2	52/414	14.0	(9.2–19.2)
Active syphilis[f]	24/414	5.5	(2.6–9.4)
Hepatitis B	12/414	1.9	(0.7–3.7)

N number of participants responding, *n* number of participants with characteristic

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

[b] No participant indicated cohabitating with a man and previously being married to or cohabitating with a woman, thus the categories listed are mutually exclusive

[c] Unadjusted, could not be estimated with RDS estimator

[d] Past 12 months

[e] Past 30 days

[f] RPR titer >= 1:8 dilutions

meeting casual partners at adult theatres (2.6, 1.0–6.6) (similar to HIV), and residence in Central Quito (4.3, 1.6–11.4) (similar to syphilis) and was uniquely linked to unions with women (7.4, 2.2–25.0).

Table 3 Bivariate associations with HIV, HSV-2 and active syphilis infections among MSM in Quito, Ecuador, 2010–2011 ($N = 406$)

Variable	HIV			HSV-2			Active syphilis		
	Percent	OR	95 % CI	Percent	OR	95 % CI	Percent	OR	95 % CI
Demographics									
Age									
15–17	1.7	1.0	–	20.7	1.0	–	0.0	ne	–
18–24	8.9	5.6	(0.7–46.4)	9.1	0.4	(0.1–2.0)	2.1	1.0	–
≥25	10.9	7.0	(0.8–57.8)	14.5	0.7	(0.1–3.3)	11.8	7.0	(2.0–24.2)
Education									
Secondary or lower	12.6	1.0	–	14.2	1.0	–	6.2	1.0	–
Vocational/university	8.1	0.6	(0.3–1.4)	11.3	0.8	(0.3–1.8)	6.7	1.1	(0.3–3.6)
Residence in Quito									
Northern	7.8	1.0	–	7.8	1.0	–	7.8	1.0	–
Central	9.3	1.2	(0.3–4.4)	26.5	4.3	(1.6–11.4)	12.2	1.7	(0.4–6.4)
Southern	12.0	1.6	(0.6–4.2)	10.8	1.4	(0.5–3.9)	2.8	0.3	(0.1–1.4)
Valleys/*Mitad del Mundo*	11.3	1.5	(0.5–4.5)	13.6	1.9	(0.5–7.1)	1.2	0.2	(0.0–1.3)
Employed	10.3	1.3	(0.6–2.8)	14.3	1.7	(0.7–4.2)	5.0	0.5	(0.2–1.7)
Marital status									
Single	8.9	1.0	–	9.1	1.0	–	6.1	1.0	–
Cohabitating with a man	13.9	1.6	(0.4–6.1)	22.5	2.9	(0.9–9.8)	7.7	1.3	(0.2–8.8)
Married or cohabitating with a women, separated or divorced	10.6	1.2	(0.2–6.3)	42.5	7.4	(2.2–25.0)	11.6	2.0	(0.2–17.3)
Circumcised	12.3	1.5	(0.6–3.4)	10.0	0.8	(0.3–1.9)	2.9	0.4	(0.1 – 2.0)
Sexual orientation									
Gay/homosexual	8.0	1.0	–	11.3	1.0	–	5.6	1.0	–
Heterosexual	0.0	ne	–	13.5	1.2	(0.1–12.0)	57.7	23.0	(2.3–226.5)
Bisexual	14.4	1.9	(0.9–4.4)	15.5	1.4	(0.6–3.5)	5.2	0.9	(0.3–2.8)
Gender identity									
Male	10.0	1.0	–	11.6	1.0	–	5.8	1.0	–
Female/transgender	1.5	0.1	(0.0–1.1)	16.1	1.5	(0.4–5.6)	23.6	5.1	(0.7–37.5)
Sexual relationships									
Age of sexual debut									
<12	15.0	1.0	–	15.2	1.0	–	5.8	1.0	–
12–17	10.9	0.7	(0.2–2.2)	12.7	0.8	(0.2–2.7)	5.8	1.0	(0.2–5.1)
≥18	6.3	0.4	(0.1–1.4)	7.8	0.5	(0.1–2.0)	8.3	1.5	(0.2–8.9)
Any casual, male anal sex partners	9.9	1.5	(0.5–4.8)	11.9	0.7	(0.2–2.1)	7.3	6.5	(1.3–32.9)
No. male anal sex partners									
1	4.7	1.0	–	8.1	1.0	–	10.0	1.0	–
2–4	6.0	1.3	(0.2–7.4)	16.7	2.3	(0.7–7.8)	6.5	0.6	(0.1–3.4)
≥5	14.2	3.4	(0.6–18.2)	11.1	1.4	(0.4–5.3)	4.5	0.4	(0.1–2.6)
No. female sex partners									
0	9.3	1.0	–	11.3	1.0	–	6.6	1.0	–
≥1	10.6	1.2	(0.4–3.9)	22.1	2.2	(0.8–6.6)	3.2	0.5	(0.1–1.9)
Solicited sex ever	7.8	0.8	(0.3–2.2)	15.6	1.4	(0.5–3.9)	18.0	4.6	(1.2–17.9)
Solicited sex past 12 months	15.7	1.7	(0.2–17.7)	2.6	0.2	(0.0–2.1)	0.0	1.0	(1.0–1.0)
Sex work ever	19.7	3.1	(1.3–7.6)	23.2	2.8	(1.0–7.3)	13.6	3.0	(0.8–11.9)
Sex work past 12 months	12.6	1.4	(0.4–5.7)	9.0	0.7	(0.2–2.9)	28.0	8.0	(1.8–34.7)
Consistent condom use									
Stable male partners	12.1	1.4	(0.5–4.1)	7.2	0.5	(0.1–1.6)	10.9	1.7	(0.4–8.3)
Casual male partners	12.9	1.9	(0.8–4.4)	13.7	1.3	(0.5–3.2)	8.8	1.4	(0.4–4.7)

Table 3 continued

Variable	HIV			HSV-2			Active syphilis		
	Percent	OR	95 % CI	Percent	OR	95 % CI	Percent	OR	95 % CI
Female partners	3.4	0.5	(0.1–4.7)	11.2	0.5	(0.1–3.6)	0.8	0.4	(0.0–4.1)
Sexual role in anal intercourse									
Insertive	3.4	1.0	–	13.1	1.0	–	1.8	1.0	–
Receptive	8.8	2.7	(0.6–13.2)	12.9	1.0	(0.3–3.4)	4.6	2.6	(0.4–18.5)
Both ("versatile")	12.4	4.0	(1.3–12.2)	12.1	0.9	(0.4–2.3)	6.7	3.9	(1.0–16.1)
Met casual male partners via:									
Internet	8.6	0.8	(0.4–1.9)	9.7	0.7	(0.3–1.4)	4.3	0.5	(0.2–1.7)
Bars or dance clubs	13.7	1.9	(0.9–4.4)	9.9	0.7	(0.3–1.8)	6.7	1.0	(0.2–4.6)
Saunas	11.2	1.3	(0.4–3.7)	7.0	0.5	(0.1–1.8)	3.1	0.4	(0.1–3.5)
Public transport/parks/street	23.5	3.5	(1.2–9.8)	13.4	1.1	(0.3–4.1)	10.9	1.9	(0.4–8.3)
Adult theatres	19.6	2.7	(1.0–7.2)	24.1	2.6	(1.0–6.6)	10.4	1.8	(0.5–6.8)
Alcohol and drug use									
Binge drinking	9.2		(0.4–2.3)	12.5	1.4	(0.5–3.9)	7.1	1.7	(0.4–7.9)
Illicit drug use									
Marijuana	9.3	0.9	(0.4–2.5)	12.7	1.1	(0.4–3.0)	3.3	0.4	(0.1–2.2)
Crack/cocaine	11.2	1.0	(0.5–3.6)	9.6	0.7	(0.2–2.5)	14.9	3.1	(0.7–14.8)
Other	3.8	1.3	(0.1–2.0)	16.2	1.4	(0.3–6.3)	10.5	1.7	(0.2–12.1)
HIV knowledge		0.4							
UNGASS HIV knowledge index	5.2		(0.2–0.8)	8.3	0.5	(0.2–1.1)	6.6	1.0	(0.3–3.3)
Received HIV information/education	10.2	0.4	(0.5–2.9)	21.7	2.8	(1.4–5.9)	3.7	0.5	(0.1–1.6)
STI knowledge		1.2							
Correctly identifies STI symptoms	8.3		(0.4–2.2)	12.3	0.9	(0.3–2.1)	2.4	0.4	(0.1–1.6)
Experienced STI symptoms	10.8	0.9	(0.6–3.3)	16.1	1.6	(0.7–3.7)	5.0	1.2	(0.3–3.9)
Infection status									
HIV	–	–	–	27.3	3.2	(1.2–8.6)	12.3	2.2	(0.7–7.6)
HSV-2	21.2	3.2	(1.2–8.2)	–	–	–	12.2	2.3	(0.6–8.8)
Active syphilis	17.8	2.2	(0.7–7.6)	22.8	2.3	(0.6–8.5)	–	–	–
Hepatitis B	17.0	2.0	(0.3–13.0)	10.3	0.8	(0.2–4.6)	0.0	ne	–

Table excludes participants diagnosed with HIV prior to the study. Percent of population infected and odds ratios (ORs) are weighted estimates. ORs and confidence intervals (CIs) are estimated from bivariate logistic regression models. HSV-2 models control for recruiter's HIV infection and adjust additionally for clustering by shared recruiter group

ne not estimable

In multivariate analysis a distinct set of predictors emerged (Table 4). HIV was independently associated with history of sex work, a versatile sex role, meeting male sex partners at bars or dance clubs and HSV-2 infection; in addition, meeting partners at adult theatres, lower levels of HIV knowledge and reporting ≥5 recent male sex partners were marginally associated with HIV. In contrast, HSV-2 was independently associated with residence in Central Quito, cohabitating with a male partner, a current or past union with a female partner, history of sex work, lower levels of HIV knowledge, recent exposure to HIV prevention and HIV infection. Active syphilis was independently associated with a versatile sex role; marginal associations included past-year sex work and reporting a recent casual male partner.

In addition, a second-order quadratic specification for centered age (i.e., age minus the sample mean, 24.8 years) provided the best fit for HIV and syphilis models. With other variables at their reference values, this suggests probability of infection increasing with age, reaching a peak at 31 and 34 years, respectively, and then declining at older ages.

Discussion

This study is the first in a decade to report on the HIV epidemic among MSM in Ecuador and provides the first characterization of transmission risk behaviors, prevention coverage and risk factors associated with HIV and other

Table 4 Multivariate models predicting HIV, HSV-2 and active syphilis infections in MSM in Quito, Ecuador, 2010–2011

Variable	HIV ($N = 360$)		HSV-2 ($N = 384$)		Active syphilis ($N = 379$)	
	AOR	95 % CI	AOR	95 % CI	AOR	95 % CI
Demographics						
Age (continuous)	1.1	(1.0–1.2)			1.2	(1.1–1.3)
Age^2	1.0	(1.0–1.0)			1.0	(1.0–1.0)
Residence in Quito						
Central			2.6	(1.1–6.3)		
Other areas			1.0	–		
Marital status						
Single			1.0	–		
Cohabiting with a man			3.2	(1.1–9.8)		
Married or cohabitating with a women, separated or divorced			6.2	(1.8–21.5)		
Sexual relationships						
Any casual, male anal sex partners					5.53	(0.9–35.3)
No. male partners						
1	1.0	–				
2–4	1.4	(0.4–5.0)				
≥5	3.0	(0.9–9.9)				
Sex work ever	3.3	(1.2–8.6)	2.4	(1.0–6.0)		
Sex work past 12 months					4.2	(0.9–20.3)
Sexual role in anal intercourse						
Insertive	1.0	–			1.0	–
Receptive	2.8	(0.4–19.7)			4.9	(0.6–42.9)
Both (“versatile”)	7.2	(1.6–32.1)			4.9	(1.0–23.3)
Met casual male partners via						
Bars or dance clubs	3.6	(1.4–9.1)				
Adult theatres	2.7	(0.9–7.8)				
HIV knowledge						
UNGASS HIV knowledge index	0.4	(0.2–1.1)	0.4	(0.2–0.9)		
Received HIV information/education			2.9	(1.4–6.1)		
Infection status						
HIV			2.8	(1.0–7.4)		
HSV-2	3.0	(1.1–7.6)				
Recruiter controls						
HIV			0.3	(0.1–1.0)		

Table includes predictors significant at the 10 % level. Models include inverse degree weighting. The HSV-2 model adjusts additionally for clustering by shared recruiter group

STI’s among MSM in Quito. Our results suggest continuing high levels of HIV and HSV-2 infections comparable to those reported by a previous, 1999–2001 study [6] as well as to recent studies using similar RDS methodology elsewhere in Latin America [24–27]. Among those with HIV, we found considerable levels of co-infection with other STI’s, which is linked with greater infectivity [28]. Together with these prevalence findings, the study suggests significant behavioral risk: the vast majority of MSM in Quito are not in stable relationships, have had multiple recent anal sex partners (more than a third had ≥5), and most do not use condoms consistently during anal intercourse with either casual or stable partners. Most also engage in receptive anal sex, which may accelerate HIV transmission through MSM populations [29]. Potentially related to unsafe sexual practices is the highly prevalent practice among MSM in Quito of frequent heavy drinking, as drinking has been causally linked with intentions to engage in unsafe sex [30]. This study also estimated a relatively young age of sexual debut (<12 years for more

than 1 in 10 MSM), which may increase the time period of exposure to HIV and STI infections. Our findings that more than 4 in 10 MSM have never been tested for HIV and that a majority have a limited understanding of HIV transmission and STI symptoms, suggest further that most MSM in Quito do not have the tools needed to identify high-risk situations in order to take action to minimize their personal risk of STI acquisition or transmission.

At the same time, this study finds a relatively low prevalence of syphilis infection (5.5 %) similar to recent community samples of MSM in Peru, where syphilis prevalence has declined in recent years [31], and El Salvador [26]. While not uncommon, levels of co-infection with syphilis among MSM with HIV (12.3 %) were comparatively lower than estimates from Peru [32] and several Western European cities [33].

Identifying patterns of elevated risk among MSM subgroups can help improve prevention targeting. We found that HIV was more prevalent among MSM who seek sex at bars and dance clubs or adult theatres. Such venues are natural targets for prevention. A history of sex work was associated with all STI's examined. Sex workers often play an important role in HIV transmission, particularly given high levels of STI, as in Quito [34]. At the same time, MSM in stable sexual relationships or residing in Central Quito were at elevated risk for HSV-2 but not HIV infection; in these subgroups early preventive action may be warranted to stay ahead of the HIV epidemic. Anecdotally, Central Quito is viewed as the center of social and sexual interaction for gay-identified men and contains a greater concentration of gay-identified venues and male sex work locations. This could provide one explanation for this area's elevated STI prevalence; however, additional research is needed to understand local patterns of infection.

This study also introduced advances in bi- and multivariate analysis of RDS data to account for recruitment patterns. Whereas recent work recommends controlling for the recruiter's value of the outcome variable [19], we demonstrated that a broader search for other potential recruiter controls can prove worthwhile (i.e., recruiter's HIV in the HSV-2 model). Taking into account clustering by shared recruiter group [19, 20] proved necessary in one model, but not in others, illustrating the importance of careful model specification.

Several limitations should be noted. Inference regarding prevalence trends is problematic as the 1999–2001 study used venue-based sampling. However, because HIV prevalence was significantly higher among venue-going MSM in our sample, had we replicated the earlier study's recruitment strategy, our estimated prevalence may have been even higher. Second, unlike other studies in Latin America, [6, 35] our sample included no heterosexual-identified MSM who did not also identify as trans; this study is therefore not representative of heterosexual-identified MSM if present in Quito. The definition of sex work did not capture sex in exchange for non-monetary favors or gifts. The broad measure of recent participation in "informational or educational HIV/AIDS activities" may have been interpreted differently by different participants and should be viewed as an upper bound on coverage of HIV prevention interventions. The sampling method, RDS, also has shortcomings: peer-driven recruitment may be biased toward individuals closer to the study location [36, 37]. Standard errors produced by the RDS-1 estimator, and consequently, confidence intervals and test *P* values, are currently thought to be under-estimated;[38] and one recent evaluation suggests RDS statistical adjustments may not always improve over crude estimates [39]. Yet, RDS may perform better at reaching segments of the population not in contact with services, community organizations [37] or MSM-identified venues, compared to other methods [40]. In this study, the degree of error in each of these areas cannot be assessed as the true population distributions are unknown.

To conclude, our findings of considerable HIV and STI prevalence and ongoing risk behaviors suggest an urgent need to rapidly identify and scale up effective educational and behavior-change interventions among MSM in Quito. Several prevention interventions with demonstrated effectiveness for reducing sexual risk behaviors among MSM are available [41]. Interventions must provide MSM with context-specific strategies for safe sex practices as well as targeting the groups identified with elevated HIV and STI infection risk. Finally, expanding access to and demand for HIV testing is imperative both as a prevention strategy and an entry point into treatment [42].

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