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HIV testing among men who have sex with men in Tijuana, Mexico: a cross-sectional study

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ABSTRACT

Objectives: HIV testing is critical to the delivery of comprehensive HIV prevention and care services, yet coverage of sexual minorities by HIV testing programmes remains insufficient in many low- and middle-income countries, including Mexico. The objective of this study was to identify the prevalence and correlates of HIV testing among men who have sex with men (MSM) in Tijuana, Mexico.

Methods: We conducted a cross-sectional study (2012–2013) among 189 MSM recruited via respondent-driven sampling (RDS). RDS-weighted logistic regression was used to identify correlates of prior HIV testing.

Results: RDS-adjusted prevalence of prior and recent (≤12 months) HIV testing was 63.5% (95% CI 51.9% to 73.5%) and 36.8% (95% CI 25.4% to 46.4%), respectively. Prior HIV testing was positively associated with older age (adjusted OR (AOR)=1.09, 95% CI 1.04 to 1.15), being born in Tijuana (AOR=2.68, 95% CI 1.05 to 6.86), higher levels of education (AOR=2.65, 95% CI 1.08 to 6.53), identifying as homosexual or gay (AOR=3.73, 95% CI 1.48 to 9.42), being more 'out' about having sex with men (AOR=1.28, 95% CI:1.02 to 1.62), and a history of sexual abuse (AOR=3.24, 95% CI 1.06 to 9.86). Prior HIV testing was negatively associated with reporting more condomless anal intercourse acts (past 2 months) (AOR=0.95, 95% CI 0.92 to 0.98) and greater internalised homophobia (AOR=0.92, 95% CI 0.86 to 0.99).

Conclusions: Our findings indicate an urgent need for expanded HIV testing services for MSM in Tijuana. Innovative, non-stigmatising, confidential HIV testing interventions targeted at young, less educated, migrant and non-gay identifying MSM may facilitate HIV testing and timely linkage to HIV care and treatment within this population.

Strengths and limitations of this study

- We examined HIV testing behaviours among men who have sex with men in Tijuana, Mexico, a population disproportionately affected by HIV with a high prevalence of undiagnosed HIV infection.
- Respondent-driven sampling was employed to overcome barriers to accessing this marginalised population, but may have limited the generalisability of our findings.
- Participants may have under-reported sensitive information on sexual and substance use behaviours due to social desirability bias.

regular HIV testing is critical to the delivery of comprehensive HIV prevention, treatment and care services.[3] Given that men who have sex with men (MSM) are disproportionately affected by HIV/AIDS worldwide, including those in low- and middle-income countries (LMIC),[4] the WHO recommends that MSM undergo HIV testing annually.[3] Yet coverage of sexual minorities by HIV testing programmes remains insufficient in many LMIC.[5]

Research with MSM in LMIC has documented a relationship between HIV testing and several sociodemographic, behavioural, psychosocial and structural factors.[6–15] HIV testing has been associated with older age,[6–10][13] higher levels of education[6][9–12] and self-identifying as homosexual or gay.[7][13] Individuals who have never tested for HIV tend to perceive themselves to be at low risk of infection,[9] while testing is more common among those with greater HIV-related knowledge,[6] a history of sexually transmitted infection (STI),[7–9] a history of sexual violence[6] and those reporting sexual risk behaviours (ie, more sexual partners[12] and transactional sex[8]). However, an inverse association between condomless anal intercourse and HIV testing has been reported.[7][10][11]

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INTRODUCTION

Early HIV diagnosis, linkage to care, initiation of antiretroviral therapy (ART) and viral suppression improve the health of HIV-infected individuals[1] and reduce the risk of onward sexual transmission.[2] As such,

Individuals with stigmatised attitudes towards people living with HIV,[11] as well as those who fear a positive test result and the negative social consequences associated with testing positive, are also less likely to seek HIV testing.[9 14] Structural factors, including homophobia and HIV-related stigma, have also been inversely associated with HIV testing.[9 14 15] Moreover, research has shown that HIV testing is dependent on access to HIV education or service programmes,[12] which are often less prevalent in LMIC due to limited resource allocation to HIV prevention services for sexual minorities as well as the criminalisation and stigmatisation of same-sex sexual behaviours.[5]

In Mexico, HIV prevalence among MSM (16.9%, 95% CI 15.6% to 18.3%)[16] is 73 times that among reproductive-aged adults (0.23%, 95% CI 0.18% to 0.32%).[17] Although Mexico implemented universal access to ART for HIV-infected individuals in 2003, national HIV prevention strategies have not emphasised targeted HIV testing for key populations, including MSM.[16] Tijuana borders San Diego, California and is located in Mexico's northern state of Baja California, which has the third highest cumulative HIV incidence in the country.[18] Although HIV-related research with MSM in the Mexico-USA border region has been limited, a recent Tijuana-based study estimated an HIV prevalence of 20.2% (95% CI 12.5% to 29.1%) among MSM, and 89% of those infected are unaware of their HIV-positive status.[19] Despite the availability of free HIV testing at government-funded clinics and community-based organisations in Tijuana, only 63.7% (95% CI 53.2% to 74.5%) of MSM have ever been tested.[19] Taken together, these findings underscore the need for targeted HIV testing services to curb the HIV epidemic within this population.

To contribute to the limited HIV-related literature on MSM in the Mexico-US border region and inform the development of HIV testing programmes that facilitate adherence to the WHO testing guidelines within this population, we aimed to (1) describe HIV testing behaviours, (2) characterise motivations and barriers to HIV testing, and (3) identify correlates of prior HIV testing among MSM in Tijuana.

METHODS
Study population and sampling methods
Between August 2012 and May 2013, a Tijuana-based HIV prevalence study[19] recruited 216 MSM via respondent-driven sampling (RDS), a chain-referral sampling technique often employed to reach hidden and marginalised populations.[20 21] The study was conducted in collaboration with *Agencia Familiar Binacional* (AFABI), a community-based organisation in Tijuana that addresses the HIV prevention and treatment needs of key populations. As previously described,[19] AFABI outreach workers recruited potential seeds at venues frequented by MSM (eg, discos, bars, bathhouses). Initially,

six individuals with large social networks (>15 individuals) and heterogeneous with respect to age, ethnicity, socioeconomic status, location of residence in Tijuana and sexual orientation were selected to serve as seeds. Halfway through the study, four additional seeds were selected to boost recruitment. Seeds were given three coupons to invite male peers who have sex with men from their social networks to participate in the study. Eligible recruits were then given three coupons to invite their male peers who have sex with men in subsequent recruitment waves. Each coupon was coded with a unique number and had a 3-week expiration date. Given that the study's primary purpose was to determine the prevalence of HIV among MSM in Tijuana, recruitment continued until a sample size of approximately 200 was achieved to detect an HIV prevalence of 20% with at least 80% power, assuming a design effect of 2 and an α-level of 0.05. Nine seeds recruited 191 eligible peer recruits. Eligible seeds and peer recruits were at least 18 years old, biologically male, Tijuana residents, reported oral or anal intercourse with a male in the past year, not under the influence of alcohol or drugs at enrolment and willing to provide informed consent. Fifteen peer recruits did not meet eligibility criteria and were excluded for the following reasons: no oral or anal intercourse with male in the past year (n=8); under the influence of alcohol or drugs at enrolment (n=4); and not a Tijuana resident (n=3).

Study procedures
RDS Coupon Manager (Cornell University, Ithaca, New York, USA) software was used to track peer recruitment and collect biometric data to prevent repeat enrolment. Trained AFABI staff trusted by the community screened individuals for eligibility, obtained informed consent and administered surveys via computer-assisted personal interviewing. All participants also underwent rapid HIV testing (Advanced Quality HIV Test Kits; Intec Products, Inc, Xiamen, China), as well as pretest and post-test counselling according to Mexican national guidelines. If positive, a second rapid test was performed. Positive results on both rapid tests were confirmed via immunofluorescence assay at the San Diego County Public Health Laboratory. Confirmed HIV-positive participants were referred to psychosocial support services at AFABI and medical care at CAPASITS, the main HIV care and treatment clinic in Tijuana. Participants were compensated up to US$35: US$20 for completing study procedures and US$5 for each recruited peer. Study procedures were approved by Human Subjects Protection Committees at the Universidad Autónoma de Baja California and the University of California, San Diego (#120517).

Measures
Sociodemographics included age, gender identity (male or transgender female), birthplace (Tijuana, outside Tijuana in Mexico, USA, or other), sexual orientation

(homosexual/gay, bisexual, or heterosexual/straight), highest level of education (cannot read or write, some grade school, completed grade school, some secondary school, completed secondary school, some high school, completed high school, some university, completed university or advanced degree), employment status (unemployed, part-time or full-time), monthly income (no income,<$1000, $1000–$1499, $1500–$1999, $2000–$2499, $2500–$2999, $3000–$3500, >$3500), travel to the USA, deportation from the USA and incarceration history.

Sexual behaviours were measured in the past 2 months and included the number of sexual partners, relationship types (spouse, steady, casual or anonymous), frequency of and condom use during anal and/or vaginal intercourse, and venues visited to meet male sexual partners (bar, nightclub, disco, bathhouse or sauna, dark room (unlit rooms attached to bars where men have sex),[22] adult movie theatre, internet café and public places (eg, park, restroom, bus)). Participants were also asked whether they had exchanged money for sex in the past 6 months.

Substance use measures elicited information on lifetime and past month use of illicit drugs (marijuana, heroin, inhalants, methamphetamine, ecstasy, cocaine, tranquillisers, barbiturates, amyl nitrites (poppers), γ-hydroxybutyric acid, ketamine and other), as well as the frequency of alcohol and drug use before or during sex in the past 2 months. Hazardous alcohol consumption was measured using the Alcohol Use Disorder Identification Test (AUDIT) and defined as an AUDIT score ≥8.[23]

Personal social network size was measured by asking the following questions: "How many MSM at least 18 years of age do you know in Tijuana, Mexico?"; "How many of these men have seen you in the past month?"; "How many of these men know you back?" Participants' personal social network size was determined on the basis of their response to the third question, which provides an estimate of the number of MSM ≥18 years of age living in Tijuana with whom participants had been in contact in the past month and believed would have recruited them if provided with a coupon.

History of sexual, physical and emotional abuse was assessed via three separate questions about whether participants had ever been forced or coerced to have sex against their will, physically abused (ie, hit or assaulted) or emotionally abused.

Social support was measured via Likert scale responses (1=strongly disagree, 2=disagree, 3=agree, 4=strongly agree) to 7 items on help and support received from friends and family (eg, "The people close to you let you know they care about you").[24] Item scores were summed such that higher total scores indicate greater social support (α=0.91).

Perceived HIV-related stigma was measured via Likert scale responses (1=strongly disagree, 2=somewhat disagree, 3=somewhat agree, 4=strongly agree) to 7 items

assessing participants' perception of others' reactions to people living with HIV/AIDS (eg, "People treat others differently when they find out that they are HIV-positive").[25] Item scores were summed such that higher total scores indicate greater perceived HIV-related stigma (α=0.87).

Outness about having sex with men was assessed among participants identifying as gay or bisexual by asking them to describe how 'out' they are about having sex with men on a scale of 1–7 (1=not out to anyone; 4=out to about half the people I know; 7=out to everyone).[26]

Internalised homophobia refers to the internalisation of societal stigma towards MSM and was measured among participants identifying as gay or bisexual using a 9-item scale.[27] Participants indicated their level of agreement with scale items (eg, "I feel that being gay/bisexual is a personal shortcoming for me") via Likert scale responses (1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, 5=strongly agree). Item scores were summed such that higher total scores indicate greater internalised homophobia (α=0.90).

HIV-related knowledge was measured via 18 true/false questions on HIV transmission behaviours (eg, "A person will not get HIV if she/he is taking antibiotics").[28] Knowledge scores were calculated by summing the number of correct responses. Participants were also asked if they had accessed an HIV/STI counselling or education programme in the past 2 months.

HIV testing history was assessed via the following: "Have you ever tested for HIV?" and "When was your last HIV test?" Those reporting any prior HIV testing were asked what motivated them to seek or agree to their last test, while those reporting no prior testing were asked about barriers to testing.

HIV/STI diagnosis history was assessed via self-report. If participants reported prior HIV testing, they were asked the result of their last test. Participants were also asked if they had been diagnosed with gonorrhoea, chlamydia or syphilis in the past 2 months.

Statistical analysis
Seeds (n=10) and peer recruits with previous HIV diagnoses (n=2) were excluded from the present analysis. All other peer recruits who provided information on their HIV testing history contributed to the analysis (n=189). RDS-unadjusted and RDS-adjusted descriptive statistics were calculated to characterise the sample and the MSM population in Tijuana, respectively. RDS-adjusted population estimates were obtained using the RDS Analysis Tool (RDSAT V.7.1; Cornell University, Ithaca, New York, USA), with parameters set to dual component for average network estimation, 25 000 resamples for bootstrapping, 0.025 for the α level and enhanced data smoothing for the estimation algorithm. Individual RDS weights were generated following an RDSAT partition analysis of prior HIV testing (outcome of interest) and were applied to the analysis sample for use in RDS-weighted logistic regression analyses.[21] RDS-weighted logistic regression

Table 1 Characteristics of men who have sex with men in Tijuana, Mexico (N=189)

	RDS-unadjusted*		RDS-adjusted†	
	n	(%)	%	95% CI
Sociodemographics				
Age (in years)				
18–24	65	(34.4)	38.2	27.9 to 48.6
25–29	46	(24.3)	22.3	14.2 to 30.0
30–34	32	(16.9)	14.4	8.1 to 22.0
≥35	46	(24.3)	25.1	17.1 to 35.0
Gender identity				
Male	174	(92.6)	94.3	89.4 to 99.0
Transgender female (male-to-female)	14	(7.5)	5.7	1.0 to 10.6
Sexual orientation				
Homosexual or gay	118	(62.8)	61.1	49.6 to 71.5
Bisexual	64	(34.0)	35.7	25.9 to 46.8
Heterosexual or straight	6	(3.2)	3.2	0.2 to 7.2
Birthplace				
Tijuana, Mexico	60	(31.8)	31.1	21.2 to 41.9
Outside Tijuana in Mexico	126	(66.7)	67.8	57.2 to 77.9
USA	3	(1.5)	1.1	0.0 to 2.3
At least a high school education	92	(48.7)	48.0	37.5 to 60.6
Employed	115	(61.2)	58.2	47.6 to 69.2
Monthly income ≥3500 pesos (US$~280)	102	(56.4)	52.6	41.8 to 64.5
Ever incarcerated (jail or prison)	53	(29.1)	32.2	20.6 to 42.6
Ever travelled to the USA	54	(34.4)	33.5	21.5 to 45.6
Ever deported from the USA	13	(8.6)	3.5	0.6 to 8.5
Sexual behaviours				
Traded sex for money (≤6 months)	47	(25.1)	23.2	13.3 to 34.2
Any female sexual partners (≤2 months)	45	(30.0)	32.4	23.4 to 52.4
Number of male sexual partners (≤2 months), mean (SD)	6.5	(11.3)	–	–
Number of CAI acts with male sexual partners (≤2 months), mean (SD)	7.7	(21.9)	–	–
Relationship to male sexual partners (≤2 months)				
Spouse or live-in partner	46	(25.8)	30.7	19.9 to 43.5
Steady non-live-in partner	118	(65.9)	65.6	56.1 to 76.8
Casual partner	98	(54.4)	47.0	37.1 to 58.5
Anonymous partner	62	(37.6)	32.5	20.1 to 42.1
Venues visited to meet male sexual partners (≤2 months)				
Bar, nightclub or disco	51	(28.2)	22.3	13.6 to 31.5
Bathhouse or sauna	20	(10.7)	8.5	3.8 to 14.4
Adult movie theatre	16	(8.6)	4.0	1.8 to 6.8
Dark room	18	(9.7)	6.8	2.9 to 11.6
Internet café	16	(8.6)	11.3	3.9 to 23.7
Public place (eg, park, restroom, bus)	36	(19.5)	11.5	5.8 to 18.5
Substance use				
Illicit drug use (lifetime)				
Marijuana	95	(50.5)	53.6	42.4 to 63.8
Methamphetamine	53	(28.2)	29.5	18.9 to 39.7
Cocaine	52	(27.8)	32.2	20.9 to 42.8
Amyl nitrite (poppers)	32	(17.0)	15.6	8.7 to 26.7
Heroin	15	(8.0)	8.9	3.2 to 16.5
Illicit drug use (≤1 month)				
Marijuana	57	(30.5)	32.4	21.6 to 43.4
Methamphetamine	41	(21.8)	22.1	12.9 to 31.7
Cocaine	16	(8.6)	9.1	3.2 to 17.1
Amyl nitrite (poppers)	11	(5.9)	6.6	1.7 to 10.2
Heroin	10	(5.3)	4.8	0.7 to 10.5
Any injection drug use (≤1 month)	9	(5.0)	5.0	0.7 to 10.8
Hazardous alcohol consumption (≤12 months)	76	(40.6)	33.7	24.2 to 44.3
Any drug use before/during sex (≤2 months)	23	(12.8)	10.7	5.6 to 18.8
Any alcohol use before/during sex (≤2 months)	75	(40.3)	34.8	25.2 to 44.7

Continued

Table 1 Continued

	RDS-unadjusted*		RDS-adjusted†	
	n	(%)	%	95% CI
History of abuse				
Ever experienced sexual abuse	52	(27.7)	24.4	15.2 to 34.9
Ever experienced physical abuse	35	(18.8)	16.3	9.9 to 23.6
Ever experienced emotional abuse	62	(33.7)	30.4	21.5 to 41.6
Psychosocial factors				
Social support, mean (SD)	22.2	(3.5)	–	–
Perceived HIV-related stigma, mean (SD)	22.7	(3.9)	–	–
Outness about having sex with men, mean (SD)‡	5.2	(1.9)	–	–
Internalised homophobia, mean (SD)‡	19.0	(6.3)	–	–
HIV/STI knowledge				
HIV/STI counselling or education programme (≤2 months)	28	(15.9)	12.3	6.3 to 19.9
HIV knowledge, mean (SD)	13.5	(2.6)	–	–
HIV/STI prevalence				
Tested HIV-positive	31	(16.4)	20.2	12.2 to 28.8
Self-reported STI diagnosis (≤2 months)	29	(15.4)	17.0	9.7 to 25.5
HIV testing history				
Any prior HIV testing (lifetime)	133	(70.4)	63.5	51.9 to 73.5
Recent HIV testing (≤12 months)	79	(42.7)	36.8	25.4 to 46.4

Numbers may not sum to total due to missing data; percentages may not sum to 100 due to rounding or omission of one category for binary variables.
*RDS-unadjusted sample estimates.
†RDS-adjusted population estimates obtained using RDS Analysis Tool v7.1 (Cornell University, Ithaca, New York, USA).
‡Only asked of participants who identify as gay or bisexual.
CAI, condomless anal intercourse; RDS, respondent-driven sampling; STI, sexually transmitted infection.

was used to examine prior HIV testing in univariate and multivariate analyses as a function of sociodemographics, sexual behaviours, substance use, abuse history, psychosocial factors, HIV knowledge and STI history. Covariates were selected for inclusion in multivariate models on the basis of previous research indicating their association with HIV testing among MSM (ie, age, sexual orientation, education, exchange of money for sex (past 6 months), number of condomless anal intercourse acts (past 2 months), history of sexual abuse, outness about having sex with men, internalised homophobia, HIV knowledge, self-reported STI diagnosis (past 2 months))[6–15] and univariate results (ie, p value ≤0.05; birthplace, venues visited to meet male sexual partners, substance use). Missing data on travel to the USA (n=34), deportation from the USA (n=39) and the number of female sexual partners (past 2 months) (n=45) precluded their inclusion in regression analyses. All regression analyses were conducted using SAS V.9.3 (SAS Institute, Inc, Cary, North Carolina, USA).

RESULTS

Of the 603 coupons distributed to seeds and peer recruits, 206 (34.2%) were returned and led to the enrolment of 191 peer recruits (see online supplementary figure S1). The median number of waves was five, with 55% of participants recruited at wave five or higher. The largest recruitment chain had 11 waves and recruited 59% of participants (see online supplementary table S1).

Participants were recruited by friends (78%), sex partners (15%), acquaintances (5%) and relatives (2%).

Table 1 presents RDS-unadjusted and RDS-adjusted descriptive statistics. Participants mostly identified as male (93%), 59% were aged under 30 years, 32% were born in Tijuana and 49% had at least a high school education. Most participants identified as homosexual or gay (63%), while 34% identified as bisexual and 3% identified as heterosexual or straight.

Overall, 70% (n=133) of participants reported any prior HIV testing and 43% (n=79) of participants reported recent (≤12 months) HIV testing. Among those reporting any prior HIV testing, 61% reported testing in the past 12 months (median time since last test=8.9 months; IQR=4.1–24.9). The RDS-adjusted population estimates of any prior HIV testing and recent HIV testing were 63.5% (95% CI 51.9% to 73.5%) and 36.8% (95% CI 25.4% to 46.4%), respectively. Differences in RDS-unadjusted and RDS-adjusted estimates may be explained by preferential recruitment of peers with similar characteristics and differential recruitment by personal social network size (see online supplementary table S2).

Motivations for and barriers to HIV testing are reported in table 2. Among those reporting any prior HIV testing, 78% sought their last test because they wanted to know their HIV status, while only 20% sought their last test based on a doctor or other healthcare provider's recommendation. Among those reporting no prior HIV testing, "I worry that testing HIV-positive will change my life" was

Table 2 Motivations for and barriers to HIV testing among men who have sex with men in Tijuana, Mexico (N=189)

	n	(%)*
Motivation for seeking or agreeing to last HIV test†		
Wanted to know my HIV status	97	(78.2)
Regular testing	53	(46.9)
Risky behaviour	44	(37.9)
Someone I know tested HIV+	32	(29.4)
Doctor/healthcare professional's suggestion	22	(20.2)
Someone I know died of AIDS	21	(19.3)
Partner or family member's suggestion	18	(16.2)
Health concerns	15	(13.5)
Risky behaviour with HIV+ person	14	(12.8)
Barriers to HIV testing‡		
I worry that testing HIV+ will change my life	29	(53.7)
I am at low risk for HIV/AIDS	25	(47.2)
HIV test results are not confidential	24	(44.4)
I am too healthy to be HIV+	23	(43.4)
There is no testing on weekends or after hours	16	(32.7)
Getting tested for HIV costs too much	17	(32.1)
I do not trust the clinics that do HIV testing	17	(32.1)
I will be discriminated against by medical professionals if I test HIV+	16	(29.6)
I will think too much about dying if I test HIV+	14	(27.5)
It is difficult for me to get transportation to a testing clinic	12	(23.1)
It takes a long time to get your test results	9	(18.4)

*Respondent-driven sampling (RDS) unadjusted sample estimates.
†Among those who had ever tested for HIV (n=133).
‡Among those who had never tested for HIV (n=56).

most frequently reported as a barrier to testing (54%) followed by "I am at low risk for HIV/AIDS" (47%) and "HIV test results are not confidential" (44%).

In an RDS-weighted multivariate logistic regression analysis (table 3), any prior HIV testing was positively associated with older age (adjusted OR (AOR)=1.09, 95% CI 1.04 to 1.15), having been born in Tijuana (AOR=2.68, 95% CI 1.05 to 6.86), having at least a high school education (AOR=2.65, 95% CI 1.08 to 6.53), identifying as homosexual or gay (AOR=3.73, 95% CI 1.48 to 9.42), being more 'out' about having sex with men (AOR=1.28, 95% CI 1.02 to 1.62) and a history of sexual abuse (AOR=3.24, 95% CI 1.06 to 9.86). Prior HIV testing was negatively associated with reporting more condomless anal intercourse acts in the past 2 months (AOR=0.95, 95% CI 0.92 to 0.98) and greater internalised homophobia (AOR=0.92, 95% CI 0.86 to 0.99). A sensitivity analysis excluding participants identifying as transgender female yielded qualitatively similar results.

DISCUSSION

We determined the prevalence and identified correlates of prior HIV testing among MSM in Tijuana, Mexico. We estimated that 63.5% of this population has ever tested for HIV, which is lower than that reported for MSM in Peru (74.3%),[8] but higher than that reported for MSM in Brazil (51.6%).[6] However, our findings corroborate earlier evidence that many MSM in Tijuana do not undergo annual HIV testing[22] as recommended by the WHO.[3] Given that regular HIV testing is integral to the implementation of comprehensive HIV prevention, treatment and care services,[3] efforts to scale up testing among sexual minorities in Tijuana are urgently needed.

Our findings suggest that several sociodemographic, behavioural and psychosocial factors are associated with HIV testing and shed light on potential strategies to promote testing within this population. Consistent with previous research, we found that younger age[6–10 13] and lower levels of education[6 9–12] were associated with never having tested for HIV. These findings emphasise the need for age-specific HIV education and testing campaigns to support regular testing and adherence to the WHO guidelines.

The odds of prior HIV testing were also lower for participants born outside Tijuana. The Mexico-USA border region is characterised by migration from Central America and within Mexico in search of economic opportunities in the region, as well as cross-border mobility with the Tijuana-San Diego border recognised as the busiest international border crossing in the world.[29] Migrants in the region are particularly vulnerable to HIV/STIs, which have been linked to their experiences of social isolation, economic insecurity and discrimination.[30] Research with people who inject drugs in Tijuana suggests that these social and structural factors may limit access to HIV testing and other healthcare services among migrants deported from the USA.[31] Given that 68% of our sample was born outside Tijuana, research examining HIV/STI vulnerability and access to healthcare among migrant MSM in Tijuana is needed to design HIV testing and prevention services for this population.

Encouragingly, participants with a history of sexual abuse were more likely to have ever tested for HIV. However, participants reporting other risk factors for HIV were less likely to report prior HIV testing. For example, reporting more condomless anal intercourse acts in the past 2 months was inversely associated with prior HIV testing. This finding is consistent with previous research conducted with sexual minorities in other LMIC,[7 10 11] as well as earlier research with MSM in Tijuana documenting a relationship between condomless anal intercourse in the past year and not having had a recent HIV test.[22] MSM in Tijuana who engage in HIV risk behaviours may incorrectly perceive themselves to be at low risk and/or have limited access to HIV testing and prevention services.[22] Tailored HIV education interventions that include risk reduction messages and encourage regular HIV testing may improve testing rates among MSM at greatest risk of HIV infection in Tijuana.

Internalised homophobia was associated with never having tested for HIV, while prior HIV testing was

Table 3 Factors associated with prior HIV testing among men who have sex with men in Tijuana, Mexico

	No prior HIV testing (N=56)		Prior HIV testing (N=133)		Univariate RDS-weighted*		Multivariate RDS-weighted† (N=176)	
	n	(%)‡	n	(%)‡	OR	95% CI	OR	95% CI
Sociodemographics								
Age in years, mean (SD)	27.7	(9.2)	30.2	(8.3)	1.04	1.01 to 1.08	1.09	1.04 to 1.15
Male-identifying	53	(94.6)	121	(91.7)	0.28	0.06 to 1.32		
Gay-identifying	26	(46.4)	92	(69.7)	3.11	1.68 to 5.73	3.73	1.48 to 9.42
Born in Tijuana	14	(25.0)	46	(34.6)	2.26	1.10 to 4.62	2.68	1.05 to 6.86
At least a high school education	19	(33.9)	73	(54.9)	2.40	1.29 to 4.45	2.65	1.08 to 6.53
Employed	27	(48.2)	88	(66.7)	1.57	0.87 to 2.84		
Monthly income ≥3500 pesos (US$~280)	28	(51.9)	74	(58.3)	1.05	0.57 to 1.93		
Ever incarcerated (jail or prison)	16	(29.6)	37	(28.9)	1.15	0.60 to 2.19		
Sexual behaviours								
Exchanged money for sex (≤6 months)	19	(33.9)	28	(21.4)	0.42	0.21 to 0.82	1.28	0.49 to 3.37
Number of male sexual partners (≤2 months), mean (SD)	7.0	(14.5)	6.3	(9.8)	1.00	0.97 to 1.04		
Number of CAI acts (≤2 months), mean (SD)	6.6	(18.8)	8.2	(23.2)	0.98	0.97 to 1.00	0.95	0.92 to 0.98
Relationship to male sexual partners (≤2 months)								
Spouse or live-in partner	12	(24.0)	34	(26.6)	1.02	0.51 to 2.02		
Steady non-live-in partner	37	(69.8)	81	(64.3)	0.88	0.47 to 1.66		
Casual partner	29	(53.7)	69	(54.8)	0.95	0.52 to 1.72		
Anonymous partner	18	(37.5)	44	(37.6)	0.69	0.36 to 1.34		
Venues visited to meet male sexual partners (≤2 months)								
Bar, nightclub or disco	15	(28.9)	36	(27.9)	0.59	0.29 to 1.20		
Bathhouse or sauna	7	(12.5)	13	(9.9)	0.33	0.12 to 0.94	0.33	0.08 to 1.43
Adult movie theatre	5	(9.1)	11	(8.4)	0.62	0.14 to 2.71		
Dark room	7	(12.7)	11	(8.4)	0.19	0.05 to 0.71	0.31	0.06 to 1.74
Internet café	7	(12.7)	9	(6.8)	0.88	0.34 to 2.31		
Public place (eg, park, restroom, bus)	13	(24.1)	23	(17.6)	0.56	0.23 to 1.35		
Substance use								
Illicit drug use (lifetime)								
Marijuana	29	(52.7)	66	(49.6)	0.56	0.31 to 1.03		
Methamphetamine	21	(38.2)	32	(24.1)	1.18	0.61 to 2.27		
Cocaine	14	(25.5)	38	(28.8)	1.30	0.69 to 2.48		
Amyl nitrite (poppers)	5	(9.1)	27	(20.3)	2.76	1.01 to 7.53	2.32	0.49 to 10.96
Heroin	5	(9.1)	10	(7.5)	2.07	0.62 to 6.90		
Illicit drug use (≤1 month)								
Marijuana	19	(34.6)	38	(28.8)	0.74	0.40 to 1.39		
Methamphetamine	18	(32.7)	23	(17.3)	0.77	0.38 to 1.55		
Cocaine	5	(9.1)	11	(8.3)	0.44	0.16 to 1.20		
Amyl nitrite (poppers)	2	(3.6)	9	(6.8)	9.43	0.64 to 138.01		
Heroin	4	(7.3)	6	(4.5)	2.54	0.52 to 12.43		
Any injection drug use (≤1 month)	4	(7.4)	5	(4.0)	2.50	0.50 to 12.43		
Hazardous alcohol consumption (≤12 months)	22	(40.0)	54	(40.9)	0.49	0.26 to 0.91	0.78	0.32 to 1.89
Any drug use before/during sex (≤2 months)	8	(15.1)	15	(11.8)	1.05	0.40 to 2.76		
Any alcohol use before/during sex (≤2 months)	20	(36.4)	55	(42.0)	0.67	0.36 to 1.24		
History of abuse								
Ever experienced sexual abuse	11	(19.6)	41	(31.1)	4.91	2.00 to 12.05	3.24	1.06 to 9.86
Ever experienced physical abuse	8	(14.6)	27	(20.6)	2.21	0.88 to 5.54		
Ever experienced emotional abuse	16	(29.6)	46	(35.4)	1.67	0.85 to 3.28		
Psychosocial factors								
Social support, mean (SD)	21.8	(3.2)	22.4	(3.6)	1.03	0.95 to 1.13		
Perceived HIV-related stigma, mean (SD)	23.4	(3.9)	22.5	(3.9)	1.01	0.94 to 1.09		
Outness about having sex with men, mean (SD)§	4.5	(2.0)	5.5	(1.7)	1.27	1.08 to 1.50	1.28	1.02 to 1.62
Internalised homophobia, mean (SD)§	21.2	(6.5)	18.1	(6.1)	0.96	0.91 to 1.00	0.92	0.86 to 0.99
HIV/STI knowledge								
HIV/STI counselling or education programme (≤2 months)	4	(8.2)	24	(18.9)	1.95	0.69 to 5.57		
HIV knowledge, mean (SD)	12.3	(2.9)	14.1	(2.3)	1.29	1.14 to 1.46	1.10	0.93 to 1.31

Continued

Table 3 Continued

	No prior HIV testing (N=56)		Prior HIV testing (N=133)		Univariate RDS-weighted*		Multivariate RDS-weighted† (N=176)	
	n	(%)‡	n	(%)‡	OR	95% CI	OR	95% CI
HIV/STI prevalence								
Tested HIV-positive	11	(19.6)	20	(15.0)	1.43	0.67 to 3.07		
Self-reported an STI diagnosis (≤2 months)	7	(12.7)	22	(16.5)	1.11	0.50 to 2.45	0.67	0.20 to 2.23

*Univariate RDS-weighted ORs=study design adjusted estimates.
†Multivariate RDS-weighted ORs=study design and confounder adjusted estimates.
‡RDS-unadjusted sample estimates.
§Only asked of participants who identify as gay or bisexual; analysis excludes participants who identify as heterosexual.
AOR, adjusted OR; CAI, condomless anal intercourse; RDS, respondent-driven sampling; STI, sexually transmitted infection.

associated with identifying as homosexual or gay and being more 'out' about having sex with men. These findings are consistent with research documenting internalised homophobia as a barrier to accessing HIV testing and prevention services.[15] Cultural norms of machismo and homophobia contribute to stigma towards same-sex sexual behaviours in Mexico. Previous research suggests that non-gay identifying, HIV-positive men who have sex with both men and women in Mexico avoid gay community affiliation out of fear of homophobic reactions.[32] As such, innovative strategies are needed to engage non-gay identifying MSM in HIV testing programmes without exacerbating experiences of stigma and discrimination. Structural interventions addressing societal stigma towards MSM may also minimise internalised homophobia and support HIV testing uptake among sexual minorities in Tijuana.

Motivations for and barriers to HIV testing point to additional strategies that may promote testing within this population. The most frequently reported barrier to HIV testing was "I worry that testing HIV-positive will change my life," suggesting that MSM in Tijuana may perceive testing HIV-positive as a death sentence or worry about the potential for negative social consequences on testing positive.[9 14] Community-wide education campaigns that correctly frame HIV/AIDS as a chronic disease in the context of ART, focus on the benefits of regular HIV testing, and raise awareness about universal ART access in Mexico may decrease HIV-related stigma and improve HIV testing rates within this population. Moreover, our ability to recruit MSM in Tijuana via RDS suggests that HIV educational campaigns and prevention interventions that rely on the diffusion of information through social networks might increase HIV-related knowledge and support regular HIV testing uptake among MSM in Tijuana.[33]

Most participants who reported prior HIV testing sought their last test because they wanted to know their HIV status. However, only 20% of those reporting prior HIV testing indicated that their last test was motivated by a healthcare provider's suggestion. Although data on the location of participants' last HIV test were not collected, this finding points to potential missed opportunities for testing.

However, given the stigmatisation of same-sex sexual behaviours in Mexico,[32] MSM may be reluctant to disclose their sexual orientation or same-sex sexual practices to healthcare providers. Provider training on culturally competent care for sexual minorities[34] may promote open discussions about sexual practices, facilitate risk reduction counselling, support the delivery and uptake of antiretrovirals for use as pre-exposure (once approved in Mexico) and postexposure prophylaxis, increase HIV testing and ensure timely linkage to HIV care for this population.

Our study has several limitations. First, given the study's cross-sectional design, we cannot infer that observed associations are causal. Second, although RDS was implemented to overcome barriers to accessing this hidden population, using this potentially biased recruitment method may have limited the generalisability of our findings. Third, RDS weighting procedures can yield imprecise estimates,[21 35] and may explain the wide 95% CIs obtained for some ORs in our RDS-weighted logistic regression analyses. Fourth, participants may have underreported sensitive information on sexual and substance use behaviours. However, to minimise the potential for this social desirability bias, surveys were administered by AFABI staff who are trusted members of the community. Fifth, barriers to HIV testing were not measured via open-ended questions. As such, future research should include in-depth interviews with MSM in Tijuana, particularly subgroups with a low prevalence of prior HIV testing (eg, young, less educated, migrant MSM), to better understand their barriers to testing and inform targeted interventions for MSM least likely to access HIV testing. Finally, although our findings were qualitatively similar in analyses excluding biological males who have sex with men and identify as transgender female, additional research examining the unique barriers to HIV testing experienced by this population is needed as they may differ from those experienced by biological males who have sex with men and identify as male.

CONCLUSIONS

Our findings highlight the need for HIV testing programmes among MSM in Tijuana, Mexico and provide

useful information for the development of HIV testing services that address the specific needs of this population. Innovative, non-stigmatising, confidential HIV education and testing interventions targeted at young, less educated, migrant and non-gay identifying MSM may facilitate regular HIV testing and timely linkage to HIV care and treatment among MSM in this setting.

REFERENCES

1. Lundgren JD, Babiker AG, Gordin F, et al. Initiation of antiretroviral therapy in early asymptomatic HIV infection. *N Engl J Med* 2015;373:795–807.
2. Cohen MS, Chen YQ, McCauley M, et al. Prevention of HIV-1 infection with early antiretroviral therapy. *N Engl J Med* 2011;365:493–505.
3. World Health Organization. Consolidated guidelines on HIV testing services. 2015. http://apps.who.int/iris/bitstream/10665/179870/1/9789241508926_eng.pdf?ua=1&ua=1 (accessed 23 Jul 2015).
4. Baral S, Sifakis F, Cleghorn F, et al. Elevated risk for HIV infection among men who have sex with men in low- and middle-income countries 2000–2006: a systematic review. *PLoS Med* 2007;4:e339.
5. Beyrer C. Global prevention of HIV infection for neglected populations: men who have sex with men. *Clin Infect Dis* 2010;50 (Suppl 3):S108–13.
6. Brito AM, Kendall C, Kerr L, et al. Factors associated with low levels of HIV testing among Men Who Have Sex with Men (MSM) in Brazil. *PLoS ONE* 2015;10:e0130445.
7. Guadamuz TE, Cheung DH, Wei C, et al. Young, Online and in the Dark: Scaling Up HIV Testing among MSM in ASEAN. *PLoS ONE* 2015;10:e0126658.
8. Lee SW, Deiss RG, Segura ER, et al. A cross-sectional study of low HIV testing frequency and high-risk behaviour among men who have sex with men and transgender women in Lima, Peru. *BMC Public Health* 2015;15:408.
9. Reisen CA, Zea MC, Bianchi FT, et al. HIV testing among MSM in Bogotá, Colombia: the role of structural and individual characteristics. *AIDS Educ Prev* 2014;26:328–44.
10. Vu L, Andrinopoulos K, Tun W, et al. High levels of unprotected anal intercourse and never testing for HIV among men who have sex with men in Nigeria: evidence from a cross-sectional survey for the need for innovative approaches to HIV prevention. *Sex Transm Infect* 2013;89:659–65.
11. Li X, Lu H, Raymond HF, et al. Untested and undiagnosed: barriers to HIV testing among men who have sex with men, Beijing, China. *Sex Transm Infect* 2012;88:187–93.
12. Park JN, Papworth E, Billong SC, et al. Correlates of prior HIV testing among men who have sex with men in Cameroon: a cross-sectional analysis. *BMC Public Health* 2014;14:1220.
13. Sandfort TG, Nel J, Rich E, et al. HIV testing and self-reported HIV status in South African men who have sex with men: results from a community-based survey. *Sex Transm Infect* 2008;84:425–9.
14. Beattie TS, Bhattacharjee P, Suresh M, et al. Personal, interpersonal and structural challenges to accessing HIV testing, treatment and care services among female sex workers, men who have sex with men and transgenders in Karnataka state, South India. *J Epidemiol Community Health* 2012;66(Suppl 2):ii42–8.
15. Santos GM, Beck J, Wilson PA, et al. Homophobia as a barrier to HIV prevention service access for young men who have sex with men. *J Acquir Immune Defic Syndr* 2013;63:e167–70.
16. Bautista-Arredondo S, Colchero MA, Romero M, et al. Is the HIV epidemic stable among MSM in Mexico? HIV prevalence and risk behavior results from a nationally representative survey among men who have sex with men. *PLoS ONE* 2013;8:e72616.
17. Secretaria de Salud, Centro Nacional para la Prevención y el Control del VIH y el SIDA (CENSIDA). Informe nacional de avances en la respuesta al vih y el sida: Mexico 2015. 2015. http://www.unaids.org/sites/default/files/country/documents/MEX_narrative_report_2015.pdf (accessed 23 Dec 23 2015).
18. Instituto Nacional de Estadistica y Geografia. Estadísticas a propósito del día mundial de la lucha contra el SIDA. 2011. http://www.inegi.org.mx/inegi/contenidos/espanol/prensa/contenidos/estadisticas/2011/sida11.asp?s=inegi&c=2819&ep=78 (accessed 23 Jul 2014).
19. Pitpitan EV, Goodman-Meza D, Burgos JL, et al. Prevalence and correlates of HIV among men who have sex with men in Tijuana, Mexico. *J Int AIDS Soc* 2015;18:19304.
20. Heckathorn DD. Respondent-driven sampling: a new approach to the study of hidden populations. *Soc Probl* 1997;44:174–99.
21. Heckathorn DD. Extensions of respondent-driven sampling: analyzing continuous variables and controlling for differential recruitment. *Soc Methodol* 2007;37:151–207.
22. Barrón-Limón S, Semple SJ, Strathdee SA, et al. Correlates of unprotected anal sex among men who have sex with men in Tijuana, Mexico. *BMC Public Health* 2012;12:433.
23. Saunders JB, Aasland OG, Babor TF, et al. Development of the alcohol use disorders identification test (audit): who collaborative project on early detection of persons with harmful alcohol consumption–II. *Addiction* 1993;88:791–804.
24. Pearlin LI, Mullan JT, Semple SJ, et al. Caregiving and the stress process: an overview of concepts and their measures. *Gerontologist* 1990;30:583–94.
25. Semple SJ, Grant I, Patterson TL. Utilization of drug treatment programs by methamphetamine users: the role of social stigma. *Am J Addict* 2005;14:367–80.
26. Centers for Disease Control and Prevention (CDC). HIV/STD risks in young men who have sex with men who do not disclose their sexual orientation–six U.S. cities, 1994–2000. *MMWR Morb Mortal Wkly Rep* 2003;52:81–6.
27. Herek GM, Cogan JC, Gillis JR, et al. Correlates of internalized homophobia in a community sample of lesbians and gay men. *J Gay Lesbian Med Assoc* 1997;2:17–25.
28. Carey MP, Schroder KE. Development and psychometric evaluation of the brief HIV Knowledge Questionnaire. *AIDS Educ Prev* 2002;14:172–82.
29. Strathdee SA, Magis-Rodriguez C, Mays VM, et al. The emerging HIV epidemic on the Mexico-U.S. border: an international case study characterizing the role of epidemiology in surveillance and response. *Ann Epidemiol* 2012;22:426–38.
30. Goldenberg SM, Strathdee SA, Perez-Rosales MD, et al. Mobility and HIV in Central America and Mexico: a critical review. *J Immigr Minor Health* 2012;14:48–64.
31. Brouwer KC, Lozada R, Cornelius WA, et al. Deportation along the U.S.-Mexico border: its relation to drug use patterns and accessing care. *J Immigr Minor Health* 2009;11:1–6.
32. Kendall T, Herrera C, Caballero M, et al. HIV prevention and men who have sex with women and men in México: findings from a qualitative study with HIV-positive men. *Cult Health Sex* 2007;9:459–72.
33. Valente TW. Network interventions. *Science* 2012;337:49–53.
34. Gay and Lesbian Medical Association (GLMA). Health People 2010: Companion document for lesbian, gay, bisexual, and transgender (LGBT) health. 2001. http://www.glma.org/_data/n_0001/resources/live/HealthyCompanionDoc3.pdf (accessed 20 July 2015).
35. Winship C, Radbill L. Sampling weights and regression analysis. *Soc Methods Res* 1994;23:230–57.