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ORIGINAL PAPER

Prevalence and Risk Factors for HIV Infection in a Population of Homosexual, Bisexual, and Other Men Who Have Sex with Men in the Metropolitan Region of Chile: A Re-emerging Health Problem

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Abstract
According to the most recent UNAIDS report, the number of new HIV infections has increased by 34% since 2010 in Chile, representing the largest increase in the Americas. The objective of this study was to identify factors associated with HIV prevalence among men who have sex with men (MSM) in the metropolitan region (MR) of Santiago, Chile. Cross-sectional study of MSM living in the MR, recruited using respondent-driven sampling (RDS). Participants were tested using Human Immunodeficiency virus rapid test, and reactive cases were confirmed withELISA. Participants were interviewed using a questionnaire adapted for the Chilean population. Descriptive and logistic regression analyses were then performed. All applicable ethical norms were followed in the execution of this study. The total sample consisted of 375 individuals. HIV prevalence among MSM was 17.6% overall. Among the HIV-negative men, most (71.5%) had not been tested for sexually-transmitted diseases (STIs) other than HIV in the past 12 months, and 24.1% had never been tested for HIV. Participants who had been tested for an STI other than HIV in the past 12 months had a 3.56-fold greater OR for HIV-positive status than those who had not. Conversely, having had an HIV test in the past 12 months was a protective factor against positive HIV status (OR = 0.09). The high prevalence of HIV among MSM suggests a re-emergence of the disease in Chile, and cases are specifically concentrated among young MSM. Access to sexual health care and STI testing in Chile is insufficient. Targeted prevention efforts are urgently needed as part of the Chilean national strategy to combat the spread of HIV, including community-based testing programs.

Keywords HIV · HIV prevalence · Homosexual · Bisexual · MSM

Introduction

According to the most recent UNAIDS [1] report, annual rates of new HIV infections have remained stable in Latin America as a whole over the past decade. In Chile, however, the rate has increased by 34% since 2010, the largest increase of any country in the Americas, above, for example, Guatemala (23%), Costa Rica (16%), Honduras (11%), and Panama (9%). Even more alarmingly, the most recent data from the Chilean Public Health Institute (*Instituto de Salud Pública de Chile* (ISP)) suggests that rates over the past 5 years may have increased by as much as 66% [2].

The Chilean Epidemiology Department's report on the evolution of HIV/AIDS infections in Chile from 1984 to 2015 [3] indicates that HIV and AIDS notification rate have increased, reaching 9.7 and 5.7 per 100,000 inhabitants in 2015, respectively. The preliminary report for 2016 indicates an HIV/AIDS notification rate of 16.3 per 100,000 inhabitants [4]. The most common transmission route is sexual intercourse, representing 99% of new cases over the past 5 years in Chile. HIV cases are concentrated primarily among young men aged 20–34 years in this country,

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especially among homosexual and bisexual men. Furthermore, notification rate of HIV infection have increased strikingly among males 15–19 years of age, from 7.6% of all reported cases in 2015 to 9.1% in 2016 [4].

HIV surveillance in Chile is mainly first-generation, that is, limited to monitoring the morbimortality of the disease within the general population. However, international experts recommend a shift to second-generation surveillance (SGS), which would expand the focus to include the determinants that affect the behavior of the epidemic [5, 6]. Biobehavioral monitoring of at-risk groups, such as men who have sex with men (MSM), would allow for more accurate measurements of the prevalence of HIV and other sexually-transmitted Infections (STI), enhance forecasting of impending increases in prevalence, and contribute to the design of effective prevention initiatives [7]. One goal of the 2011–2020 National Chilean Health Strategy (*Estrategia Nacional de Salud de Chile*) is to reduceHIV/AIDS mortality to 1.2 per 100,000 inhabitants by the year 2020. However, the plan does not include goals associated with prevention strategies [8].

One strategy for improving surveillance involves respondent-driven sampling (RDS), as this technique allows researchers to access hard-to-reach populations such as MSM. Unlike other "snowball" sampling methods, RDS uses the characteristics of the target population's social network not just to recruit subjects but also to estimate selection probabilities and develop sampling weights for each observation. This method, therefore, reduces the biases associated with snowball sampling, resulting in a representative study population that is relatively independent of the "seeds" or initial group of participants [9–11].

The objectives of this investigation were to estimate HIV prevalence and identify socio-demographic and biobehavioral factors associated with the infection among homosexual, bisexual, and other MSM in the Metropolitan Region (MR) of Chile.

Methods

Type of Study

Cross-sectionalstudy, with analytical component.

Study Population and Inclusion Criteria

Homosexual, bisexual, and other men who have sex with men (MSM) living in the Metropolitan Region of Santiago, Chile (MR), including Chilean and foreign-born inhabitants. Inclusion criteria were: at least 18 years of age, having engaged in penetrative anal sex with other men during the past 12 months, and having signed the informed consent form to participate.

Sampling Method

The data was collected using respondent-driven sampling (RDS). RDS is a type of snowball sampling, in which an initial group of participants (seeds) is selected non-randomly from the target population (in this case, MSM). The seeds recruit other participants from their social networks, who then recruit other participants, and so on, resulting in recruitment "waves" that penetrate the target population.

Given a confidence level of 95%, an estimated HIV prevalence of 15%, estimation error of 5%, and effect of design of 2, the target sample size calculated was 392 individuals [10].

Recruitment was performed at 2 non-governmental organizations that work with the target population (NGOs). The diversity of the sample was determined to the choice of the initial seeds; to choose them a qualitative descriptive study with an exploratory component was carried out. Each participant, including the seeds, were given 3 coupons for recruiting other participants. Participants were a free HIV screening test and completed a biobehavioral questionnaire. Each participant was paid US$10 for the three additional participants that he recruited into the study (that is, for the three coupon that was submitted).

Data Collection Instrument

A behavioral questionnaire that has been used for second-generation HIV/AIDS surveillance in Spain wascross-culturally adaptedfor Chile [12]. Content adaptation was performed according to the recommendations of Family Health International [13]. The applicability of the instrument was assessed in 51 MSM who were beneficiaries or volunteers at the NGO Social Health Orientation Network [*Red de Orientación en Salud Social (Red OSS)*] in Conchalí, a neighborhood in Santiago, Chile. The original instrument was reviewed individually, and then a Delphi panel was conducted to share insights and concerns. Finally, a second Delphi panel was conducted to make the definitive decisions regarding which items to keep, eliminate, or modify. The final instrument had 97 items, including 7 indicators recommended by the Global AIDS Monitoring (GAM).

HIV Prevalence

Participants provided a saliva sample for testing using the ABON™ HIV 1/2/O Tri-Line Human Immunodeficiency Virus Rapid Test (BioPharm Hangzhou Co., Ltd.). All participants received pre- and post-test counseling. Previously undiagnosed cases with a reactive result were asked to give a blood sample to confirm the diagnosis using ELISA, which

was performed at the ISP (the national reference laboratory) according to established protocols, which include western blot and enzyme immunoassays online. Results were given to patients in the NGO, and confirmed HIV cases were referred to their corresponding health care center.

Data Analysis

HIV prevalence was estimated for the total population of MSM in the Metropolitan Region, as well as by age group. The sociodemographic characteristics of the population as a whole and by HIV status were estimated using descriptive analysis. Access to diagnostic and counseling services by HIV status was also assessed. A dual-component estimator (RDS I/DC) and enhanced data smoothing were applied for this analysis, controlling for differential recruitment (homophily) and differences in degree between the groups. Bootstrapping was used to calculate 95% confidence intervals, with 15,000 resamples. Data analysis was performed using RDSAT v.7.1.46. The seeds were excluded from data analysis.

Multiple logistic regression analysis was used to evaluate the risk factors associated with HIV infection. The RDSI/DC-generated individual weights were used, with age group and socioeconomic status treated as adjustment variables. A total of 10 logistic regression models were tested, and the final model was selected according to the number of significant ($p < 0.05$) covariates, taking into account the adjustments indicated by the F-adjusted mean residual test. Logistic regression analyses were performed using STATA version 12.

Ethical Issues

The project and informed consent forms were approved by the Ethics Committee of the School of Medicine, University of Chile.

Results

The total sample consisted of 375 observations, including 9 initial seeds, 1 re-seed (seed 2), and 365 recruits from a total of 13 waves. Equilibrium was reached by wave 12 for the variables "estimated HIV prevalence,""age group,""socioeconomic level," and "nationality" (Fig. 1). The most successful seeds were 1, 5, 7, and 9, with 13, 12, 11, and 11 waves, respectively. The least successful seeds were 2 and 8, with 1 and 3 waves, respectively (Fig. 2). The Fig. 3 shows homogeneity of HIV prevalence across seeds.

Global estimated HIV prevalence in the study population was 17.6% (95 CI% 9.6–26.0%). Among men aged 25–34 years, prevalence was 25.1%, and among those 35–44 years, prevalence was 36.4%. Prevalence was higher among participants from lower-middle and middle socioeconomic groups, and among Chilean versus foreign-born participants (Table 1).

Tables 2 and 3 show the estimated sociodemographic, behavioral, and clinical-epidemiological characteristics of the MSM in the Metropolitan Region, as well as a comparison between MSM with and without HIV. Seventy-seven point five percent identifies as homosexual, 42.9% reports being verbally harassed and 46.2% reports having been the victim of discrimination because of their attraction to other men. Most of MSM declare that met their most recent partner at work or school (45.7%) or through a dating app (32.1%). Only 55.4% says that always used a condom while engaging in anal penetration with casual partners over the last 6 months, and approximately 42% reports that never used a condom or only used a condom about half of the time. Only 19.8% of respondents says that acquired condoms at health centers.

The majority (82.9%) of MSM withHIVhad paying jobs. In contrast, less than half (42.8%) of the MSM without HIV had paying jobs ($p = 0.005$). The majority of MSM without HIV (71.5%) had not been tested for sexually transmitted infections (STI) in the past 12 months, unlike the HIV-positive MSM, of whom 71.9% had been tested ($p = 0.003$). Among the MSM without HIV, 24.1% had never been tested for HIV, while 95.7% of the HIV-positive had been tested at some point in their lives ($p = 0.001$). Approximately 26.8% of the HIV-negative MSM had not been tested during the past 12 months, versus 12.6% of the HIV-positive ($p < 0.001$).

Table 4 shows the results for access to diagnostic and counseling services. A total of 42.0% of the persons with HIV and 49.1% of those without HIV had been diagnosed or tested within the past 12 months in the private healthcare system. Moreover, 45.2% and 35.0% of the HIV-negative and -positive subjects, respectively, reported that they did not receive counseling when given their results/diagnosis.

The results of the final logistic regression model are shown in Table 5. After adjusting for age and socioeconomic level, the factor significantly associated with the presence of HIV was having been tested professionally for an STI other than HIV within the past 12 months (OR = 3.56; 95% CI 1.55–8.15) and; having been tested for HIV with the past 12 months was a protective factor (OR = 0.09; 95% CI 0.04–0.24).

Discussion and Conclusions

Recent epidemiological data have provided strong evidence of a re-emergence of HIV in Chile. While rates had become relatively stable by 2011, prevalence began to climb once

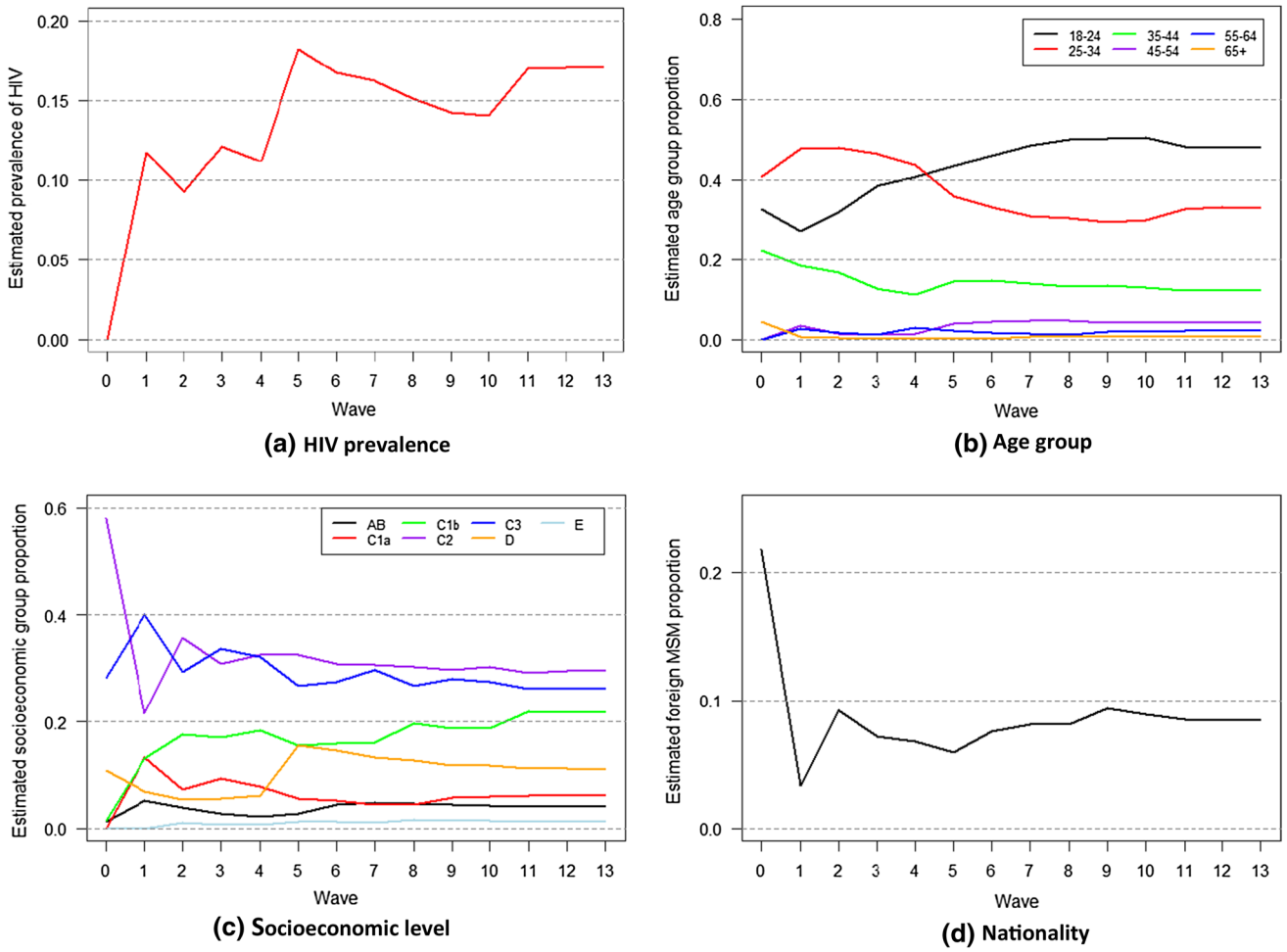

Fig. 1 Sampling equilibrium graphs by variable

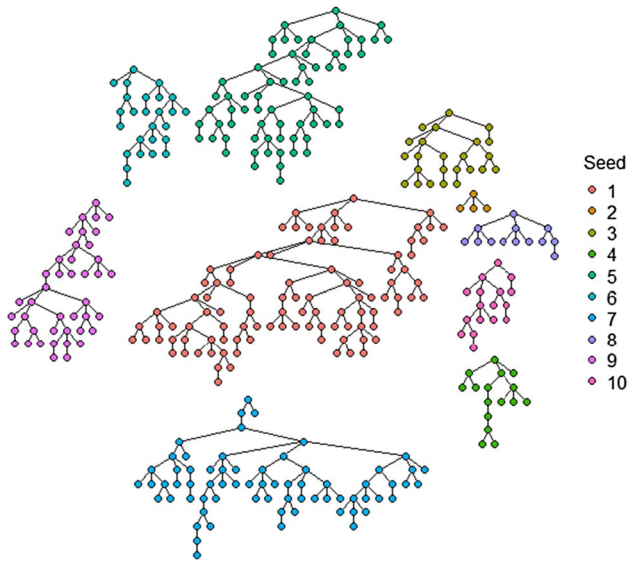

Fig. 2 Recruitment chains by seed

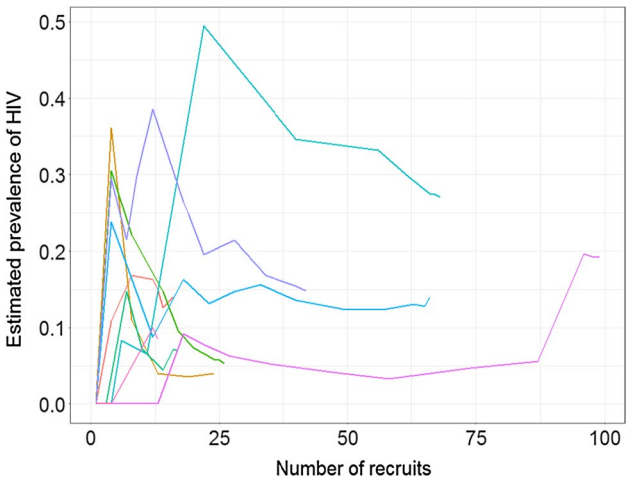

Fig. 3 Homogeneity of HIV prevalence across seeds

Table 1 Estimated HIV prevalence overall and by age group, socioeconomic level, and nationality

	Prevalence (IC 95)[a], in%
Total	17.6 (9.6–26.0)
Age	
18–24	6.3 (3.2–9.5)
25–34	25.1 (10.4–40.5)
35–44	36.4 (2.4–67.9)
45 and older	35.3 (4.2–68.3)
Socioeconomic level[b]	
AB	5.7 (0.0–21.6)
(C1a + C1b)	20.4 (4.6–41.2)
(C2 + C3 + D+E)	17.5 (8.5–28.2)
Country of origin	
Chile	17.9 (9.5–26.9)
Foreing-born	10.6 (0.0–32.9)

[a]RD5 I/DC-generated estimator, CI bootstrap

[b]AB: upper or middle socioeconomic class; C1a and C1b: lower middle class; C2, C3, D, **E:** lower class or indigent

moreafter 2014 [1–4]. In this study, the global estimated prevalence of HIV among homosexual, bisexual, and other MSM was 17.6%. This result indicates that the epidemic is concentrated in the population of MSM in Chile, given that prevalence in the general population between 15 and 49 years of age is 0.5% [4].

These data are consistent with results from other studies in Latin American and Europe for similar populations [14–16], also in Chile where a study from 2010 found a self-reported HIV prevalence of 17.8% among MSM [17]. Furthermore, with the drastic increase notification over the last 5 years—66% according to ISP data. According to UNAIDS, Chile ranks as the country with the steepest increase in new HIV cases since 2010 within Latin America, at 36.0% [1, 2].

The high prevalence of HIV among the population of young MSM is especially alarming; our study found a prevalence of 25.1% among participants aged 25–34 years. This finding indicates an urgent need for public policies targeting this population, with prevention strategies that are relevant to the current sociocultural environment. Policies should incorporate combined prevention strategies, implemented in collaboration with healthcare providers and civil organizations. Prevention initiatives should include enhanced access to community-based testing, sexual health education in schools, structural interventions to reduce stigma and discrimination, and social policies to safeguard the human rights of sexual minorities [18–22].

In terms of social monitoring, it is crucial that Chile implement second-generation surveillance, including serial biobehavioral surveys in the populations at highest risk. Many Latin American and European countries have used this approach to identify the social determinants associated with HIV transmission, trends in incidence, and the impact of targeted prevention policies [23–25].

Of the HIV-positive cases in this project, 36.0% did not know their serological status before the study test. This finding is consistent with reports that late HIV diagnosis is common in Chile, representing approximately 40% of cases [4]. There are many implications of late HIV diagnosis, including a deterioration in health, increased viral load, and a greater probability of transmitting HIV and other STIs [26]. These data underline the need to improve community testing and social monitoring for this disease, with the goal of improving access to testing and identifying the social determinants associated with HIV in Chile [5, 6].

Our data indicate that 42.9% and 46.2% of MSM had been verbally harassed or suffered discriminated, respectively, because of their attraction to other men. These experiences have been linked to elevated risk for acquiring HIV and other STIs, as stigma and discrimination are often associated with decreased access to health care, reduced efficacy of prevention initiatives, and elevated rates of risky sexual behaviors, such as incorrect condom use or failing to discuss HIV status with one's sexual partners [27–29].

Pachankiste et al. 2015 suggested that the increasing use of new social technologies such as mobile dating Apps is facilitating contact among MSM [30, 31]. Our study confirmed that a third of MSM had met their most recent sexual partner through a dating App (32.1%). International reports suggest that MSM are often among the first to adopt this type of technology, as the population tends to consist of young men with a higher-than-average level of education and income [32] [28]. Furthermore, people who use this type of App are more likely to engage in risky sexual behaviors [32–34]. It would be interesting to explore the use of apps as a prevention strategy in Chile, although their use may be limited by the stigma surrounding homosexuality and HIV [35].

When engaging in anal penetration with casual partners in the past 5 months, 55.4% of the MSM reports that they consistently/always used a condom, while approximately 42% never used a condom or only used a condom about half of the time. Only 19.8% acquired condoms at public health centers.

According to the 2016–2017 Chilean National Health Survey (*EncuestaNacional de Salud de Chile*(ENS)) [36], only 12.8% of sexually-active men and 7.1% of sexually-active women in the general population always use a condom. While the population of MSM in our study use condoms more frequently than the general population, their exposure to HIV and other STIs is greater due to a larger number of casual partners and higher-risk sexual practices [37]. Condoms continue to be the most effective primary prevention strategy against the spread of HIV. However, in

Table 2 Sociodemographic characteristics of homosexual, bisexual, and other MSM in the MR of Santiago, Chile

	Percentage (95% Cl)[a], in %			
	Overall	HIV−	HIV+	*p* value[b]
Age				
18–24	49.4 (39.9–573)	56.4 (46.4–64.8)	17.5 (8.4–35.1)	0.012
25–34	32.6 (25.2–41.1)	29.6 (23.0–37.7)	45.7 (20.4–73.0)	
35–44	12 (5.3–20.9)	9.4 (3.8–17.0)	25.0 (1.6–53.3)	
45 and older	5.9 (2.7–10.3)	4.7 (1.9–8.2)	11.8 (1.2–33.0)	
Socioeconomic level (NSE)[c]				
AB	3.3 (1.2–7.6)	3.7 (1.2–9.1)	1.0 (0.0–3.8)	
(C1a + C1b)	28.3 (20.6–36.3)	27.4 (20.6–34.3)	32.2 (8.0–62.4)	0.698
(C2 + C3 + D+E)	68.4 (59.5–75.8)	68.8 (60.7–75.4)	66.8 (36.7–91.1)	
Country of origin				
Chile	92.1 (87.0–96.5)	91.5 (85.8–96.5)	95.2 (84.6–100.0)	0.999
Other	7.9 (3.5–13.0)	8.5 (3.5–14.3)	4.8 (0.0–15.4)	
Employment status				
Paid employee	50.0 (41.4–59.0)	42.8 (33.9–51.8)	82.9 (65.6–92.3)	
Unpaid work	4.9 (2.5–8.0)	5.1 (2.3–8.8)	3.0 (0.3–8.6)	0.005
Student	27.9 (20.4–35.4)	32.8 (24.6–41.2)	6.7 (1.6–16.1)	
Student and paid employee	15.6 (11.1–20A)	17.8 (12.7–23.4)	5.7 (1.2–14.2)	
Other	1.6 (0.3–3.2)	1.6 (0.1–3.6)	1.6 (0.0–5.8)	
Education level				
Primary	3.7 (1.8–6.0)	3.5 (1.6–5.8)	3.8 (0.0–11.7)	
Secondary	64.7 (55.7–72.3)	66.9 (57.9–74.4)	52.0 (25.9–80.2)	0.487
College or greater	31.5 (24.2–40.7)	29.5 (22.5–38.5)	44.2 (16.4–70.4)	
Sexual identity				
Homosexual	77.5 (70.1–84.4)	79.0 (73.1–84.6)	65.7 (38.8–97.0)	
Bisexual	**15.1** (8.6–22.6)	12.4 (8.1–17.6)	31.6 (0.0–58.4)	0.509
Heterosexual	1.2 (0.2–2.5)	1.5 (0.3–3.2)	–	
None/other/not sure/no response	6.2 (3.2–10.0)	7.0 (3.6–11.7)	2.7 (0.0–9.1)	
Have you ever been verbally harassed due to your attraction to other men?				
Yes	42.9 (34.8–51.2)	41.8 (35.1–50.2)	48.6 (20.2–71.6)	0.649
No	56.4 (48.2–64.6)	57.3 (49.2–64.3)	51.4 (27.7–79.7)	
Not sure/no response	0.7 (0.0–2.1)	0.9 (0.0–2.5)	–	
Have you ever been physically assaulted due to your attraction other men?				
Yes	11.4 (7.1–15.8)	13,1(8.5–17.9)	3.6 (0.5–9.5)	0.816
No 88.3	(83.9–92.5)	86.5 (81.9–91.3)	96.4 (90,6–99.6)	
Not sure/no response	0.3 (0.0–0.9)	0.3 (0.0–1.0)	–	
Have you ever been the victim of discrimination due to your attraction to other men?				
Yes	46.2 (38.5–54.3)	45.0 (37.5–52.8)	49.9 (21.3–74.0)	0.999
No	53.3 (45.1–60.7)	54.4 (46.7–61.5)	49.4 (25.7–77.8)	
Not sure/no response	0.6 (0.0–1.5)	0.7 (0.0–1.6)	0.7 (0.0–2.7)	

[a]RD5 I/DC-generated estimator, CI bootstrap

[b]Fisher's exact test, null hypothesis of homogeneity between both groups (HIV + and HIV-) was applied

[c]AB: upper or middle socioeconomic class; C1a and C16: lower middle class; C2, C3, D, E: lower class or indigent

order for this measure to be effective, easy access to condoms must be available, not only at public health centers but also in leisure/recreation spaces and in schools and universities.

Many of the men in this study had previously been diagnosed with HIV (42.0%) or had been tested for HIV within the past 12 months (49.1%) in the private health system. Of those who had been diagnosed or tested, many did not

Table 3 Behavioral and clinical-epidemiological characteristics of homosexual, bisexual, and other MSM in the MR of Santiago, Chile

	Percentage (95% Cl)[a], in%			
	Overall	HIV-	HIV+	p-value[b]
–Where did you meet your most recent sexual partner?				0.042
Gay/bisexual website	11.8 (6.6–17.5)	12.9 (6.9-19.5)	5.7 (0.0–15.5)	
Mobile all	32.1 (25.8–39.7)	35.4 (27.9–43.5)	17.4 (7.9–35.7)	
Bar or other venue (cafe, theater, sauna, disco)	10.5 (4.7–17.9)	7.5 (3.6–12.4)	25.2 (3.5–53.4)	
Work or school	45.7 (37,6–54,2)	44.2 (36.4–52.3)	51.7 (24.8–78.0)	
Have you ever had a stable, long–term male partner?				
Yes	84.7 (79.3–90.0)	81.8 (75.6–88.1)	96.9 (88.5–100.0)	0.023
No	15.3% (10.0–20.7)	18.2 (11.9–24.3)	3.1 (0.0–11.4)	
In the past 6 months, how often did you use condoms				
When engaging in anal penetration with a (male) stable/long–term partner?				
Never	23.8 (15.4–41.9)	23.4 (14.5–39.1)	20.8 (0.0–76.3)	0.256
Half of the time	45.0 (31.4–53.0)	51.2 (33.0–56.4)	22.4 (10.8–62.5)	
Always	31.2 (17.9–43.4)	25.4 (16.8–42.6)	56.8 (0.0–65.8)	
In the past 6 months, how often did you use condoms				
When engaging in anal penetration with (male) casual partners?				
Never	7.2 (3.4–12.5)	7.9 (3.3–14.5)	3.8 (0.0–12.5)	
Half of the time	34.5 (27.5–47,3)	39.3 (31.8–50.4)	20.1 (8.2–62.1)	0.573
Always	55.4 (41.6–63.1)	49.2 (37.6–56.6)	76.1 (32.5–89.3)	
Not Sure/No response	2.9 (0.7–5.9)	3.6 (0.8–7.0)	–	
The last time you had sexual intercourse with a casual male partner, did you engage in anal sex?				
Yes, he penetrated me	23.8 (18.0–29.7)	24.8 (18.1–31.4)	18.8 (7.5–37.9)	
Yes, I penetrated him	37.4 (29.1–45,9)	34.2 (27.1–41.6)	54.1 (17.2–75.2)	0.362
Yes, we both penetrated each other	18.5 (13.4–23.5)	18.7 (13.4–23.9)	17.7 (7.3–36.1)	
No	19.1 (14.0–25.2)	21.1 (15.1–27.9)	8.5 (2.7–20.1)	
Not Sure/No response	1.1 (0.3–2.7)	1.2 (0.2–3.0)	0.9 (0.0–3.5)	
Did he use a condom when he penetrated you?				
Yes	69.9 (56.1–74.1)	71.3 (55.3–77.1)	62.5 (37.1–80.9)	
No	28.3 (23.5–42.6)	26.7 (20.8–43.1)	34.7 (16.0–58.3)	0.327
Not Sure/No response	1.8 (0.0–5.4)	2.0 (0.0–7.0)	2.7 (0.0–13.7)	
Where did you acquire the condoms that you used?				
Health center or clinic				
Yes	19.8 (12.8–28.4)	13.9 [9.1–20.3]	47.4 (19.2–73.9)	0.000
No	80.2 (71.6–87.2)	86.1 (79.8–90.8)	52.6 (26.3–80.7)	
Gay/homosexual organization or other				
Yes	8.9 (5.9–12.4)	8.7 (5.6–12.5)	8.4 (2.6–19.0)	0.369
No	91.1 (87.6–94.1)	91.3 (87.6–94.4)	91.6 (81.0–97.5)	
Pharmacy or supermarket				
Yes	78.8 (71.2–84,7)	81.5 (73.3–87.1)	65.4 (37.2–84.6)	0.000
No	21.2 (15.3–28.8)	18.5 (13.0–27.0)	34.6 (15.7–62.9)	
During the past 12 months, when using a condom, have you:				
Used a condom without lubricant?				
Yes	57.9 (49.4–65.3)	57.4 (49.0–64.0)	60.3 (32.6–83.8)	
No	41.6 (34.0–49.9)	42.5 (35.7–51.0)	36.9 (13.8–64.4)	0,091
Not Sure/No response	0.6 (0.0–1.7)	0.1 (0.0–0.6)	2.9 (0.0–9.6)	
Used a condom that did not fit your penis?				
Yes	24.1 (18.0–30.7)	26.3 (19.6–33.1)	12.4 (4.7–28.8)	
No	74.1 (67.3–80.0)	72.9 (65.9–79.4)	81.3 (59.9–91.6)	0.004

Table 3 (continued)

	Percentage (95% CI)[a], in%			
	Overall	HIV-	HIV+	p-value[b]
Not sure/no response	1.8 (0.7–3.7)	0.8 (0.0–2.6)	6.3 (1.3–16.1)	
Have you been tested for an STD other than HIV during the past 12 months?				
Yes	35.5 (27.4–44.6)	28.5 (22.3–36.2)	71.9 (47.2–85.8)	0.003
No	64.5 (55.4–72.6)	71.5 (63.8–77.8)	28.1 (14.3–53.2)	
Have you *ever* acquired or been diagnosed with the following STDs?				
Syphilis				
Yes	12.6 (8.6–17.2)	10.7 (6.3–15,0)	23.3 (11.9–47.0)	0.000
No	86.5 (81.3–90.6)	88.1 (83.3–92.8)	76.7 (54.0–88.0)	
Not Sure/No response	1.0 (0.0–2.9)	1.2 (0.1–3.0)	–	
Gonorrhea	12.7 (8.0–17.8)	11.7 (7.1–17.0)	17.7 (6.1–39.8)	0.139
Yes	86.9 (81.6–91.6)	87.9 (82.5–92.6)	82.3 (59.9–94.1)	
No	0,3 (0.0–1.7)	0.4 (0.0–1.5)	–	
Not Sure/No response				
Chlamydia				
Yes	2.4 (0.1–7.3)	2.6 (0.1–8.6)	0.1 (0.0–0.5)	0.999
No	97.0 (92.1–99.4)	96.6 (90.6–99.3)	99.9 (99.5–100.0)	
Not Sure/No response	0.7 (0.0–1.5)	0.8 (0.0–1.7)	–	
Anal or genital warts				
Yes	24.3 (17.3–33.4)	20.0 (14.1–28.4)	43.2 (17.2–71.0)	0.001
No	75.3 (66.0–82.1)	79.6 (71.0–85.5)	56.8 (28.8–82.8)	
Not Sure/No response	0.4 (0.0–1.7)	0.4 (0.0–1.5)	–	
Genital herpes				
Yes	4.6 (11–7.8)	4.0 (1.5–7.2)	7.0 (1.1–18.6)	0.124
No	95.0 (91.3–97.5)	95.6 (92.1–98.2)	93.0 (81.4–98.9)	
Not Sure/No response	0.4 (0.0–1.9)	0.4 (0.0–1.5)	–	
Have you ever been tested for HIV?				
Yes	79.5 (73.0–85.0)	75.9 (69.0–82.3)	95.7 (85.6–100.0)	0.001
No	20.5 (15.0–27.0)	24.1 (17.7–31.0)	4.3 (0.0–14.4)	
Have you been tested for HIV in the last 12 months? (n = 281)				
Yes	60.3 (47.2–68.8)	73.2 (62.4–79.0)	12.6 (4.9–27.6)	0.000
No	39.7 (31.5–52.7)	26.8 (20.9–37.5)	87.4 (72.6–95.1)	

[a]RD5 I/DC-generated estimator, CI bootstrap

[b]Fisher's exact test, null hypothesis of homogeneity between both groups (HIV + and HIV-) was applied

receive counseling (approximately 40%). The large proportion of MSM who rely on private health services for HIV testing reflects structural barriers to access to the public health system in Chile, especially for primary care. Given the large proportion of the national territory that the public system covers, it is important to improve sexual health services. Efforts should include increasing the availability of HIV and STI testing and providing training for healthcare professionals in topics related to sexual health such as pre- and post-test counseling. Increasing access to the public system would encourage linking to care and utilization of testing [38].

It is note worthy that 6.4% of the HIV-positive and 24.9% of the HIV-negative MSM received their HIV testing through a non-governmental organization. These organizations have been shown to be an effective tool for diagnosing HIV and other STI [39–41], due to their acceptance by the community, knowledge of the MSM culture and environment, availability of professionals who belong to the same community, and accessibility of pre- and post-test counseling [42]. These elements increase patient receptivity to sexual health messages, level of satisfaction with the services received, and rates of testing for HIV and other STIs.

Table 4 Access to diagnostic and counseling services among homosexual, bisexual, and other MSM in the MR of Santiago, Chile

	Percentage of population (%)
HIV-positive	
Where were you first diagnosed with HIV/AIDS?	
Public health facility	51.5
Private health facility	42.0
Non-governmental organization	6.4
When you were first diagnosed with HIV/AIDS, how satisfied were you with the confidentiality with which your information was treated?	
Very satisfied	37.4
Neutral	15.5
Very unsatisfied	45.4
Do not remember/Did not think about it	1.6
When you were first diagnosed with HIV/AIDS, how satisfied were you with the way that you were treated?	
Very satisfied	30.8
Neutral	17.5
Very unsatisfied	46.9
Do not remember/Did not think about it	4.8
When you were first diagnosed with HIV/AIDS, how satisfied were you with the counseling that you received?	
I did not receive counseling	35.0
I do not remember	0.5
Very satisfied	30.7
Unsatisfied	2.4
Very unsatisfied	31.4
HIV-negative	
Where have you been tested for HIV in the past 12 months?	
Public health facility	19.9
Private health facility	49.1
Non-governmental organization	24.9
Location outside of the country	3.1
Other	3.0
When you received the results of your HIV test, how satisfied were you with the counseling that you received?	
I did not receive counseling	45.2
I do not remember	3.6
Very satisfied	25.2
Satisfied	8.7
Neutral	4.2
Unsatisfied	0.5
Very unsatisfied	1.7
Not sure/no response	11.0

It is urgent that Chile develop public policies to fund NGOsthat address issues related toHIV, sexual rights, sexual diversity, and sexual health. Moreover, it is crucial to improve access to community-based testing and to enhance cooperative efforts between the NGOs to strengthening the networks on a national level. The international literature demonstrates the importance of systematizing the indicators used for community-based testing in the prevention and diagnoses HIV. Also, it is vital strengthen the social fabric of the community [39].

A total of 39.7% of the MSM had not been tested for HIV in the past 12 months. Having been tested for HIV within the past 12 months was a protective factor against HIV (OR = 0.09). It is likely that men who seek more regular HIV testing are more conscious of maintaining their sexual health. Interestingly, having been tested for other STIs

Table 5 Factors associated with HIV prevalence among homosexual, bisexual, and other MSM in the MR of Santiago, Chile

Variable/item	Category	OR (95% CI)
Age groups, in years (reference = 18–24)	25–34	1.26 (0.55–2.89)
	35–44	1.59 (0.60–4.24)
	45 and older	0.98 (0.20–4.76)
Socioeconomic level (reference = AB)±	C1a or C1b	0.99 (0.15–6.39)
	C2, C3, D, or E	1.11 (0.19–6.65)
	No data	1.46 (0.15–13.82)
Where did you meet your most recent sexual partner? (reference = Gay/bisexual website)	Mobile app	–
	Bar or other location	–
	Work or school	–
In the past 6 months, with how many (male) casual partners did you engage in anal penetration?	Continuous variable	–
In the past 6 months, how often did you use condoms when engaging in anal penetration with (male) casual partners? (reference = Never)	Half of the time	–
	Always	–
How many casual (male) partners have you had in your life whose HIV status you did not know at the time?	Continuous variable	–
Have you been tested for an STD other than HIV during the past 12 months?	1 = Yes; 0 = No	3.56 (1.55–8.15)*
Have you ever been tested for HIV?	1 = Yes; 0 = No	–
Have you been tested for HIV during the past 12 months?	1 = Yes; 0 = No	0.09 (0.04–0.24)**

*$p < 0.01$; **$p < 0.001$ f Multiple logistic regression model

± AS; upper or middle socioeconomic class; C1a and Cab: lower middle class; C2, C3, 0, **E:** lower class or indigent

increased the likelihood of having an HIV-positive status (OR = 3.56). On a national level, according to the most recent ENS [36] report, only 17.2% of Chileans reported having been tested for HIV during the past year. This figure represents a significant decline since the 2009–2010 ENS report, in which 28.8% of respondents reported that they had been tested. In Chile, access to testing is inadequate, both in groups with elevated exposure to HIV and within the general population.

The use of RDS in this study was successful. This sampling method was performed according to recommendations from the literature regarding studies involving social networks of MSM [10]. A total of 365 participants were recruited through 10 initial seeds, in 13 waves, over a period of 22 weeks. Therefore, the sampling method was both effective and efficient. The number of seeds, the size of the final sample, and the number of waves is within or above the range reported in other studies that have applied RDS [43].

This is the first study on HIV prevalence and associated risk factors in Chile to rigorously apply this sampling methodology, allowing for a sizeable sample and deep infiltration into the social networks of each initial seed. Because we were able to control for homophily, degree, and demographic variables, the estimates of HIV prevalence are likely representative of the target population. Moreover, application of this technique allowed the research group to strengthen our relationship with the participating social organizations and generated material that will be used to plan preventive interventions in the community.

The high prevalence of HIV documented in this study is consistent with a re-emergence of the disease in Chile, with cases concentrated among men who have sex with men between the ages of 25 and 44 years. This group has inadequate access to healthcare and testing within the public system. While 60% of study participants had been tested for HIV within the past year, ideally this percentage should be much greater, given the elevated levels of exposure to HIV and the large number of HIV-positive persons who remain undiagnosed within this population. Current prevention programs are insufficient and fail to reach the populations that need them most. Targeted prevention efforts are urgently needed as part of our national strategy to combat the spread of HIV, including community-based testing programs.

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Compliance with Ethical Standards

Conflict of interest Authors declare that they have no conflicts of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The project was approved by the Ethics Committee of the Faculty of Medicine of the University of Chile, approval No. 175-2014.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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