

RESEARCH ARTICLE

Prevalence and correlates of lifetime and recent HIV testing among men who have sex with men (MSM) who use mobile geo-social networking applications in Greater Tokyo

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Abstract

Men who have sex with men (MSM) are disproportionately burdened by the human immunodeficiency virus (HIV), accounting for 78% of all Japanese male HIV cases in 2016. Over 30% of newly identified HIV infections in Japan are diagnosed as AIDS annually, suggesting a large proportion of people living with HIV were unaware of their own infection status. An estimated two-thirds of Japanese men who have sex with men (MSM) are not attached to the gay community, and previous studies have largely sampled gay venues, thus, previous studies have likely failed to reach many men in this population. This study therefore examined HIV testing prevalence and correlates among MSM in Greater Tokyo who use gay mobile geo-social networking applications (gay mobile apps), which have been found to increase access to MSM not traditionally accessible through venue-based surveys. Among a sample of 1657 MSM recruited through advertisements on gay mobile apps, the prevalence of lifetime and six-monthly HIV testing was 72.8% and 29.7% respectively. In multiple regression analysis, higher lifetime HIV testing was associated with older age, education, HIV knowledge, anal intercourse with regular and casual male partners, and gay venue attendance. Testing was negatively associated with regular male partner condom use, marriage, residing outside central Tokyo and having both male and female partners. These results indicated that MSM who use gay mobile apps in Greater Tokyo do not meet the CDC yearly testing recommendations for high risk populations. Considering limited HIV prevention funding in Japan for MSM, moderate lifetime and recent testing, and the large number of gay mobile app users, utilization of popular gay mobile apps to promote nearby HIV testing facilities may be an effective prevention policy to target non-community attached MSM, particularly at-risk youth and individuals at risk of sudden-onset AIDS.

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Introduction

HIV testing is an essential component of HIV prevention. HIV testing has positive effects for both HIV prevention and care, and it is well documented that people who learn they are HIV-positive take preventive action to reduce the risk of transmission to others [1], and testing is associated with a 68% efficacy for lowering condomless anal intercourse (CLAI) in meta-analysis [2]. Testing is central to the UNAIDS 90-90-90 Targets, with the first of the goals being to diagnose 90% of all HIV-positive individuals by 2020 [3]. Moreover, testing is an essential prerequisite for effective treatment as prevention (TasP) strategies, in which all HIV-positive people are treated with anti-retroviral therapy (ART) to stop onward infection to future sexual partners [4,5], and has been found highly effective at preventing HIV transmission in serodiscordant couples in both heterosexual [4] and more recently, homosexual couples [6,7]. Frequent testing also reduces the likelihood of late diagnosis and the number of acquired immunodeficiency virus (AIDS) diagnoses.

Men who have sex with men (MSM) are estimated to make up between 4.0 to 4.6% of the male population in Japan, but are disproportionately burdened by the human immunodeficiency virus (HIV) [8,9,10], accounting for 78% of all Japanese male HIV cases, though this is likely to be higher due to underreporting of MSM transmission [11]. Although AIDS has become infrequent among MSM in Western developed nations such the UK [12], it remains a substantial health burden for MSM in Japan where over 30% of newly diagnosed HIV cases were reported as AIDS in 2016 (1,011 HIV and 437 AIDS) [13]. Moreover, this figure is likely to be underreported as some small healthcare centers, where approximately 40% of Japanese HIV tests take place, do not differentiate between HIV and AIDS and report all cases as HIV [14]. Furthermore, the volume of HIV tests in Japan has reduced by 35% from their peak of 177,000 in 2008 to 118,000 in 2016 due to fewer advertising campaigns and redirection of resources from HIV prevention to AIDS care, and the subsequent closure of free testing centres [15]. Considering the network of health services providing free testing and access to treatment in Greater Tokyo, HIV testing is still infrequent compared to other countries with similar services. From 2011 to 2014, one third (32%) of patients newly diagnosed with HIV went for voluntary testing; over half (53%) were reported due to presence of other diseases, unchanged from 2000 to 2004 [16].

Previous studies among Japanese MSM have focused on the gay community-attached MSM population using traditional venue-based sampling techniques. However, an estimated two-thirds of Japanese MSM are not attached to the gay community [17], thus, previous studies have likely failed to reach many men in this population. Because gay geo-social networking applications, henceforth referred to as gay mobile apps, have users who are both attached and non-community-attached, they have been found to increase access to MSM not traditionally accessible through venue-based surveys [18–22]. Gay mobile apps enable users to use global positioning systems (GPS) in mobile phones to search through a grid of nearby users based on their proximity, and to contact and meet nearby users, enabling MSM to encounter each other more quickly and easily [22,23]. Gay mobile apps have very quickly become one of the most popular ways to arrange sex among MSM globally [24] and in Japan [25]. Although Grindr is currently the most popular gay mobile application in the world with almost 3 million active daily users [26], Japanese application use varies significantly from the West. In 2017, the most used application was 9Monster, with 300,000 Japanese users as of April 2017 [27]. While gay internet use has been extensively researched [28], there is a distinct lack of research about MSM who use gay mobile apps outside the US, Australia, and China [29]. Existing research has shown gay mobile app users to have higher numbers of sexual partners [18,30], and higher rates of HIV testing [18,29] than non-app using MSM.

This research therefore utilizes a gay mobile app based cross-sectional survey to investigate the frequency and psychosocial correlates of lifetime and recent HIV testing and future testing intention among gay mobile app using MSM. Understanding testing rates and testing intention among this hard-to-reach population of gay mobile app using MSM improves our understanding of different MSM subgroups, and in doing so enables us to better profile the Japanese HIV epidemic and potentially tailor prevention strategies for different MSM populations.

Materials and methods

Recruitment

Subjects were recruited using the geo-location feature of gay mobile apps, similar to methods previously used to recruit Grindr users in the US [22,31]. Popular gay mobile apps were used (e.g. jack'd, Hornet, Grindr, 9Monster) that were used in a previous similar study recruiting MSM in Japan [32], and were recommended during piloting in order to gain access to the most MSM. Gay mobile apps use geo-location to sort users by proximity, with the users closest to the researcher displayed at the top of a grid of photos with 3–4 photos per row. The researcher was positioned in Tokyo centrally, launched the most popular in Japan and randomly selected one user from each row until 50 previously uncontacted users were messaged with a link to the survey each day. Recruitment messages consisting of a greeting and short message regarding the purpose of the survey and link were sent to gay mobile app users. Messages were logged by the app chat functions, hence previously messaged users were recorded and not messaged again. The survey was conducted between November 22nd 2015 to January 16th 2016, recruiting 215 valid respondents. Slow recruitment due to frequent social networking services (SNS) scamming in Japan [33], in which users are often messaged by fake accounts attempting to steal personal information, and subsequent potential recruitment bias in which many respondents would not reply, led to a change in recruitment strategy. Because an advertisement must be screened by app companies prior to its promotion in-app, this was deemed more trustworthy to potentially recruit more participants. A splash screen poster (a full-screen advertisement that appears when the user opens the app) encouraging application users to respond to the linked survey was placed on 9Monster, the most popular Japanese gay mobile app [27], for one week from January 17th to January 23rd, 2017 to supplement response numbers. This methodology was used previously with success in the US [19,21]. The advertisement was displayed only to MSM who used gay mobile apps in Greater Tokyo. It was shown in rotation whenever the application was opened, and could be seen in the 'advertising' section in Greater Tokyo, recruiting a further 1442 participants for a total of 1657 valid respondents. All survey participants were notified they could win prizes of up to 80 USD by random lottery, as well as receive a survey results report. In total, 1335 (80.6%) of participants applied for the lottery incentive and 964 (58.2%) applied for the survey results.

Only respondents of 18 years or older, who self-reported as MSM (defined as identifying as 'gay' or 'bisexual', or having sexual experience with other men), and who provided online consent to participate in the survey were included in results. Ethics approval was granted by the University of Melbourne Human Research Ethics Committee, ID: 1646197. This research project was reviewed and approved by the Ministry of Foreign Affairs and the University of the Ryukyus in Japan to obtain the necessary visa approvals in order to undertake this study as a foreign researcher. The survey was an anonymous self-administered online questionnaire. Duplicate IP addresses were checked, and responses that did not sufficiently complete the questionnaire were removed. Participation was voluntary and there were no consequences for electing not to participate. All participants were provided with the details for local MSM

helplines at the conclusion of the survey. The survey was translated into Japanese and back-translated into English by an independent Japanese native translator.

Study measures

Socio-demographic characteristics of participants was determined by 12 items previously used in Japan [34], including age, gender, sexual orientation, marital status, birthplace, current residence, length of residence in Greater Tokyo, self-rated health, education, occupation, work hours, and intercourse partner sex. Gay mobile app use motivations were defined as 'to find sex', 'to find friends', 'to find a serious relationship', or 'to avoid being identified as gay'. Gay community participation measured years and frequency of gay bar and gay event attendance, frequency of gay bathhouse (*hattenba*) attendance, organized gay group activity participation in past six-months (defined as participation in a gay political or social meeting, community event such as a parade, party, fair, or volunteer activity), and identity as a gay community member. Respondents were asked three questions regarding HIV testing: ever having had an HIV test, having had an HIV test in the previous six months, and intention to get tested in the future (all with 'yes' or 'no' response options). 'Recent testing' was defined as testing within the previous six months. Respondents were asked frequency of lifetime condom use during penetrative or receptive anal intercourse with regular partners (defined as a boyfriend or committed romantic relationship), casual male partners (defined as a sex friend, 'fuck buddy', or any self-defined non-committed sexual relationship with a male partner), and sex with female partners. Lifetime condom use frequency was recorded as 'never', 'rarely', 'most of the time', and 'always'. Following previous studies, low condom use was defined as 'never use condoms' or 'rarely use condoms', while high condom use was defined as 'always use condoms' and 'use condoms most of the time' [35]. Lifetime condom use analyses excluded those who did not have intercourse with each respective partner type.

Statistical analysis

Data were analyzed using SPSS version 24. Descriptive statistics were used to describe all variables. We used multivariate binary regression analysis to examine the correlates of lifetime and recent HIV testing as well as future HIV testing intentions. The enter method was used and variables with unadjusted odds ratios yielding p-values of 0.05 or less were considered eligible for the multivariate model. Unadjusted and adjusted odds ratios with their respective 95% confidence intervals and p-values are reported in the tables.

Results

Socio-demographic characteristics

The socio-demographic characteristics of the sample are displayed in [Table 1](#). Over half (53.4%) resided in the 23 wards of central Tokyo, and almost all (96.3%) respondents were born in Japan. The mean age was 35 and the vast majority were single (95.6%). They were well educated, with 58.1% completing university or a postgraduate degree. Nearly three-quarters (73.9%) were employed fulltime, and 4.2% were unemployed. There was high gay (85.1%) and bisexual (14.1%) identification, while 8.9% had both male and female sex partners. Just over half of participants had ever attended a gay bar (56.8%), just under half (47.6%) had ever attended a *hattenba* (gay bathhouse), and one-tenth (13.2%) participated in a gay group activity in the past six months.

Table 1. Socio-demographic characteristics.

| | | n | % |
|-------------------------|---------------------------|------|-------|
| Current residence | Tokyo | 883 | 53.4 |
| | Greater Tokyo | 553 | 33.4 |
| | Another prefecture | 209 | 12.6 |
| | Another country | 8 | 0.5 |
| | Total | 1653 | 100.0 |
| Birthplace | Japan | 1593 | 96.3 |
| | Other | 62 | 3.7 |
| | Total | 1655 | 100.0 |
| Age | 18–25 | 319 | 19.4 |
| | 26–35 | 550 | 33.4 |
| | 36–45 | 507 | 30.8 |
| | 46+ | 270 | 16.4 |
| | Total | 1646 | 100.0 |
| Gender | Male | 1641 | 99.2 |
| | Other | 14 | 0.8 |
| | Total | 1655 | 100.0 |
| Marital status | No | 1582 | 95.6 |
| | Yes | 72 | 4.4 |
| | Total | 1654 | 100.0 |
| Occupation | Full-time | 1133 | 68.5 |
| | Part-time | 185 | 11.2 |
| | Student | 168 | 10.2 |
| | Self-employed | 73 | 4.4 |
| | Freelance | 16 | 1.0 |
| | Unemployed | 69 | 4.2 |
| | Other | 9 | 0.5 |
| | Total | 1653 | 100.0 |
| Education | High school or less | 421 | 25.4 |
| | Two-year technical school | 274 | 16.5 |
| | University | 800 | 48.3 |
| | M.A. | 135 | 8.2 |
| | PhD | 26 | 1.6 |
| | Total | 1656 | 100.0 |
| Intercourse partner sex | Men | 1488 | 91.1 |
| | Men and women | 146 | 8.9 |
| | Total | 1634 | 100 |
| Sexuality | Homosexual | 1408 | 85.1 |
| | Bisexual | 233 | 14.1 |
| | Other | 14 | 0.8 |
| | Total | 1655 | 100 |
| Health | Healthy | 1056 | 63.9 |
| | Fair or poor health | 598 | 36.1 |
| | Total | 1654 | 100 |

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HIV prevention characteristics

Table 2 shows levels of HIV testing, lifetime condom use, and information sources. Almost three-quarters of respondents (72.8%) ever tested for HIV. Less than one-third (29.7%) had

Table 2. HIV prevention characteristics.

| | | n | % |
|--------------------------------------------------------------------------------------------------------------|---------------------------------------|------|------|
| Have you ever been tested for HIV? | No | 448 | 27.2 |
| | Yes | 1199 | 72.8 |
| | Total | 1647 | 100 |
| Have you been tested for HIV in the last six months? | No | 1148 | 70.3 |
| | Yes | 484 | 29.7 |
| | Total | 1632 | 100 |
| Are you planning on getting tested for HIV in the future? | No | 194 | 11.8 |
| | Yes | 1447 | 88.2 |
| | Total | 1641 | 100 |
| How often do you use a condom with a regular (penetrative and receptive anal sex) male partner? ^a | No anal sex with regular male partner | 246 | 14.9 |
| | Never | 217 | 15.5 |
| | Rarely | 302 | 21.5 |
| | Most of the time | 443 | 31.6 |
| | Always | 442 | 31.5 |
| | Total | 1404 | 100 |
| How often do you use a condom with casual (penetrative and receptive anal sex) male partners? ^b | No anal sex with casual male partner | 318 | 19.3 |
| | Never | 35 | 2.6 |
| | Rarely | 197 | 14.8 |
| | Most of the time | 490 | 36.8 |
| | Always | 609 | 45.8 |
| | Total | 1331 | 100 |
| How often do you use a condom with female (penetrative and anal sex) partners? ^c | No sex with female partner | 1358 | 82.6 |
| | Never | 29 | 10.1 |
| | Rarely | 28 | 9.8 |
| | Most of the time | 68 | 23.8 |
| | Always | 161 | 56.3 |
| | Total | 286 | 100 |
| Whose advice about practicing safe sex would you be most likely to follow? | Doctor | 630 | 38.3 |
| | Regular sex partner | 159 | 9.7 |
| | Non-regular sex partner | 20 | 1.2 |
| | Internet resource | 273 | 16.6 |
| | Government agency | 136 | 8.3 |
| | LGBT Community Centre | 418 | 25.4 |
| | Friend | 9 | 0.5 |
| | Other | 2 | 0.1 |
| | Total | 1647 | 100 |
| HIV /AIDS information sources | School education | 370 | 22.3 |
| | Hospital pamphlet | 329 | 19.9 |
| | Gay internet resource | 1441 | 87.0 |
| | Government internet resource | 255 | 15.4 |
| | Friend | 435 | 26.3 |
| | Gay bar | 316 | 19.1 |
| | Television/newspaper | 366 | 22.1 |
| | Gay magazine | 570 | 34.4 |
| | Family | 13 | 0.8 |
| | Sex Partner | 118 | 7.1 |
| Total | 1656 | 100 | |

^a analysis based on a subsample of 1404 people who have anal sex with a regular partner

^b analysis based on a subsample of 1331 people who have anal sex with a casual partner

^c analysis based on a subsample of 286 people who have sex with women

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been tested in the past six months. However, the vast majority of the sample (88.2%) reported that they intended to obtain a test in the future. About one-third of those engaging in lifetime condomless anal intercourse (CLAI) with regular (31.5%) and casual (30.7%) male partners, and one-quarter engaging in condomless sex with female partners (23.6%), had been tested within the past six months. Among participants who had been tested for HIV in their lifetimes, over two-thirds (69.4%) engaged in CLAI with regular male partners, 54.1% engaged in CLAI with casual male partners, and 42.9% had condomless sex with female partners. Similarly, MSM who had never been tested for HIV engaged in risk-taking sexual behaviors: among participants who had never been tested, almost two-thirds (65.5%) engaged in CLAI with regular male partners, over half (54.8%) engaged in CLAI with casual male partners, and 44.4% had condomless sex with female partners. One-fifth (20%) of those never tested had no intention of undertaking future HIV testing. MSM aged 18–25 years had the lowest lifetime HIV testing (50%) and lowest rate of HIV testing in the past six-months (24.7%).

Gay internet resources were by far the leading source of HIV information, providing 87.0% of respondents with HIV/AIDS information. School education provided less than a quarter (22.3%) of respondents with HIV/AIDS information. Younger respondents were more likely to have been provided HIV/AIDS information at school, and half of respondents (49.5%) under 25, were provided with HIV/AIDS information in their school education compared to around a quarter (28.5%) of respondents aged 26–35, and less than 10% of respondents aged over 36. Despite gay internet resources providing the most HIV/AIDS information, respondents were most likely to follow a doctors' advice about practicing safe sex (38.3%), followed by LGBT community centers (25.4%), compared to 16.6% for gay internet resources. There was low trust in government agencies; less than one-tenth (8.3%) of respondents would follow a Japanese government agency's advice about safe sex.

Correlates of lifetime HIV testing

The prevalence of lifetime HIV testing and binary logistic regression models examining the correlates of lifetime HIV testing are presented in [Table 3](#). There were 17 variables in the univariate regression with significant p-values of under 0.05. The final multivariate logistic regression model showed that the odds of having ever been tested for HIV were higher among MSM who were older, educated, HIV knowledgeable, out to close friends, who had ever attended a gay bar or event, *hattenba*, or participated in gay community activities in the past six-months, and had sex with regular or casual male partners. Lifetime HIV testing odds were lower among participants who: were students; were self-employed; were married; were residing outside of Greater Tokyo; were using gay mobile apps in order to avoid being identified as gay; also had female sex partners; and, who reported high condom use with regular male partners.

Correlates of recent HIV testing

The prevalence and univariate and multivariate logistic regression models examining the correlates of HIV testing in the past six-months are presented in [Table 4](#). The final multivariate logistic regression model showed recent HIV testing odds were higher among MSM who attended *hattenba* (AOR, 1.30; 95% CI, 1.03–1.65), and who have a regular male partner (AOR, 1.85; 95% CI, 1.25–2.72).

Correlates of future HIV testing intent

The prevalence and univariate and multivariate logistic regression models examining the correlates of future HIV testing intent are presented in [Table 5](#). The final multivariate logistic

Table 3. Multivariate logistic regression for lifetime HIV testing.

| | Number of respondents (n) | % Reporting Lifetime HIV Testing | Unadjusted Odds Ratio (95% C.I.) | p-Value | Adjusted Odds Ratio (95% C.I.) | p-Value |
|-------------------------------------------------------------|---------------------------|----------------------------------|----------------------------------|---------|--------------------------------|---------|
| <i>Age (years)</i> | | | | | | |
| 18–25 | 316 | 52.2 | REF | | | |
| 26–35 | 550 | 74.0 | 1.60 (1.39–1.85) | 0.000 | 1.37 (1.14–1.64) | 0.001 |
| 36–45 | 506 | 80.4 | 1.55 (1.40–1.72) | 0.000 | 1.43 (1.25–1.64) | 0.000 |
| 46+ | 266 | 80.5 | 1.39 (1.26–1.52) | 0.000 | 1.36 (1.21–1.54) | 0.000 |
| <i>Place of Birth</i> | | | | | | |
| Japan | 1584 | 72.8 | 0.99 (0.56–0.17) | 0.969 | | |
| Other | 62 | 72.6 | REF | | | |
| <i>Education</i> | | | | | | |
| High School or less | 416 | 64.7 | REF | | | |
| 2 year university | 272 | 72.8 | 1.10 (1.01–1.20) | 0.026 | 1.02 (0.93–1.12) | 0.724 |
| University | 799 | 75.3 | 1.67 (1.29–2.16) | 0.000 | 1.44 (1.06–1.95) | 0.020 |
| Graduate degree | 160 | 81.3 | 2.37 (1.52–3.7) | 0.000 | 2.00 (1.20–3.33) | 0.008 |
| <i>Employment</i> | | | | | | |
| Full-time work | 1131 | 76.7 | REF | | | |
| Part-time work | 183 | 68.3 | 0.66 (0.47–0.92) | 0.015 | 0.76 (0.51–1.13) | 0.178 |
| Student | 167 | 50.3 | 0.31 (0.22–0.43) | 0.000 | 0.63 (0.40–1.00) | 0.048 |
| Self-employed | 96 | 69.8 | 0.70 (0.44–1.11) | 0.129 | 0.52 (0.32–0.86) | 0.010 |
| Unemployed | 68 | 79.4 | 1.17 (0.64–2.14) | 0.607 | 1.29 (0.65–2.56) | 0.468 |
| <i>Current marital status</i> | | | | | | |
| Single | 1574 | 73.3 | REF | | | |
| Married | 72 | 61.1 | 0.57 (0.35–0.93) | 0.024 | 0.51 (0.29–0.92) | 0.025 |
| <i>Current residence</i> | | | | | | |
| Central Tokyo | 880 | 76.9 | REF | | | |
| Greater Tokyo | 549 | 69.0 | 0.67 (0.52–0.85) | 0.001 | 0.87 (0.67–1.14) | 0.323 |
| Other prefecture | 207 | 63.8 | 0.53 (0.38–0.73) | 0.000 | 0.67 (0.47–0.97) | 0.034 |
| <i>Intercourse partners</i> | | | | | | |
| Only men | 1480 | 75.1 | REF | | | |
| Both men and women | 146 | 56.2 | 0.43 (0.30–0.61) | 0.000 | 0.90 (0.54–1.49) | 0.688 |
| <i>Health</i> | | | | | | |
| Healthy | 1052 | 72.1 | 0.89 (0.71–1.12) | 0.311 | | |
| Fair/poor health | 593 | 74.4 | REF | | | |
| <i>Out to close friends</i> | | | | | | |
| No | 667 | 66.6 | REF | | | |
| Yes | 961 | 77.1 | 1.69 (1.36–2.11) | 0.000 | 1.57 (1.21–2.03) | 0.001 |
| <i>Identify as a member of the gay community</i> | | | | | | |
| No | 1360 | 74.3 | REF | | | |
| Yes | 276 | 65.2 | 1.54 (1.17–2.03) | 0.002 | 1.14 (0.83–1.56) | 0.419 |
| <i>Use gay mobile apps for sex</i> | | | | | | |
| No | 634 | 68.9 | REF | | | |
| Yes | 1006 | 75.3 | 1.38 (1.11–1.72) | 0.004 | 1.05 (0.8–1.37) | 0.729 |
| <i>Use gay mobile apps to find friends</i> | | | | | | |
| No | 400 | 74.0 | REF | | | |
| Yes | 1232 | 72.6 | 0.93 (0.72–1.21) | 0.596 | | |
| <i>Use gay mobile apps to avoid being identified as gay</i> | | | | | | |
| No | 1493 | 73.7 | REF | | | |

(Continued)

Table 3. (Continued)

| | Number of respondents (n) | % Reporting Lifetime HIV Testing | Unadjusted Odds Ratio (95% C.I.) | p-Value | Adjusted Odds Ratio (95% C.I.) | p-Value |
|------------------------------------------------------------------------------|---------------------------|----------------------------------|----------------------------------|---------|--------------------------------|---------|
| Yes | 131 | 60.3 | 0.54 (0.37–0.78) | 0.001 | 0.65 (0.43–1.00) | 0.048 |
| <i>Use gay mobile apps to find a serious relationship</i> | | | | | | |
| No | 763 | 74.8 | REF | | | |
| Yes | 866 | 71.1 | 0.83 (0.67–1.03) | 0.094 | | |
| <i>Ever attended A gay bar</i> | | | | | | |
| No | 710 | 61.3 | REF | | | |
| Yes | 931 | 81.8 | 2.85 (2.28–3.57) | 0.000 | 1.58 (1.21–2.05) | 0.001 |
| <i>Recent participation in gay group/community or volunteer activities</i> | | | | | | |
| No | 1425 | 70.9 | REF | | | |
| Yes | 218 | 85.3 | 2.38 (1.61–3.52) | 0.000 | 1.59 (1.02–2.47) | 0.040 |
| <i>Hattenba attendance</i> | | | | | | |
| No | 858 | 64.9 | REF | | | |
| Yes | 783 | 81.5 | 2.38 (1.89–2.99) | 0.000 | 1.53 (1.17–1.99) | 0.002 |
| <i>HIV Knowledge: Having other STIs doesn't increase chance of infection</i> | | | | | | |
| Correct | 1505 | 74.0 | REF | | | |
| Incorrect | 130 | 58.5 | 2.02 (1.40–2.92) | 0.000 | 1.60 (1.04–2.45) | 0.033 |
| <i>Anal sex with regular male partners</i> | | | | | | |
| No | 244 | 57.4 | REF | | | |
| Yes | 1399 | 75.6 | 2.31 (1.74–3.05) | 0.000 | 2.00 (1.39–2.86) | 0.000 |
| <i>Anal sex with casual male partners</i> | | | | | | |
| No | 317 | 57.0 | REF | | | |
| Yes | 1325 | 76.5 | 2.37 (1.84–3.06) | 0.000 | 1.51 (1.08–2.13) | 0.016 |
| <i>Sex with female partners</i> | | | | | | |
| No | 1352 | 75.7 | REF | | | |
| Yes | 285 | 58.9 | 0.46 (0.35–0.60) | 0.000 | 0.66 (0.45–0.99) | 0.042 |
| <i>Condom use with regular male partners^a</i> | | | | | | |
| Low | 516 | 79.3 | REF | | | |
| High | 883 | 73.4 | 0.72 (0.56–0.94) | 0.014 | 0.72 (0.54–0.96) | 0.026 |
| <i>Condom use with casual male partners^b</i> | | | | | | |
| Low | 231 | 75.8 | REF | | | |
| High | 1094 | 76.6 | 1.05 (0.75–1.46) | | | |
| <i>Condom use with female partners^c</i> | | | | | | |
| Low | 56 | 55.4 | REF | | | |
| High | 229 | 59.8 | 1.20 (0.67–2.17) | | | |

^a analysis based on a subsample of 1404 people who have anal sex with a regular partner; Low condom use = never/rarely use a condom; High condom use = most of the time/always use a condom

^b analysis based on a subsample of 1331 people who have anal sex with a casual partner; Low condom use = never/rarely use a condom; High condom use = most of the time/always use a condom

^c analysis based on a subsample of 286 people who have sex with women; Low condom use = never/rarely use a condom; High condom use = most of the time/always use a condom

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regression model showed future HIV testing intention odds were higher among MSM who attend gay bars (AOR, 1.47; 95% CI, 1.06–2.05), use gay mobile apps to find friends (AOR 1.58; 95% CI, 1.12–2.22), are healthy (AOR 1.46; 95% CI, 1.06–2.03), have a regular sex partner (AOR, 2.01; 95% CI, 1.31–3.10), and who engage in high condom use with casual male

Table 4. Multivariate logistic regression for recent HIV testing.

| | Number of respondents (n) | % Reporting Recent HIV Testing | Unadjusted Odds Ratio (95% C.I.) | p-Value | Adjusted Odds Ratio (95% C.I.) | p-Value |
|------------------------------------------------------|---------------------------|--------------------------------|----------------------------------|---------|--------------------------------|---------|
| <i>Age (years)</i> | | | | | | |
| 18–25 | 316 | 24.7 | REF | | | |
| 26–35 | 545 | 33.0 | 1.24 (1.06–1.45) | 0.007 | 1.15 (0.96–1.39) | 0.137 |
| 36–45 | 498 | 30.9 | 1.12 (1.01–1.24) | 0.040 | 1.07 (0.94–1.22) | 0.296 |
| 46+ | 264 | 26.9 | 1.04 (0.94–1.14) | 0.474 | 1.00 (0.89–1.12) | 0.979 |
| <i>Place of Birth</i> | | | | | | |
| Japan | 1570 | 29.3 | 0.66 (0.39–1.11) | 0.114 | | |
| Other | 61 | 39.3 | REF | | | |
| <i>Education</i> | | | | | | |
| High School or less | 415 | 26.7 | REF | | | |
| 2 year university | 269 | 25.3 | 0.98 (0.90–1.07) | 0.670 | 0.96 (0.87–1.05) | 0.340 |
| University | 790 | 31.4 | 1.25 (0.96–1.63) | 0.094 | 1.13 (0.85–1.51) | 0.395 |
| Graduate degree | 158 | 36.1 | 1.55 (1.05–2.29) | 0.029 | 1.40 (0.92–2.12) | 0.120 |
| <i>Employment</i> | | | | | | |
| Full-time work | 1115 | 31.3 | REF | | | |
| Part-time work | 182 | 28.0 | 0.85 (0.60–1.20) | 0.358 | 0.87 (0.60–1.28) | 0.484 |
| Student | 168 | 24.4 | 0.71 (0.49–1.02) | 0.066 | 0.91 (0.57–1.45) | 0.700 |
| Self-employed | 97 | 21.6 | 0.60 (0.37–0.99) | 0.047 | 0.61 (0.36–1.02) | 0.059 |
| Unemployed | 68 | 29.4 | 0.91 (0.53–1.56) | 0.728 | 1.02 (0.58–1.79) | 0.943 |
| <i>Current marital status</i> | | | | | | |
| Single | 1560 | 29.7 | REF | | | |
| Married | 71 | 29.6 | 1.00 (0.59–1.68) | 0.985 | | |
| <i>Current residence</i> | | | | | | |
| Central Tokyo | 871 | 32.5 | REF | | | |
| Greater Tokyo | 544 | 27.8 | 0.80 (0.63–1.01) | 0.060 | 0.94 (0.73–1.20) | 0.605 |
| Other prefecture | 206 | 22.3 | 0.60 (0.42–0.85) | 0.005 | 0.69 (0.48–1.01) | 0.056 |
| <i>Intercourse partners</i> | | | | | | |
| Only men | 1468 | 31.0 | REF | | | |
| Both men and women | 143 | 19.6 | 0.55 (0.36–0.84) | 0.005 | 0.68 (0.39–1.17) | 0.165 |
| <i>Health</i> | | | | | | |
| Healthy | 1045 | 29.8 | 1.01 (0.81–1.26) | 0.936 | | |
| Fair/poor health | 585 | 29.6 | REF | | | |
| <i>Out to close friends</i> | | | | | | |
| No | 662 | 25.8 | REF | | | |
| Yes | 951 | 32.2 | 1.36 (1.09–1.70) | 0.006 | 1.21 (0.95–1.53) | 0.119 |
| <i>Identify as a member of the gay community</i> | | | | | | |
| No | 274 | 25.9 | REF | | | |
| Yes | 1347 | 30.3 | 1.24 (0.93–1.67) | 0.148 | | |
| <i>Use gay apps for sex</i> | | | | | | |
| No | 627 | 25.8 | REF | | | |
| Yes | 998 | 32.2 | 1.36 (1.09–1.70) | 0.007 | 1.18 (0.92–1.50) | 0.188 |
| <i>Use gay apps to find friends</i> | | | | | | |
| No | 398 | 27.9 | REF | | | |
| Yes | 1219 | 30.3 | 1.12 (0.87–1.44) | 0.367 | | |
| <i>Use gay apps to avoid being identified as gay</i> | | | | | | |
| No | 1497 | 30.1 | REF | | | |

(Continued)

Table 4. (Continued)

| | Number of respondents (n) | % Reporting Recent HIV Testing | Unadjusted Odds Ratio (95% C.I.) | p-Value | Adjusted Odds Ratio (95% C.I.) | p-Value |
|------------------------------------------------------------------------------|---------------------------|--------------------------------|----------------------------------|---------|--------------------------------|---------|
| Yes | 130 | 26.2 | 0.82 (0.55–1.24) | 0.348 | | |
| <i>Use gay apps to find a serious relationship</i> | | | | | | |
| No | 760 | 28.7 | REF | | | |
| Yes | 854 | 30.7 | 1.10 (0.89–1.36) | 0.382 | | |
| <i>Ever attended A gay bar</i> | | | | | | |
| No | 704 | 24.6 | REF | | | |
| Yes | 922 | 33.6 | 1.56 (1.25–1.94) | 0.000 | 1.19 (0.93–1.52) | 0.174 |
| <i>Recent participation in gay group/community or volunteer activities</i> | | | | | | |
| No | 1412 | 28.4 | REF | | | |
| Yes | 216 | 37.5 | 1.51 (1.12–2.04) | 0.007 | 1.25 (0.90–1.72) | 0.179 |
| <i>Hattenba attendance</i> | | | | | | |
| No | 852 | 25.5 | REF | | | |
| Yes | 774 | 34.2 | 1.52 (1.23–1.89) | 0.000 | 1.30 (1.03–1.65) | 0.030 |
| <i>HIV Knowledge: Having other STIs doesn't increase chance of infection</i> | | | | | | |
| Correct | 1493 | 30.2 | REF | | | |
| Incorrect | 128 | 23.4 | 1.41 (0.93–2.16) | 0.109 | | |
| <i>Anal sex with regular male partners</i> | | | | | | |
| No | 242 | 17.8 | REF | | | |
| Yes | 1387 | 31.7 | 2.12 (1.50–3.00) | 0.000 | 1.85 (1.25–2.72) | 0.002 |
| <i>Anal sex with casual male partners</i> | | | | | | |
| No | 313 | 21.4 | REF | | | |
| Yes | 1315 | 31.6 | 1.69 (1.27–2.27) | 0.000 | 1.02 (0.72–1.45) | 0.890 |
| <i>Vaginal sex with female partners</i> | | | | | | |
| No | 1341 | 30.9 | REF | | | |
| Yes | 281 | 23.1 | 0.70 (0.50–0.90) | 0.009 | 0.90 (0.60–1.33) | 0.583 |
| <i>Condom use with regular male partners^a</i> | | | | | | |
| Low | 514 | 31.1 | REF | | | |
| High | 873 | 32.1 | 1.05 (0.83–1.32) | 0.715 | | |
| <i>Condom use with casual male partners^b</i> | | | | | | |
| Low | 227 | 30.8 | REF | | | |
| High | 1088 | 31.8 | 1.05 (0.77–1.43) | 0.776 | | |
| <i>Condom use with female partners^c</i> | | | | | | |
| Low | 56 | 21.4 | REF | | | |
| High | 225 | 23.6 | 1.13 (0.56–2.30) | 0.736 | | |

^a analysis based on a subsample of 1387 people who have anal sex with a regular partner; Low condom use = never/rarely use a condom; High condom use = most of the time/always use a condom

^b analysis based on a subsample of 1315 people who have anal sex with a casual partner; Low condom use = never/rarely use a condom; High condom use = most of the time/always use a condom

^c analysis based on a subsample of 281 people who have sex with women; Low condom use = never/rarely use a condom; High condom use = most of the time/always use a condom

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partners (AOR, 2.09; 95% CI, 1.38–3.18). Lower odds of intention of future HIV testing was associated with respondents who were married (AOR, 0.45; 95% CI, 0.24–0.85), and attended *hattenba* (AOR, 0.64; 95% CI, 0.46–0.90).

Table 5. Multivariate logistic regression for future HIV testing intent.

| | Number of respondents (n) | % Reporting Future HIV Testing Intent | Unadjusted Odds Ratio (95% C.I.) | p-Value | Adjusted Odds Ratio (95% C.I.) | p-Value |
|------------------------------------------------------|---------------------------|---------------------------------------|----------------------------------|---------|--------------------------------|---------|
| <i>Age (years)</i> | | | | | | |
| 18–25 | 318 | 90.6 | REF | | | |
| 26–35 | 546 | 90.1 | 0.98 (0.77–1.23) | 0.843 | 1.06 (0.80–1.40) | 0.682 |
| 36–45 | 503 | 87.3 | 0.90 (0.77–1.04) | 0.153 | 0.97 (0.81–1.17) | 0.770 |
| 46+ | 265 | 83.0 | 0.85 (0.75–0.96) | 0.007 | 0.93 (0.80–1.08) | 0.327 |
| <i>Place of Birth</i> | | | | | | |
| Japan | 1579 | 88.0 | 0.65 (0.256–1.63) | 0.354 | | |
| Other | 61 | 91.8 | REF | | | |
| <i>Education</i> | | | | | | |
| High School or less | 418 | 86.1 | REF | | | |
| 2 year university | 270 | 87.4 | 1.03 (0.92–1.15) | 0.629 | 1.04 (0.92–1.18) | 0.495 |
| University | 793 | 88.5 | 1.24 (0.87–1.77) | 0.227 | 1.21 (0.82–1.79) | 0.341 |
| Graduate degree | 160 | 93.1 | 2.18 (1.11–4.27) | 0.023 | 2.01 (1.00–4.07) | 0.051 |
| <i>Employment</i> | | | | | | |
| Full-time work | 1122 | 88.1 | REF | | | |
| Part-time work | 185 | 85.4 | 0.79 (0.50–1.23) | 0.289 | 0.94 (0.57–1.55) | 0.797 |
| Student | 167 | 94.0 | 2.11 (1.08–4.10) | 0.028 | 1.78 (0.81–3.92) | 0.152 |
| Self-employed | 97 | 84.5 | 0.73 (0.41–1.31) | 0.295 | 0.77 (0.42–1.41) | 0.393 |
| Unemployed | 68 | 86.8 | 0.88 (0.43–1.82) | 0.729 | 1.14 (0.53–2.45) | 0.746 |
| <i>Current marital status</i> | | | | | | |
| Single | 1568 | 88.8 | REF | | | |
| Married | 72 | 73.6 | 0.35 (0.20–0.60) | 0.000 | 0.45 (0.24–0.85) | 0.013 |
| <i>Current residence</i> | | | | | | |
| Central Tokyo | 877 | 87.5 | REF | | | |
| Greater Tokyo | 547 | 90.1 | 1.30 (0.92–1.84) | 0.131 | | |
| Other prefecture | 206 | 85.4 | 0.84 (0.54–1.23) | 0.427 | | |
| <i>Intercourse partners</i> | | | | | | |
| Only men | 1475 | 88.7 | REF | | | |
| Both men and women | 146 | 89.7 | 1.13 (0.65–2.00) | 0.677 | | |
| <i>Health</i> | | | | | | |
| Healthy | 1048 | 90.0 | 1.57 (1.16–2.13) | 0.003 | 1.46 (1.06–2.03) | 0.022 |
| Fair/poor health | 591 | 85.1 | REF | | | |
| <i>Out to close friends</i> | | | | | | |
| No | 661 | 87.6 | REF | | | |
| Yes | 961 | 88.6 | 1.10 (0.81–1.49) | 0.557 | | |
| <i>Identify as a member of the gay community</i> | | | | | | |
| No | 272 | 88.6 | REF | | | |
| Yes | 1358 | 88.1 | 0.95 (0.63–1.43) | 0.804 | | |
| <i>Use gay apps for sex</i> | | | | | | |
| No | 553 | 87.6 | REF | | | |
| Yes | 889 | 88.6 | 1.10 (0.81–1.50) | 0.543 | | |
| <i>Use gay apps to find friends</i> | | | | | | |
| No | 398 | 83.9 | REF | | | |
| Yes | 1228 | 89.7 | 1.68 (1.21–2.32) | 0.002 | 1.58 (1.12–2.22) | 0.009 |
| <i>Use gay apps to avoid being identified as gay</i> | | | | | | |
| No | 1487 | 88.2 | REF | | | |

(Continued)

Table 5. (Continued)

| | Number of respondents (n) | % Reporting Future HIV Testing Intent | Unadjusted Odds Ratio (95% C.I.) | p-Value | Adjusted Odds Ratio (95% C.I.) | p-Value |
|------------------------------------------------------------------------------|---------------------------|---------------------------------------|----------------------------------|---------|--------------------------------|---------|
| Yes | 131 | 88.5 | 1.04 (0.59–1.82) | 0.896 | | |
| <i>Use gay apps to find a serious relationship</i> | | | | | | |
| No | 763 | 86.2 | REF | | | |
| Yes | 860 | 90.1 | 1.46 (1.07–1.97) | 0.016 | 1.15 (0.83–1.59) | 0.402 |
| <i>Ever attended A gay bar</i> | | | | | | |
| No | 704 | 86.1 | REF | | | |
| Yes | 931 | 89.8 | 1.42 (1.05–1.92) | 0.022 | 1.47 (1.06–2.05) | 0.022 |
| <i>Recent participation in gay group/community or volunteer activities</i> | | | | | | |
| No | 1420 | 88.0 | REF | | | |
| Yes | 217 | 88.9 | 1.09 (0.70–1.72) | 0.699 | | |
| <i>Hattenba attendance</i> | | | | | | |
| No | 885 | 90.2 | REF | | | |
| Yes | 780 | 86.0 | 0.67 (0.50–0.91) | 0.010 | 0.64 (0.46–0.90) | 0.011 |
| <i>HIV Knowledge: Having other STIs doesn't increase chance of infection</i> | | | | | | |
| Correct | 1500 | 88.1 | REF | | | |
| Incorrect | 129 | 89.9 | 0.83 (0.46–1.51) | 0.545 | | |
| <i>Anal sex with regular male partners</i> | | | | | | |
| No | 243 | 79.0 | REF | | | |
| Yes | 1395 | 89.7 | 2.29 (1.61–3.26) | 0.000 | 2.01 (1.31–3.10) | 0.001 |
| <i>Anal sex with casual male partners</i> | | | | | | |
| No | 315 | 83.5 | REF | | | |
| Yes | 1322 | 89.3 | 1.62 (1.15–2.28) | 0.006 | 1.32 (0.85–2.06) | 0.211 |
| <i>Vaginal sex with female partners</i> | | | | | | |
| No | 1347 | 88.4 | REF | | | |
| Yes | 285 | 86.7 | 0.85 (0.58–1.24) | 0.385 | | |
| <i>Condom use with regular male partners^a</i> | | | | | | |
| Low | 516 | 90.1 | REF | | | |
| High | 879 | 89.5 | 0.94 (0.65–1.35) | 0.729 | | |
| <i>Condom use with casual male partners^b</i> | | | | | | |
| Low | 230 | 80.4 | REF | | | |
| High | 1092 | 91.1 | 2.50 (1.70–3.67) | 0.000 | 2.09 (1.38–3.18) | 0.001 |
| <i>Condom use with female partners^c</i> | | | | | | |
| Low | 57 | 80.7 | REF | | | |
| High | 228 | 88.2 | 1.78 (0.82–3.85) | 0.143 | | |

^a analysis based on a subsample of 1395 people who have anal sex with a regular partner; Low condom use = never/rarely use a condom; High condom use = most of the time/always use a condom

^b analysis based on a subsample of 1322 people who have anal sex with a casual partner; Low condom use = never/rarely use a condom; High condom use = most of the time/always use a condom

^c analysis based on a subsample of 285 people who have sex with women; Low condom use = never/rarely use a condom; High condom use = most of the time/always use a condom

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Discussion

This survey shows that gay mobile app users in Greater Tokyo are unlikely to reach the first of the 90-90-90 aims set by UNAIDS, having 90% of people living with HIV (PLHIV) diagnosed by 2020, with 72.8% of MSM respondents ever tested for HIV. Two-fifths (40.4%) of MSM

who had undergone lifetime HIV testing underwent testing at least once every six months, meeting CDC MSM yearly HIV-testing recommendations [36]. Comparisons with existing Japanese data show lifetime testing was similar to previous MSM lifetime testing reports. For example, a 2013 survey of 491 MSM in Greater Tokyo found almost three quarters (72.9%) to have been tested for HIV in their lifetime, over a third (35.0%) in the past year, and almost nine-tenths (86.2%) had considered getting an HIV test [10]. Lifetime testing was higher than previous data collected by MSM internet surveys in Asia, including Korea [37], China (60.5% [18]; 58.3% [38]) and Vietnam (23.5%; [39]), possibly due to higher availability in Japan of free HIV testing, counselling, antiretroviral therapy, and lower stigma, associated with HIV testing uptake. Respondents had higher lifetime testing in this research than gay bar attending MSM in Japan with a similar age profile to this study (61.0%; Shiono [9]), supported by previous findings where gay mobile app users were also found to have higher lifetime testing than non-users in China [18] and meta-analysis [29].

Socio-demographic factors significantly associated with lifetime testing (age, education, residence) were similar to previous findings among both gay mobile app using and non-using MSM in Japan and abroad. Higher education was associated with higher lifetime testing among respondents similar to previous findings among venue-attending MSM in Japan [9], and abroad [38,40,41], and rural residency was significantly associated with lower lifetime HIV testing among MSM, possibly due to lower HIV information access and lower tolerance for sexual minorities [42], and lower HIV knowledge [43]. Lifetime HIV testing was significantly lower among MSM youth, and only half (52.2%) of respondents aged 18–25 had been tested for HIV, and one-quarter (24.7%) in the past 6-months. Youth have been found to have lower HIV testing among MSM who use gay mobile apps [21], internet [44] and attend gay venues [40]. Youth may have lower lifetime HIV testing because they are younger, and therefore have had fewer partners, thus perceive their risk as lower, and have had fewer years to be tested [45]. However, studies have shown that compared to older MSM, young MSM (YMSM) are more likely to engage in CLAI concurrently with both their primary partner and with someone outside the relationship [46], and are thus at higher risk for HIV [47]. Only half of respondents aged 18–25 had learned about HIV in schools, indicating the pressing need for good quality sex education in Japanese high schools.

Respondents who engaged in anal sex with regular partners were twice as likely to have been tested in their lifetime, and more likely to have been tested recently. Although due to the cross-sectional nature of this study causation cannot be determined, two explanations are possible for the association between anal intercourse with male partners and lifetime and recent HIV testing. First, perceived risky sexual behaviors may lead to HIV testing. Thus, MSM who have engaged in risky sexual behaviors with regular and casual male partners may perceive this risk and get tested. A second potential explanation is that respondents are engaging in negotiated safety, where regular partners agree not to have CLAI with outside partners after being tested with regular partners [48]. HIV negative seroconcordant relationships (e.g. where both partners are HIV negative), are associated with low HIV incidence [49]. However, respondents not discussing or complying with negotiated safety is a risk factor for HIV transmission as MSM often continue to use gay mobile apps throughout relationships [23], and over half were found to have both regular and casual partners concurrently [50]. Condom use may become increasingly inconsistent as casual MSM relationships continue [51], posing significant risk of infection to regular partners with whom they have a higher number of sex acts, more frequent receptive roles, and lower condom use; subsequently, regular partners accounted for 68% of MSM HIV transmissions in the US [52], but only one-tenth in Australia where negotiated safety has been promoted more among MSM [53].

Although respondents who engaged in CLAI with regular male partners were more likely to have undergone testing in their lifetime, participants who engaged in CLAI with casual male partners or condomless sex with female partners were not more likely to have undergone lifetime or recent testing. Without knowing an individual's Pre-exposure prophylaxis (PrEP) status and viral load, it is difficult to ascertain the risk posed by CLAI. However, PrEP is not currently approved for HIV prevention in Japan [54], and MSM engaging in CLAI with casual male partners may therefore be at higher risk of HIV but are not following CDC testing guidelines for high-risk individuals to undergo testing more regularly [36].

Unlike anal intercourse with male partners, sex with female partners was significantly associated with lower lifetime HIV testing. Previous research has found lower regular and lifetime HIV testing associated with both bisexual behavior [40] and bisexual identity [9,45,55] among MSM. Increased internalized homo-negativity, associated with lower HIV testing [56], and lower gay community attachment may potentially explain the association between MSM who have intercourse with both male and female partners and lower lifetime HIV testing. All forms of gay community attachment and participation (gay bar attendance, gay community activity participation, *hattenba* attendance, as well as coming out to close friends) were associated with higher lifetime testing. Lower gay community attachment was associated with less access to HIV testing information, and lower emotional support for a positive HIV result without which the fear of a positive result may make MSM reticent of being tested [45]. More explicitly, in Japan, free HIV testing facilities and HIV prevention information is almost exclusively advertised through gay NGOs at gay venues. Survey respondents with both male and female sex partners participated less in the gay community, and therefore had less information regarding access to HIV testing facilities.

Increasing access to HIV testing

In order to increase testing numbers, both HIV testing promotion and additional testing strategies such as expansion of rapid voluntary counselling and testing (VCT), which is associated with a threefold increase in HIV testing uptake and a twofold increase in receipt of results [57], and approval of self-testing kits such as rapid, oral, fluid HIV home tests, a cost-efficient and effective prevention method for networks with high-risk sexual practices [58] should be examined. Utilizing the ubiquity of vending machines in Japan in order to sell self-testing kits together with other items such as in China [59], particularly outside of urban areas such as Tokyo where access to testing is poor, may lead to an increase in testing if promoted effectively. Research into the kinds of testing services Japanese MSM, particularly non-community attached MSM, would be likely to utilize may also give useful feedback for appropriate resource allocation for HIV testing among high-risk populations. Previous research has shown significantly higher HIV testing levels after HIV testing promotions using mobile apps [60]. Increasing HIV testing rates for non-gay community MSM, specifically bisexual and young MSM may help stop HIV bridging into the Japanese heterosexual population, which has been previously identified as possible but low risk [61]. Gay mobile app users are largely willing to receive HIV prevention materials via mobile apps [20], and the majority of respondents requested results from this study, showing an interest in prevention and MSM community behaviors. Because respondents use gay mobile apps frequently, and Japanese gay mobile apps have shown willingness to provide price discounts for MSM surveillance and prevention research, utilization of popular gay mobile apps to promote HIV testing facilities may prove to be a cost-effective prevention policy for targeting non-community attached MSM youth who are particularly at-risk for HIV infection and increasingly use gay mobile apps instead of attending traditional gay venues to meet sex partners in Japan [25]. In order to facilitate testing, increasing

the amount of free testing facilities, extending testing hours in order to fit around busy Japanese work schedules, adding free optional HIV testing to the annual health check-ups available to all residents of Japan (with proper privacy protection), and providing cultural competency training for interviewers and health providers at testing centers should be implemented.

Limitations

The research was subject to a variety of limitations that must be taken into account. Respondents were recruited through an advertisement, and may not be representative of all Japanese MSM. Furthermore, the behaviors and attitudes reported were self-rated and may have been subject to social desirability bias where male participants may downplay certain behaviors they believe to be undesirable [62]. However, because the survey was anonymous and online this effect was likely minimized. Due to limited resources, this research only used specific gay mobile applications. HIV-positive individuals were not excluded from this study. Recent HIV testing, and future HIV testing intention may not be representative of the reality of the situation in Japan. However, the levels of recent HIV testing and future HIV testing intention reported in this study were similar to previous findings in Japan. Other mobile SNS applications are specifically used by particular MSM populations (such as “Mister” for older men), and may contain different MSM populations worthy of future research. All of these apps function similarly, and this study method would likely be appropriate for future comparative and inclusive research in Japan.

Conclusion

These results show that MSM who use gay mobile apps in Greater Tokyo do not meet the CDC yearly testing recommendations for high risk populations. Although higher than neighbouring nations, HIV testing was still infrequent compared to other countries providing similar levels of care. Considering limited HIV prevention funding in Japan for MSM, moderate lifetime and recent testing, and the large number of gay mobile app users, utilization of popular gay mobile apps to promote nearby HIV testing facilities may be an effective prevention policy to target non-community attached MSM, particularly at-risk youth and individuals at risk for sudden-onset AIDS.

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