



Published in final edited form as:

*Sex Health*. 2017 June ; 14(3): 229–237. doi:10.1071/SH16150.

## Exploring the role of sex-seeking apps and websites in the social and sexual lives of gay, bisexual and other men who have sex with men: a cross-sectional study

Kiffer G. Card<sup>A,B,E</sup>, Nathan J. Lachowsky<sup>A,D</sup>, Zishan Cui<sup>A</sup>, Susan Shurgold<sup>A</sup>, Maya Gislason<sup>B</sup>, Jamie I. Forrest<sup>C</sup>, Ashleigh J. Rich<sup>A,C</sup>, David Moore<sup>A,C</sup>, Eric Roth<sup>A,D</sup>, and Robert S. Hogg<sup>A,B</sup>

<sup>A</sup>B.C. Centre for Excellence in HIV/AIDS, 608-1081 Burrard Street, Vancouver, BC V6Z 1Y6, Canada

<sup>B</sup>Simon Fraser University, 8888 University Drive, Vancouver, BC V5A 1S6, Canada

<sup>C</sup>University of British Columbia, 2329 West Mall, Vancouver, BC V6T 1Z4, Canada

<sup>D</sup>University of Victoria, 3800 Finnerty Road, Victoria, BC V8P 5C2, Canada

### Abstract

**Background**—The objective of this study was to explore the relationship between online sex-seeking, community/social attachment and sexual behaviour.

**Methods**—Respondent-driven sampling was used to recruit 774 sexually active gay and bisexual men in Vancouver, Canada, aged 16 years. Multivariable logistic regression compared men who had used online sex-seeking apps/websites in the past 6 months ( $n = 586$ ) with those who did not ( $n = 188$ ).

**Results**—Multivariable results showed that online sex seekers were more likely to be younger [adjusted odds ratio (aOR) = 0.95, 95% CI: (0.93–0.96)], college educated [aOR = 1.60, 95% CI: (1.07, 2.40)], have more Facebook friends [aOR = 1.07, 95% CI: (1.01, 1.13)], spend more social time with other gay men [aOR = 1.99, 95% CI: (1.33–2.97)], and were more likely to identify emotionally with the gay community [aOR = 1.08, 95% CI: (1.01–1.16)]. Further, they had displayed high sensation-seeking behaviour [aOR = 1.08, 95% CI: (1.03–1.13)], were more likely to engage in serodiscordant/unknown condomless anal sex [aOR = 2.34, 95% CI: (1.50–3.66)], use strategic positioning [aOR = 1.72, 95% CI: (1.08–2.74)], ask their partner's HIV-status prior to sex [aOR = 2.06, 95% CI: (1.27–3.37)], and have ever been tested for HIV [aOR = 4.11, 95% CI: (2.04–8.29)].

**Conclusion**—These findings highlight the online and offline social behaviour exhibited by gay and bisexual men, pressing the need for pro-social interventions to promote safe-sex norms online. We conclude that both Internet and community-based prevention will help reach app/web users.

<sup>E</sup>Corresponding author. kcard@sfu.ca.

#### Conflicts of interest

None declared.

## Keywords

community; gay men; HIV/AIDS; Internet; sexual health

---

## Introduction

Historically, socialisation into gay communities has corresponded with the uptake of safer sex practices,<sup>1</sup> improved ability to cope with minority stress and lower internalised homophobia.<sup>2</sup> Recently, connection to gay communities has been associated with increased exposure to information about HIV,<sup>3</sup> greater social support and improved psychological wellbeing.<sup>4</sup> Further, social network factors have been shown to have significant effect on sexual health risk.<sup>5–7</sup>

Providing rationale for the observed interrelationships between community attachment and sexual behaviour, many theoretical perspectives have been advanced in the context of gay men's health. For example, Nimmons *et al.* suggested that while the values shaping sexual risk among gay and bisexual men are not fully understood, self-interest alone is insufficient to explain the altruistic behaviour they exhibit when engaging in pleasure-inhibiting risk management.<sup>8,9</sup> While this theory suggests that safer sex is motivated, in part, by altruistic concern for others, it does not articulate the mechanism by which these concerns come to be internalised by individuals. Filling this gap, a range of social theories address how societies and cultures shape individuals. One popular mechanism articulated by Ashmore *et al.*, operationalised by Luhtanen and Crocker, and adapted for gay men's health by Frost and Meyer is the concept of collective identity.<sup>10–12</sup> Collective identity describes the social construction of identity and behaviour through emotional attachments developed through group membership and identification, providing insight into how various forms of social attachment can shape individuals and their behaviour.

Beginning in the late 20th century, applications of these and other social theories have allowed researchers to study how various social and demographic factors effect the way individuals interact with their communities and how these interactions shape their sexual behaviour.<sup>13</sup> Within this body of research is evidence that gay and bisexual men's patterns of community involvement have changed.<sup>14–17</sup> In particular, this evidence suggests that: (1) personal networks, rather than institutional organisations, now characterise gay and bisexual men's social behaviour;<sup>15,17,18</sup> and (2) Internet apps and websites are increasingly used as partner-seeking venues for many gay and bisexual men.<sup>19</sup>

As many sexual health interventions continue to be developed, tested and deployed through community-based organisations,<sup>15</sup> it is increasingly important that community leaders and prevention specialists understand how social influence in online environments shapes sexual behaviour. Doing so will allow them to understand better how to engage with gay and bisexual men who may be at increased risk when seeking sex online.<sup>20</sup> In response, prevention efforts have increasingly targeted online venues.<sup>21–23</sup> This is motivated, in part, by apparent health risks associated with Internet use. Although within-subject comparisons do not clearly identify online sex-seeking as a risk factor,<sup>24</sup> reported risks include more frequent sexual partnering and greater likelihood for condomless sex.<sup>20,25</sup> Additionally,

Internet users may be less likely to participate in the gay community<sup>15,18,26</sup> and therefore have less access to traditional prevention efforts.<sup>15</sup> For example, research from Holt *et al.* suggests that HIV testing is correlated with decreased community involvement and greater Internet use – suggesting a potential trade-off between the two.<sup>27</sup> Likewise, Ross *et al.* found that those who used the Internet extensively were less likely to be involved in the gay community.<sup>28</sup> However, Shilo and Mor found that men who sought sex online not only had more sexual partners, but were more likely to be out to friends, had stronger social support, and were more connected to the gay community.<sup>29</sup> The apparent conflict in these findings suggests that the association between Internet use and decreased social attachment remains unclear and is an important area for public health prevention and research in gay and bisexual communities.

Consistent with these observations, our analysis aimed to: (1) describe gay and bisexual men's participation in gay communities; and (2) explore the relationship between sex-seeking apps and websites with gay men's demographics, community and social attachment, and sexual behaviour. Based on sociological research linking wide-spread decline in social interaction to the emergence of new technologies,<sup>13,30</sup> we hypothesised that the use of sex-seeking apps and websites would be associated with lower community attachment. To test this hypothesis, we used a social ecologic approach.<sup>31</sup> This approach acknowledges the dynamic interrelations among various personal and environmental factors, and as initially conceptualised by Bronfenbrenner, postulates the need to examine concurrently the individual-level and interpersonal factors that might shape an individual's behaviour.<sup>32,33</sup> As applied in the present study, we examined the behavioural, psychological and interpersonal correlates of online-sex seeking.

## Methods

### Sampling procedures

Between February 2012 and February 2015, respondent-driven sampling (RDS) was used to recruit study participants into an observational cohort of gay, bisexual and other men who have sex with men to investigate the effects of expanded access to Highly Active Antiretroviral Therapy in Vancouver, British Columbia, Canada. RDS was deemed appropriate for this study as the method utilises social networks for recruitment and statistically adjusts point estimates for network size and homophily to arrive at more representative estimates of behaviour.<sup>26</sup> Thirty RDS seeds were initially selected from both community venues and via a popular social-sexual networking app, and were given up to six vouchers each to recruit other participants in their sexual or social networks. Participants were trained and instructed on how to recruit peers in-person by the study coordinator or a research assistant. Due to slow initial recruitment, 89 additional seeds were added. Inclusion criteria restricted participation to those who: (1) identified as a man; (2) were 16 years of age or older; (3) reported sex with a man in the past 6 months; (4) possessed a RDS voucher, or were purposively invited to be an initial recruit; (5) were able to complete a questionnaire written in English; (6) resided in Metropolitan Vancouver and surrounding areas; and (7) were able to and did provide informed consent. More detailed information regarding our recruitment procedures can be found elsewhere.<sup>34,35</sup> At the conclusion of the study visit,

participants were offered an honorarium of \$50.00 CAD for their participation. Participants could opt for payment in cash or equivalent draw tickets (\$10/ticket) for a \$250 electronics gift card (drawn monthly) or a \$2000 travel voucher (drawn every 6 months).

Ethical approval for this study was obtained from the research ethics boards at Simon Fraser University, the University of British Columbia and the University of Victoria. All participants provided informed consent before participation in our study.

### Data collection

Data for this analysis were cross-sectional and self-reported using a computer-administered questionnaire at our study site in Vancouver's West End – the city's gay neighbourhood. The questionnaire included a variety of demographic, attitudinal, social and behavioural questions. Participation in the survey was followed up with a clinical questionnaire, point-of-care HIV test and collection of venipuncture blood samples for hepatitis C virus and syphilis screening by an on-site nurse.

### Dependent variable

'Online sex-seeking' was measured by asking participants two questions: 'In the past 6 months, how often have you used smartphone apps to meet other guys for sex?' and 'In the past 6 months, how often have you used Internet hook-up sites or other websites to meet other guys for sex?' Response options for both question included 'Never', 'Less than once per month', 'About once per month' and 'More than once per month.' Responses were collapsed into a dichotomous variable: any use of either Internet hook-up sites or smartphone apps in the past 6 months versus none.

### Demographic variables

To identify important demographic patterns, several important sociodemographic factors were considered: age (*continuous in years*), sexual identity (*gay-identified vs those identifying as bisexual/questioning/queer/lesbian/other*), education (*completed at least high school vs not*), ethnicity (*white vs non-white*) annual income (\$29999, \$30000 to \$59999, \$60000), whether participants had a current regular partner (*yes or no*) and self-reported HIV status (*HIV-negative, HIV-positive, unknown*).

### Community and social variables

As researchers continue to struggle with defining gay community participation, we used a variety of measures and scales to explore the diverse aspects of social and community attachment. Based on previous research, these include measures of social network characteristics, community participation and emotional connection to gay communities<sup>12,28,36</sup> To measure network size and social support factors, participants estimated their number of Facebook friends (*continuous*) and the number of gay and bisexual men they were close to in the Vancouver area (*continuous*). Participants also reported the amount of social time they spent with gay men (< 25%, 26–75%, 76% ); the frequency ( '*not in the past 6 months*'; '*less than once per month*'; '*about once per month*'; or '*more than once per month*' ) of participation with gay sports teams, attendance at gay-specific group meetings, patronage of gay bars or clubs, and how often they read gay

newspapers or magazines. Frequency items for these participation variables were dichotomised as ‘yes’ versus ‘no’ for our main analysis, and at various frequency cut-off points in our sensitivity analysis. Participants also reported participation in the annual gay pride parade (‘No’; ‘Yes, I attended it as a spectator’; or ‘Yes, I was in the parade or was a parade volunteer’). Scales measuring collective identity<sup>10</sup> and communal altruism<sup>37</sup> were used to characterise other aspects of connectedness to gay communities. The Collective Identity scale (Study  $\alpha = 0.81$ ) is a four-item scale measuring how important being part of the gay community is to an individual (e.g. ‘Being part of the gay/bisexual/queer community is an important reflection of who I am.’). Final scores are summed from the four items and range from 0 (unimportant) to 12 (very important). The Communal Altruism Scale (Study  $\alpha = 0.85$ ) is a six-item sub-scale measuring community motivations for practising safe sex (e.g. ‘Having safer sex is doing my part to end the epidemic.’). Final scores are summed from the six items and range from 0 (Not altruistic) to 30 (Highly Altruistic). We hypothesised that these measures assessing emotional connectedness to gay communities would be negatively associated with online sex-seeking. Additional information about these scales can be found elsewhere.<sup>10,37</sup>

### Sexual behaviour variables

Items assessing sexual behaviour were introduced using serostatus-specific language stating: ‘Some (HIV-positive) guys use strategies to prevent getting (transmitting) HIV (to their sex partners). Do you do any of the following to prevent (your sex partners from) getting HIV? Check all that apply.’ Participants then reported whether they used strategic positioning, serosorting (i.e. ‘Having anal sex without condoms only with guys I know are [of the same HIV status]’) or viral load sorting to prevent HIV transmission/acquisition (i.e. ‘Having anal sex without condoms if my viral load is low or I’m on HIV treatment/with HIV-positive guys who have low viral loads or are on HIV treatment.’). Participants also reported the number of anal sex partners they had in the past 6 months (*continuous*), whether they ever had a HIV test (*yes vs no*) and the frequency in which they asked their partner about their HIV status before sex (‘never/rarely or sometimes’; ‘a lot or most of the time’; or ‘every time’). The Sexual Sensation Seeking Scale<sup>38</sup> (Study  $\alpha = 0.73$ ) was also included, as sensation-seeking tendencies have been previously associated with sexual risk in online environments.<sup>39</sup> This scale is an 11-item measure assessing pleasure and adventure-seeking behaviour (e.g. ‘I like wild ‘uninhibited’ sexual encounters.’). Final scores are calculated from summing each item and range from 11 (low-sensation seeking) to 44 (high-sensation seeking).

### Data analysis

All statistical analyses were conducted in SAS version 9.4 (SAS Corporation Cary, NC, USA). Small counts were collapsed into other categories where possible. Participants with missing data were not included in analyses relevant to the missing responses. All analyses were adjusted for homophily and network size using RDS-II estimators.<sup>40</sup> To adjust for network size, participants were asked, ‘If you gave them a study voucher, how many of [the gay and bisexual men you know in the Vancouver area] do you think would bring their study voucher to the Momentum office within 1 month of receiving it?’ RDS-adjusted descriptive and bivariable statistics were calculated to assess between-group variance (app/website users

vs non-users). Bivariable results were considered statistically significant at  $P < 0.05$ . However, as we intended to identify the factors that were independently associated with online sex-seeking, while at the same time optimising the statistical significance of these associations with respect to other variables included in the model, final multivariable logistic models were created using a backwards elimination procedure. After including all variables of interest that were significant at  $P < 0.20$  on the bivariable level,<sup>41</sup> backwards elimination was used to remove those with the least significant likelihood ratio statistic, identified by having the largest Type III  $P$ -value, until an optimal (minimised) Akaike Information Criterion (AIC) value was achieved.<sup>42</sup> This approach balanced the trade-off between goodness of fit and model complexity, allowed for greater reproducibility compared with stepwise selection, and enabled us to determine the significance of terms after adjusting for the potential confounding effect of other variables in the model.<sup>43</sup> For ease of interpretability, marginal probabilities of online sex-seeking, given other selected variables set at population estimated values (i.e. RDS-adjusted per cent for categorical variables and median for other continuous variables), were also calculated at the first and third quantiles for each continuous variable that was statistically significant in the final multivariable model.

As previous research has indicated a possible dose–response relationship between Internet use and community connectedness,<sup>44</sup> a sensitivity analysis was also conducted by calculating bivariable odds and confidence intervals to test whether online sex-seeking was correlated with increased frequency of participation in the gay community or with attendance at a higher number of venue types. As this analysis was conducted after final models were constructed, these variables were not included in our model building procedure in order to reduce error associated with multiple testing.

## Results

Between February 2012 and February 2015, we recruited 774 men using respondent-driven sampling in Vancouver, British Columbia, Canada. Crude and RDS-weighted sample statistics for demographic characteristics are provided in Table 1. The RDS-adjusted estimates demonstrated the sample was predominantly white, non-partnered, gay-identified, college educated, HIV-negative and had a median age of 34 years.

### Objective 1: gay and bisexual men's participation in gay communities

Reported levels of community attachment are provided in Table 2. The majority of men reported visiting at least one gay-related event or venue (i.e. sports team, bar/club, gay-specific group meetings, annual pride parade) during the past 6 months. Reading gay news media was the most common form of community attachment. The majority of men also reported attending gay bars and clubs and going to annual pride parade events. Approximately one-third of participants reported going to gay-specific group meetings, and approximately one-in-ten participated on a gay sports team. The sample also reported high levels of social attachment to other gay men. The median number of gay and bisexual men known to the participant was 40 ( $Q_1$ – $Q_3$ : 15, 100), with ~15 ( $Q_1$ – $Q_3$ : 7, 30) of these being 'close' friends, family or partners. Moreover, over two-thirds of the sample spent more than



one-quarter of their social time with other gay or bisexual men. Regarding the primary outcome of interest, over two-thirds of the sample reported using apps or websites to seek sex in the past 6 months, with nearly half these using apps or websites more than monthly (the greatest frequency recorded).

## Objective 2: covariates of online sex-seeking

In bivariable analysis, online sex-seeking men differed from non-app/web users with regards to important patterns of sexual behaviour. They were more likely to engage in condomless anal sex, and had lower communal altruism. However, they were also more likely to use strategic positioning, serosorting and/or viral-load sorting to manage their risk of HIV transmission. Despite these differences in sexual behaviour, they were no less likely than non-app/web users to participate in gay sports, attend gay-specific group meetings, go to gay bars/clubs, read gay news media or participate in the annual pride parade; nor were they closer to fewer gay and bisexual men.

Table 3 provides results from our sensitivity analysis testing whether online sex-seeking was associated with differing frequency or diversity of participation in the gay community. These results suggest that while participation in the gay community is not associated with increased online sex-seeking, more frequent attendance at gay bars and clubs and more frequent consumption of gay news media may be associated with online sex-seeking. However, our sensitivity analysis indicated that the number of venues visited (i.e. gay sports teams, bars/clubs, gay-specific group meetings, pride parade) was not associated with online sex-seeking [OR=1.11, 95% CI: (0.96–1.29)].

Identifying the correlates of online sex-seeking, multivariable results are provided in Table 4. These indicate that younger age, higher education, being single, spending more social time with other gay and bisexual men, having more Facebook friends, and higher collective identity scores were associated with online sex-seeking. Regarding sexual behaviour, multivariable results showed that higher Sexual Sensation Seeking scores and greater likelihood of condomless anal sex with serodiscordant or unknown-status partners in the past 6 months were both associated with seeking sex online. Partially offsetting these risks, strategic positioning, HIV serostatus inquiry of sexual partners and lifetime HIV testing were also associated with online sex-seeking. Given the difficulty in interpreting odds ratios of continuous variables in the context of logistic regression, marginal probabilities for statistically significant continuous variables at the first and third quantiles are provided in Table 5.

## Discussion

Among a community-based sample of 774 gay, bisexual and other men who have sex with men recruited through RDS in Vancouver, Canada, we found that three-quarters read gay media and attended gay bars, over half attended annual pride events and one-third attended an event or meeting hosted by a gay-specific group in the 6 months before recruitment. Two-thirds of participants also reported using apps or websites to seek sex in the past 6 months. These findings show that, in general, in-person socialisation and online sex-seeking are both important social activities for gay and bisexual men.

On the bivariable level, online sex seekers were no less likely than non-app/web users to connect with gay communities; nor were they closer to fewer gay and bisexual men. These bivariable results seem to contradict the assertion that Internet users are not involved in the gay community and support research by Shilo *et al.*, which has likewise recently documented a positive correlation between social/community attachment and online sex-seeking.<sup>29</sup> More broadly, these findings add support to a growing body of literature that refutes the assertion that technology-use deprives individuals of greater social and community attachment.<sup>45</sup>

Further, based on our sensitivity analysis, we suggest it may be possible that some online sex seekers actually visit some gay community venues, such as bars and clubs, more often than non-app/web users. Considering that gay bars and clubs are another venue at which men can meet sexual partners, these results support previous research indicating that frequent Internet users are more likely to use multiple venues to seek sex<sup>46</sup> – perhaps putting them at increased risk for engaging in condomless anal sex. Therefore, identifying individuals who frequent multiple venues is likely a key strategy to reduce the transmission of sexually transmissible infections, especially between online and offline networks.

Considering the interaction between online and offline networks, our multivariable results showed that online sex seekers were more likely to spend more social time with other gay and bisexual men, had more Facebook friends, and had higher collective identity scores—signs of greater social connectedness to the gay community. These findings are somewhat surprising given the common narrative that internet users are disconnected from the gay community. However, these findings are not without precedent. For example, Shilo & Mor (2015) recently reported that online sex seeking is associated with having more sexual partners, being out, higher social support, and stronger connectedness to the gay community.<sup>29</sup> This may suggest that sex seeking apps and websites are no longer used predominantly by GBM seeking anonymity, but now serve as a core venue of community attachment. However, it remains likely that the operationalization of online sex seeking averages across important sub-groups of gay and bisexual men. Indeed, some men who seek sex online may be highly connected to the gay community, while others remain isolated from it.

In examining the intersection of online sex seeking and sexual behavior among gay and bisexual men, the present study does not directly examine the rationale for increased risk among men who seek sexual partners via the internet. However, one explanation, advanced by Grosskopf *et al.*, for the prevalence of risky behaviour in online-initiated encounters is the use of apps and websites by men with higher sensation seeking tendencies. Our findings support this assertion in demonstrating that Sexual Sensation Seeking scores were significantly higher among app and website users.

Another explanation, advanced by Grosskopf *et al.*, for the prevalence of risky behaviour in online-initiated encounters is the use of apps and websites by men with higher sensation-seeking tendencies.<sup>39</sup> Our findings also support this assertion in demonstrating that Sexual Sensation Seeking scores were significantly higher among app and website users. The use of these technologies by men with high sensation-seeking tendencies, may thus explain the



associated risk and high frequency of sexual contact that occurs through these venues. However, as our multivariable model demonstrates, online sex-seeking was independently associated with risky sexual behaviour. Specifically, we found that online sex-seeking men were more than twice as likely to have condomless sex with someone whose HIV status was different from their own or whose HIV status they did not know. As this risk behaviour was independently associated with online sex-seeking, we conclude that neither the social environment (as measured here) nor the presence of sensation-seeking men can fully explain the risk observed in online environments. This position is supported by the findings of a recent systematic review by Melendez-Torres *et al.*, who found that online sex-seeking is inconsistently linked with risky sex in within-person studies.<sup>24</sup> In other words, the risk associated with Internet use is not only a result of contextual factors associated with meeting partners online, but also due to personal risk perceptions or traits influenced by one's interpersonal interactions.

Indeed, social norms and networks are widely regarded as important determinants of human development and behaviour. For instance, sexual scripts theory describes how interpersonal scripts, shaped by social learning and interpersonal norms, come together to shape sexual behaviour.<sup>49</sup> Likewise, the reasoned action approach – one of the most widely validated frameworks for understanding sexual behaviour – models behaviour as a product of personal intentions, which are ultimately shaped by social norms and lived experiences.<sup>50</sup> Considering these approaches along with the wider context of social and cultural theory, our findings suggest that app/web users exhibit similar patterns of community participation as those who do not seek sex online. This suggests that both venue-based and socially driven network interventions may be effective at influencing the sexual behaviour and social norms of gay and bisexual men. However, based on the broader theoretical formulation of collective identity introduced earlier, further research is needed to understand if and how pro-social interventions can leverage and promote emotional attachment to the gay community among Internet users, and thereby facilitate the development of altruistic and preventive behaviour.<sup>37</sup> Preliminary research into this question suggests that e-interventions may be able to facilitate a positive reciprocal relationship between community ties and HIV prevention.<sup>51</sup>

Considering the content of potential interventions, our evidence suggests that gay and bisexual men already employ several strategies to reduce the risk of HIV transmission. For instance, we found that men who sought sex online were nearly twice as likely to use strategic positioning to manage their risk of HIV transmission, twice as likely to ask their partner's status every time, and four-fold as likely to have ever been tested for HIV. These findings suggest that online sex-seeking men are working to manage their risks and maintain their sexual health.<sup>52</sup> However, it is unclear whether these risk practices are facilitated by innate aspects of online sex-seeking (e.g. ability to disclose HIV status via one's profile) or by increased risk perceptions associated with frequent casual sex. Regardless of the rationale for increased seroadaptive behaviour in online settings, the presence of these strategies suggest that men seeking sex online are indeed interested in reducing their risk. However, we should note that these risk management strategies are specifically focussed on reducing the risk of HIV, and may therefore fuel the spread of other sexually transmissible infections.<sup>53</sup> Further, the success of these strategies rely not only on their innate ability to

reduce an individual's risk of exposure to the virus, but also on the ability of individual's to accurately assess their HIV status and employ these strategies. These obvious limitations necessitate the need for education regarding the efficacy of seroadaptive behaviours<sup>54</sup> and promotion of frequent HIV testing among men who use the Internet to meet casual sex partners.

### Future research

To improve the potential efficacy of online HIV-prevention efforts, further research is needed to: (1) identify how community and social networks can be best leveraged to promote the health and wellbeing of gay and bisexual men; (2) determine whether community and social attachment among online sex seekers continues to reduce unsafe sex as it has in the past; (3) assess longitudinally the relationship between Internet use and social behaviour; (4) assess how offline HIV prevention campaigns diffuse through online social networks (and vice versa); and (5) identify appropriate prevention venues and methods to respond to these ever-shifting social and behavioural contexts.

### Limitations

With these goals in mind, readers should be cautious when interpreting our findings as they were derived from cross-sectional data, which do not allow us to define the relationships between the observed associations, nor are we able to observe changes in the variables over time. These data were also collected from a RDS-recruited sample of urban gay and bisexual men, and therefore may not be generalisable to all men who have sex with men in all settings. The generalisability of our findings are further constrained by characteristics unique to Vancouver (e.g. availability of antiretroviral therapy free-of-charge to all people living with HIV, heavy promotion of treatment as prevention, high inclusivity of sexual minorities, active LGBT community groups, etc.), and may not be applicable to areas where patterns of community involvement differ significantly due to context-dependent factors (e.g. stigma towards sexual minorities.) The data is also self-reported and vulnerable to recall and response biases. With regard to our analysis, the use of a collapsed outcome measure (i.e. use of apps and/or websites in the past 6 months) does not allow us to separate out the unique aspects of these two platforms and may obscure important patterns lost when collapsing variables. Similarly, the use of a dichotomous outcome variable for online sex-seeking (i.e. 'any' vs 'none') does not allow us to understand possible dose-response relationships that may have significant effect on community connectedness variables. We also note that while some findings may be statistically significant, it is difficult to ascertain at what level these differences are practically meaningful. It is also difficult to ascertain whether the scales we used remain appropriately validated for social research among online sex-seeking men in the modern era. Finally, by using multiple measures to assess community connectedness rather than a validated scale, we may be increasing the risk for type-II errors.

### Conclusions

Despite these limitations, our findings offer relevant insight into the social and sexual lives of gay and bisexual men. Given that online sex-seeking men were no less likely to read gay

news media, visit gay bars, attend gay meetings or participate in annual pride events, these venues remain important targets for prevention efforts, and our findings endorse both online and offline modes of prevention outreach. Moreover, as online sex seekers are connected to both online and offline networks, have more Facebook friends, report being close to many gay and bisexual men, and have higher collective identity, socially driven network-based interventions may best aid in broadly promoting safe-sex norms throughout online venues and the broader gay community.<sup>55</sup>

## Acknowledgments

The authors would like to thank the Momentum Health Study participants, office staff and community advisory board, as well as our community partner agencies: Health Initiative for Men, YouthCO HIV & Hep C Society, and Positive Living Society of BC. The authors would also like to thank Kirk J. Hepburn for his assistance in editing this manuscript throughout the writing process and for final publication. Momentum is funded through the National Institute on Drug Abuse (R01DA031055-01A1) and the Canadian Institutes for Health Research (MOP-107544, 143342). NJL is supported by a CANFAR/CTN Postdoctoral Fellowship Award. DMM is supported by a Scholar Award from the Michael Smith Foundation for Health Research (#5209).

## References

1. Seibt AC, Ross MW, Freeman A, Krepcho M, Hedrich A, McAlister A, Ferna'Ndez-Esquer ME. Relationship between safe sex and acculturation into the gay subculture. *AIDS Care*. 1995; 7:85–8. DOI: 10.1080/09540129550126876
2. Meyer I. Minority stress and mental health in gay men. *J Health Soc Behav*. 1995; 36:38–56. DOI: 10.2307/2137286 [PubMed: 7738327]
3. Veinot TC, Meadowbrooke CC, Loveluck J, Hickok A, Bauermeister JA. How “community” matters for how people interact with information: mixed methods study of young men who have sex with other men. *J Med Internet Res*. 2013; 15:e33.doi: 10.2196/jmir.2370 [PubMed: 23428825]
4. Kertzner RM, Meyer IH, Frost DM, Stirratt MJ. Social and psychological well-being in lesbians, gay men, and bisexuals: the effects of race, gender, age, and sexual identity. *Am J Orthopsychiatry*. 2009; 79:500–10. DOI: 10.1037/a0016848 [PubMed: 20099941]
5. Finneran C, Stephenson R. Social network composition and sexual risk-taking among gay and bisexual men in Atlanta, GA. *AIDS Behav*. 2014; 18:59–68. DOI: 10.1007/s10461-013-0569-y [PubMed: 23904146]
6. Peterson JL, Rothenberg R, Kraft JM, Beeker C, Trotter R. Perceived condom norms and HIV risks among social and sexual networks of young African American men who have sex with men. *Health Educ Res*. 2009; 24:119–27. DOI: 10.1093/her/cyn003 [PubMed: 18281710]
7. Frye V, Koblin B, Chin J, Beard J, Blaney S, Halkitis P, Vlahov D, Galea S. Neighborhood-level correlates of consistent condom use among men who have sex with men: a multi-level analysis. *AIDS Behav*. 2010; 14:974–85. DOI: 10.1007/s10461-008-9438-5 [PubMed: 18712593]
8. Nimmons D, Folkman S. Other-sensitive motivation for safer sex among gay men: expanding paradigms for HIV prevention. *AIDS Behav*. 1999; 3:313–24. DOI: 10.1023/A:1025437418276
9. Nimmons D. In this together. *J Psychol Human Sex*. 1998; 10:75–87. DOI: 10.1300/J056v10n03\_06
10. Luhtanen, R., Crocker, J. Self-esteem and intergroup comparisons: toward a theory of collective self-esteem. In: Suls, J., Wills, TA., editors. *Social comparison: contemporary theory and research*. Hillsdale: Lawrence Erlbaum Associates, Inc; 1991. p. 211–34.
11. Ashmore RD, Deaux K, McLaughlin-Volpe T. An organizing framework for collective identity: articulation and significance of multidimensionality. *Psychol Bull*. 2004; 130:80–114. DOI: 10.1037/0033-2909.130.1.80 [PubMed: 14717651]
12. Frost DM, Meyer IH. Measuring community connectedness among diverse sexual minority populations. *J Sex Res*. 2012; 49:36–49. DOI: 10.1080/00224499.2011.565427 [PubMed: 21512945]

13. Putnam, RD. *Bowling alone: the collapse and revival of American community*. 1. New York: Simon and Schuster; 2001.
14. Simon Rosser BR, West W, Weinmeyer R. Are gay communities dying or just in transition? Results from an international consultation examining possible structural change in gay communities. *AIDS Care*. 2008; 20:588–95. DOI: 10.1080/09540120701867156 [PubMed: 18484330]
15. Rowe MS, Dowsett GW. Sex, love, friendship, belonging and place: is there a role for “Gay Community” in HIV prevention today? *Cult Health Sex*. 2008; 10:329–44. DOI: 10.1080/13691050701843098 [PubMed: 18484377]
16. Ghaziani, A. *There goes the gayborhood?*. Princeton: Princeton University Press; 2014.
17. Lea T, de Wit J, Reynolds R. “Post-gay” yet? the relevance of the lesbian and gay scene to same-sex attracted young people in contemporary Australia. *J Homosex*. 2015; 62:1264–85. DOI: 10.1080/00918369.2015.1037139 [PubMed: 25927352]
18. Holt M. Gay men and ambivalence about “gay community”: from gay community attachment to personal communities. *Cult Health Sex*. 2011; 13:857–71. DOI: 10.1080/13691058.2011.581390 [PubMed: 21644116]
19. Grov C, Breslow AS, Newcomb ME, Rosenberger JG, Bauermeister JA. Gay and bisexual men’s use of the Internet: research from the 1990s through 2013. *J Sex Res*. 2014; 51:390–409. DOI: 10.1080/00224499.2013.871626 [PubMed: 24754360]
20. Lewnard JA, Berrang-Ford L. Internet-based partner selection and risk for unprotected anal intercourse in sexual encounters among men who have sex with men: a meta-analysis of observational studies. *Sex Transm Infect*. 2014; 90:290–6. DOI: 10.1136/sextrans-2013-051332 [PubMed: 24518249]
21. Schnall R, Travers J, Rojas M, Carballo-Diéguez A. eHealth interventions for HIV prevention in high-risk men who have sex with men: a systematic review. *J Med Internet Res*. 2014; 16:e134.doi: 10.2196/jmir.3393 [PubMed: 24862459]
22. Webb TL, Joseph J, Yardley L, Michie S. Using the internet to promote health behavior change: a systematic review and metaanalysis of the impact of theoretical basis, use of behavior change techniques, and mode of delivery on efficacy. *J Med Internet Res*. 2010; 12:e4. [PubMed: 20164043]
23. Taggart T, Grewe ME, Conserve DF, Gliwa C, Roman Isler M. Social media and HIV: a systematic review of uses of social media in HIV communication. *J Med Internet Res*. 2016; 17:e248.
24. Melendez-Torres GJ, Nye E, Bonell C. Internet sex-seeking is inconsistently linked with sexual risk in men who have sex with men: systematic review of within-subjects comparisons. *Sex Health*. 2015; 12:183–7. [PubMed: 25844812]
25. Liao A, Millett G, Marks G. Meta-analytic examination of online sex-seeking and sexual risk behavior among men who have sex with men. *Sex Transm Dis*. 2006; 33:576–84. DOI: 10.1097/01.olq.0000204710.35332.c5 [PubMed: 16540884]
26. Zablotska IB, Holt M, Prestage G. Changes in gay men’s participation in gay community life: implications for HIV surveillance and research. *AIDS Behav*. 2012; 16:669–75. DOI: 10.1007/s10461-011-9919-9 [PubMed: 21424273]
27. Holt M, Rawstorne P, Wilkinson J, Worth H, Bittman M, Kippax S. HIV testing, gay community involvement and internet use: social and behavioural correlates of HIV testing among Australian men who have sex with men. *AIDS Behav*. 2012; 16:13–22. DOI: 10.1007/s10461-010-9872-z [PubMed: 21213035]
28. Ross MW, Tikkanen R, Berg RC. Gay community involvement: its interrelationships and associations with Internet use and HIV risk behaviors in Swedish men who have sex with men. *J Homosex*. 2014; 61:323–33. DOI: 10.1080/00918369.2013.839916 [PubMed: 24383861]
29. Shilo G, Mor Z. Seeking sex online: social and sexual risk factors among adolescent and young gay and bisexual men. *Sex Health*. 2015; 12:217–23. DOI: 10.1071/SH14229 [PubMed: 25751619]
30. McPherson M, Smith-Lovin L, Brashears ME. Social isolation in America: changes in core discussion networks over two decades. *Am Sociol Rev*. 2006; 71:353–75. DOI: 10.1177/000312240607100301

31. Kaufman M, Cornish F, Zimmerman RS, Johnson BT. Health behavior change models for HIV prevention and AIDS care: practical recommendations for a multi-level approach. *J Acquir Immune Defic Syndr*. 2014; 66:S250–8. DOI: 10.1097/QAI.0000000000000236 [PubMed: 25007194]
32. Bronfenbrenner, U. Developmental ecology through space and time: a future perspective. In: Moen, P.Elder, GH., Lüscher, K., editors. *Examining lives in context: perspectives on the ecology of human development*. Washington, DC: American Psychological Association; 1995. p. 619–47.
33. Baral S, Logie CH, Grosso A, Wirtz AL, Beyrer C. Modified social ecological model: a tool to guide the assessment of the risks and risk contexts of HIV epidemics. *BMC Public Health*. 2013; 13:482.doi: 10.1186/1471-2458-13-482 [PubMed: 23679953]
34. Lachowsky NJ, Lal A, Forrest JI, Card KG, Cui Z, Sereda P, Rich A, Raymond HF, Roth EA, Moore DM, Hogg RS. Including online-recruited seeds: a respondent-driven sample of men who have sex with men. *J Med Internet Res*. 2016; 18:e51.doi: 10.2196/jmir.5258 [PubMed: 26980147]
35. Forrest JI, Lachowsky NJ, Lal A, Cui Z, Sereda P, Raymond HF, Ogilvie G, Roth EA, Moore D, Hogg RS. Factors associated with productive recruiting in a respondent-driven sample of men who have sex with men in Vancouver, Canada. *J Urban Health Bull N Y Acad Med*. 2016; 93:379–87. DOI: 10.1007/s11524-016-0032-2
36. LeBeau RT, Jellison WA. Why get involved? Exploring gay and bisexual men's experience of the gay community. *J Homosex*. 2009; 56:56–76. DOI: 10.1080/00918360802551522 [PubMed: 19197643]
37. O'Dell BL, Rosser BRS, Miner MH, Jacoby SM. HIV prevention altruism and sexual risk behavior in HIV-positive men who have sex with men. *AIDS Behav*. 2008; 12:713–20. DOI: 10.1007/s10461-007-9321-9 [PubMed: 17985229]
38. Kalichman SC, Rompa D. Sexual sensation seeking and Sexual Compulsivity Scales: reliability, validity, and predicting HIV risk behavior. *J Pers Assess*. 1995; 65:586–601. DOI: 10.1207/s15327752jpa6503\_16 [PubMed: 8609589]
39. Grosskopf NA, Harris JK, Wallace BC, Nanin JE. Online sex-seeking behaviors of men who have sex with men in New York City. *Am J Men Health*. 2011; 5:378–85. DOI: 10.1177/1557988310372801
40. Voltz, E., Wejnert, C., Cameron, C., Spiller, M., Barash, V., Degani, I., et al. *Respondent-Driven Sampling Analysis Tool (RDSAT)*. Ithaca, NY: Cornell University; 2012.
41. Maldonado G, Greenland S. Simulation study of confounder-selection strategies. *Am J Epidemiol*. 1993; 138:923–36. [PubMed: 8256780]
42. Lima VD, Geller J, Bangsberg DR, Patterson TL, Daniel M, Kerr T, Montaner JSG, Hogg RS. The effect of adherence on the association between depressive symptoms and mortality among HIV-infected individuals first initiating HAART. *AIDS*. 2007; 21:1175–83. DOI: 10.1097/QAD.0b013e32811ebf57 [PubMed: 17502728]
43. Dohoo, IR., Martin, SW., Stryhn, H. *Methods in epidemiologic research*. 2012. Available online at: <https://www.islandscholar.ca/islandora/object/ir%3A8372/> [verified 20 September 2016]
44. Tikkanen R, Ross MW. Technological tearoom trade: characteristics of Swedish men visiting gay Internet chat rooms. *AIDS Educ*. 2003; 15:122–32. DOI: 10.1521/aeap.15.3.122.23833
45. Hampton, K., Goulet, LS., Her, EJ., Rainie, L. *Social isolation and new technology*. Pew Research Center: Internet, Science & Tech. 2009. Available online at: <http://www.pewinternet.org/2009/11/04/social-isolation-and-new-technology/> [verified 19 September 2016]
46. Downing MJ. Using the internet in pursuit of public sexual encounters is frequency of use associated with risk behavior among MSM? *Am J Men Health*. 2012; 6:18–27. DOI: 10.1177/1557988311407906
47. Finlayson, T. Effects of stigma, sense of community, and self-esteem on the HIV sexual risk behaviors of African American and Latino men who have sex with men. *Psychol Diss*. 2007 Jun. Available online at: [http://scholarworks.gsu.edu/cgi/viewcontent.cgi?article=1029&context=psych\\_diss](http://scholarworks.gsu.edu/cgi/viewcontent.cgi?article=1029&context=psych_diss) [verified 11 June 2016]
48. White D, Stephenson R. Identity formation, outness and sexual risk among gay and bisexual men. *Am J Men Health*. 2014; 8:98–109. DOI: 10.1177/1557988313489133

49. Simon W, Gagnon JH. Sexual scripts: permanence and change. *Arch Sex Behav.* 1986; 15:97–120. DOI: 10.1007/BF01542219 [PubMed: 3718206]
50. Fishbein, M., Ajzen, I. Predicting and changing behavior: the reasoned action approach. 1. New York: Psychology Press; 2009.
51. Young SD, Holloway I, Jaganath D, Rice E, Westmoreland D, Coates T. Project HOPE: online social network changes in an HIV prevention randomized controlled trial for African American and Latino men who have sex with men. *Am J Public Health.* 2014; 104:1707–12. DOI: 10.2105/AJPH.2014.301992 [PubMed: 25033137]
52. Berry M, Raymond HF, Kellogg T, McFarland W. The Internet, HIV serosorting and transmission risk among men who have sex with men, San Francisco. *AIDS.* 2008; 22:787–9. DOI: 10.1097/QAD.0b013e3282f55559 [PubMed: 18356611]
53. Beymer MR, Weiss RE, Bolan RK, Rudy ET, Bourque LB, Rodriguez JP, Morisky DE. Sex on-demand: geosocial networking phone apps and risk of sexually transmitted infections among a cross-sectional sample of men who have sex with men in Los Angeles County. *Sex Transm Infect.* 2014; 90:567–72. DOI: 10.1136/sextrans-2013-051494 [PubMed: 24926041]
54. Vallabhaneni S, Li X, Vittinghoff E, Donnell D, Pilcher CD, Buchbinder SP. Seroadaptive practices: association with HIV acquisition among HIV-negative men who have sex with men. *PLoS One.* 2012; 7:e45718.doi: 10.1371/journal.pone.0045718 [PubMed: 23056215]
55. Wang K, Brown K, Shen S-Y, Tucker J. Social network-based interventions to promote condom use: a systematic review. *AIDS Behav.* 2011; 15:1298–308. DOI: 10.1007/s10461-011-0020-1 [PubMed: 21811843]



**Table 1**Sample demographics( $n = 774$ )

	<i>n</i> (%)	RDS% (95% CI)
Age (Median, Q <sub>1</sub> –Q <sub>3</sub> )		34 (26–47)
Sexual orientation		
Gay identified	655 (84.6)	79.9 (75.6–84.6)
Other/bisexual	119 (15.4)	20.1 (15.4–24.4)
Ethnicity		
White	585 (75.6)	68.7 (61.8–74.9) <sup>A</sup>
Non-White	189 (24.4)	31.3 (25.1–38.2) <sup>A</sup>
Education		
High school	166 (21.9)	29.0 (23.4–36.6) <sup>A</sup>
>High school	592 (78.1)	71.0 (63.4–76.6) <sup>A</sup>
Annual income (CAD)		
\$29999	485 (62.7)	72.9 (67.7–78.6) <sup>A</sup>
\$30 000–\$59 999	200 (25.8)	18.6 (14.3–22.7) <sup>A</sup>
60000	89 (11.5)	8.6 (5.4–11.9)
Self-reported HIV status		
Negative	492 (63.6)	68.9 (61.9–75.8)
Positive	218 (28.2)	19.9 (12.8–27.6) <sup>A</sup>
Unknown	64 (8.3)	11.2 (7.9–15.1)
Current partner		
No	477 (61.6)	62.4 (56.4–68.4)
Yes	297 (38.4)	37.6 (31.6–43.6)

RDS, respondent-driven sampling adjusted

<sup>A</sup>Crude proportion falls outside RDS 95% confidence interval (CI).

**Table 2**Community attachment(*n* = 774)

	<i>n</i> (%)	RDS% (95% CI)
Social time spent with gay men <sup>A</sup>		
25% or less	181 (23.4)	32.3 (27.1–38.2) <sup>D</sup>
26–75%	448 (58.0)	55.9 (49.8–61.2)
76% or more	144 (18.6)	11.8 (8.5–15.5) <sup>D</sup>
Play on gay sports team <sup>A</sup>		
No	684 (88.4)	91.6 (87.9–95.0)
Yes	90 (11.6)	8.4 (5.0–12.1)
Attend gay-specific groups meeting <sup>A</sup>		
No	474 (61.2)	66.5 (60.6–72.6)
Yes	300 (38.8)	33.5 (27.4–39.4)
Attend gay bars/clubs <sup>A</sup>		
No	157 (20.3)	26.3 (20.5–32.7) <sup>D</sup>
Yes	617 (79.7)	73.7 (67.3–79.5) <sup>D</sup>
Read gay news/media <sup>A</sup>		
No	134 (17.3)	24.6 (19.6–30.5) <sup>D</sup>
Yes	640 (82.7)	75.4 (69.5–80.4) <sup>D</sup>
Pride parade participation <sup>B</sup>		
No	288 (37.2)	44.4 (38.5–51.0) <sup>D</sup>
Yes, spectator	381 (49.2)	45.1 (39.1–51.0)
Yes, in or volunteer	105 (13.6)	10.5 (6.8–14.3)
Use apps or websites to seek sex <sup>A</sup>		
No	188 (24.3)	32.7 (27.5–40.5) <sup>D</sup>
Less than monthly	138 (17.8)	18.4 (14.3–23.4)
About monthly	97 (12.5)	10.0 (6.9–13.5)
More than monthly	351 (45.4)	38.9 (31.6–43.3) <sup>D</sup>
Number of gay venue types visited <sup>C</sup>		
0	68 (8.8)	12.2 (8.4–16.7)
1	186 (24.0)	29.8 (24.4–35.5) <sup>D</sup>
2	298 (38.5)	37.6 (31.9–43.7)
3	177 (22.9)	15.8 (11.6–19.7) <sup>D</sup>
4	45 (5.8)	4.7 (2.3–7.7)

RDS, respondent-driven sampling adjusted

<sup>A</sup> In past 6 months.<sup>B</sup> In past 12 months.<sup>C</sup> Includes sports, meetings, bars/clubs and pride parade.

<sup>D</sup>Crude proportion falls outside RDS 95% CI.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

**Table 3**Bivariable sensitivity analysis of community attachment ( $n = 774$ )

	Any vs none	Monthly vs monthly/none	More than monthly vs monthly
Play on gay sports team <sup>A</sup>	1.24 (0.73–2.09)	1.14 (0.60–2.15)	1.31 (0.61–2.81)
Attend gay specific groups <sup>A</sup>	1.32 (0.84–2.07)	1.29 (0.89–1.87)	1.32 (0.84–2.07)
Attend gay bars/clubs <sup>A</sup>	1.33 (0.95–1.87)	1.22 (0.91–1.65)	<b>1.41 (1.01–1.97)</b>
Read gay news/media <sup>A</sup>	0.85 (0.63–1.14)	0.85 (0.63–1.14)	<b>1.72 (1.18–2.49)</b>
Pride parade participation <sup>B</sup>	0.99 (0.73–1.34)	–	–
Number of groups attended <sup>C</sup>	1.11 (0.96–1.29)	–	–

Bold text indicates significant findings. Data are presented as odds ratios and 95% Confidence Intervals. Dashes indicate category is not applicable to the specified variable

<sup>A</sup> In past 6 months.

<sup>B</sup> In past 12 months.

<sup>C</sup> Includes sports, meetings, bars/clubs, and pride parade.

**Table 4**

Covariates of online sex-seeking (OSS)

Categorical variables	No OSS <i>n</i> (RDS %)	Any OSS <i>n</i> (RDS %)	Bivariable OR (95% CI)	Multivariable aOR (95% CI)
Gay-identified (vs bisexual/other)	153 (76.0)	502 (84.3)	1.69 (1.18–2.44)	
Ethnicity				
White	145 (72.0)	440 (68.8)	1.00	
Non-White	24 (15.4)	115 (23.4)	1.17 (0.84–1.62)	
Education				
High school	54 (34.4)	112 (22.5)	1.00	
>High school	129 (65.6)	463 (77.5)	1.81 (1.29–2.54)	1.60 (1.07–2.40)
Self-reported HIV status				
Negative	126 (54.1)	390 (67.6)	1.00	
Positive	61 (30.9)	157 (25.6)	0.66 (0.47–0.93)	
Unknown	25 (15.0)	39 (6.7)	0.36 (0.22–0.60)	
Current regular partner	103 (53.2)	194 (29.3)	0.37 (0.27–0.5)	0.31 (0.21–0.45)
Social time spent with gay men				
25% or less	55 (40.7)	126 (25.2)	1.00	1.00
26–75%	95 (45.0)	353 (61.2)	2.20 (1.58–3.08)	1.99 (1.33–2.97)
76% or more	37 (14.3)	107 (13.6)	1.54 (0.96–2.48)	1.17 (0.66–2.08)
Play on gay sports team <sup>A</sup>	20 (8.4)	70 (10.1)	1.24 (0.73–2.09)	
Attend gay specific groups <sup>A</sup>	73 (31.9)	227 (35.8)	1.19 (0.86–1.64)	
Attend gay bars/clubs <sup>A</sup>	153 (71.0)	464 (76.5)	1.33 (0.95–1.87)	
Read gay news/media <sup>A</sup>	158 (80.6)	482 (77)	0.8 (0.55–1.17)	
Past year pride parade participation				
Yes, spectator (vs no)	92 (44.9)	289 (46.2)	1.02 (0.74–1.41)	
Yes, in or volunteer (vs no)	27 (13.5)	78 (11.8)	0.87 (0.54–1.40)	
Condomless anal sex (CAS) <sup>A</sup>	103 (51.5)	401 (67.1)	1.93 (1.42–2.62)	
Serodiscordant/unknown CAS <sup>A</sup>	45 (19.9)	246 (42.1)	2.92 (2.03–4.19)	2.34 (1.50–3.66)
Strategic positioning	45 (16.6)	180 (30.5)	2.21 (1.51–3.23)	1.72 (1.08–2.74)
Serosorting	63 (29.4)	245 (36.7)	1.4 (1.01–1.93)	
Viral load sorting	26 (10.5)	114 (16.9)	1.72 (1.08–2.73)	
Asks partner's HIV status				
Never/rarely or sometimes	102 (53.3)	232 (44.5)	1.00	1.00
A lot or most of the time	48 (27.5)	213 (31.5)	1.37 (0.97–1.95)	1.24 (0.81–1.90)
Every time	38 (19.2)	141 (24)	1.5 (1.01–2.22)	2.06 (1.27–3.37)
HIV test, ever	166 (86.0)	564 (95.4)	3.42 (1.99–5.89)	4.11 (2.04–8.29)
Continuous variables	Median (Q <sub>1</sub> ,Q <sub>3</sub> )	Median (Q <sub>1</sub> ,Q <sub>3</sub> )	OR (95% CI)	
Age (years)	41.5 (28, 50)	32 (25, 45)	0.96 (0.94–0.97)	0.95 (0.93–0.96)
No. of GBM: close to	15 (6, 25)	15 (7, 30)	1.01 (1.00–1.01)	
Collective identity scale	8 (6, 9)	8 (6, 9)	1.07 (1.01– 1.14)	1.08 (1.01– 1.16)

Categorical variables	No OSS <i>n</i> (RDS %)	Any OSS <i>n</i> (RDS %)	Bivariable OR (95% CI)	Multivariable aOR (95% CI)
Communal altruism scale	3.67 (3, 4)	3.5 (2.83, 4)	0.76 (0.61–0.96)	
No. of Facebook friends <sup>B</sup>	87.5 (0345)	262.5 (75, 500)	1.16 (1.10–1.23)	1.07 (1.01–1.13)
No. of male anal sex partners <sup>A</sup>	1 (1, 3)	4 (2, 10)	1.03 (1.01–1.04)	
Sexual sensation score	29.5 (26.5, 32)	31 (29,34)	1.09 (1.05–1.13)	1.08 (1.03–1.13)

RDS, respondent-driven sampling adjusted; OR, Odds ratio; aOR, adjusted Odds ratio; CI, confidence interval

<sup>A</sup> In the past 6 months.

<sup>B</sup> Odds per 100.



**Table 5**

Marginal probabilities of significant continuous variables

	<b>Q<sub>1</sub></b>	<b>Q<sub>3</sub></b>
Age (years)	0.83	0.61
Collective identity scale	0.73	0.77
No. of Facebook friends	0.74	0.79
Sexual sensation score	0.71	0.80

Data are presented as marginal probabilities