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Associations between Sexual Partner Number and HIV Risk Behaviors: Implications for HIV Prevention Efforts in a Treatment as Prevention (TasP) Environment

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Abstract

Previous research indicates that gay and bisexual men (GBM) have significantly more sexual partners than same-aged heterosexual men and women. As a result, some HIV intervention programs have focused on partner reduction. However, new research findings question the relevance of sexual partner number as a sexual risk measure for GBM given Treatment as Prevention (TasP) programs and new seroadaptive strategies which have led to lower GBM community viral load and new HIV prevention behaviors. To assess if sexual partner number continues to remain an important measure of sexual risk for GBM living in a city that actively promotes TasP as provincial policy, we analysed cross-sectional data from 719 GBM recruited through respondent-driven sampling in Vancouver, Canada. Multivariable negative binomial regression analysis showed that partner number was significantly associated with previously identified HIV risk factors including condomless anal intercourse with serodiscordant and/or unknown serostatus partners, using sex toys, attending group sex events, receiving money for sex, and sex drug use. These results indicate that sexual partner number remains an important proximate HIV risk measure. However, more nuanced measures of HIV treatment status and greater understanding of the possible causes of increased partner number among GBM are needed.

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Keywords

Gay and bisexual men; Men who have sex with men; Sexual partners; HIV; Sexual risk

Introduction

Gay and bisexual men (GBM) tend to have significantly more lifetime and annual sexual partners than same-aged heterosexual men and women (Glick et al., 2012). Additionally, survey data from North American urban centers indicate that GBM report younger age at first intercourse, greater frequency of new sexual partners, higher prevalence of multiple concurrent partners, and more partner age disparity (Glick et al., 2012). Each of these differences has been linked to elevated risk of HIV transmission and acquisition. Multiple sexual partners are independently associated with HIV incidence (Koblin et al., 2006), large sexual networks can exacerbate the spread of drug-resistant HIV strains (Beyrer et al., 2012), partner concurrency facilitates HIV transmission in sexual networks (Morris & Kretzschmar, 1995), and age disparate relationships are associated with elevated risk because older GBM are more likely to be HIV-positive (Anema et al., 2013). Recognizing these factors, some HIV intervention programs have focused on reducing partner number as a risk reduction strategy (Rosenberg, Sullivan, DiNenno, Salazar, & Sanchez, 2011).

Historically, partner number and condomless anal sex, which has an HIV transmission probability of approximately 18 times greater than vaginal sex (Baggaley, White, & Boily, 2010), have been classified as high-risk behaviours and frequently used as outcome measures as in HIV research. However, because of new pharmacological and behavioural treatment strategies, there is uncertainty about what now constitutes “high risk” sexual behavior (Persson, 2013; Prestage, Brown, Down, Jin, & Hurley, 2013). Proper adherence to highly active anti-retroviral therapy (HAART) has reduced community viral loads and increased the number of HIV-positive people with suppressed viral loads (VL≤200 copies/mL) in different North American sites (Das et al., 2010; Moore et al., 2016). In British Columbia, a Treatment as Prevention (TasP) program has provided free access to HAART since 1997 for all HIV-positive provincial residents (Lima et al., 2015; Montaner et al., 2014) and recent research suggests that 81.4% of HIV-positive GBM in Vancouver are virally suppressed (Moore et al., 2016). Research also indicates that in addition to biomedical prevention strategies, GBM engage in a variety of seroadaptive strategies including serosorting (i.e., selectively choosing sexual partners based on their HIV status) and viral load sorting (i.e., selectively engaging in sexual activities based on an HIV-positive sexual partner’s viral load count) suggesting that condomless anal sex may not be high-risk in all contexts (Card et al., 2017). Likewise, HIV-negative GBM who recently attended group sex events considered condomless anal sex with HIV-positive men on treatment and who report a low/undetectable viral load to be a seroadaptive practice (Rich et al., 2015). Finally, in a large analysis of over 225,000 condomless anal intercourse episodes reported by Australian GBM from 2001–2007, the term *“any condomless anal intercourse”* by itself was found not to be an accurate measure of HIV risk behavior due to the high prevalence of seroadaptive strategies including serosorting, sexual positioning, and withdrawal (Jin et al., 2015).

While the importance of sexual partner number as an HIV risk factor for GBM is not as clear as previously thought, some research has addressed the question of *why* GBM have distinctive sexual partner distributions. One important example is Parsons and colleagues' (2015) study of 370 highly sexually active GBM, defined as having 9 or more sexual partners in the previous three months. Study participants completed the Sexual Compulsivity Scale (Kalichman & Rompa, 1995) and the Hypersexual Disorder Screening Inventory (Kafka, 2010). Results showed three distinctive groups in this sample: 1) sexually compulsive (30%), 2) sexually compulsive and hypersexual (21%), and 3) neither sexually compulsive nor hypersexual (49%). Further analysis found no significant differences between groups for number of male partners, anal sex acts, or anal sex acts with serodiscordant partners, and the majority of men in the total sample were actively engaged in HIV/STI prevention practices. Consequently, the authors proposed that many highly sexually active GBM reflect culturally normative social behavior, rather than a psychosexual disorder. The difference between these two explanations is large, with one suggesting a psychological pathology, and the other sex-positive cultural norms.

All these findings raise questions about the current importance and interpretation of sexual partner numbers among GBM. To address these questions, we analyzed the recent sexual partner distribution for GBM enrolled in the [redacted] Study in Vancouver, Canada to: 1) assess associations between number of recent sexual partners with previously cited HIV risk factors including psycho-social factors, substance use, and sexual behavior and 2) interpret results in terms of distal variables underlying partner distributions.

Methods

Protocol

[Redacted] is a prospective cohort study investigating possible behavioral changes among GBM associated with British Columbia's expanded Treatment as Prevention program (Lima et al., 2015; Montaner et al., 2014). The study uses respondent-driven sampling (RDS; Heckathorn, 2002) to recruit HIV-positive and HIV-negative GBM in Vancouver, British Columbia; full methodology has been published elsewhere (Moore et al., 2016). Briefly, RDS begins by identifying "seeds", or participants screened and selected by researchers, who share key characteristics (e.g., sexual orientation, substance use, etc.) with a target population. Seeds are then invited to participate and subsequently recruit members of their social networks via coupon distribution. Eligibility criteria for participation in the study included being 16 years of age or older, identifying as male (including trans men), having had sex with another man in the past six months, living in the greater Vancouver area, and being able to complete a questionnaire written in English. Eligible candidates completed a computer-assisted self-interview (CASI) and biological tests with a study nurse consisting of point-of-care HIV testing or HIV serology (viral load and CD4 count) as appropriate, blood tests for hepatitis C and syphilis, and optional tests for gonorrhea and chlamydia. Study participants received a fifty-dollar honorarium and were given up to 6 coupons to recruit further respondents, for which they earned an additional ten dollars for each successful recruit. Eligible participants returned every six months for repeated tests and surveys, but

only data from baseline visits are analyzed for this cross-sectional study. All procedures received human ethics clearances from [redacted].

Dependent Variable

The distribution of recent male sexual partners was derived from responses to the question, "*During the past 6 months, how many guys have you had sex with?"* Responses represented count data used as the dependent variable in analyses.

Independent Variables

Independent variables included previously cited high risk factors including sexual behavior, substance use, and psycho-social measures; socio-demographic variables were used as controls. In the first regard, Prestage and colleagues (2009) found GBM who attended group sex events were at heightened HIV infection risk because of condomless anal intercourse with unknown serostatus partners and substance use at these events. Similarly, a case control study of Australian gay and bisexual men (Kippax et al., 1998) revealed a suite of high risk sexual behaviors termed "Sexual Adventurism", exemplified by substance use, fisting, sex toys, and watersports. Finally, receiving money and/or drugs for sex, and working as a sexual escort are well-documented HIV risk factors for gay and bisexual men (Baral et al., 2014). All these behaviors were recorded as categorical "yes/no" responses to questions asking about sexual behaviors in the past 6 months. Anal sex behavior, also over the last 6 months, was represented by a multi-level variable distinguishing no condomless anal intercourse, condomless anal intercourse with seroconcordant partners only, and condomless anal intercourse with a serodiscordant or unknown serostatus partner; only the last option was considered high risk. Participants also reported their anal sex role preference (e.g., top, bottom, or versatile).

Substance use variables included responses to the 10-item Alcohol Use Disorders Identification Test (AUDIT) which classified participants based on their alcohol use over the past 12 months as "harmful or hazardous drinkers" if they had a score ≥8 (Saunders, Aasland, Babor, De la Fuente, & Grant, 1993). Additional questions asked about 'sex drug' use (i.e., erectile dysfunction drugs, poppers, crystal methamphetamine, and Ecstasy) in the past six months (Ostrow et al., 2009). Psychosocial measures included three validated scales previously linked to high risk sexual behavior. First, the Sexual Escape Scale (12 items, range 4–48, study α=0.90) evaluates the extent to which participants use alcohol and/or illicit substances to diminish cognitive recognition of high risk sexual behavior (McKirnan, Vanable, Ostrow, & Hope, 2001). Participants use a 4-point Likert scale (strongly disagree/disagree/agree/strongly agree) to rate agreement to items such as "When I am high or drunk, I am more likely to do sexual things I usually wouldn't do". Second, the Sensation Seeking Scale (Revised, 11 items, range 11–44, study α=0.73), measures respondents' attitudes towards sexual thrill-seeking (Kalichman et al., 1994). For example, using a 4-point Likert scale (not at all like me/not like me/like me/very much like me) participants indicate how similar each of the items is to their own experience (e.g., "I like to have new and exciting sexual experiences"). Third, the HIV Treatment Optimism-Skepticism Scale (adapted from Van De Ven, Crawford, Kippax, Knox, & Prestage, 2000; 12 items, range 0–36, study α=0.85), examines sexual HIV risk perceptions associated with antiretroviral treatment.

Participants use a 4-point Likert scale (strongly disagree/disagree/agree/strongly agree) to rate agreement to items such as “A person with undetectable viral load cannot pass on the virus”. Sociodemographic control variables included age, education, annual income, race/ethnicity, residence within the greater Vancouver area, sexual orientation (gay, bisexual, other), and a self-reported measure of HIV status.

Statistical Analyses

Partner number and associated independent variables were analyzed via negative binomial regression, which was designed for count data with non-negative integers and non-normal distributions (Allison, 2012). We used the SAS (Ver. 9.3) PROC GENMOD sub-routine to model associations between independent variables and number of recent male sexual partners by calculating risk ratios for univariable models and adjusted risk ratios for the subsequent multivariable model, along with 95% confidence intervals for all independent variables. Independent variables with probability values <0.20 were selected from univariable models for potential inclusion in the subsequent multivariable model. The final multivariable model was determined using a backward elimination procedure based on the Akaike Information Criterion and Type-III p-values (Lima et al., 2007). In RDS procedures, successive recruitment waves permit population parameter estimation via Markov chain procedures (Heckathorn, 2002). Accordingly, raw sociodemographic data were adjusted by the RDS program RDSAT version 7.1 (Volz et al., 2012) using respondents’ social network size estimates and each corresponding variable as the weighting variable. Results compared original data with weighted results which represented population estimates and included 95% confidence intervals. Original data falling outside these limits were considered statistically significant.

Results

Sample Characteristics

A total of 719 gay and bisexual men, including 119 (16.6%) seeds, were recruited from February 2012 to February 2014. Table I shows descriptive statistics, including raw and respondent-driven sampling adjusted values and 95% confidence intervals. Overall, the sample was predominantly White and well-educated, with a median age of 33 years (Q1,Q3:26,47) and an adjusted HIV prevalence of 23.1%. Based on RDS estimated population parameter estimates, gay, white men with annual incomes from $30,000-$59,999, and more than a high school education were over-represented. Inversely, men, who had annual incomes below $30,000, and were not educated beyond high school, were under-represented.

Recent Male Sexual Partner Distributions

The distribution of male sexual partners reported for the previous six months is shown in Figure 1. This had a modal number of partners of 1, reported by 13% of the sample. The distribution mean was 15 partners, the median was 5, and there was a standard deviation of 39 partners. These last descriptive statistics reflected the fact that a small number of men with a large number of sexual partners resulted in a long, non-normal partner distribution

sample tail. Thus, while men reporting >100 partners (n=21) constituted only 3% of the total sample they accounted for 37% of the total 11,037 sex partners reported.

Table II shows the association of partner number with independent variables as determined by univariable and multivariable negative binomial regression analyses. Results indicated that most significant ($p<.05$) variables were positively signed (>1.0), indicating that risk ratios increased with partner number. For example, the adjusted risk ratio for the Sexual Sensation Seeking Scale was 1.03 (95% CI = 1.01, 1.06), such that each additional point on the continuously distributed scale was associated with an estimated average 3% increase in sexual partners (Hilbe, 2011). Interpretation of dichotomous categorical variables in the multivariable model was exemplified by men attending a group sex event, who were estimated to average almost two and a half more partners than men who did not attend such events (aRR=2. 44, 95%CI=2.04–2.93). Sexual behavior variables significantly associated with increased partner number in the final multivariable model included condomless anal intercourse with a serodiscordant and/or unknown serostatus partner, attending a group sex event, using sex toys, receiving money in exchange for sex, and preferring either top or versatile anal sex roles. Additionally, using crystal methamphetamine, poppers, or Ecstasy, and higher levels of sexual sensation seeking were also associated with reporting more sexual partners. In contrast, men who self-identified as bisexual or other (compared with gay), lived outside of the downtown urban core, and who reported having condomless anal intercourse with only seroconcordant partners in the past 6 months, were more likely to report fewer sexual partners.

Discussion

In light of changing HIV prevention practices, this study aimed to determine if the number of sexual partners reported by gay and bisexual men remains an important HIV risk factor, as demonstrated by continued associations with other known HIV risk factors. Additionally, we sought to better understand why the sexual partnership distributions of GBM differ significantly from those of same-aged heterosexual men and women. To address these questions, we analyzed recent male sexual partner distribution for GBM participating in the [redacted] Study and found that this distribution was consistent with previously reported distributions of North American GBM. Vallabhaneni and colleagues (2013) examined four North American longitudinal cohorts of GBM from HIV-prevention studies spanning 1995–2007. In their pooled sample of 12,277 men, 29.0% reported more than 10 sexual partners in the past 6 months (range=16.4%–34.0%). In this study, the corresponding figure was 27%.

Results of multivariable negative binomial regression analysis showed that previously recognized high HIV risk behaviors, including condomless anal sex with a discordant/unknown serostatus partner, attending a group sex event, receiving money for sex, fisting, and using Ecstasy, crystal methamphetamine, or poppers, were significantly associated with reporting more male sexual partners. These findings strongly indicate that number of sexual partners remains an important proxy measure for HIV risk among GBM. However, results also show the limitations of using partner number alone as a risk measure. In particular, HIV-positive participants exemplify the complexity of determining risk behavior in a TasP environment. Laboratory testing of these participants showed that over 80% (163/199) of

men on HAART were immunologically suppressed (VL≥200 copies/mL) (Moore et al., 2016). However, unsuppressed participants were younger, more economically disadvantaged, and most importantly for this paper, significantly more likely to engage in condomless anal intercourse with a serodiscordant and/or unknown serostatus partner. This last factor emphasizes that being on HAART is not enough by itself to lower HIV transmission probabilities, viral load suppression is necessary, and GBM report recognizing condomless anal intercourse with serodiscordant partners on HAART *and who reported a low viral load* as a sero-adaptive strategy (Rich et al., 2015). Because of this, the significant association between partner number and condomless anal intercourse with a serodiscordant or unknown serostatus partner recorded in the multivariable model is difficult to interpret without knowledge of the partner's viral load. If suppressed, it represents a seroadaptive strategy; if not, it constitutes high risk sexual behavior.

Considering the present complexities of determining context-specific sexual risk, it may be useful instead to focus on identifying distal variables addressing the question of *why* gay and bisexual men feature distinctive sexual partner distributions. Independent variables significantly associated with increasing sexual partner number in this study suggest at least three different factors. First, receiving money for sex represents an economic rationale for multiple partners. Second, attending group sex events, using sex toys, and using sex drugs including Ecstasy, poppers, or crystal methamphetamine, as well as engaging in condomless anal intercourse with serodiscordant and/or unknown serostatus partners suggest sexually adventurous gay and bisexual cultural norms (Prestage et al. 2009). Thirdly, respondents with high Sexual Sensation Seeking scores remind us that some people engage in sensation or risk seeking to maximize their sexual pleasure (Flowers, Hart, & Marriott, 1999; O'Byrne & Homnes, 2011; Race, 2009). These three different pathways to sexual partner number, representing distinctive economic, cultural, and psychological factors, highlight the need for multiple, specialized HIV education and intervention approaches, rather than a generalized emphasis on partner reduction. We suggest that additional studies attempting to delineate distal variables underlying the increased partner number of many GBM could help to improve understanding of sexual health risks and overall sexual behavior among GBM.

The present study has limitations. Our cross-sectional research design cannot attribute causality. Specifically, it is important to note that having multiple sexual partners does not cause HIV transmission or acquisition; at most, it can be considered a proximate variable, denoting associated risks of HIV. Further, our data are from Vancouver which is the epicentre of the province's TasP program; therefore, results may not be generalizable to other locales and populations where access to HAART may be more restricted. Finally, while the [redacted] Study sample is highly comparable with other North American GBM research samples in terms of partner number distribution, it may be unique in the high proportion of HIV-positive men who are virally suppressed and the low number of HIV-negative participants using pre-exposure prophylaxis (Lachowsky et al., 2016). Despite these caveats, analysis supported previous research emphasizing sexual partner number as an important risk factor for GBM. However, rather than considering partner reduction as an HIV program endpoint as previously emphasised, we suggest using partner number as a starting point to understand why the partnership distributions of GBM differ from heterosexual men and women. As in this study, we expect results of such research to

delineate multiple, co-existing causes which could provide the basis for more effective and specialized interventions and education programs.

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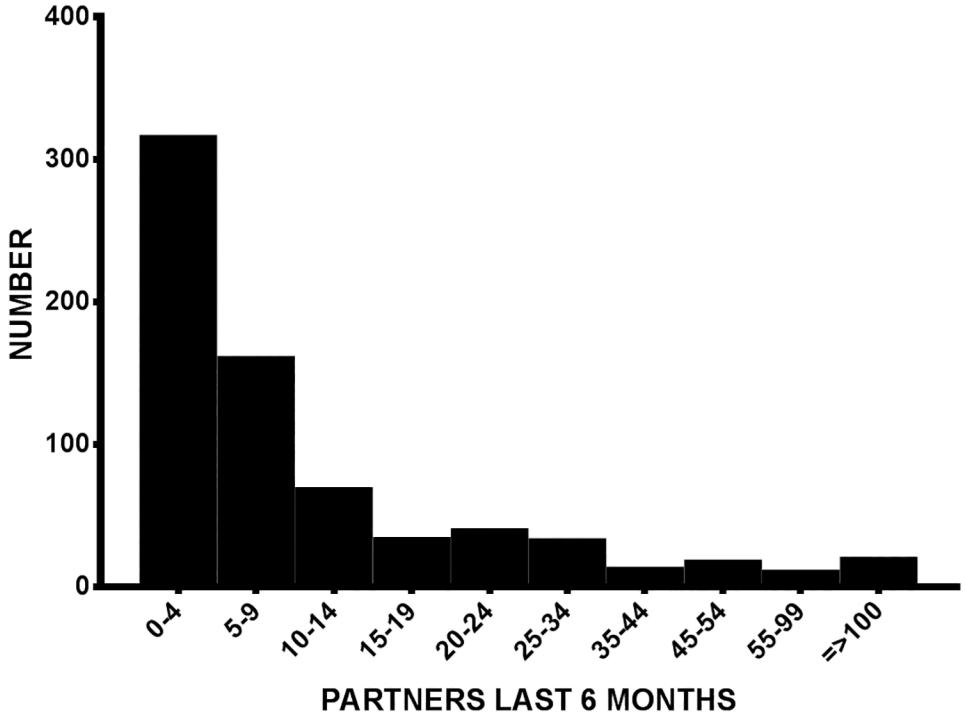

Figure 1.
Recent male sexual partner distribution.

Table I.

Crude and respondent-driven sampling (RDS) sample descriptive statistics.

Variable	N *Median, (Q1,Q3)*	RDS %	RDS 95% CI
Age	*33, (26, 47)*		
Ethnicity			
White	539	68.0	60.6, 74.4
Asian	72	9.9	6.2, 14.8
Aboriginal	50	10.3	5.6, 16.2
Other	58	11.8	7.0, 17.1
Sexual Identity			
Gay	612	80.3	75.6, 85.2
Bisexual/Other	107	19.7	14.8, 24.4
Education			
Less than high school	61	14.2	9.5, 19.5
High school or greater	644	85.8	80.5, 90.5
Neighborhood			
Downtown Vancouver	356	51.8	43.8, 59.2
Vancouver (not downtown)	223	30.5	24.0, 36.7
Outside Vancouver	140	17.7	13.0, 24.1
Annual Income			
< $30,000	457	74.5	69.8, 79.9
$30–59,999	182	17.2	13.2, 20.9
≥ $60,000	80	8.3	5.2, 11.8
Self-reported HIV Status			
Negative	524	76.9	68.8, 84.4
Positive	195	23.1	15.6, 31.2
Number of Sex Partners, P6M	*5, (2,13)*		
Condomless Anal Sex, P6M			
No	256	38.2	32.8, 45.4
Seroconcordant partners only	185	26.0	20.6, 31.6
Serodiscordant/unknown partners (i.e., high risk sex)	262	35.8	29.1, 41.4
Fisting, P6M	73	7.1	4.6, 10.0
Sex Toys, P6M	199	24.6	19.4, 29.8
Watersports, P6M	99	8.4	5.6, 11.7
Anal Sex Preference			
Bottom	241	35.9	29.5, 41.3
Versatile	193	27.6	22.3, 33.4
Top	253	36.5	31.5, 42.8
Attended Group Sex Party, P6M	180	21.4	16.3, 26.2

Variable	N *Median, (Q1,Q3)*	RDS %	RDS 95% CI
Worked as Escort, P6M	43	8.6	4.5, 13.1
Received Money for Sex, P6M	63	10.1	5.7, 14.8
Received Drugs for Sex, P6M	61	10.9	6.3, 15.4
HAART Treatment Optimism Scale (range: 0–36)	*25 (21, 28)*		
Sensation Seeking Scale (range: 11–44)_	*31 (27, 34)*		
Cognitive Escape Scale (range: 4–48)	*29 (25, 33)*		
AUDIT Score ≥8	243	31.2	25.2, 37.0
Used EDD, P6M	162	17.3	12.2, 21.6
Used Poppers, P6M	266	34.3	28.7, 40.3
Used Crystal Meth, P6M	136	19.6	13.7, 25.4
Used Ecstasy, P6M	176	18.9	14.2, 24.0

Note: P6M = past 6 months; EDD = erectile dysfunction drugs

Table II.

Univariable and multivariable binomial regression results for recent (past 6 months) male sexual partner distribution. Statistically significant ($p<0.05$) variables in bold.

Variable	Univariable Models		Multivariable Model	
	RR	95% CI	aRR	95% CI
Age	**1.02**	**1.01, 1.03**	Not selected	
Ethnicity				
White	Ref		Not selected	
Asian	**0.53**	**0.39, 0.73**		
Aboriginal	0.76	0.52,1.09		
Other	1.12	0.80, 1.57		
Sexual Identity				
Gay	Ref		Ref	
Bisexual/Other	**0.53**	**0.41, 0.68**	**0.55**	**0.44, 0.69**
Education				
Less than high school	Ref			
High school or greater	0.98	0.71, 1.36		
Neighborhood				
Downtown	Ref		Ref	
Vancouver (not downtown)	**0.57**	**0.47, 0.71**	**0.75**	**0.63, 0.89**
Outside Vancouver	1.12	0.88, 1.42	0.90	0.74, 1.10
Annual Income				
< $30,000	Ref		Not selected	
$30–59,999	1.19	0.95, 1.47		
≥ $60,000	**1.55**	**1.15, 2.09**		
Self-reported HIV Status				
Negative	Ref		Not selected	
Positive	**1.58**	**1.29, 1.94**		
Condomless Anal Sex, P6M				
No	Ref		Ref	
Seroconcordant partners only	0.96	0.77, 1.21	**0.81**	**0.66, 0.98**
Serodiscordant/unknown partners (i.e., high risk sex)	**2.96**	**2.41, 3.62**	**1.25**	**1.04, 1.52**
Any Fisting, P6M	**3.49**	**2.62, 4.65**	Not selected	
Any Sex Toys Use, P6M	**1.82**	**1.48, 2.23**	**1.30**	**1.04, 1.63**
Any Watersports, P6M	**2.83**	**2.19, 3.65**	Not selected	
Anal Sex Preference				
Bottom	Ref		Ref	
Top	**1.56**	**1.23, 1.98**	**1.21**	**1.001, 1.47**
Versatile	**1.39**	**1.12, 1.74**	**1.29**	**1.08, 1.54**
Attended Group Sex Party, P6M	**4.37**	**3.63, 5.26**	**2.44**	**2.04, 2.93**
Worked as Escort, P6M	**3.19**	**2.19, 4.64**	Not selected	
Received Money for Sex, P6M	**4.14**	**3.06, 5.61**	**2.45**	**1.90, 3.17**

Variable	Univariable Models		Multivariable Model	
	RR	95% CI	aRR	95% CI
Received Drugs for Sex, P6M	**2.16**	**1.56, 2.98**	Not selected	
HAART Treatment Optimism Scale	**1.02**	**1.01, 1.04**	Not selected	
Sensation Seeking Scale	**1.14**	**1.11, 1.16**	**1.03**	**1.01, 1.06**
Cognitive Escape Scale	**1.02**	**1.01, 1.03**	Not selected	
AUDIT Score ≥8	1.12	0.92, 1.36		
Used EDD, P6M	**3.26**	**2.66, 4.00**	Not selected	
Used Poppers, P6M	**2.02**	**1.68, 2.44**	**1.20**	**1.02, 1.41**
Used Crystal Meth, P6M	**2.80**	**2.24, 3.50**	**1.61**	**1.31, 1.98**
Used Ecstasy, P6M	**2.31**	**1.88, 2.83**	**1.20**	**1.005, 1.44**

Note: RR = Risk Ratio, aRR = Adjusted Risk Ratio, P6M = past 6 months