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2018

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This article was originally published at:

<https://doi.org/10.1177/1557988318786872>

Citation for this paper:

Roth, E. A., Cui, Z., Wang, L., Armstrong, H. L., Rich, A. J., Lachowsky, N. J., Sereda, P., Card, K. G., Jollimore, J., Howard, T., Olarewaju, G., Moore, D. M., & Hogg, R. S. (2018). "Substance Use Patterns of Gay and Bisexual Men in the Momentum Health Study." *American Journal of Men's Health*, 12(5), 1759–1773. <https://doi.org/10.1177/1557988318786872>

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American Journal of Men's Health
2018, Vol. 12(5) 1759–1773
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DOI: 10.1177/1557988318786872
journals.sagepub.com/home/jmh


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Abstract

Research with male sexual minorities frequently combines gay and bisexual men as Men Who Have Sex with Men or Gay and Bisexual Men. When analyzed separately, bisexual men consistently feature negative health differentials, exemplified by higher substance use levels. This interpretation is not clear-cut because studies may combine bisexual men and women, use different dimensions of sexual orientation to define bisexuality, and/or not consider number of sexual partners as a possible confounding factor. This study conducted separate bivariate and multivariate analyses comparing gay to bisexual Momentum Study participants based on self-identity, sexual attraction, and sexual behavior, while controlling for number of sexual partners and sociodemographic, psychosocial, and sexual behavior measures. The study hypothesized that, regardless of definition, bisexual men feature higher substance use levels compared to gay men. Bivariate analyses revealed significantly higher ($p < .05$) use among bisexual men for multiple substances in all samples. Nonprescription stimulants and heroin were significant in all multivariate logistic regression models. In contrast, all bisexual samples reported lower use of erectile dysfunction drugs and poppers, substances associated with anal sex among gay men. Subsequent analysis linked these results to lower levels of anal sex in all bisexual samples. Bivariate analyses also revealed that bisexual men featured significantly lower educational levels, annual incomes, and Social Support Scales scores and higher Anxiety and Depression Sub-Scale Scores. In summary, findings revealed bisexual men's distinctive substance use, sexual behavior, psychosocial, and sociodemographic profiles, and are important for tailoring specific health programs for bisexual men.

Keywords

bisexual men, gay men, substance use, behavioral issues, sexual dimensions

Received March 4, 2018; revised May 23, 2018; accepted June 7, 2018

The majority of research with male sexual minorities categorizes them as “gay and bisexual men” (GBM), or “men who have sex with men” (MSM). For example, Kaestle and Ivory's (2012) content analysis of PUBMED literature dating from 1987 to 2007 reported that less than 20% of 348 articles mentioning bisexuality performed separate analyses for bisexuals. While intended to be inclusive, terms like MSM and GBM make it difficult to draw valid conclusions regarding bisexuals or other men who have sex with both men and women while simultaneously skewing data for gay men (Young & Meyer,

2005; Bauer & Brennan, 2013). In particular, conflating gay and bisexual men is an important problem for men's health research, since studies that do separate gay from bisexual men indicate multiple negative health differentials for bisexual men (Friedman et al., 2014; Friedman & Dodge, 2016). Currently, problems in defining and classifying bisexuality in survey data remain in analyzing gay and bisexual men's health parameters separately and/or in comparison to other sexual groups.

Reports of higher substance use levels for bisexual men in comparison to gay men (Shelton, 2017) exemplify



both these health differentials and their associated problems. Analysis of US Multicenter AIDS Cohort Study (MACS) data reported significantly higher polydrug use for bisexual men compared to gay men (Friedman et al., 2014). In other comparisons with gay men, Ibañez, Purcell, Stall, Parsons, and Gomez (2005) identified HIV-positive bisexual men more frequently using injection drugs, while Nakamura, Semple, Strathdee, and Patterson (2011) revealed HIV-positive methamphetamine-using bisexual men with significantly higher use levels for crack, alcohol, marijuana, cocaine, hallucinogens, and heroin. Brennan-Ing, Porter, Seidel, and Kapiak (2014) indicated that bisexual men 50 years of age and over were significantly more likely to use tobacco, cocaine, crack, and heroin in comparison to same-aged gay men, and a comparison of gay and bisexual men from upstate New York identified significantly higher alcohol severity scores for bisexual men (Hequembourg, Parks, Collins, & Hughes, 2015). Finally, a national probability sample determined that bisexual male adolescents use more illegal substances than either gay or straight male youths (Russell, Driscoll, & Truong, 2002).

While the earlier studies denote higher substance use levels for bisexual men compared to gay men, this interpretation can be problematic for at least three reasons. First, some studies combine bisexual men and women in their analysis (Bauer, Flanders, MacLeod, & Ross, 2016; Hequembourg & Dearing, 2013; Ross et al., 2014), negating direct comparisons between gay and bisexual men. Second, studies may use differing criteria to define bisexuality. Miller, André, Ebin, and Besonova (2007, p. 2) define bisexuality as, "... the capacity for emotional, romantic, and/or physical attraction to more than one sex or gender," while stressing that, "... capacity for attraction may or may not manifest itself in terms of sexual interaction." This definition recognizes three dimensions of human sexual orientation: identity, attraction, and behavior (Laumann, 1994). Using differing dimensions as eligibility criteria negates direct comparisons. Thus, while McCabe, Bostwick, Hughes, West, and Boyd (2010) used identity in their analysis of National Epidemiologic Survey on Alcohol and Related Conditions Data, Bowers, Branson, Fletcher, and Reback (2011)

emphasized sexual behavior to study Los Angeles' bisexual men, and Bauer et al. (2016) focused on sexual attraction to examine Canadian bisexual men and women. One proposed solution to this challenge is to use all three dimensions of sexual orientation whenever possible (Bauer & Brennan, 2013; McCabe, Hughes, Bostwick, & Boyd, 2005; Saewyc et al., 2004; Scheer et al., 2003).

The third difficulty is particularly relevant for behavioral bisexuality. Bauer and Brennan (2013) note that in survey data, classification as bisexual necessitates having both male and female partners within a stated time-period. In contrast, lesbians, gays, and heterosexual men and women need only one sexual partner to "define" their sexual orientation. This is an important difference because increased partner number is frequently associated with increased substance use and sexual behavior risk (Cavazos-Rehg et al., 2011; Mercer, Hart, Johnson, & Cassell, 2009). For example, Cavazos-Rehg et al. (2011) discovered that sexual partner numbers increased with substance use intensification, and Armstrong et al. (2018) documented significant associations between poppers, crystal methamphetamine, and MDMA and increasing number of sexual partners. Despite such findings, sexual partner number is often omitted from analyses comparing bisexuals with other groups (Baldwin et al., 2015; Friedman et al., 2014; Hequembourg & Dearing, 2013; Nakamura et al., 2011). Bauer and Brennan (2013) suggest this potential confounding problem can be mitigated by including the number of sexual partners (both male and female) in multivariable models, restricting analyses to survey participants with at least two partners, and/or conducting sensitivity analyses to check for statistically significant differences between study groups.

This study analyzes data generated by the Momentum Health Study. Momentum focused primarily on gay men, and previous analyses have not separated gay from bisexual study participants (Moore et al., 2016; Rich et al., 2016; Roth et al., 2018). Nonetheless, Momentum data have the potential to address the three challenges outlined earlier. Specifically, they pertain to gay and bisexual men only, the study questionnaire considers all three sexual dimensions of sexual orientation, and includes the number of recent sexual partners, both male and female, for

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all participants. Study goals in analyzing these data are two-fold. The first is to test the hypothesis that compared to gay Momentum Study participants bisexual men in the study have higher substance use patterns, regardless of the definition of bisexuality. The second is to identify psychosocial, demographic, and socioeconomic factors associated with bisexuality in the Momentum sample. These factors are important because as Ebin (2012) observes, it is not bisexuality *per se* that determines substance patterns, but rather how bisexual men and women are stigmatized and marginalized. Shelton (2017, pp. 120–121) lists three related societal factors that negatively affect bisexual men and women's health: (a) invisibility, (b) double discrimination, and (c) insistence that one must be either gay or straight. The first factor results from conflating bisexual and gay men, as discussed earlier, as well as bisexuals labeled as gay or straight based on their partner's gender. Double discrimination means that bisexuals lack recognition and support from society in general as well as from lesbian and/or gay communities (Dodge et al., 2012). The third factor is the belief that bisexuality is merely a transitional stage before individuals inevitably conform to the heterosexuality/homosexuality dichotomy (Friedman et al., 2014). Results of such societal stressors include higher prevalence of mental health and substance use problems for bisexual men and women (Feinstein & Dyer, 2017).

Methods

Protocol

Momentum is a prospective cohort study of the health, sexual behavior, and substance use patterns of gay and bisexual men in Vancouver, British Columbia, Canada. Momentum uses respondent-driven sampling (RDS; Heckathorn, 1997) to recruit participants. In this approach, purposefully selected "seeds" sharing similar characteristics with target populations are initial study participants who are subsequently encouraged to recruit additional participants from their social and sexual networks. Seed recruitment was through community agencies with the assistance of Momentum's community advisory board and later via mobile smartphones and gay Website advertisements (Moore et al., 2016). Seeds underwent a short training session of peer-recruitment procedures and received six coupons, hard copy or digitally generated, to offer acquaintances who met the study's eligibility criteria. These included being at least 16 years of age, self-identification as a man (regardless of sex at birth), reporting sex with a man in the past 6 months, ability to complete a questionnaire in English, and residence in the Greater Vancouver Area. Potential participants came to the study's downtown Vancouver

study office where a research assistant insured they met the eligibility criteria and were a seed or had received a study coupon from another study participant. All eligible participants signed an Informed Consent form, received a \$50 honorarium for participation, and a further \$10 for each person they recruited. Alternatively, participants could enter a monthly draw for a \$250 gift card or a 6-monthly draw for a \$2000 travel voucher. RDSCM v. 3.0 software (Ithaca, NY) managed coupons, recorded recruiter-recruit relationships, and tracked compensation and coupon redemption patterns. Every 6 months, study participants completed a computer-assisted self-interview questionnaire and biological tests including point-of-care HIV testing or HIV blood work as appropriate, blood tests for hepatitis C and syphilis, and optional tests for gonorrhea and chlamydia. Participant recruitment covered the period February 2012–February 2015. This study used only baseline data from participants' first study visit. All procedures received human ethics clearances from Simon Fraser University (ID Number 2011s0691), the University of British Columbia (ID Number H11-00691), and the University of Victoria (ID Number 11-459).

Measures

Dependent variables were responses to questions about sexual orientation, measured by identity, attraction, and behavior. For identity, the study questionnaire asked, "How would you describe your sexual orientation?" with responses including "gay," "bisexual," "queer," "questioning," and "other." Men giving the last three responses ($n=46$) were removed from the identity analysis, leaving a direct comparison between self-identified gay ($n = 655$) and bisexual men ($n = 73$). Responses to the query, "In the past two years who have you had sexual fantasies about?" determined sexual attraction. Respondents who answered "men only" were considered gay ($n = 541$), while bisexuality ($n = 233$) was defined by responses indicting fantasies about men as well as women. Behavioral bisexuality was determined from responses to the question, "In the past two years who have you had sex with?" Behavioral bisexuality was defined as having sex with at least one male and one female during this time ($n = 114$). In contrast, participants having sex only with men were considered gay ($n = 660$).

Independent variables consisted of substance use, sociodemographic characteristics, and psychosocial and sexual behavior measures. Substance use questions asked if respondents used erectile dysfunction drugs, crystal methamphetamine, poppers, heroin, and/or injected drugs (including steroids) in the past 6 months. In addition, composite variables asked about use of hallucinogens (Ecstasy/MDMA, LSD, Ketamine, mushrooms), prescription stimulants (Concerta®, Adderall®, and

Ritalin®), nonprescription stimulants (crack and cocaine), prescription sedatives (GHB, benzodiazepines, and barbiturates), and prescription opioids (Morphine, Codeine, Oxycontin®, Percocet®) in the same time period. Questions pertaining to alcohol use permitted calculation of Alcohol Use Disorder Test scores (AUDIT; Saunders, Aasland, Babor, De la Fuente, & Grant, 1993). These classified participants as: (a) Low Risk Drinkers (AUDIT score 0–7), (b), Hazardous Drinkers (AUDIT score ≥ 8 –15), (c) Harmful Drinkers (AUDIT score 16–19), or (d) Alcohol Dependent Drinkers (AUDIT score ≥ 20). Sociodemographic variables included measures of age, annual income, education, neighborhood, and current health self-assessment. Psychosocial variables consisted of the Hospital Anxiety and Depression Scale (HAD) (Snaith, 2003), divided into the Anxiety Subscale (study $\alpha = 0.79$), plus the Depression Subscale (study $\alpha = 0.83$), and the Social Support Scale (Lubben et al., 2006, study $\alpha = 0.86$). Sexual variables included the total number of sexual partners, both male and female, number of male sex partners, and male anal sex partners reported in the past 6 months.

Statistical Analysis

Samples were interdependent, as men could be included in one, two, or all three samples. Therefore, analysis followed the McCabe et al. (2005) methodology and conducted separate bivariate and multivariate analyses among each bisexual sample. In the first regard, differences between bisexual and gay men were assessed using Wilcoxon Rank-Sum tests for continuous variables and χ^2 tests for categorical variables. Subsequent analyses compared bisexual with gay men as the dependent variable in univariate and multivariate logistic regression models using the SAS® v. 9.4 PROC LOGISTIC routine (Cary, NC) (Allison, 2012). Final multivariable models were determined using a backward elimination procedure based on the Akaike Information Criterion (AIC) and Type-III p -values (Lima et al., 2007). RDS uses social network size estimates and measures of homophily between recruited men and their recruiters to adjust for sampling bias and produce population parameter estimates (Heckathorn, 2002). The RDS program RDSTAT v. 4.9 adjusted raw data, with network size determined by asking participants how many gay and bisexual men in the Vancouver area they would be comfortable giving a study voucher.

Results

Descriptive Sample Statistics

The final sample contained 774 gay and bisexual men, including 134 seeds. Table 1 presents raw count data and

percentages, plus RDS-adjusted values and their 95% confidence intervals (CIs) for the total sample. The raw data indicated that 76% ($n = 585$) of the sample self-identified as White, 9.6% ($n = 74$) as Asian, 6.5% ($n = 50$) as Indigenous, and 4.5% ($n = 35$) as Hispanic. A final classification consisted of 30 men (3.9%) who identified as Arab ($n = 7$), Black ($n = 10$), or simply responded as “Other,” with the last designation retained for analysis. More than three-quarters of participants had more than a high school education ($n = 595$, 76.9%). Despite the overall high educational level, the majority were in the lowest annual income group, $< \$30,000$ ($n = 485$, 62.7%). The RDS-adjusted percentage of self-reported HIV-positive men was 21% ($n = 218$).

Bivariate Analysis Results

Tables 2–4 present bivariate analyses results conducted upon RDS-adjusted data respectively for the identity, attraction, and behavior samples. In the identity results presented in Table 2, bisexual men featured significantly higher values for Anxiety ($p < .001$) and Depression ($p < .001$) Sub-Scales, and lower Social Support Scale scores ($p < .001$). Contrary to expectations, bisexual men reported lower number of male and female sex partners ($p = .020$), male sex partners ($p = .003$), and male anal sex partners ($p = .011$). Other sociodemographic differentials included significantly lower annual income ($p < .001$), educational attainment ($p < .001$), and percentages of men self-identifying as White ($p = .006$) for bisexual men. In addition, these men had a different residence pattern, with fewer living in Downtown Vancouver and the suburbs, represented by Greater Vancouver ($p = .007$). Finally, bisexual men in this sample uniformly self-assessed their current health as inferior to gay men ($p < .001$). With respect to substance use patterning, bisexual men reported significantly higher levels of use of prescription ($p < .001$) and nonprescription ($p < .001$) stimulants, crystal methamphetamine ($p = .001$), prescription opioids ($p < .001$), and heroin ($p < .001$). Only in the case of poppers did bisexual men exhibit significantly lower use levels ($p = .001$).

This pattern of higher substance use, combined with negative socioeconomic and health differentials, is repeated for the much larger ($n = 233$) attraction sample results, presented in Table 3. Compared to gay men, bisexual men in this sample again featured significantly higher Anxiety ($p < .001$) and Depression Sub-Scale Scores ($p < .001$), along with lower Social Support Scale scores ($p < .001$), annual incomes ($p < .001$), and educational attainment ($p < .007$), and similarly assessed their health as worse than gay sample members ($p < .001$). Ethnic differences were also significant ($p < .028$), with more bisexual men identifying as Indigenous, Hispanic,

Table 1. Total Sample Descriptive Statistics, Raw and RDS-Adjusted, Values Outside the RDS 95% CI in Bold.

Variable	N	%	RDS %	RDS 95% CI
Age (Median, Q1, Q3)	34, 26, 47			
Ethnicity				
White	585	75.6	68.5	[61.1, 74.5]
Asian	74	9.6	9.2	[5.9, 14.8]
Aboriginal	50	6.5	9.7	[5.1, 15.1]
Hispanic	35	4.5	7.3	[3.2, 11.7]
Other	30	3.9	5.1	[2.6, 8.7]
Education				
Less than or equal to high school	179	23.1	32.6	[26.9, 39.8]
More than high school	595	76.9	67.4	[60.2, 73.1]
Neighborhood				
Downtown	382	49.4	51.0	[43.2, 58.2]
Vancouver	240	31.0	30.8	[24.8, 37.0]
Outside Greater Vancouver	152	19.6	18.2	[13.5, 24.6]
Annual Income				
<\$30,000	485	62.7	72.9	[67.6, 78.5]
\$30–\$59,999	200	25.8	18.6	[14.4, 22.7]
>\$60,000	89	11.5	8.6	[5.3, 12.0]
HIV status—Self-report				
Negative/Unknown	556	71.8	79.0	[72.1, 85.9]
Positive	218	28.2	21.0	[14.1, 27.9]
Sexual orientation (Identity)				
Gay	655	84.6	80.4	[76.0, 84.9]
Bisexual	73	9.4	14.7	[10.4, 18.7]
Queer/Questioning ^a	25	3.5	1.5	[0.7, 2.5]
Other ^a	19	2.5	3.4	[1.6, 5.7]
Sexual orientation (past 2 years—Attraction)				
Males only—Gay	541	69.9	66.6	[60.8, 72.1]
Other = Bisexual	233	30.1	33.4	[27.9, 39.2]
Sexual orientation (past 2 years—Behavior)				
Males only = Gay	660	85.3	77.3	[71.9, 82.9]
Other = Bisexual	114	14.7	22.7	[17.1, 28.1]

Note. ^aOmitted from analysis of self-identified men. CI = confidence interval; Q1 = first quartile; Q3 = third quartile; RDS = respondent-driven sampling.

and “Other.” As in the identity model, bisexual men overwhelmingly featured higher substance use levels, represented by significantly higher use for prescription ($p = .001$) and nonprescription ($p < .001$) stimulants, crystal methamphetamine ($p = .020$), injection drug use ($p = .022$), hallucinogens ($p = .014$), heroin ($p < .001$) and prescription opioids ($p = .013$). An important exception to this pattern was significantly lower popper use ($p < .001$), also recorded for self-identified bisexual men. As in the identity sample, erectile dysfunction drug use was lower for bisexual than gay men but was statistically significant ($p = .023$).

Table 4 presents bivariate analysis results for men who were behaviorally bisexual within the past 2 years. As before, overall results depict bisexual men with

negative socioeconomic and psychosocial differentials and distinctly higher substance use levels. Behaviorally bisexual men had significantly higher Anxiety ($p = .005$) and Depression Sub-Scale Scores ($p < .001$), and lower Social Support Scale Scores ($p < .001$) relative to gay sample members. Similar to the other samples, behaviorally bisexual men featured lower educational attainment ($p < .001$) and annual income distribution ($p < .001$), and assessed their current health as worse than gay men ($p < .001$). Behaviorally bisexual men had more Indigenous, Hispanic and “Other” ethnic members ($p < .001$) than gay sample members, and a significantly different residence pattern ($p = .001$). Despite being twice as large as the identity sample and one-half the size of the attraction sample, this group had very

Table 2. Results for Bivariate RDS-Adjusted Data Analysis, *Identify Model* (Bisexual Men = 73, Gay Men = 655).

Continuous variable	Gay men			Bisexual men			Probability
	MD	Q1	Q3	MD	Q1	Q3	
Age	34	26	47	39	28	50	.088
HAD anxiety	8	5	11	9	7	12	.015
HAD depression	4	2	6	6	3	9	<.001
Social support	10	8	12	8	5	10	<.001
Male and female sex partners P6M	5	2	13	3	2	8	.020
Male sex partners P6M	5	2	12	2	1	4	.003
Male sex partners P6M	3	1	9	1	10	3	.011

Categorical Variable	Gay men		Bisexual men		Probability
	<i>n</i>	%	<i>n</i>	%	
Annual income					<.001
<\$30,000	387	66.6	62	89.9	
\$30,000–\$59,999	185	22.6	7	6.0	
>\$60,000	83	10.8	4	4.1	
Ethnicity					.006
White	490	70.1	57	66.2	
Asian	71	10.3	2	3.3	
Indigenous	41	8.3	4	8.9	
Hispanic	31	7.7	4	7.6	
Other	22	3.6	7	14.0	
Education					<.001
Less than or equal to high school	136	25.8	37	53.8	
More than high school	519	74.2	36	46.2	
Neighborhood					.007
Downtown	333	52.3	34	47.8	
Vancouver	192	25.9	44	39.3	
Greater Vancouver	130	21.8	15	12.9	
Current Health					<.001
Excellent	120	19.6	4	2.0	
Very good	267	36.9	22	25.6	
Good	196	30.4	27	45.4	
Fair	60	10.4	15	17.3	
Poor	10	2.4	3	4.1	
DK	2	0.3	2	2.7	

Categorical variable	Gay men		Bisexual men		Probability
	<i>n</i>	%	<i>n</i>	%	
Non-Rx stimulants P6M					<.001
No	479	72.0	39	45.5	
Yes	176	28.0	34	54.5	
Injection drug use P6M					.147
No	595	91.6	59	87.4	
Yes	60	8.4	14	13.6	
Rx stimulants P6M					<.001
No	620	94.7	65	85.8	
Yes	35	5.3	8	14.2	

(continued)

Table 2. (continued)

Categorical variable	Gay men		Bisexual men		Probability
	<i>n</i>	%	<i>n</i>	%	
Crystal meth P6M					
No	532	82.6	50	68.5	.001
Yes	132	17.4	23	31.5	
Rx sedatives P6M					
No	517	81.3	57	74.2	.082
Yes	138	18.7	16	25.8	
Hallucinogens P6M					
No	452	72.4	50	71.3	.801
Yes	203	27.6	23	18.7	
Heroin P6M					
No	641	98.0	60	85.6	<.001
Yes	14	2.0	13	14.4	
Rx opioids P6M					
No	602	91.8	59	80.0	<.001
Yes	53	8.2	14	20.0	
Poppers P6M					
No	401	64.5	51	80.4	.001
Yes	254	35.5	22	19.6	
Erectile dysfunction drugs P6M					
No	491	78.8	58	86.1	.071
Yes	164	21.2	15	13.9	
Other drugs P6M					
No	590	90.1	63	93.6	.391
Yes	65	9.9	10	6.4	
AUDIT scores					
Low risk 0–7	394	63.3	39	56.9	.558
Hazardous 8–15	173	23.9	21	27.7	
Harmful 16–19	46	6.9	7	8.3	
Dependence ≥20	38	5.9	5	7.0	

Note. Referent = gay men. P6M = past 6 months. MD = median; Q1 = first quartile; Q3 = third quartile; HAD = hospital anxiety and depression scale; RDS = respondent-driven sampling.

strong similarities to both, reporting significantly higher use of injection drugs ($p = .049$), prescription ($p < .001$) and nonprescription stimulants ($p < .001$), crystal methamphetamine ($p = .004$), prescription sedatives ($p < .001$), and heroin ($p < .001$). This sample also had a significantly higher AUDIT score distribution ($p < .001$), with a larger proportion of men classified as Alcohol Dependent (gay men = 5.2%, bisexual men = 17.7%). Important exceptions to the overall pattern of higher substance use for bisexual men were once again represented by significantly lower scores for poppers ($p < .001$) and slightly lower erectile dysfunction drug use ($p = .571$).

Logistic Regression Results

Overall, bivariate analyses revealed distinctive pattern of substance use, psychosocial and socioeconomic and

demographic variables associated with bisexuality, no matter how defined within the overall Momentum sample. These patterns were maintained in subsequent univariate and multivariate logistic regression analyses, with Table 5 presenting statistically significant ($p < .05$) variables in the final multivariable model. These revealed significantly lower Social Support Scale scores for all three samples, lower annual income distributions for the identity and behavior models, and significantly lower education attainment for the identity model. In contrast, in all three models, bisexual men assessed their current health status as inferior to gay men, and the small “Other” ethnic group was statistically significant in the identity and behavior samples, while the also numerically small Hispanic sample was significant in the behavior model. Multivariate results again indicated higher substance use levels for bisexual men, with heroin and nonprescription stimulants significantly higher in all samples, along with

Table 3. Results for RDS-Adjusted Bivariate Data Analysis, Attraction Model (Bisexual Men = 233, Gay Men = 541).

Continuous variable	Gay men			Bisexual men			Probability
	MD	Q1	Q3	MD	Q1	Q3	
Age	34	26	47	33	25	46	.472
HAD anxiety	8	5	10	9	6	12	<.001
HAD depression	4	2	6	5	2	7	<.001
Social support	10	8	12	9	7	11	<.001
Male + female sex partners P6M	5	2	14	4	2	10	.748
Male sex partner P6M	5	2	12	4	2	10	.946
Male anal sex partner P6M	4	1	9	2	1	5	.487

Categorical variable	Gay men		Bisexual men		Probability
	<i>n</i>	%	<i>n</i>	%	
Annual income					
<\$30,000	318	65.5	167	81.0	<.001
\$30,000–\$59,999	153	22.9	47	14.0	
>\$60,000	70	11.6	19	5.1	
Ethnicity					
White	406	70.3	179	68.6	.028
Asian	60	10.7	14	5.3	
Indigenous	35	8.4	15	10.8	
Hispanic	22	6.9	13	8.2	
Other	14	3.8	12	7.1	
Education					
Less than or equal to high school	113	25.9	66	35.2	.007
More than high school	428	74.1	167	64.8	
Neighborhood					
Downtown	273	51.6	109	47.8	.177
Vancouver	165	26.8	75	39.3	
Greater Vancouver	103	21.5	49	12.9	
Current health					
Excellent	100	20.4	28	8.6	<.001
Very good	228	38.7	75	26.0	
Good	154	29.8	89	40.7	
Fair	51	9.4	30	16.7	
Poor	6	1.3	9	5.8	
DK	2	0.4	2	2.2	
Rx stimulants P6M					
No	513	96.0	211	89.9	.001
Yes	28	4.0	22	10.1	

Categorical	Gay men		Bisexual men		Probability
	<i>n</i>	%	<i>n</i>	%	
Non-Rx stimulants P6M					
No	399	73.7	149	56.6	<.001
Yes	142	26.3	84	43.4	
Injection drug use P6M					
No	490	90.6	201	87.0	.022
Yes	51	9.4	32	13.0	
Crystal meth P6M					
No	427	82.4	177	75.2	.020
Yes	114	17.6	56	24.8	

(continued)

Table 3. (continued)

Categorical	Gay men		Bisexual men		Probability
	<i>n</i>	%	<i>n</i>	%	
Rx sedatives P6M					
No	423	80.7	179	74.3	.040
Yes	118	19.3	54	25.7	
Hallucinogens P6M					
No	373	73.9	152	65.3	.014
Yes	168	26.1	82	34.7	
Heroin P6M					
No	530	98.1	213	90.8	<.001
Yes	11	1.9	20	8.2	
Rx opioids P6M					
No	496	91.2	204	85.3	.013
Yes	45	8.8	29	14.7	
Poppers P6M					
No	322	62.4	161	77.2	<.001
Yes	219	37.6	72	22.8	
Erectile dysfunction drugs P6M					
No	403	77.8	184	84.8	.023
Yes	138	22.2	49	15.2	
Other drugs P6M					
No	483	90.3	210	93.7	.115
Yes	58	9.7	23	6.3	
AUDIT scores					
Low risk 0–7	328	64.8	133	56.5	.073
Hazardous 8–15	137	22.3	67	27.9	
Harmful 16–19	41	6.4	15	5.6	
Dependence ≥20	32	6.5	16	9.9	

Note. Referent = gay men. MD = median; Q1 = first quartile; Q3 = third quartile; P6M = past 6 months; HAD = hospital anxiety and depression scale; RDS = respondent-driven sampling.

prescription opioids and AUDIT scores in the behavior model, and hallucinogens in the attraction model.

The two important exceptions to the pattern of higher substance use remained in the multivariate models, with erectile dysfunction drug use significantly lower in the identity analysis and popper use significantly lower in all three analyses. These results differ from previously reported patterns for gay men, in which erectile dysfunction drugs and poppers are respectively associated with insertive and receptive anal sex behavior (Fisher, Reynolds, & Napper, 2010; Rich et al., 2016). This study's results parallel reports of lower bisexual men's popper use compared to gay men (Bowers et al., 2011; Brennan-Ing et al., 2014). Lower popper and erectile dysfunction drug levels suggested lower anal sex frequency for bisexual men. RDS-adjusted measures denoting the number of gay and bisexual men reporting no anal sex in the past 6 months for each sample allowed testing of this suggestion. Figure 1 demonstrates that all bisexual samples reported higher levels for no anal sex. χ^2 analysis revealed that these differences were significant for the

identity ($p = .016$) and attraction ($p = .006$), but not the behavior ($p = .105$) samples. We anticipate further testing this patterning using Momentum event-level data (Rich et al., 2016).

Discussion

Studies with gay and bisexual men are frequently analyzed and reported under the combined rubric "Men Who Have Sex with Men," or conflated as "Gay and Bisexual Men." When studies do distinguish between male sexual minorities, results point to higher substance use levels among bisexual men. This interpretation is weakened when analyses combine bisexual men and women, use differing dimensions of human sexuality to define bisexuality, and do not consider possible differences in number of sexual partners. In an attempt to avoid these pitfalls, this study analyzed data from Momentum Health Study participants, conducting separate analyses for bisexuality defined by self-identity, attraction to men and women, and sex with both men and women. Bivariate univariable

Table 4. Results for Bivariate RDS-Adjusted Data Analysis, Behavior Model (Bisexual Men = 114, Gay Men = 660).

Continuous variable	Gay men			Bisexual men			Probability
	MD	Q1	Q3	MD	Q1	Q3	
Age	34	26	48	33	25	44	.101
HAD anxiety	8	5	11	9	6	12	.005
HAD depression	4	2	6	5	3	7	<.001
Social support	10	8	12	9	6	11	<.001
Male + female sex partners P6M	5	2	13	5	2	10	.138
Male sex partners P6M	5	2	13	3	2	6	.253
Male anal sex partners P6M	3	1	9	2	1	5	.676

Categorical variable	Gay men		Bisexual men		Probability
	<i>n</i>	%	<i>n</i>	%	
Annual income					
<\$30,000	395	66.4	90	88.6	<.001
\$30,000–\$59,999	184	22.9	16	14.0	
≥\$60,000	81	10.7	8	7.0	
Ethnicity					
White	500	72.6	85	56.6	<.001
Asian	71	10.3	3	2.6	
Indigenous	41	7.9	9	7.9	
Hispanic	26	3.9	9	7.9	
Other	22	3.3	8	7.0	
Education					
Less than or equal to high school	135	25.9	44	41.7	<.001
More than high school	525	74.1	70	58.3	
Neighborhood					
Downtown	336	52.8	46	42.7	.001
Vancouver	195	26.1	45	40.5	
Greater Vancouver	129	21.4	23	16.8	
Current health					
Excellent	116	19.5	12	4.7	<.001
Very good	275	36.9	28	24.7	
Good	192	30.5	51	44.8	
Fair	67	11.2	14	13.6	
Poor	8	1.5	7	8.4	
DK	2	0.3	2	3.7	

Categorical variable	Gay men		Bisexual men		Probability
	<i>n</i>	%	<i>n</i>	%	
Injection drug use P6M					
No	598	91.5	93	86.4	.049
Yes	62	8.5	21	13.6	
Non-Rx stimulants P6M					
No	489	74.3	59	42.8	<.001
Yes	171	25.7	55	57.2	
Rx stimulants P6M					
No	623	95.6	101	87.8	<.001
Yes	37	4.4	13	12.2	
Crystal meth P6M					
No	542	82.0	80	70.2	.004
Yes	136	18.0	34	29.8	

(continued)

Table 4. (continued)

Categorical variable	Gay men		Bisexual men		Probability
	<i>n</i>	%	<i>n</i>	%	
Rx sedatives P6M					
No	521	81.5	81	66.8	<.001
Yes	139	18.5	33	33.2	
Hallucinogens P6M					
No	453	72.4	71	66.7	.142
Yes	207	27.6	43	33.3	
Heroin P6M					
No	645	97.7	98	87.3	<.001
Yes	15	2.3	16	12.7	
Rx opioids P6M					
No	610	92.0	90	77.7	<.001
Yes	50	8.0	24	22.3	
Poppers P6M					
No	403	63.7	80	81.4	<.001
Yes	257	36.3	34	18.6	
Erectile dysfunction drugs P6M					
No	497	79.7	90	81.6	.571
Yes	163	20.3	24	18.4	
Other drugs P6M					
No	596	91.2	97	92.1	.701
Yes	64	8.8	17	7.9	
AUDIT Scores					
Low risk 0–7	401	65.4	59	48.8	<.001
Hazardous 8–15	172	23.5	32	26.3	
Harmful 16–19	47	5.9	9	7.2	
Dependence ≥20	34	5.2	14	17.7	

Note. MD = median; Q1 = first quartile; Q3 = third quartile; P6M = past 6 months; HAD = hospital anxiety and depression scale; RDS = respondent-driven sampling.

analyses indicated overall higher substance use levels for all bisexual samples, and all multivariable analyses revealed that bisexual men specifically featured significantly higher non-prescription stimulant and heroin use. Prescription opioid use also was significant in the identity and behavior models.

These results support the hypothesis that no matter how defined, bisexual Momentum participants feature higher substance use patterns. This interpretation is strengthened by noting the different sample sizes, from the small ($n = 73$) self-identity sample to the largest attraction ($n = 233$) sample, as well as by analyses controlling for sexual partner number in the multivariate models. Important exceptions to this pattern were lower popper and erectile dysfunction drug use for bisexual men, which subsequent analysis linked to lower levels of anal sex compared to gay men. These findings indicate that bisexual men's substance patterns differ not only in use levels, but also in terms of sexual context. Specifically, they suggest that bisexual men's substance use patterns may differ from the strong association between sex and

substances known as “Chemsex” or “Party and Play” for gay men (Card et al., 2018; Weatherburn, Hickson, Reid, Torres-Rueda, & Bourne, 2016).

This study's second goal was to identify socioeconomic, demographic and psychosocial variables associated with bisexuality. Bivariate analyses revealed that all bisexual samples featured significantly lower educational levels, Social Support Scale scores, and annual incomes, combined with significantly higher Anxiety and Depression Sub-Scale scores. Social Support Scale scores remained significant in all multivariate models. This may be particularly important since previous studies noted bisexual men's feeling of not belonging to either the general population or the gay community (Dodge et al., 2012; Feinstein & Dyar, 2017; Friedman & Dodge, 2016). Furthermore, finding higher Anxiety and Depression Sub-Scale scores, coupled with lower Social Support Scale scores, annual incomes, and educational levels, suggests a possible syndemic effect for bisexual men's health, as suggested by Friedman and Dodge (2016). However, our cross-sectional data preclude attribution of

Table 5. Results from Multivariable Models.

Variable	Identity (<i>n</i> = 73) Referent = Gay men		Attraction (<i>n</i> = 233) Referent = Men only		Behavior (<i>n</i> = 114) Referent = Men only	
	aOR	95% CI	aOR	95% CI	aOR	95% CI
Social support	0.87	[0.81, 0.96]	0.93	[0.88, 0.98]	0.92	[0.86, 0.98]
Annual income						
<\$30,000	Ref.		Not selected ^a		Ref.	
\$30,000–\$59,999	0.32	[0.13, 0.80]			0.45	[0.23, 0.89]
>\$60,000	0.67	[0.23, 1.96]			0.52	[0.20, 1.36]
Ethnicity						
White	Ref.		Not selected ^a		Ref.	
Asian	0.52	[0.16, 1.63]			0.67	[0.26, 1.72]
Indigenous	0.40	[0.14, 1.02]			1.21	[0.60, 2.41]
Hispanic	1.55	[0.64, 3.76]			5.14	[2.59, 10.19]
Other	9.52	[3.84, 23.62]			5.18	[2.31, 11.66]
Education						
Less than or equal to high school	Ref.		Not selected ^a		Not selected ^a	
More than high school	0.52	[0.31, 0.89]				
Current health						
Excellent	Ref.		Ref.		Ref.	
Very good	9.03	[1.98, 41.09]	1.39	[0.80, 2.41]	3.09	[1.31, 7.30]
Good	17.39	[3.91, 77.29]	2.71	[1.58, 4.63]	6.02	[2.61, 13.89]
Fair	11.34	[2.35, 54.73]	2.66	[1.39, 5.14]	2.89	[1.17, 5.60]
Poor	9.46	[1.50, 59.80]	5.69	[1.94, 16.70]	12.15	[3.28, 45.01]
Non-Rx stimulants P6M^a						
No	Ref.		Ref.		Ref.	
Yes	1.73	[1.01, 2.96]	1.55	[1.07, 2.25]	2.09	[1.31, 3.33]
Rx stimulants P6M						
No	Ref.		Not selected ^a		Not selected ^a	
Yes	3.19	[1.27, 7.59]				
Heroin						
No	Ref.		Ref.		Ref.	
Yes	4.56	[1.68, 12.46]	3.91	[1.67, 9.18]	4.45	[1.91, 10.38]
Rx opioids						
No	Not selected ^a		Not selected ^a		Ref.	
Yes					2.31	[1.28, 4.18]
Poppers						
No	Ref.		Ref.		Ref.	
Yes	0.47	[0.22, 0.99]	0.41	[0.28, 0.61]	0.35	[0.22, 0.57]

Variable	Identity (<i>n</i> = 73) Referent = Gay men		Attraction (<i>n</i> = 233) Referent = Men only		Behavior (<i>n</i> = 114) Referent = Men only	
	aOR	95% CI	aOR	95% CI	aOR	95% CI
Erectile dysfunction drugs						
No	Ref.		Not selected ^a		Not selected ^a	
Yes	0.47	[0.22, 0.99]				
Hallucinogens P6M						
No	Not selected ^a		Ref.		Not selected ^a	
Yes			1.71	[1.14, 2.57]		
AUDIT scores						
Low risk 0–7					Ref.	
Hazardous 8–15	Not selected ^a		Not selected ^a		1.27	[0.77, 2.09]
Harmful 16–19					1.13	[0.48, 2.67]
Dependence ≥20					3.44	[1.63, 7.25]

Note. Statistically significant ($p < .05$) variables are in bold. aOR = adjusted odds ratio; Ref. = referent.

^aNot selected by AIC.

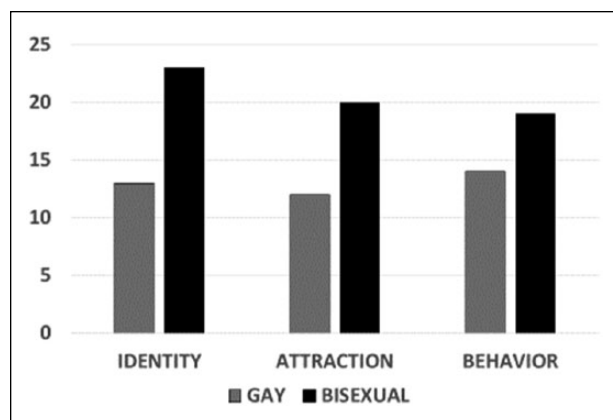


Figure 1. RDS-adjusted percentages reporting no anal sex in past 6 months.

causation. Future longitudinal research, using both quantitative and qualitative approaches, could fruitfully focus on identifying underlying motives, contexts, and associations in bisexual men's substance use levels and patterns in relation to these factors. In particular, mediation analysis may help define possible relationships between psychosocial factors, social isolation, and substance use, while qualitative studies could search for substance use motivations, as previously done for gay men (Weatherburn, Hickson, Reed, Torres-Rueda, & Bourne, 2016).

This study has limitations. While adjusting data for RDS sampling, we make no claim that the result is a representative sample, and therefore results are inapplicable to other locales. Further, as in all studies based on self-reports of substance use and sexual behavior, data may suffer from social desirability bias. In addition, substance use data constituted categorical "yes/no" responses and did not indicate use frequency. We could not therefore distinguish between episodic substance use and more serious substance use disorders. Finally, having sex with a man in the past 6 months as an eligibility criterion meant our sample did not include bisexual men attracted to both men and women or who self-identify as bisexual but did not have sex with a man during this period. Instead, we focused on identifying and analyzing separately bisexual and gay men's health parameters in a sample that previously lumped both together under the rubric Men Who Have Sex with Men (Moore et al., 2016) or Gay and Bisexual Men (Roth et al., 2018).

Despite these caveats, while focusing on substance use, this study found that Momentum Health Study bisexual participants also featured distinctive sexual behavior, psychosocial, and sociodemographic patterns in comparison to their gay counterparts. These results are particularly important in relation to calls for intervention and education patterns specifically tailored for bisexual men

(Friedman & Dodge, 2016; Shelton, 2017) and illustrate the benefits of separating bisexual from gay men's data, rather than conflating them under the rubric of "gay and bisexual men" and/or "Men Who Have Sex with Men."

Acknowledgments

The authors are grateful for the assistance and involvement of Momentum Health Study participants, office staff and community advisory board, as well as our community partner agencies, the Health Initiative for Men, YouthCo HIV and Hep C Society, and the Positive Living Society of BC.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Funding for Momentum is through the National Institute on Drug Abuse (Grant # R01DA031055-01A1) and the Canadian Institutes for Health Research (Grant # MOP-107544, 143342, PJT-153139). A CANFAR/CTN Postdoctoral Fellowship Award supported NJL. Scholar Awards from the Michael Smith Foundation for Health Research (#5209, #16863) support DMM and NJL. HLA is supported by a Postdoctoral Fellowship Award from the Canadian Institutes of Health Research (Grant # MFE-152443). AJR is supported by a Frederick Banting and Charles Best Doctoral Research Award from the Canadian Institutes of Health Research (#379361).

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