Correlates of Alcohol-Using Network Size Among Men Who Have Sex with Men in San Francisco, CA

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Abstract

Men who have sex with men (MSM) have a high prevalence of hazardous alcohol consumption. While network-level characteristics such as social network size have been indicated as upstream determinants of alcohol use in general population samples, no studies have examined factors associated with alcohol using network size (ANS), among MSM. This secondary analysis examined demographic, substance use, and sexual behavior correlates of ANS using data from a diverse sample of alcohol-using MSM in San Francisco ($N = 252$). Associations were calculated using multivariable negative binomial regression, adjusting for age, race, education, and employment.
The median ANS was 10. Factors associated with larger ANS in multivariable analyses included identifying as Hispanic/Latino, having completed a college education or higher, having a higher Alcohol Use Disorders Identification Test (AUDIT) score, having a greater number of sexual partners, polysubstance use, and being unaware of one's own HIV status. Factors associated with smaller ANS included being between 18 and 24 years of age, reporting a low income, and having any lifetime history of injection drug use.
For MSM, ANS was associated with increased likelihood of hazardous alcohol use, as well specific individual-level substance use and sexual risk behaviors. These results highlight the role of ANS in hazardous alcohol consumption and sexually transmitted infection transmission among MSM. These results also indicate ways that research and intervention programs aimed at reducing alcohol use among MSM might be improved through network-based recruitment or engagement. Finally, these results suggest the need for further research on HIV-unknown MSM.

Introduction

Hazardous and heavy drinking behaviors, which together rank as the seventh leading risk factor for death and Disability-Adjusted Life Years globally, are highly prevalent among men who have sex with men (MSM) (GBD, 2016, 2018). These behaviors are also linked to individual-level health outcomes and behaviors such as condomless anal intercourse, HIV transmission, illicit substance use, depression, and sexually transmitted infections among MSM (Ferro et al., 2015; Marshall et al., 2015; Santos, 2015).

Emerging evidence on network-level characteristics such as drinking group size, social network size, and drinking buddies has indicated that these may act as upstream determinants of individual-level correlates of drinking. At the time of this study, 2019, prior research investigating network-level associations with alcohol use

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have not focused on MSM; however, one study among young MSM in New York reported that "convivial" or social drinking was associated with an increase in frequency of drinking (Ristuccia et al. 2019). Drawing from the Framingham Heart Study, researchers reported a correlation between the drinking behavior of an individual and that of their social network (Rosenquist et al., 2010). Two additional studies are conducted among college students in Connecticut in 2011 and bar patrons in California in 2009 are informative as well. Each reported a positive relationship between drinking group size and both the amount of alcohol an individual consumed and the likelihood that a participant continued to drink after leaving a bar (Cullum et al., 2016; Reed et al., 2013).

For MSM, network-level characteristics may be particularly salient: bars and clubs that serve alcohol function as important spaces for socialization with network members and remain ubiquitous within gay communities (Boyle et al., 2017; Emslie et al., 2008). It is important to understand which factors may be associated with the size of alcohol-using networks of MSM. To address this gap, this study explores the relationship between alcohol-using network size (ANS) and demographic and risk factors among MSM in the San Francisco Bay Area.

Methods

The SEEDS Study

This study is a secondary analysis of data from the 2014 SEEDS Study, a cross-sectional, respondent-driven sampling (RDS) study of alcohol-using MSM in the San Francisco Bay Area. The methods for this paper have been previously described elsewhere (Santos et al., 2018). In brief, participants completed a 30-min Audio Computer-Assisted Self-Interview (ACASI) to assess self-reported demographic characteristics, substance use, sexual behavior, and HIV status. Eligible participants (1) used alcohol in the last year, (2) had sex with men, (3) were 18 years of age or older, (4) resided in the San Francisco Bay Area, and (5) currently identify as male. No trans women or transfeminine people participated in the study. The final sample size was $N = 252$ alcohol-using self-identified MSM, all of whom were included in the present analysis.

Measures

To assess ANS, participants were asked to report a count of how many alcohol-using MSM they had contact with in the last 30 days. Due to the exploratory nature of this analysis, all individual-level demographic, substance use, and sexual risk behaviors collected in the ACASI survey were included as potential correlates. To improve interpretability, continuous correlates were scaled based on one standard deviation.

Analyses and Variable Selection

Due to overdispersion of the outcome, negative binomial regression was used. Table 1 presents unadjusted bivariable associations between ANS and all candidate variables. Candidates were included in the final multivariable regression model if they had at least one category with a Wald Test p-value of ≤ 0.20. The multivariable model was then refined using purposeful selection until it contained only variables reaching $p < 0.05$ (Bursac et al., 2008). All analyses were completed using STATA 15 (StataCorp, 2017).

Results

Participant Characteristics

This analysis included a diverse sample of 252 alcohol-using MSM. Most participants were MSM of color ($n = 169$, 67%), were between ages 18 and 44 ($n = 139$, 55%), and earned less than $30,000 annually ($n = 170$, 70%). A majority were HIV negative ($n = 174$, 69%) and reported having a median of four sexual partners in the past 6 months (SD = 22, Range: 0–200). Use of two or more illicit substances in the last 6 months ("polysubstance use") was common ($n = 132$, 52%) and many reported alcohol use four times a week or more ($n = 100$, 40%). The median ANS was 10 (SD = 21, Range = 0–150), and the median Alcohol Use Disorder Identification Test (AUDIT) score was 14 (SD = 9, Range = 1–40).

Multivariable Analyses

Presented in Table 2, several demographic, substance use, and sex-related factors were associated with ANS in the final multivariable model. Associations presented here are measured using incidence rate ratios (IRRs). Factors associated with larger ANS included identifying as Hispanic/Latino (IRR 1.44), having completed college or graduate school (IRR 1.76), increased AUDIT score (IRR 1.23 per each SD), and polysubstance use in the last 6 months (IRR 1.41). Reporting an increased number of male sex partners was also associated with increased ANS (IRR 1.15 per each SD), as was being unaware of one's own HIV status (IRR 2.99). Factors associated with smaller ANS included being 18–24 years old (IRR 0.56), earning a low annual income (IRR 0.67) and reporting any lifetime history of injection drug use (IRR 0.47).

Table 1. Sample Characteristics.

Sample Characteristics. This table contains all variables assessed in the statistical models for the study sample of *N* = 252 alcohol-using MSM from the San Francisco Bay Area. For the gender variable, inclusion criteria allowed transgender people to participate if they were assigned male gender at birth or currently self-identified as male. Income status was assigned based on household size and HUD Income limits for San Francisco for 2017. For employment, the "employed" category includes participants with both full-time and part-time employment. AUDIT score was calculated using the standard AUDIT inventory, in which a score of 16 is considered "High Risk."

Categorical Variables

Characteristic	Count	Frequency (%)
Race		
Black/African American	78	30.95
Asian/Pacific Islander	33	13.10
Hispanic/Latino	38	15.08
Mixed/Other	20	7.94
White	83	32.94
Total, of color	169	67.06
Age		
18–24	12	4.76
25–34	90	35.71
35–44	37	14.68
45+	113	44.84
Total < 45	139	55.16
Gender		
Cisgender male	234	92.86
Transgender male	3	1.19
Transgender female	14	5.56
Other	1	0.40
Income (per HUD limits for San Francisco, 2017)		
Low income	170	67.46
Average or above	67	26.59
No response	15	5.95
Education		
Less than college	73	28.97
Some college	83	32.94
College or graduate school	94	37.30
No response	2	0.79
Employment		
Unemployed	132	52.38
Employed	120	47.62
HIV status		
Negative	174	69.05
Positive	71	28.17
Unknown	6	2.38
No response	1	0.40
Number of different illicit substances used (last 6 months)		
2+	132	52.38
1	40	15.87
0	79	31.35
No response	1	0.40

(continued)

Table 1. (continued)

Categorical Variables

Characteristic	Count	Frequency (%)
Alcohol use frequency		
Monthly or less	14	5.56
2 to 4 times a month	44	17.46
2 to 3 times a week	94	37.30
4 or more times a week	100	39.68
Number of male sexual partners, past 6 months		
0	10	3.97
1	45	17.86
2-5	103	40.87
6+	89	35.32
No response	5	1.98

Continuous variables		
Characteristic	Measure	SD (Range)
Alcohol-user network size (ANS)		
Mean	17	21 (0–150)
Median	10	
Number of male sexual partners		
Mean	10	22 (0–200)
Median	4	
AUDIT score		
Mean	15	9 (1–40)
Median	14	

Discussion

These results indicate that for MSM, ANS is significantly correlated with specific alcohol, substance use, sexual, clinical, and demographic factors. The result that increased AUDIT score is associated with larger ANS corroborates earlier research on network characteristics and alcohol-related poor health outcomes. One study using a representative sample of Copenhagen, Denmark residents from 1991 to 1994 reported that having more frequent contact with friends was associated with increased risk of developing an AUD (Mikkelsen et al., 2015). A U.S. study, using data from a nationally representative sample from 2001 to 2005, reported that social network diversity was associated with alcohol use disorder (AUD) (Mowbray et al., 2014). Research on "drinking buddies" in a population of mostly female U.S. college students showed a positive association between number of drinking buddies, binge drinking frequency, and rate of "alcohol-related problems" (Lau-Barraco et al., 2014).

Taken together, these results suggest that having a greater number of alcohol-using contacts, having a greater variety of alcohol-using contacts (e.g., friends, coworkers, family), and frequently spending time with them, may each increase risk of hazardous alcohol use. Given the ubiquity and social nature of alcohol use among MSM, it is plausible that the ANS measure used

Table 2. Regression Results.

Characteristic	Bivariable models			Multivariable model			
	IRR	*p*	95% CI	IRR	*p*	95% CI	
Age							
18–24	0.80	0.44	0.45 1.42	0.56	0.05	0.32	0.99
25–34	2.29	0.00	1.76 2.97	1.23	0.18	0.92	1.67
35–44	1.59	0.01	1.12 2.26	1.12	0.51	0.79	1.59
45+ (ref)	–	–	–	–	–		–
Race							
Black/African American	0.60	0.00	0.44 0.81	0.91	0.56	0.67	1.25
Asian/Pacific Islander	1.20	0.36	0.81 1.76	0.97	0.89	0.67	1.42
Hispanic/Latino	1.54	0.02	1.07 2.22	1.44	0.04	1.02	2.02
Mixed/Other	1.21	0.43	0.76 1.93	1.07	0.74	0.70	1.63
White (ref)	–	–	–	–	–		–
Income (per HUD limits for San Francisco, 2017)							
Low income	0.46	0.00	0.35 0.60	0.67	0.01	0.49	0.92
Average or above (ref)	–	–	–	–	–		–
Employment							
Employed	1.76	0.00	1.38 2.24	NA			
Unemployed (ref)	–	–	–				
Education—level completed							
Some college	1.21	0.11	0.95 1.74	1.26	0.13	0.93	1.70
College degree	2.41	0.00	1.80 3.23	1.76	0.00	1.21	2.58
Less than college (ref)	–	–		–	–		–
Current student							
Yes	1.32	0.32	0.76 2.32	NA			
No (ref)	–	–	–				
Relationship status							
Marriage or domestic partnership	1.17	0.46	0.77 1.79	NA			
Committed or open relationship	1.31	0.08	0.97 1.76				
Other	0.95	0.90	0.47 1.96				
Single (ref)	–	–	–				
Number of sexual partners (last 6 months)							
Each additional 20 partners (1 SD)	1.16	0.04	1.01 1.34	1.15	0.00	1.03	1.28
				–			
Number of sexual partners—met in a bar (out of 3 reported on)							
1	0.94	0.72	0.69 1.29	NA			
2	2.05	0.01	1.21 3.50				
3	(empty)	–	–				
0 (ref)	–	–	–				
Number of sexual partners – had condomless anal intercourse (out of 3 reported on)							
1	1.01	0.98	0.65 1.55	NA			
2	0.81	0.18	0.60 1.10				
3	0.75	0.08	0.54 1.04				
0 (ref)	–	–	–				
Meth (any use in last 6 months)							
Yes	0.74	0.03	0.57 0.97	NA			
No (ref)	–	–	–				
Ecstasy (any use in last 6 months)							
Yes	1.8	0.00	1.37 2.36	NA			
No (ref)	–	–	–				
Coke (any use in last 6 months)							
Yes	2.02	0.00	1.57 2.59	NA			
No (ref)	–	–	–				

Table 2. (continued)

Characteristic	Bivariable models			Multivariable model			
	IRR	*p*	95% CI	IRR	*p*	95% CI	
GHB (any use in last 6 months)							
Yes	1.34	0.09	0.95 1.87	NA			
No (ref)	–	–	–				
Ketamine (any use in last 6 months)							
Yes	1.85	0.00	1.28 2.68	NA			
No (ref)	–	–	–				
Poppers (any use in last 6 months)							
Yes	1.45	0.01	1.18 1.88	NA			
No (ref)	–	–	–				
Viagra (any use in last 6 months)							
Yes	1.50	0.01	1.13 2.00	NA			
No (ref)	–	–	–				
Cigarettes (any use in last 6 months)							
Yes	0.97	0.85	0.74 1.29	NA			
No (ref)	–	–	–				
Injected any illicit substance (in last 6 months)							
Yes	0.41	0.00	0.29 0.57	NA			
No (ref)	–	–	–				
Ever injected any substance (lifetime)							
	0.41	0.00	0.31 0.53	0.47	0.00	0.35	0.62
	–	–	–	–	–	–	–
Number of unique substances used (Last 6 months)							
1	1.28	0.20	0.88 1.86	1.22	0.29	0.85	1.75
2+	1.99	0.00	1.51 2.61	1.41	0.02	1.06	1.86
0 (ref)	–	–	–	–			
Ever shared a needle (lifetime)							
Yes	0.76	0.19	0.51 1.15	NA			
No (ref)	–	–	–				
Ever used a sterile needle (lifetime)							
Yes	0.80	0.00	0.72 0.88	NA			
No (ref)	–	–	–				
Alcohol use frequency							
2 to 4 times a month	2.34	0.01	1.26 4.35	NA			
2 to 3 times a week	3.20	0.00	1.79 5.72				
4 or more times a week	2.91	0.00	1.63 5.19				
Monthly or less (ref)	–	–	–				
Attempted to stop or reduce drinking							
Less than monthly	0.93	0.67	0.67 1.30	NA			
Monthly	1.39	0.10	0.94 2.04				
Weekly	1.11	0.61	0.75 1.66				
Daily or almost daily	0.84	0.40	0.57 1.26				
Never (ref)	–	–	–				
Failed to do what's normal routine after drinking							
Less than monthly	1.27	0.11	0.94 1.70	NA			
Monthly	1.93	0.00	1.26 2.93				
Weekly	0.86	0.46	0.59 1.27				
Daily or almost daily	0.48	0.00	0.29 0.79				
Never (ref)	–	–	–				

(continued)

Table 2. (continued)

Characteristic	Bivariable models			Multivariable model			
	IRR	*p*	95% CI	IRR	*p*	95% CI	
Needed a drink to "get going" after drinking							
Less than monthly	0.90	0.53	0.64 1.25	NA			
Monthly	0.70	0.21	0.40 1.23				
Weekly	0.33	0.00	0.20 0.54				
Daily or almost daily	0.75	0.15	0.52 1.10				
Never (ref)	–	–	–				
Felt guilt after drinking							
Less than monthly	1.33	0.06	0.98 1.79	NA			
Monthly	1.90	0.00	1.26 2.87				
Weekly	1.72	0.03	1.06 2.79				
Daily or almost daily	0.65	0.11	0.39 1.10				
Never (ref)	–	–	–				
Had trouble remembering after drinking							
Less than monthly	1.78	0.00	1.34 2.37	NA			
Monthly	1.60	0.02	1.09 2.36				
Weekly	1.14	0.58	0.72 1.79				
Daily or almost daily	0.93	0.80	0.49 1.72				
Never (ref)	–	–	–				
Alcohol delivery service use							
Less than monthly	1.79	0.12	0.85 3.75	NA			
Monthly	0.67	0.39	0.27 1.65				
Weekly	0.53	0.13	0.23 1.21				
Daily or almost daily	0.30	0.05	0.09 0.99				
Never (ref)	–	–	–				
Binge drinking							
Less than monthly	1.06	0.80	0.68 1.66	NA			
Monthly	1.61	0.05	1.01 2.58				
Weekly	1.56	0.04	1.01 2.40				
Daily or almost daily	1.01	0.95	0.63 1.65				
Never (ref)	–	–	–				
Someone was injured as a result of participant's drinking							
Yes, but not in the last year	1.01	0.95	0.74 1.38	NA			
Yes, during the last year	1.14	0.50	0.78 1.68				
Never (ref)	–	–	–				
Someone expressed concern about participant's drinking							
Yes, but not in the last year	1.03	0.86	0.73 1.45	NA			
Yes, during the last year	1.01	0.97	0.76 1.34				
Never (ref)	–	–	–				
Ever sought treatment for drinking							
Yes	0.80	0.10	0.61 1.04	NA			
No (ref)	–	–	–				
AUDIT score (scaled at 1 SD)							
Each additional 9 points (1 SD)	1.02	0.87	0.84 1.22	1.23	0.00	1.08	1.40
Participant HIV Status							
Positive	0.76	0.05	0.57 1.00	1.20	0.20	0.90	1.60
Unknown	1.65	0.23	0.74 3.69	2.99	0.00	1.45	6.18
Negative (ref)	–	–	–	–	–	–	–

Note. Outcome: Alcohol-user network size (continuous).
Method: Negative binomial regression.
Note: "-"- denotes a reference category, "NA" denotes a variable that was eliminated from the multivariable model.

here captures some of the effects of each of these network factors, explaining in part the association observed between ANS and AUDIT score.

The result that polysubstance use is associated with larger ANS is consistent with earlier research indicating that polysubstance use is a highly social activity for MSM. Several studies have identified high rates of polysubstance and use at MSM-serving social events, night clubs, and parties (Colfax et al. 2015; Fernández et al., 2005; Santos et al., 2018). Concurrent alcohol and polysubstance use at these events and venues may explain the association observed between polysubstance use and larger ANS.

Having any lifetime history of injection drug use (IDU) was associated with smaller ANS. More research on this topic is needed: a sole study of social network size among MSM IDU took place in China, and demonstrated an association in the opposite direction (Koram et al., 2011). Research on MSM IDU in North America indicates that social stigma against IDU is common; this may explain the link observed between IDU and smaller ANS (Semple, 2004; 2012). Additionally, general surveys on IDU in North America have reported an association between injection drug use and poverty (Long et al., 2015). This coincides with the current study's result that having a low income is associated with decreased ANS and may partially explain the effect observed.

The result in the present study that increased number of sexual partners was associated with increased ANS supports the results of a 2016 study of men who have sex with men in Vancouver, Canada, which reported a similar positive association between number of sexual partners and larger social network size (Forrest et al., 2016). This result may also represent overlap between sexual, social, and alcohol-using networks, a recognized risk factor for HIV (Tieu et al., 2015). A unique result from the current study was that unknown HIV status was associated with larger ANS. This result is broadly consistent with the results of an earlier study of MSM that showed that having unknown HIV status was associated with having a larger network of sexual partners. More research on this population is needed in order to elucidate the strength and directionality of these associations.

In line with previous studies that identified race/ethnicity as a correlate of sexual network size among MSM, this study showed that Hispanic/Latino identity was associated with increased ANS in a multivariable model, and that Black/African-American identity was associated with smaller ANS in a bivariate model (Kuhns et al., 2015; Tieu et al., 2015). Studies on MSM sexual networks have reported a link between racial/ethnic assortativity and network size—assortativity may help explain the observed association with ANS as well. The association between being 18–24 years of age and smaller ANS

may be due to U.S. laws that prohibit the sale of alcohol to people under 21 years of age – thereby limiting young MSM's access to a variety of commercial/social establishments where older MSM can freely network. The relationship shown between reporting a low income and smaller ANS is reflective of one study on older LGBTQIA+ adults, which reported that lower income was linked to smaller social networks (Erosheva et al., 2015). It is plausible that the lack of financial resources available to low-income MSM may hinder their participation in social and networking events, reducing their contact with alcohol-using peers compared to high-income MSM. In the current sample, having a college education or higher was associated with larger ANS. Higher education institutions may act as important physical and social contexts where college or graduate student MSM come into contact, leading to larger ANS compared to MSM who have not attended college or higher.

The present study has several limitations. It is exploratory and data-driven, and results should be interpreted solely in the context of hypothesis generation. The study also relied on self-reported data, which is subject to recall bias. Given the sensitive nature of the content of the survey—detailed questions about sex and illicit substance use—it is possible that social desirability bias affected participants' responses. The data used for this study were collected using ACASI, however, which may reduce these biases (Ghanem et al., 2005). Finally, eligibility criteria for the original SEEDS study required that participants be residents of the San Francisco Bay Area. This restriction may have resulted in a sample with localized, idiosyncratic patterns with respect to exposures of interest, thereby limiting the generalizability of these results.

Conclusions

Despite its limitations, this study identified significant correlates of alcohol network size in a sample of men who have sex with men in the San Francisco Bay Area. In particular, these results suggest that ANS is closely related to increased likelihood of alcohol use disorder, illicit substance use, and behaviors associated with HIV transmission. Researchers interested in these associations might investigate or control for characteristics such social network size, network diversity, average drinking group size, or group drinking norms, in order to clarify any independent effects of these factors.

While these results are exploratory, applications to public health interventions may be possible. Modest evidence exists that network-level interventions are effective at reducing alcohol and illicit substance use among youth (MacArthur et al., 2016; Newton et al., 2017). Public Health practitioners may take a "peer-leader" approach, for example, to develop an intervention that

jointly addresses alcohol use, illicit substance use, and sexual risk behaviors. In this scenario, peer leaders might be recruited based on reporting large ANS, and then trained to disseminate information on reducing intoxication and HIV testing. Future research might investigate the utility and viability of these interventions among MSM.

These results may also be informative for researchers interested in using network-based recruitment techniques such as RDS to reach MSM for interventions or studies on alcohol use. For example, MSM who are under 25, Black/African American, IDU, or low-income may be less likely to be connected to large alcohol using networks, and thereby harder to recruit using network-based approaches. Researchers may want to plan their recruitment strategies accordingly, in order to achieve efficient recruitment of a balanced sample.

Finally, more research on HIV-unknown MSM is needed: these results add to the evidence that they may have a unique risk profile compared to HIV-known men, and that alcohol use is an important correlate for HIV transmission (Grov, 2016; Santos et al., 2018). While this specific result is preliminary, it may have profound implications for HIV transmission and suggests the need for public health interventions targeted at HIV-unknown MSM – especially those who use alcohol.

Declaration of Conflicting Interests

Funding

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