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Drinking Settings, Alcohol Consumption, and Sexual Risk Behavior among Gay Men

Rhonda Jones-Webb, Dr.P.H.¹, Derek Smolenski, Ph.D.¹, Sonya S. Brady, Ph.D.¹, Michael Wilkerson, Ph.D.¹, and Simon Rosser, Ph.D.¹

¹ University of Minnesota School of Public Health, Division of Epidemiology and Community Health

Abstract

We sought to 1) describe the settings or groups of settings where men who have sex with men (MSM) consume alcohol in 16 U.S. metropolitan statistical areas (MSA); and 2) investigate whether certain drinking settings or groups of settings are associated with higher levels of alcohol consumption, problem drinking, and sexual risk behavior. Latent class analysis was used to develop our measure of drinking settings. The final latent class model consisted of four distinct classes which captured the typical settings where MSM consumed alcohol: “home” “social,” “bar/social,” and “general” drinkers (i.e., drinks in all settings). Regression models showed that “general” drinkers were more likely than “social” drinkers to engage in frequent heavy drinking. Compared to “social” drinkers, general drinkers were also more likely to engage in unprotected anal intercourse (UAIMP) and UAIMP with men met in bars and other venues (e.g., private parties, bath houses) while intoxicated. Assessment of drinking settings may be a means of identifying MSM who are at greater risk for frequent, heavy drinking and related sexual risk behavior.

Keywords

alcohol consumption; sexual risk behavior; drinking settings; gay men

Introduction

Alcohol use among men who have sex with men (MSM) is pervasive (Ostro & Stall, 2008) and a cause for concern. MSM comprise the majority of HIV infections (CDC, 2011), and studies have shown that heavy alcohol use is associated with HIV risk behaviors, HIV transmission (Baliunas et al., 2010; Celentano et al., 2006; Geibel et al., 2008; Trocki & Leigh, 1991; VanDevanter, 2011), and other health problems including cardiovascular disease, diabetes mellitus, liver cirrhosis, and several cancers (Corrao, Bagnardi, Zambon, & La Vecchia, 2004; Rehm et al., 2003; Rehm, Bondy, Sempos, & Vuong, 1997).

Drinking settings refer to the places where individuals consume alcohol, and include both public milieus (bars, restaurants, night clubs, sporting and outdoor events, parks) and private milieus (e.g., one's own home). Given the prevalence of both drinking and HIV risk behavior among MSM (Ostro & Stall, 2008, CDC, 2011) and the association between alcohol use and risk behavior (Baliunas et al., 2010, Celentano et al., 2006), identifying the

settings where MSM typically consume alcohol can elucidate the way drinking settings contribute to heavy drinking and sexual risk behavior.

Several studies have investigated the association between drinking settings and alcohol use (Casswell, Pledger, & Pratap, 2002; Curran, Harford, & Muthen, 1996; Kairouz & Greenfield, 2006), but few of these studies have focused exclusively on MSM (Greenwood, et al., 2001; Stall et al., 2001; Wong, Kipke & Weiss, 2008). These studies suggest that the social context in which drinking occurs can influence both the amount of alcohol an individual consumes as well as their subsequent health risk. Some studies have reported a positive relationship between frequency of drinking in bars and higher levels of alcohol consumption (Casswell, et al., 2002; Curran, et al., 1996; Kairouz et al, 2006; Trocki & Drabble 2008), as well as problems such as drinking and driving, injuries, and fights (Stockwell, Lang, & Rydon, 1994; Usdan, Moore, Schumacher, & Talbott, 2005). Other studies have reported that settings such as parks, sporting events, and parties are also associated with increased alcohol consumption and drinking problems (Clapp, Reed, Holmes, Lange, & Voas, 2006; Harford, Seabring, & Wechsler, 2002; Jones-Webb et al., 1997; Wells, Graham, Speechley, & Koval, 2005). Still, other studies have found the relationship between drinking settings and alcohol use differs by important demographic variables such as age, gender, and education (Clapp et al., 2006; Harford et al., 2002; Wells et al, 2005; Usdan, et al., 2005).

Studies of drinking settings and alcohol use among MSM have primarily examined gay bar settings (Greenwood, et al., 2001; Wong, et al., 2008). This is not surprising given gay bars historically have served as an important social institution in gay community life (Wolitski, Stall, & Valdiserri, 2008). Wong and colleagues (2008) examined the relationship between frequency of gay bar attendance and alcohol consumption among 526 young adult MSM in Los Angeles and found that gay bar attendance was associated with greater frequency of drinking and binge drinking. Greenwood et al., (2000) also reported that frequency of gay bar attendance was associated with heavy alcohol use among MSM and bisexual men living in San Francisco. In contrast, Trocki and colleagues (2005) reported that drinking in bars was not associated with heavy drinking among gay, bisexual, and heterosexual men; however this study did not focus exclusively on gay bars or MSM. While studies of gay bar attendance and alcohol use have provided valuable insight into the social context surrounding heavy alcohol use among MSM, these studies have a number of limitations. First, studies in this area have focused solely on gay bars to the exclusion of other drinking settings where heavy drinking might occur such as parties. Thus, little is known about the settings where MSM consume alcohol and if certain settings are associated with higher levels of alcohol consumption than other settings. Second, despite high rates of alcohol use and HIV infection among MSM (Stall et al., 2001; CDC, 2011), studies of gay bar attendance and alcohol use have not explored whether drinking settings are associated with sexual risk behavior. Lomba and colleagues (2009) examined the relationships between drinking settings, alcohol use, and sexual risk behavior among teens and young adults in Portugal. About 3% of Lomba's sample included respondents who self-identified as gay or lesbian. Lomba found that frequency of attending night clubs/bars was associated with higher levels of alcohol consumption and that higher levels of alcohol consumption were associated with sexual risk behaviors, such as drinking while engaging in sex. The study by Lomba and colleagues (2009) did not directly test whether drinking settings were associated with sexual risk behavior. To date, no studies have investigated whether certain drinking settings or groups of settings are associated with sexual risk among MSM or other populations.

The aims of our study were to 1) describe the settings or groups of settings where MSM consume alcohol in 16 U.S metropolitan statistical areas (MSAs), and 2) investigate whether

certain drinking settings or groups of settings (e.g., bars, restaurants, parties) are associated with higher levels of alcohol consumption, problem drinking, and sexual risk behavior.

Methods

Data

The present study is part of a larger, five-year study (SILAS) examining the effects of state laws related to homosexuality on alcohol use, unsafe sexual behavior, and alcohol-related unsafe sex among MSM (Horvath, 2010). The SILAS sample was comprised of MSM who were recruited online from 16 moderately sized metropolitan statistical areas (MSAs) in the U.S, e.g., Minneapolis, Albany, Cleveland, and Portland. Data for this analysis were collected in 2008.

Recruitment

In 2008, SILAS participants were recruited online from the two of the largest gay/bi social networking sites, [Manhunt.net](#) and [Gay.com](#). Eligibility criteria included being 1) age 18 years or older, 2) a male who self-reported having sex with a man, 3) a resident in one of the 16 MSAs, and 4) a new study participant. Banner advertisements promoting a “Sex and Alcohol Survey” were displayed on the websites. Upon clicking on the banner advertisement, potential participants were brought to the log-in page. Over 3,370 invitations were issued to individuals who clicked on the banner advertisements and who provided contact information. Of the 2,305 eligible enrollees, 1,725 (90.55%) completed an online survey questionnaire, yielding an overall completion rate of 74.83%.

We screened for duplicate respondents prior to and following the survey. Prior to taking the full study survey, respondents were asked to complete a screener survey. The screener gathered qualifying demographics such as age and location, along with logistical information such as an email for [Amazon.com](#) payments, and a preferred email where the SILAS team would send qualifying candidates a survey activation link. When surveys were submitted, the IP address of qualifying candidates was recorded and compared to their stated location. This information was also compared against the database of existing users. Potential duplicates were identified based on IP address and location, and a simple algorithm assigned candidates a possible duplicate score. Once determined to be eligible, study subjects provided their numerical age at the beginning of the survey, and a birth date (dd/mm/yy) at the end of the survey. Age, birth date, other elements of demographic information, and time taken to complete the survey were analyzed using our deduplication algorithm, and once again subjects were assigned a possible duplicate score. Throughout all phases of the study, duplicate respondents were identified and not allowed to advance. If respondents were identified as duplicates after completing the survey, their first survey would be kept, and all subsequent surveys were removed from the dataset.

Data Collection and Measures

The questionnaire included items and scales on a variety of topics including typical Internet use, sexual and alcohol behavior with partners met online versus in bars/clubs, versus in other locations, current alcohol and drug use, and sexuality and relationship measures. Data were collected between June 18, 2008 and October 1, 2008, and participants were compensated \$30 for their participation. On average, participants completed the online survey in 71 minutes.

Outcome variables—Dependent variables were alcohol consumption, problem drinking, and sexual risk behavior. We assessed alcohol consumption by combining two items to construct a quantity and frequency drinking typology that ranged from abstinence to

frequent heavy drinking (see categories in Table 5). The first question examined frequency: “In the past 3 months, on average, how often did you drink any kind of alcoholic beverage?” (never, < 1 a month, about once a month, 2–3 times a month, 1–2 times a week, 2–3 times a week, nearly every day, at least once a day), and the second, quantity: “In the past 3 months, on a day when you drank some alcohol, how many drinks did you usually have?” (Greenfield, Midanik & Rogers, 2000). We assessed problem drinking using the 4-item CAGE questionnaire (Ewing, 2008; Bush, Shaw, Cleary, Delbanco & Aronson, 1987). Items on the CAGE assess the individual's perceived need to cut down on alcohol use, feelings of annoyance by people criticizing one's drinking, feeling bad or guilty about drinking, and need for a drink first thing in the morning to steady one's nerves or to cure a hangover (i.e., “eye-opener”); items are scored yes or no. A total score of 2 or more “yes” responses was used to classify participants as screening positive for problem drinking.

We assessed sexual risk behavior across three environments. Participants were asked about their sexual behavior in the last 3 months separately with men met online, men met in bars, and men met in other places (e.g., private parties, bathhouses). We asked men to estimate the number of men with whom they had unprotected anal intercourse with a male partner (UAIMP) both overall and specifically while intoxicated; these served as our primary measures of sexual risk behavior. We analyzed both the UAIMP and UAIMP while intoxicated variables separately by environment as well as in an aggregate form across the three environments to examine overall risk behavior.

Exposure variable—Drinking settings served as our key exposure variable and was measured by asking the following question, “Where do you typically drink alcohol?” Response categories were in restaurants, gay bars/clubs, social gatherings, others' homes, own home, outdoor leisure, concerts/sporting events. Respondents could check all that apply. A drinking setting variable was constructed using latent class analysis (LCA) to develop a measure that captured the settings or groups of settings in which MSM consumed alcohol. The results of the LCA is described in detail in the data analysis section below.

Covariates—Demographic covariates included age, education level, income, race/ethnicity, long term relationship status, gay identification, and HIV status. These variables were selected because they have been shown to be related to drinking and/or sexual risk behavior (U.S. Department of Health and Human Services, 2010; Ostrow & Stall, 2008). Relationship status was measured by asking, “Do you have a relationship with a man who you would describe as your long-term boyfriend, domestic partner or spouse (yes/no)?” Gay identification was assessed by asking whether respondents identified as gay/homosexual, bisexual, heterosexual, or other. HIV status was measured by the following question: “Have you ever been diagnosed with HIV (yes/no)?”

Data Analysis

First, we used a latent class model to identify homogeneous groups based on their response patterns to the drinking setting item, “Where do you typically drink alcohol?” Latent class analysis (LCA) is designed to identify a small number of classes or groups that exhibit similar patterns of responses, with the result being independence among indicators within each class (Collins & Lanza, 2010). Because variability between each indicator is modeled as residual error, a latent variable is considered “error-free” and a more precise estimate of the unobserved construct than any individual indicator or simple sum of multiple indicators. In general, studies on drinking settings and alcohol use have been limited by their reliance on individual indicators of drinking settings (e.g., frequency of drinking in bars, last location alcohol was consumed prior to an injury or accident (Lang & Stockwell, 1991; MacDonald et al, 2006; McLean & Connor, 2009; Usdan et al, 2005). Our approach to measuring

drinking settings thus provides an alternative method to standard approaches of measuring drinking settings which can improve statistical inference. For example, our approach to measuring drinking settings permits us to identify distinct patterns in the drinking settings of MSM that might not be apparent using an individual indicator (e.g., 1–2 settings, 3–4 settings, etc).

Given the large sample size, we randomly divided participants into one training and two validation subpopulations prior to latent class modeling. For the training subpopulation, we estimated iterative latent class models with each additional model containing one additional class. We used standard indices of absolute and relative model fit to identify the optimal solution (Collins & Lanza, 2010). We examined the absolute fit of the model using the G^2 statistic, with a non-significant ($p > .05$) p -value indicating a non-significant discrepancy between the model implied contingency table and the observed contingency table of the data. Since multiple models can have an acceptable absolute fit, we also examined general relative fit indices including the Akaike information criterion (AIC), the Bayesian information criterion (BIC), and the Lo-Mendel-Rubin likelihood ratio test (LMR LRT). For the AIC and BIC, lower values indicated an improvement in model fit. The likelihood ratio test was used to identify a stopping point for the iterative models since a non-significant ($p > .05$) p -value indicates no further improvement in model fit resulting from an additional estimated latent class. Additional considerations in arriving at the final training model included parsimony and substantive interpretation of the latent classes. We used a multi-group latent class analysis to determine the equivalence of the item thresholds and the population distribution across the three randomly-derived subpopulations (Collins & Lanza, 2010). Non-significant differences in the G^2 statistic between freely-estimated and constrained models were used to support an inference of model replicability. The final solution was modeled using the entire analytic sample.

Next, we compared demographic variables across the identified latent classes using a multinomial regression model with the latent classes specified as the outcome variable. For the alcohol outcomes, we used a multinomial regression model with the latent classes specified as a categorical explanatory variable. We included estimates for UAIMP and UAIMP while intoxicated, both overall and stratified by environment (meeting a partner in a bar, online, or in other places), to examine the association between the drinking classes and risk behavior. For the overall variables, we had sufficient variability in the data to employ a negative binomial regression to examine the difference in the prevalence rates between the classes. For the environment-specific analyses, the counts were quite sparse, so we used a logistic regression model to examine the association between any risk behavior and the drinking venue classes. Models in which alcohol was the outcome of interest excluded *non-drinkers* since these participants, by definition, are not eligible for either the exposure or outcome used in the model; models in which the outcome was sexual risk behavior included both non-drinkers and drinkers, since the “non drinker” designation does not preclude sexual risk behavior. All regression models adjusted for age, education, income, race/ethnicity, long term relationship status, gay identification and HIV status; sexual risk models also adjusted for alcohol consumption (US. Department of Health and Human Services, 2010; Ostro & Stall, 2008). For all regression models, we used the probability of latent class assignment as a weight variable to account for the probabilistic assignment of participants to their most likely latent class (Clark & Muthén, 2009). We used robust variance estimates to account for nonindependence of observations based on the selection of study participants from 16 defined MSAs. The primary motivation for this approach to variance estimation is to account for the nonindependence of individual observations introduced by selecting study participants from defined catchment areas. Participants within a defined MSA may be more similar to one another across a broad range of characteristics than to those selected from another catchment area. Using the robust variance estimator allows us to account for

potential nonindependence to reduce bias in statistical inference. The latent class models were estimated using *Mplus*, Version 6.0 (Muthén & Muthén, 2009), and the regression models were estimated using Stata, Version 11.2 (Stata, 2012).

Results

Descriptive

Sample characteristics—Table 1 describes the demographic characteristics of the sample. In general, the sample was white (74%), young (56% age 34 years), and highly educated (51% with 4+ years of college). Most respondents were single (71%) and 14% of respondents were living with HIV.

Drinking settings—The model fit indices for several iterative latent class models in the training subsample are reported in Table 2. The four-class solution was the first solution to have a non-significant G^2 value, and had AIC and BIC values lower than those for the two- and three-class solutions. The five- and six-class models also had good absolute fit to the data, but the BIC values were higher than those for the four-class solution, and the decreases in the AIC were modest, leading us to prefer the four-class solution based on statistical criteria. Review of the class structure for the four- and five-class models also favored the four-class model in terms of improved interpretability and overall model parsimony. Multi-group assessment of the four-class model between the training and two validation subsamples indicated that the four-class model thresholds and distributions replicated across the three groups (Table 2).

Conditional item endorsement probabilities (i.e., the likelihood of favoring a particular setting) shown in Table 3 guided our naming of the four classes. Participants in the first class, 'home' drinker had a greater probability of indicating drinking in their own home than other venues, such as social gatherings. The second class, 'social' drinker consisted of higher endorsements of drinking in restaurants, at social gatherings, and at their own and others' homes than other venues. The third class, "social/bar" included participants who endorsed the two items specific to alcohol consumption in bars in addition to the other social venues. Finally, participants in the last class, 'general' had a high probability of indicating they drank at all venues included in the model. The distribution of participants into assigned latent classes was approximately uniform. Classification accuracy for each class was high, with "home" (89.5%) and the "all" (88.5%) having the highest values. The overall quality of the model, or entropy, was adequate at 0.68.

Drinking settings by demographic characteristics—Non-drinkers and 'home' drinkers were somewhat similar in terms of demographic characteristics (Table 4). Compared to 'social' drinkers, non drinkers and 'home' drinkers were older, and 'home' drinkers more likely to report being HIV positive. The 'social/bar' and 'general' drinkers were younger and more likely to self-identify as gay as compared to 'social' drinkers; the 'general' drinkers also had a greater odds of earning \$40,000 or more per year as compared to 'social' drinkers.

Multivariate

Drinking settings and alcohol use—Drinking setting was associated with level of alcohol consumption. 'General' drinkers had a significantly greater prevalence of frequent and/or heavy drinking as compared to 'social' drinkers. In contrast, 'home' drinkers were less likely to report frequent, heavy drinking; they were similar to 'social' drinkers with respect to likelihood of infrequent, heavy drinking and frequent, light/moderate drinking (Table 5). There were no differences identified between social and social/bar and social

drinkers in terms of frequency and intensity of alcohol use. Also, there were no observed differences between the drinking classes in terms of the CAGE assessment.

Drinking settings, and sexual risk behavior—Drinking setting was also associated with sexual risk behavior. Table 6 provides a more detailed analysis of the relationship between drinking setting and sexual risk behavior across and for each of the three environments examined in our UAIMP measures (i.e., men met online, bar, other). As expected, 'general' and 'social/bar' drinkers had a greater odds of reporting UAIMP with partners met in bars as compared to "social" drinkers. Of note, both the 'general' and 'social/bar' classes include drinking in bars as a defining characteristic. There was no association between drinking setting and UAIMP among MSM who met men online or in other venues. In terms of UAIMP while intoxicated, the pattern of associations was similar to UAIMP in general. For example, 'general' drinkers had the highest prevalence of UAIMP with partners met through either bars or other venues while intoxicated.

Discussion

We identified four distinct patterns in the drinking settings of MSM: 'home' (27%), 'social' (23%), 'social/bar' (23%), and 'general', i.e., drank in all settings (27%). 'General' drinkers (i.e., drank in all settings) consumed significantly more alcohol than 'social' drinkers. Because general drinkers drank in more venues than 'social' drinkers, they likely had greater opportunities to drink. 'General' drinkers also had higher incomes than 'social' drinkers and therefore had greater financial resources to drink in more settings. Non-drinkers and 'home' drinkers were more likely to be living with HIV than other types of drinkers. The potential experiences of discrimination may partially explain why 'home' drinkers typically drank at home and to a lesser degree at gay bars/clubs.

Compared to 'social' drinkers, 'general' drinkers were also significantly more likely to engage in UAIMP with male partners met at bars and other venues while intoxicated. Having oneself of alcohol across a variety of settings may lead to more opportunities to engage in risky sexual practices among MSM. Our findings on the relationship between drinking settings and sexual risk behavior have not been previously reported.

Drinking settings were not significantly associated with problem drinking as measured by the CAGE. While the CAGE has good internal reliability, responses to the CAGE are not stable over time (Dawe & Mattick, 1997). Thus, our null finding on drinking settings and problem drinking may reflect certain limitations of the CAGE. Alternatively, our findings may suggest that drinking settings are not associated with outcomes such as alcoholism.

Limitations

Several limitations of our study should be noted. First, we did not ask participants to indicate how much they drank in each setting they checked; previous studies have done so (Cassell et al, 2002; Kairouz & Greenfield, 2006). Future studies may wish to compare the validity of different approaches to measuring drinking settings among MSM. Latent class analysis offers one possible approach to measuring drinking settings. Second, we did not examine the characteristics of the drinking settings of MSM, and which characteristics were most associated with heavy drinking. Future studies should explore if certain characteristics of drinking venues are associated with heavy drinking more than others among MSM (e.g., size, location, presence of music/dancing, establishment practices and policies, presence of other roommates in private settings). Third, results from our study are generalizable to MSM who live in select MSA's. Future studies should replicate our study in other cities, especially large cities such as New York and Los Angeles. Finally, our data are cross-sectional. Although our findings are consistent with a model in which drinking in a variety of settings

leads to increased drinking and sexual risk behavior, we cannot assume that this is the case. Future studies in this area will require stronger analytical study designs to confirm results from our study.

Implications

Despite the limitations of our study, our findings have important implications for designing alcohol interventions that target MSM. Our findings suggest that alcohol interventions should target MSM who drink in multiple settings, not only gay bars. Internet-based interventions may provide a vehicle for reaching such men (Bowen, Williams, Daniel, & Clayton, 2008; Levy & Strombeck, 2002; Rhodes, 2004). Internet-based interventions reach large numbers of individuals and offer a degree of anonymity which may be appealing to MSM who are heavy drinkers (Cooper, 1998). Also, the flexibility of the Internet may make it easier to integrate health messages regarding heavy drinking and HIV risk behavior. Individual level alcohol interventions are most effective when complemented by environmental strategies that seek to alter aspects of the drinking environment, e.g., drinking settings (Toomey & Lenk, 2011). Internet based interventions that target MSM who drink in multiple settings should therefore be complemented by strategies that alter aspects of drinking settings that encourage heavy drinking, e.g., over service, drinking games, seeing others intoxicated (Zakelstaka, Mundt, Balousek, Wilson, & Fleming, 2009; Clapp et al, 2006).

Conclusion

Our results build on and expand the current research on drinking settings and alcohol consumption among MSM (Greenwood et al., 2001; Stall et al., 2001; Wong et al., 2008). Results suggest that MSM consume alcohol in a variety of settings and there are distinct patterns in where MSM consume alcohol. Further, our results indicate that drinking in a multiple settings may increase alcohol consumption as well as UAMIP with men met in bars and other venues while intoxicated. Internet-based interventions might be one avenue for reaching these men.

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Research Highlights

There are distinct patterns in where MSM consume alcohol

Drinking in a variety of settings is associated with increased alcohol consumption and sexual risk behavior

Highlights the importance of focusing on MSM who drink in multiple settings

Table 1

Demographic characteristics of SILAS respondents (n=1,725)

Variable	n	%
Age (years)		
18–24	420	24.36
25–34	554	32.13
35–44	441	25.58
45–54	233	13.52
55 and above	67	3.89
Missing	9	0.52
Education		
High school/Technical school	245	14.21
Some college	593	34.40
College	578	33.53
Post-graduate	308	17.87
Annual income (\$US)		
<20,000	458	26.57
20,000 – 39,999	512	29.70
40,000 – 59,999	336	19.49
60,000 – 79,999	154	8.93
80,000 – 99,999	72	4.18
100,000	84	4.87
Missing	108	6.26
Race/ethnicity		
White, non-Hispanic	1,269	73.61
Black, non-Hispanic	62	3.60
Hispanic	245	14.21
Other	121	7.02
Missing	27	1.57
Sexual orientation		
Gay	1,487	86.35
Bisexual	207	12.01
Heterosexual	13	0.75
Other	15	0.87
Missing	2	0.12
Relationship status		
Single	1,218	70.65
In a long-term relationship	505	29.29
Missing	1	0.06
HIV-status		
HIV-negative	1,471	85.32
HIV-positive	244	14.15

Variable	n	%
Missing	9	0.52

Table 2

Fit indices for iterative latent class models in the training sample (n = 518), and multi-group analysis of the final model solution between the training and validation split samples

Training model						
No. classes	AIC	BIC	G ² ,df	p-value	Entropy	LMR LRT p-value
2	4536.92	4609.17	368.81, 238	<.001	0.82	11067.37 <.001
3	4454.22	4564.72	238.11, 229	.039	0.75	9065.22 <.001
4	4414.98	4563.73	210.87, 220	.659	0.72	8821.89 <.001
5	4400.67	4587.67	168.98, 210	.983	0.83	8683.37 <.001
6	4402.66	4627.91	152.97, 201	.995	0.82	8602.99 <.001
Multi-group model						
				ΔG^2 , df		
Parameters freely estimated	17024.53	17597.59	663.83, 660	.451	-	-
Constrained thresholds	16978.29	17208.58	745.59, 724	.281	81.76, 64	.067
Constrained distribution	16974.08	17172.24	753.38, 730	.267	7.79, 6	.254

Note: AIC = Akaike information criterion; BIC = Bayes information criterion; χ^2 = likelihood ratio test of model fit, LMR LRT = Lo-Mendel-Rubin likelihood ratio test.

Table 3

Distribution of item endorsements within the identified latent classes (n = 1565)

Venue	Class			
	Home (27.35%) p	Social (23.45%) p	Social and bar (22.67%) p	General (26.52%) p
Restaurants	0.34	0.59	0.90	0.97
Gay bars/clubs	0.47	0.40	0.87	0.92
Non-gay bars/clubs	0.12	0.22	0.69	0.94
Social gatherings	0.19	0.81	0.95	0.99
Others' homes	0.15	0.77	0.69	0.95
Your own home	0.55	0.83	0.64	0.93
Outdoor leisure	0.01	0.42	0.08	0.86
Concert/sporting events	0.01	0.27	0.12	0.80
Average classification accuracy	89.5%	76.7%	74.4%	88.5%

Note: p=proportion of respondents in a class who endorse the particular item. Proportions in **bold** indicate a greater likelihood of endorsement for the particular item. Overall entropy of the model classification was 0.68.

Table 4

Descriptive statistics and multinomial regression of non-drinkers and drinkers, by assigned latent class, on demographic variables

	Non-drinker (n=159) M (SD)	Home (n = 428) M (SD)	Social (n = 367) M (SD)	Social/Bar (n = 355) M (SD)	General (n = 415) M (SD)
Age, years	37.9 (11.8) %	35.5 (10.9) %	33.2 (11.9) %	32.0 (9.5) %	31.7 (9.2) %
College education	52.2	47.9	45.8	58.3	53.7
Income \$40,000	41.8	38.9	40.2	35.6	44.0
Non-Hispanic White	16.4	18.2	16.4	15.8	13.5
Not gay-identified	15.1	13.1	18.0	11.0	12.1
Long-term relationship	29.6	31.4	30.5	26.2	28.7
Living with HIV	19.2	20.5	12.3	11.6	9.9
	POR (95% CI)	POR (95% CI)	POR (95% CI)	POR (95% CI)	POR (95% CI)
Age, years	1.04 (1.02, 1.07)	1.03 (1.01, 1.04)	Ref.	0.99 (0.98, 1.01)	0.99 (0.98, 1.00)
College education	1.39 (0.80, 2.42)	1.19 (0.84, 1.68)	Ref.	1.83 (1.39, 2.41)	1.48 (1.12, 1.95)
	Non-drinker POR (95% CI)	Home POR (95% CI)	Social POR (95% CI)	Social/Bar POR (95% CI)	General POR (95% CI)
Income \$40,000	1.16 (0.78, 1.74)	1.05 (0.81, 1.37)	Ref.	0.91 (0.63, 1.31)	1.28 (1.07, 1.52)
Non-Hispanic White	1.02 (0.67, 1.57)	1.16 (0.89, 1.50)	Ref.	1.02 (0.65, 1.61)	0.82 (0.62, 1.08)
Not gay-identified	0.76 (0.40, 1.46)	0.65 (0.40, 1.07)	Ref.	0.50 (0.31, 0.81)	0.59 (0.42, 0.82)
Long-term relationship	0.97 (0.67, 1.40)	1.04 (0.74, 1.46)	Ref.	0.82 (0.53, 1.25)	0.94 (0.66, 1.32)
Living with HIV	1.73 (0.97, 3.10)	1.91 (1.13, 3.23)	Ref.	0.96 (0.55, 1.67)	0.80 (0.48, 1.31)

Note: POR=prevalence odds ratio; CI = confidence interval

Table 5

Distribution and multinomial regression of alcohol consumption and CAGE outcomes on assigned latent class

Class	Alcohol consumption					CAGE	2 Row%
	Infrequent, light/moderate Row%	Infrequent, heavy Row%	Frequent, light/moderate Row%	Frequent, heavy Row%			
Home	43.54	8.37	32.06	16.03			26.07
Social ^a	34.25	7.67	36.71	21.37			26.98
Social & Bar	31.82	9.38	42.61	16.19			27.04
General	10.49	5.85	53.66	30.00			33.73
	POR (95% CI)	POR (95% CI)	POR (95% CI)	POR (95% CI)			POR (95% CI)
Home	Ref.	0.96 (0.53, 1.74)	0.70 (0.45, 1.07)	0.59 (0.37, 0.94)			0.84 (0.65, 1.08)
Social & Bar	Ref.	1.41 (0.90, 2.21)	1.20 (0.83, 1.74)	0.81 (0.53, 1.25)			0.85 (0.63, 1.15)
General	Ref.	2.98 (1.42, 6.23)	4.63 (2.76, 7.75)	4.86 (2.45, 9.63)			1.27 (0.82, 1.98)

Note: POR = prevalence odds ratio; CI = confidence interval. All POR estimates adjusted for age, education, income, race, HIV status, gay identification, and long-term relationship status. All regression models are weighted for latent class estimation uncertainty and employ a robust standard error estimate that accounts for MSA-based sampling.

^aReference category for the exposure variable in the multinomial regression.

Table 6

Logistic regression of any unprotected anal intercourse male partners (UAIMP) and any UAIMP while intoxicated on assigned latent class, both overall and by sex environment

Drinking class	All environments M (SD)	UAIMP			UAIMP while intoxicated			
		Online %	Bar %	Other %	All environments %	Online %	Bar %	Other %
Non-drinker	36.5	34.0	3.8	8.8	-	-	-	-
Home	36.9	31.5	8.9	8.4		12.2	5.6	2.3
Social ^a	38.7	34.9	5.7	10.4		14.2	5.2	4.1
Social & Bar	35.8	30.4	11.6	7.3		11.8	7.3	2.8
General	35.9	30.1	10.4	9.4		14.2	8.9	6.3
		POR (95% CI)	POR (95% CI)	POR (95% CI)	POR (95% CI)	POR (95% CI)	POR (95% CI)	POR (95% CI)
Non-drinker	0.87 (0.52, 1.44)	0.91 (0.52, 1.59)	0.50 (0.20, 1.23)	0.75 (0.37, 1.55)	-	-	-	-
Home	0.90 (0.68, 1.20)	0.83 (0.59, 1.16)	1.47 (0.93, 2.34)	0.74 (0.47, 1.18)	1.16 (0.86, 1.57)	0.78 (0.47, 1.31)	1.00 (0.64, 1.57)	0.65 (0.34, 1.24)
Social & Bar	0.93 (0.64, 1.35)	0.84 (0.52, 1.37)	2.04 (1.31, 3.20)	0.75 (0.36, 1.57)	1.40 (0.89, 2.20)	0.88 (0.49, 1.57)	1.37 (0.84, 2.23)	0.68 (0.28, 1.66)
General	0.98 (0.69, 1.38)	0.85 (0.58, 1.25)	2.06 (1.12, 3.78)	1.02 (0.65, 1.58)	1.80 (1.21, 2.67)	1.07 (0.68, 1.68)	1.95 (1.11, 3.45)	1.77 (1.06, 2.97)

Note: POR=prevalence odds ratio; CI = confidence interval. All PORs adjusted for age, education, income, race, long-term relationship status, gay identification, and HIV status. All regression models are weighted for latent class estimation uncertainty and employ a robust standard error estimate that accounts for MSA-based sampling.

^aReferent class for negative binomial regression models of UAIMP and UAIMP while intoxicated outcome variables.