

Sexual orientation, substance use behaviors and substance dependence in the United States

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ABSTRACT

Aims To assess past-year prevalence rates of substance use behaviors and substance dependence across three major dimensions of sexual orientation (identity, attraction and behavior) in a large national sample of adult women and men in the United States. **Design** Data were collected from structured diagnostic face-to-face interviews using the Alcohol Use Disorder and Associated Disabilities Interview Schedule DSM-IV version IV (AUDADIS-IV). **Setting** Prevalence estimates were based on data collected from the 2004–2005 (wave 2) National Epidemiologic Survey on Alcohol and Related Conditions (NESARC). **Participants** A large national sample of 34 653 adults aged 20 years and older: 52% female, 71% white, 12% Hispanic, 11% African American, 4% Asian and 2% Native American. **Findings** Approximately 2% of the population self-identified as lesbian, gay or bisexual; 4% reported at least one life-time same-sex sexual partner and 6% reported same-sex sexual attraction. Although non-heterosexual orientation was generally associated with a higher risk of substance use and substance dependence, the majority of sexual minority respondents did not report substance use or meet criteria for DSM-IV substance dependence. There was considerable variation in substance use outcomes across sexual orientation dimensions; these variations were more pronounced among women than among men. **Conclusions** Results support previous research findings of heightened risk of substance use and substance dependence among some sexual minority groups and point to the need for research that examines the reasons for such differences. Results also highlight important gender differences and question previous findings indicating uniformly higher risk for substance dependence among sexual minorities. Risks appear to vary based on gender and how sexual orientation is defined. Findings have implications for more effective prevention and intervention efforts that target subgroups at greatest risk.

Keywords Sexual orientation, sexual identity, sexual attraction, sexual behavior, epidemiology, DSM-IV substance dependence.

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INTRODUCTION

Approximately 20 million adults in the United States meet criteria for any past-year substance use disorder as defined in the *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition (DSM-IV) [1,2]. A growing body of research suggests that non-heterosexual (sexual minority) populations are at particularly high risk for alcohol and other drug use disorders [3–9]. Although public health researchers increasingly consider sexual orientation to be an important area of inquiry [10–14], large-

scale national epidemiological studies that assess sexual orientation are relatively rare. Population-based studies on substance use seldom ask about sexual orientation, and broad-based studies of sexual minority populations have only occasionally assessed substance use.

Recent theoretical explanations for heightened risk of substance use disorders among sexual minorities have focused predominantly on cultural and environmental factors, such as fewer roles and responsibilities (e.g. marriage and parenting) that otherwise limit or deter excessive substance use [15–17], fewer prohibitions/sanctions

against substance use [17] and social stigma, prejudice and discrimination associated with sexual minority status [8,18]. Despite the proffering of such theoretical explanations, empirical evidence supporting these theories is scant and little attention has been given to within-group variations in substance use and substance dependence. Such information is necessary to understand more clearly heightened risk of substance use and substance dependence among sexual minorities.

Central to understanding the risk of substance use disorders among sexual minority groups are issues related to the measurement and operationalization of the construct 'sexual orientation'. Although there is growing consensus that sexual orientation includes at least behavioral, affective and cognitive dimensions [19–21], the few national studies on substance use that have assessed sexual orientation have asked generally about one dimension. Given recent findings suggesting variability in substance use across (and within) the three dimensions of sexual orientation [22], reliance upon a single dimension may miss important differences in health behaviors and hinder theoretical advances [20,23–26].

Most population-based studies of the relationship between sexual identity and substance use conclude that women and men who self-identify as lesbian/gay or bisexual are at greater risk than heterosexuals for substance use behaviors [3,5,24,27,28]. However, these and other studies suggest that risks differ within sexual minority groups and across gender [9,22–25,29]. In analyses of data from the National Survey of Midlife Development in the United States (MIDUS), Cochran and colleagues found that the 1-year prevalence rates of alcohol and other drug dependence did not differ for heterosexual and self-identified sexual minority adults aged 25–74 years [3]. However, this study was limited by small sample sizes that required combining lesbian/gay and bisexual respondents.

In the few studies analyzing data from national probability sample surveys that have included sexual orientation questions, sexual behavior has been assessed most commonly [4,30,31]. In analyses of the 1996 US National Household Survey on Drug Abuse (NHSDA), Cochran and colleagues [4] combined homosexually active adult women and men who reported only same-gender sexual partners ($n = 135$) and those who reported sexual partners of both genders ($n = 59$). Life-time drug use was generally higher among respondents with same-gender sexual partners than those with other-gender partners, but very few differences were found for 30-day use. Furthermore, respondents who reported same-gender partners had significantly higher rates of past-year marijuana dependence symptoms but did not differ significantly in rates of past-year dependence symptoms

for eight other drugs (e.g. heroin, inhalants, stimulants, opioid analgesics).

Very few population-based studies have examined associations between sexual attraction and substance use behaviors, with the exception of two studies that focused on adolescents [32] and young adults [22]. These two studies found that youth attracted to both genders were more likely to report some substance use behaviors and problems, and this was especially true among young women. The findings of these two studies highlighted the importance of distinguishing between youths with only same-gender attractions and those attracted to both genders.

A few population-based studies of adults have assessed associations between substance use behaviors and more than one sexual orientation dimension [5,33]. In the 2000 National Alcohol Survey, Drabble and colleagues [5] compared heterosexual, bisexual and lesbian/gay-identified participants, and heterosexual-identified participants who reported any same-gender sexual partners. Lesbian and bisexual women had elevated or significantly greater odds of alcohol abuse and dependence than did exclusively heterosexual women, but few significant sexual orientation differences were observed among men. Participants who identified as heterosexual but reported same-gender sexual partners did not differ from heterosexuals with no same-gender sexual partners, suggesting that sexual identity may be more important than sexual behavior in predicting alcohol abuse and dependence.

Although past research has often combined lesbian/gay and bisexual adults in analyses, emerging evidence suggests that regardless of whether defined by identity [3,27,28], attraction [22] or behavior [4,31], bisexual adults appear to be at higher risk for substance use and related problems [9,34–36]. These findings suggest the usefulness of examining differences within and across dimensions of sexual orientation and sexual minority subgroups separately. Furthermore, findings indicating that the effects of sexual orientation on substance use differ by gender suggest the importance of looking at men and women separately [5,22,24]. Although most studies have found that women who identify as lesbian or bisexual are more likely than heterosexual women to be heavy drinkers [5,9,27,28], differences in drinking levels based on sexual orientation tend to be smaller among men [5,22]; in fact, some studies with younger samples have found significantly lower rates of heavy drinking among gay and bisexual men compared with their heterosexual peers [22,24]. Such information can help to identify subgroups at greatest risk and aid the development of more effective prevention and intervention strategies.

The current study presents data from wave 2 of the National Epidemiologic Survey on Alcohol and Related

Conditions (NESARC), which is the first national study to provide data on substance use and DSM-IV substance dependence among sexual minorities in the United States based on assessment of all three major dimensions of sexual orientation: identity, attraction and behavior. The number of sexual minorities in wave 2 of the 2004–05 NESARC is three to 10 times larger than in previous national studies [3–5,31,37], permitting statistical comparisons within and across sexual orientation dimensions. Thus, the main objectives of this exploratory study are to examine the prevalence of substance use behaviors and substance dependence within and across groups defined by sexual identity, attraction and behavior, and to explore potential gender differences in the relationships of the various dimensions of sexual orientation with substance use outcomes.

METHODS

The target population for the 2004–05 NESARC (wave 2) was the civilian, non-institutionalized population in the United States, 20 years of age and older, who were first interviewed in 2001–02 as part of a nationally representative probability sample. Wave 2 data were collected via face-to-face interviews conducted in respondents' households. The US Bureau of the Census trained interviewers using the Alcohol Use Disorder and Associated Disabilities Interview Schedule DSM-IV (AUDADIS-IV). Responses to this fully structured diagnostic interview were entered directly into laptop computers. The response rate for wave 1 was 81.0%; the response rate among those eligible for wave 2 was 86.7%, resulting in a cumulative response rate of 70.2% (the product of response rates from waves 1 and 2). Greater detail about the NESARC design and methods is available elsewhere [38–40]. The US Census Bureau and the US Office of Budget and Management approved the NESARC research protocol. The University of Michigan Institutional Review Board approved the current study.

Sample

Sample weights for wave 2 respondents were calculated to ensure that the weighted sample represented adults from the original sample who remained in the non-institutionalized population. After applying sampling weights, the sample ($n = 34\ 653$) represented a population that was approximately 52% female, 71% white, 11% African American, 4% Asian, 12% Hispanic and 2% Native American.

Demographic and background characteristics

Demographic and background characteristics collected in the interview included age, sex (male, female), race/

ethnicity (white, black, Native American, Asian, Hispanic), educational level (less than high school, high school, some college or higher), employment status (full-time, part-time, not working), income (less than \$19 999, \$20 000–34 999, \$35 000–69 999, \$70 000 or higher), United States Census geographical region (Northeast, Midwest, South, and West), metropolitan statistical area (MSA) (central city in MSA, not in central city in MSA, not in MSA), health insurance coverage (yes, no) and relationship status (married/cohabiting, widowed/separated/divorced, never married). History of alcohol problems in the home was assessed by asking respondents whether, when they were under 18 years old, they had lived in the home with a parent (or other adult) who was a problem drinker or alcoholic. A history of other drug problems in the home was assessed using the same language, but with reference to drugs other than alcohol.

Sexual orientation

Respondents were shown a pre-printed response card to refer to when answering questions about sexual orientation [41]. Sexual identity was assessed by asking 'Which of the categories on the card best describes you? (i) heterosexual (straight), (ii) gay or lesbian, (iii) bisexual, or (iv) not sure?'. Sexual attraction was assessed by asking 'People are different in their sexual attraction to other people. Which category on the card best describes your feelings? (i) only attracted to females, (ii) mostly attracted to females, (iii) equally attracted to females and males, (iv) mostly attracted to males, or (v) only attracted to males'. Sexual behavior was assessed by asking 'In your entire life, have you had sex with . . . ? (i) only males, (ii) only females, (iii) both males and females, or (iv) never had sex'.

Substance use behaviors

Heavy quantity drinking was assessed by asking respondents how often they drank four/five or more drinks (for women/men) in a period of 2 hours or less during the last 12 months. Based on previous research [42], responses indicating that this level of consumption occurred at least once in the past year were used to create a binary heavy quantity drinking outcome. Other drug use was assessed by asking respondents about use of a variety of medications and other drugs without a doctor's prescription. Respondents were asked about use of medications in the last 12 months that were *not* prescribed to them by a doctor or that were used in a manner not intended by the prescribing clinician (e.g. more often than prescribed, longer than prescribed, or for a reason other than prescribed, such as to get high). Drugs included marijuana, cocaine or crack, heroin, hallucinogens [e.g. lysergic acid

diethylamide (LSD), mescaline, ecstasy/3,4 methylenedioxymethamphetamine (MDMA)], inhalants, tranquilizers or anti-anxiety medications (e.g. Valium[®], Librium[®], Xanax[®]); opioid medications (e.g. codeine, Darvon[®], Percodan[®], OxyContin[®], Dilaudid[®], Demerol[®]); sedative medications (e.g. sleeping pills, barbiturates, Seconal[®], Quaaludes[®]) and stimulant medications (e.g. Ritalin[®], Preludin[®], Benzedrine[®]). A more extensive list of specific prescription medications and other drugs asked about in the interview is available elsewhere [41]. Responses indicating use at least once in the past year were used to create binary outcomes for (i) heavy drinking, (ii) marijuana use and (iii) drug use of at least one of the other eight drugs.

DSM-IV substance dependence

DSM-IV substance dependence was based on DSM-IV criteria from the AUDADIS-IV, which contains symptom questions used to operationalize DSM-IV dependence separately for 10 substances (alcohol, marijuana, cocaine, hallucinogens, inhalants, heroin, sedatives, tranquilizers, opioids and stimulants). A past-year dependence diagnosis was based on presence of at least three of the seven DSM-IV dependence criteria in the 12 months preceding the interview. Binary substance dependence outcomes were created for (i) alcohol, (ii) marijuana and (iii) other drugs which required that criteria be met for at least one of the other eight drugs. Reliability and validity of DSM-IV AUDADIS-IV substance use disorder diagnoses have been documented in numerous psychometric studies [43–53], with test–retest reliability ranging from good to excellent (0.70–0.91).

Data analysis

The NESARC design included stratification and clustering of the target population. In addition, sampling weights were computed for wave 2 respondents to offset unequal probabilities of selection, differential non-response and post-stratification adjustments. All analytical techniques in the current study were design-based, using sampling weights to calculate estimates of population parameters and specialized variance estimation techniques (e.g. Taylor series linearization) to accommodate the complex design features of the sample when estimating standard errors. To estimate the past-year prevalence of substance use and DSM-IV substance dependence based on sexual orientation, we estimated weighted proportions of each dimension-specific subgroup for (i) each individual alcohol and other drug use variable (e.g. heavy quantity drinking) and (ii) substance dependence for alcohol, marijuana and other drugs in the past 12 months. Design-based estimates of standard errors for the estimated proportions were computed

using Taylor series linearization, allowing for the calculation of 95% confidence intervals (CI) for the proportions. To assess whether sexual orientation was associated significantly with the substance use outcomes, multivariate analyses were conducted. Initial bivariate analyses used design-based Rao–Scott χ^2 tests to examine the associations of each of the three dimensions of sexual orientation and demographic and other background factors with the substance use outcomes. Following the recommendations of Hosmer & Lemeshow [54], demographic and other background variables that had relationships with the outcomes approaching significance ($P < 0.25$) were included as covariates in design-based logistic regression models. These models assessed the relationships between sexual orientation and the substance use outcome variables after adjusting for other relevant factors (i.e. race, age, educational level, personal income, employment status, relationship status, health insurance status, geographical location, metropolitan statistical area, age of alcohol onset and family history of alcohol or other drug problems). A series of additional logistic regression analyses were performed using data from both women and men to test for interactions between gender and sexual orientation in the models for the substance use outcomes. Because the interactions were statistically significant in analyses of each of the three sexual orientation dimensions, subsequent analyses were conducted separately by gender. Methods appropriate for subclass analyses [55] were used in analyses restricted to specific subgroups (e.g. males). All analyses were performed using the SUDAAN statistical software package (version 9.0.1).

RESULTS

Approximately 2% of the population identified as lesbian, gay or bisexual; 6% reported same-sex sexual attraction; and 4% reported at least one life-time same-sex sexual partner. Table 1 summarizes the distribution of sexual orientation dimensions separately for women and men.

Women's prevalence and odds ratios (ORs) for substance use and DSM-IV substance dependence

Table 2 presents weighted prevalence estimates of past-year substance use and substance dependence among women based on sexual identity, sexual attraction and sexual behavior. Table 3 presents the adjusted ORs from 18 separate logistic regression models for substance use and substance dependence across the three sexual orientation dimensions, after controlling for other demographic and background factors. Lesbian women had odds of substance use or substance dependence that were

Table 1 Estimated sexual orientation distributions in the US adult population, based on data from the National Epidemiologic Survey on Alcohol and Related Conditions (wave 2, 2004–05).

Sexual orientation measures	Women		Men	
	% (SE) ^a	Sample size ^b	% (SE) ^a	Sample size ^b
Sexual identity				
Lesbian/gay	0.7% (0.1)	145	1.1% (0.1)	190
Bisexual	0.8% (0.1)	161	0.4% (0.1)	81
Not sure	0.5% (0.1)	101	0.4% (0.1)	69
Heterosexual	98.0% (0.1)	19 489	98.1% (0.2)	14 109
Sexual attraction				
Only females	1.3% (0.1)	275	95.7% (0.2)	13 704
Mostly females	0.4% (0.1)	87	1.7% (0.1)	277
Equally males and females	1.3% (0.1)	260	0.7% (0.1)	130
Mostly males	4.2% (0.2)	880	0.5% (0.1)	96
Only males	92.8% (0.3)	18 358	1.4% (0.1)	229
Sexual behavior				
Only females	0.9% (0.1)	177	94.2% (0.3)	13 534
Both males and females	2.0% (0.1)	445	1.7% (0.1)	302
Never had sex	2.1% (0.2)	334	1.9% (0.2)	249
Only males	95.0% (0.2)	18 904	2.2% (0.2)	342

^aBased on weighted data. ^bBased on unweighted data. SE: standard error.

Table 2 Women: weighted prevalence estimates of past-year substance use and substance use disorders by sexual identity, sexual attraction and sexual behavior.

Sexual orientation measures	Past-year heavy quantity drinking % (SE)	Past-year marijuana use % (SE)	Past-year other drug use ^a % (SE)	Past-year alcohol dependence % (SE)	Past-year marijuana dependence % (SE)	Past-year other drug dependence ^b % (SE)
Sexual identity						
Lesbian	20.1 (4.7)	16.7 (4.3)	12.6 (4.4)	13.3 (4.3)	2.8 (2.0)	5.7 (4.0)
Bisexual	25.0 (4.5)	22.2 (4.0)	14.1 (3.0)	15.6 (3.7)	1.4 (1.4)	3.0 (1.7)
Not sure	14.0 (4.1)	9.0 (3.7)	8.2 (4.3)	2.1 (1.6)	0.8 (0.8)	0.0 (0.0)
Heterosexual	8.4 (0.3)	2.6 (0.2)	3.1 (0.2)	2.5 (0.2)	0.2 (0.1)	0.4 (0.1)
Sexual attraction						
Only females	14.8 (2.8)	4.8 (1.5)	2.8 (1.4)	5.1 (1.7)	1.1 (0.8)	1.0 (1.0)
Mostly females	16.2 (6.5)	19.9 (6.1)	15.0 (6.1)	15.5 (6.2)	2.0 (2.0)	6.1 (5.7)
Equally males and females	8.7 (1.9)	6.5 (1.5)	6.9 (2.1)	5.1 (1.5)	0.3 (0.3)	0.8 (0.8)
Mostly males	14.1 (1.6)	11.5 (1.6)	6.5 (1.0)	6.8 (1.3)	1.2 (0.7)	0.9 (0.4)
Only males	8.3 (0.3)	2.3 (0.2)	3.0 (0.2)	2.4 (0.1)	0.2 (0.1)	0.4 (0.1)
Sexual behavior						
Only females	15.5 (3.5)	4.3 (1.4)	1.2 (0.7)	4.0 (1.5)	0.4 (0.4)	0.0 (0.0)
Both males and females	24.5 (2.6)	22.7 (2.5)	16.8 (2.3)	12.6 (2.3)	2.0 (0.9)	2.0 (1.0)
Never had sex	7.1 (1.8)	0.3 (0.2)	2.4 (1.3)	2.3 (1.3)	0.0 (0.0)	0.6 (0.6)
Only males	8.3 (0.3)	2.5 (0.2)	3.0 (0.2)	2.5 (0.2)	0.2 (0.1)	0.4 (0.1)

^aOther drug use included non-medical use of at least one of the following drugs: sedative medication, tranquilizer medication, opioid medication, stimulant medication, cocaine, hallucinogens, inhalants or heroin. ^bOther drug dependence required that the DSM-IV dependence criteria be met for at least one of the following drugs: non-medical use of sedative medication, tranquilizer medication, opioid medication, stimulant medication, cocaine, hallucinogens, inhalants or heroin. SE: standard error.

significantly greater than the odds for heterosexual women for all outcomes except heavy quantity drinking (OR range: 3.2 for other drug use to 12.4 for other drug dependence). Bisexual identity was associated with sig-

nificantly greater odds than heterosexual identity for all substance use outcomes except past-year marijuana and other drug dependence (OR range: 1.6 for heavy quantity drinking to 3.6 for marijuana use). Odds of marijuana

Table 3 Women: estimated relationships of sexual identity, sexual attraction and sexual behavior with the odds of past-year substance use and substance use disorders based on multiple logistic regression analyses.

	Past-year heavy quantity drinking	Past-year marijuana use	Past-year other drug use ^a	Past-year alcohol dependence	Past-year marijuana dependence	Past-year other drug dependence ^b
Sexual orientation measures	Adjusted OR (95% CI) ^c	Adjusted OR (95% CI) ^c	Adjusted OR (95% CI) ^c	Adjusted OR (95% CI) ^c	Adjusted OR (95% CI) ^c	Adjusted OR (95% CI) ^c
Sexual identity						
Lesbian	1.6 (0.9–2.9)	5.2 (2.6–10.4)***	3.2 (1.4–7.2)**	3.6 (1.8–7.3)***	11.3 (1.7–75.9)*	12.4 (2.9–54.1)**
Bisexual	1.6 (1.0–2.6)*	3.6 (2.1–6.2)***	2.2 (1.2–3.9)**	2.9 (1.6–5.5)**	1.1 (0.1–16.3)	2.1 (0.4–12.1)
Not sure	1.8 (0.9–3.9)	3.4 (1.4–8.4)**	2.6 (0.8–8.3)	0.7 (0.1–3.7)	3.2 (0.4–24.8)	NA
Heterosexual	Referent	Referent	Referent	Referent	Referent	Referent
Sexual attraction						
Only females	1.8 (1.1–2.9)*	2.0 (1.0–4.1)*	0.9 (0.4–2.3)	2.0 (1.0–4.1)	7.2 (1.3–40.0)*	2.3 (0.5–10.2)
Mostly females	1.6 (0.6–4.2)	9.8 (4.1–23.5)***	4.8 (1.8–12.8)**	6.2 (2.8–13.6)***	7.8 (0.3–21.3)	17.6 (3.0–104)**
Equally males and females	1.0 (0.6–1.8)	2.3 (1.2–4.5)*	2.3 (1.1–4.7)*	2.0 (1.1–3.9)*	1.0 (0.1–12.6)	1.7 (0.2–13.7)
Mostly males	1.6 (1.2–2.1)**	4.6 (3.3–6.5)***	1.8 (1.3–2.5)**	2.3 (1.5–3.6)***	5.0 (1.1–21.9)*	1.4 (0.5–4.5)
Only males	Referent	Referent	Referent	Referent	Referent	Referent
Sexual behavior						
Only females	1.7 (0.9–3.4)	1.4 (0.6–3.3)	0.4 (0.1–1.4)	1.3 (0.5–3.1)	2.8 (0.3–26.1)	NA
Both males and females	1.8 (1.3–2.4)***	5.1 (3.5–7.5)***	3.4 (2.3–5.0)***	2.7 (1.7–4.1)***	2.9 (0.8–10.7)	1.4 (0.4–4.8)
Never had sex	0.4 (0.2–0.7)**	<0.1 (0.0–0.2)***	0.5 (0.2–1.6)	0.4 (0.1–1.4)	NA	0.5 (0.1–4.5)
Only males	Referent	Referent	Referent	Referent	Referent	Referent

Referent indicates reference group. ^aOther drug use included non-medical use of at least one of the following drugs: sedative medication, tranquilizer medication, opioid medication, stimulant medication, cocaine, hallucinogens, inhalants or heroin. ^bOther drug dependence required that the DSM-IV dependence criteria be met for at least one of the following drugs: non-medical use of sedative medication, tranquilizer medication, opioid medication, stimulant medication, cocaine, hallucinogens, inhalants or heroin. ^cAOR: odds ratios adjusted for race, age, educational level, personal income, employment status, relationship status, health insurance status, geographic location, metropolitan statistical area, age at alcohol onset and family history of alcohol or other drug problems; the results for these variables are not shown. Design-based Wald F statistic for sexual identity/attraction/behavior factor: *P < 0.05, **P < 0.01, ***P < 0.001. NA: no variance in outcome variable for this group; OR: odds ratio; CI: confidence interval.

use were significantly greater for women who were 'not sure' about their sexual identity, relative to the heterosexual identity group.

Women who were sexually attracted mostly to males had significantly greater odds than those attracted to only males on all outcome measures except other drug dependence [adjusted odds ratio (AOR) range: 1.6 for heavy quantity drinking to 5.0 for marijuana dependence]. Women attracted equally to males and females had higher odds of reporting past-year marijuana use, other drug use and alcohol dependence than those attracted only to males. In addition, women attracted mostly to females had greater odds of reporting marijuana use, other drug use, alcohol dependence and other drug dependence. Women attracted only to females had greater odds than those attracted only to males of heavy drinking, marijuana use and marijuana dependence.

Women who reported a history of both male and female sexual partners had significantly greater odds of all substance use and dependence outcomes than women whose sex partners were only males, except marijuana and other drug dependence (OR range: 1.8 for heavy quantity drinking to 5.1 for marijuana use). However, women whose life-time sex partners were only female *did not differ* from women with only life-time male sexual partners. Women who reported no life-time sex partners

had significantly lower odds of past-year heavy quantity drinking and marijuana use than did behaviorally heterosexual women.

Men's prevalence and ORs for substance use and DSM-IV substance dependence

Table 4 summarizes weighted prevalence rates of past-year substance use and substance dependence among men based on the three sexual orientation dimensions. Table 5 presents the adjusted ORs based on 18 separate logistic regression models for substance use results across the three sexual orientation measures, controlling for other demographic and background factors. With the exception of heavy drinking and marijuana dependence, men who identified as gay had higher odds of each of the substance use outcomes than did men identifying as heterosexual (AOR range: 2.9 for alcohol dependence to 4.4 for marijuana use). Bisexual men had odds more than four times greater than heterosexual men of reporting other drug use (95% CI, 2.1–8.8), alcohol dependence (95% CI, 2.2–8.2) and other drug dependence (95% CI, 1.5–26.8). Odds of both marijuana use and marijuana dependence for the 'not sure' group were greater than for heterosexual men.

With the exception of heavy drinking and alcohol dependence, men attracted mostly to females had higher

Table 4 Men: weighted prevalence estimates of past-year substance use and substance use disorders by sexual identity, sexual attraction and sexual behavior.

Sexual orientation measures	Past-year heavy quantity drinking % (SE)	Past-year marijuana use % (SE)	Past-year other drug use ^a % (SE)	Past-year alcohol dependence % (SE)	Past-year marijuana dependence % (SE)	Past-year other drug dependence ^b % (SE)
Sexual identity						
Gay	18.1 (4.0)	25.2 (4.3)	16.8 (4.2)	16.8 (3.5)	0.6 (0.6)	3.2 (1.8)
Bisexual	16.4 (4.6)	13.2 (5.1)	17.7 (5.1)	19.5 (5.4)	1.1 (1.0)	5.1 (3.0)
Not sure	9.4 (3.7)	19.0 (6.6)	5.2 (3.6)	4.8 (2.0)	7.0 (4.9)	0.0 (0.0)
Heterosexual	13.7 (0.4)	6.2 (0.3)	4.5 (0.2)	6.1 (0.3)	0.5 (0.1)	0.5 (0.1)
Sexual attraction						
Only males	8.4 (2.8)	15.8 (3.3)	10.2 (3.1)	9.4 (2.5)	0.1 (0.1)	1.4 (0.9)
Mostly males	20.6 (5.1)	15.7 (4.1)	9.8 (3.3)	11.3 (3.8)	1.2 (1.2)	2.6 (1.7)
Equally females and males	7.3 (2.5)	7.0 (2.8)	4.0 (2.5)	7.6 (2.9)	0.7 (0.7)	0.0 (0.0)
Mostly females	11.6 (2.2)	11.5 (2.7)	8.9 (1.9)	6.3 (1.6)	2.7 (1.4)	2.0 (0.9)
Only females	13.9 (0.4)	6.2 (0.3)	4.5 (0.2)	6.2 (0.3)	0.5 (0.1)	0.5 (0.1)
Sexual behavior						
Only males	11.3 (2.2)	8.1 (1.8)	5.7 (1.8)	7.0 (1.7)	0.3 (0.3)	1.4 (0.7)
Both females and males	16.2 (2.6)	20.1 (3.0)	14.1 (2.7)	13.3 (2.3)	1.2 (0.7)	1.9 (0.9)
Never had sex	7.6 (2.1)	4.4 (1.9)	3.4 (1.2)	4.7 (1.5)	2.6 (1.5)	0.8 (0.6)
Only females	14.0 (0.4)	6.3 (0.3)	4.5 (0.2)	6.2 (0.3)	0.5 (0.1)	0.5 (0.1)

^aOther drug use included non-medical use of at least one of the following drugs: sedative medication, tranquilizer medication, opioid medication, stimulant medication, cocaine, hallucinogens, inhalants or heroin. ^bOther drug dependence required that the DSM-IV dependence criteria be met for at least one of the following drugs: non-medical use of sedative medication, tranquilizer medication, opioid medication, stimulant medication, cocaine, hallucinogens, inhalants or heroin. SE: standard error.

Table 5 Men: estimated relationships of sexual identity, sexual attraction and sexual behavior with the odds of past-year substance use and substance use disorders based on multiple logistic regression analyses.

Sexual orientation measures	Past-year heavy quantity drinking	Past-year marijuana use	Past-year other drug use ^a	Past-year alcohol dependence	Past-year marijuana dependence	Past-year other drug dependence ^b
	Adjusted OR (95% CI) ^c	Adjusted OR (95% CI) ^c	Adjusted OR (95% CI) ^c	Adjusted OR (95% CI) ^c	Adjusted OR (95% CI) ^c	Adjusted OR (95% CI) ^c
Sexual identity						
Gay	1.1 (0.7–1.9)	4.4 (2.6–7.5) ^{***}	3.5 (1.9–6.5) ^{***}	2.9 (1.7–5.1) ^{***}	0.7 (0.1–7.6)	4.2 (1.3–14.1) [*]
Bisexual	1.6 (0.7–3.4)	2.0 (0.8–5.3)	4.3 (2.1–8.8) ^{***}	4.2 (2.2–8.2) ^{***}	1.3 (0.1–17.5)	6.3 (1.5–26.8) [*]
Not sure	0.6 (0.3–1.5)	3.4 (1.5–7.9) ^{**}	0.9 (0.2–3.4)	0.6 (0.2–1.7)	17.0 (2.9–101) ^{**}	NA
Heterosexual	Referent	Referent	Referent	Referent	Referent	Referent
Sexual attraction						
Only males	0.6 (0.3–1.1)	3.5 (2.1–5.9) ^{***}	2.8 (1.4–5.5) ^{**}	1.8 (1.0–3.3) [*]	0.3 (0.1–2.2)	2.5 (0.7–9.2)
Mostly males	1.7 (0.9–3.2)	2.4 (1.2–4.8) [*]	1.9 (0.8–4.3)	1.7 (0.7–4.2)	1.7 (0.1–21.8)	3.3 (0.6–17.2)
Equally females and males	0.7 (0.3–1.6)	1.4 (0.6–3.1)	1.0 (0.3–3.3)	1.5 (0.7–3.4)	1.9 (0.2–17.4)	NA
Mostly females	1.1 (0.6–1.8)	2.3 (1.3–4.1) ^{**}	2.3 (1.5–3.6) ^{***}	1.1 (0.6–2.0)	5.5 (1.4–21.4) [*]	3.1 (1.1–8.3) [*]
Only females	Referent	Referent	Referent	Referent	Referent	Referent
Sexual behavior						
Only males	0.8 (0.5–1.3)	1.3 (0.8–2.3)	1.1 (0.5–2.3)	1.2 (0.7–2.1)	0.4 (0.1–3.6)	2.1 (0.6–6.9)
Both females and males	1.1 (0.7–1.7)	3.2 (2.0–5.1) ^{***}	2.6 (1.6–4.2) ^{***}	1.9 (1.1–3.1) [*]	1.5 (0.3–7.5)	1.8 (0.6–5.3)
Never had sex	0.2 (0.1–0.4) ^{***}	0.3 (0.1–0.8) [*]	0.3 (0.2–0.7) ^{**}	0.4 (0.2–0.9) [*]	3.2 (1.0–10.5)	0.8 (0.2–3.9)
Only females	Referent	Referent	Referent	Referent	Referent	Referent

Referent indicates reference group. ^aOther drug use included non-medical use of at least one of the following drugs: sedative medication, tranquilizer medication, opioid medication, stimulant medication, cocaine, hallucinogens, inhalants or heroin. ^bOther drug dependence required that the DSM-IV dependence criteria be met for at least one of the following drugs: non-medical use of sedative medication, tranquilizer medication, opioid medication, stimulant medication, cocaine, hallucinogens, inhalants or heroin. ^cAOR: odds ratios adjusted for race, age, educational level, personal income, employment status, relationship status, health insurance status, geographic location, metropolitan statistical area, age at alcohol onset and family history of alcohol or other drug problems; the results for these variables are not shown. Design-based Wald F statistic for sexual identity/attraction/behavior factor: ^{*}P < 0.05, ^{**}P < 0.01, ^{***}P < 0.001. NA: no variance in outcome variable for this group; OR: odds ratio; CI: confidence interval.

odds of each of the substance use and dependence outcomes than those attracted only to females (AOR range: 2.3 for marijuana use to 5.5 for marijuana dependence). In contrast, no significant differences in substance use or substance dependence were found between men attracted equally to males and females and those attracted only to females. Men attracted mostly to males had higher odds of reporting past-year marijuana use than those attracted to only females, but did not differ on any other outcome variables. Men attracted only to males had higher odds of reporting marijuana use (95% CI, 2.1–5.9), other drug use (95% CI, 1.4–5.5) and alcohol dependence (95% CI, 1.0–3.3) than those attracted only to females.

The odds of substance use and substance dependence for men with histories of only male sex partners *did not differ* from those who reported only female sex partners. Compared with men who reported only female sex partners, those with histories of both male and female sex partners had greater odds of past-year marijuana use (AOR, 3.2; 95% CI, 2.0–5.1), other drug use (AOR, 2.6; 95% CI, 1.6–4.2) and alcohol dependence (AOR, 1.9; 95% CI, 1.1–3.1). Men who had never been sexually active had lower odds than those with only female sex partners for all outcomes except past-year marijuana and other drug dependence.

As noted previously, we conducted a series of additional logistic regression analyses using data from both women and men to test for gender interactions to determine whether the effects of sexual orientation on the substance use outcomes were moderated by gender. We found that sexual minority effects on substance use and substance dependence were consistently larger for women than for men, and these differences were found across all three dimensions. Finally, when comparing AORs for substance use and substance dependence across the sexual orientation dimensions, women and men who identified as lesbian or gay generally had greater odds of substance use and substance dependence than when minority sexual orientation was defined by same-sex attraction or behavior. Similar patterns of greater odds of substance use outcomes based on sexual identity were also found, albeit to a lesser degree, for bisexual women and men.

DISCUSSION

This is the first national study to assess the prevalence of substance use and substance dependence across all three dimensions of sexual orientation in the United States. Results reinforce the importance of considering multiple measures of sexual orientation and of analyzing data separately by gender and sexual minority subgroup when assessing risk for substance use and substance depen-

dence. Among the most notable findings was that past-year prevalence rates for substance use and substance dependence varied little across the three sexual orientation dimensions for respondents who were exclusively heterosexually oriented (whether sexual orientation was defined by identity, attraction or behavior), but varied substantially among sexual minority women and men across the three sexual orientation dimensions. For example, 13.3% of women who identified as lesbian, 5.1% who reported attraction only to women and 4.0% who had only female sex partners met criteria for past-year alcohol dependence. These findings emphasize the importance of sexual orientation measurement in both research and practice.

We found that the effects of sexual minority status on substance use and substance dependence were consistently larger for women than for men across all three dimensions. This is due probably, in part, to the higher base rates of substance use and substance dependence among men in the general population [1,56]. Further, unlike findings from general population studies in which rates of substance use and substance dependence are typically higher among men, in this study rates of substance use and substance dependence for sexual minority women not only exceeded those of heterosexual women, but in some cases also exceeded those of sexual minority men. For example, 25% of bisexual women reported heavy drinking—the highest rate of any group of women *or* men across all three sexual orientation dimensions. Non-conformity to traditional female roles may help explain the heightened risk of sexual minority women [15] relative to sexual minority men. In addition, the drinking and drug use of sexual minority women may be related to stress associated with multiple minority statuses and multiple forms of discrimination [57–59].

The findings of greater odds of substance use and substance dependence among women and men who identified as lesbian/gay or bisexual relative to differences based on gender of sexual partners extend previous work [5] which concluded that sexual identity may be more important than sexual behavior in predicting alcohol abuse and dependence. Sexual minority women and men who 'identify' as lesbian/gay or bisexual may have greater exposure to discrimination and other forms of minority stress than those who engage in same-sex behavior or attraction, but do not identify as a sexual minority person. Of interest is that findings of greater odds of substance use outcomes based on sexual identity (relative to sexual attraction and behavior) were less prominent among women and men who identified as bisexual than those who identified as lesbian/gay. Lesbians and gay men are believed to be more likely than bisexual women and men to disclose their sexual orientation in a variety of social contexts [60], and

thus may have greater exposure to discrimination and other forms of sexual-orientation bias. Clearly, more research is needed to understand more clearly variations in risk within sexual minority population groups.

Previous studies have found that bisexual women and men (whether defined based on identity, attraction or sexual behavior) generally report higher rates of substance use and poorer mental health outcomes than their heterosexual counterparts and, in some cases, than their lesbian/gay counterparts [9,22,25,27,30,32,33,35,36,61]. For example, Wilsnack and colleagues [9] found that women who identified as bisexual reported higher rates of hazardous drinking than women who identified as exclusively lesbian or mostly lesbian. Consistent with previous research, we found that respondents who identified as lesbian/gay or bisexual and those who reported same-sex attraction generally had higher odds of substance use and substance dependence than their heterosexual counterparts; this was especially true for women. Although there was a clear trend toward greater risk for substance use and substance dependence among women and men based on bisexual behavior, we found no greater risk among those who reported only same-sex partners. These results suggest that bisexual behavior rather than homosexual behavior is associated most strongly with heightened risk for substance dependence.

The findings from this study highlight the importance of careful assessment of sexual orientation. Understanding the relative risk of substance use and substance dependence among sexual minority women and men may facilitate the development of more effective prevention and intervention strategies.

Strengths, limitations and implications for future practice and research

Findings from this study build upon previous research that has examined associations between sexual orientation and substance dependence. Strengths of the study include the largest nationally representative sample of sexual minorities to date, multiple measures of sexual orientation and detailed information on substance use and DSM-IV substance dependence.

Our analyses included multiple comparisons across the three major sexual orientation dimensions in separate analyses for men and women. However, given the smaller sample sizes of some of the subgroups, standard errors associated with some of the comparisons were relatively large. To adjust for the multiple comparisons, a conservative Bonferroni-type correction (results not shown) was examined for each gender. The same pattern of results was observed.

Analyses of the overlap between sexual orientation dimensions (available upon request) indicated that the

three dimensions are correlated but are not entirely redundant. For example, among women equally attracted to both sexes, only 30% identified as bisexual, 59% as heterosexual and 1% as lesbian (10% were unsure). Among men who were attracted to both sexes equally, only 34% identified as bisexual, 51% as heterosexual and 4% as gay (12% were unsure). Although the lack of redundancy reinforces the decision to consider the three sexual orientation dimensions as distinct constructs in this descriptive study, future research should consider how different dimensions of sexual orientation operate together or independently of one another to enhance or reduce risk for substance dependence.

A notable limitation of the study was the use of different time-frames in assessment of the three sexual orientation dimensions. The sexual behavior question asked about sexual partners over the respondent's life-time, whereas questions about sexual identity and sexual attraction did not specify a time-frame. Different time-frames in assessments of sexual orientation are believed to account for variation in estimates of prevalence of sexual minorities [62], and may explain variations in prevalence rates of substance use outcomes reported for sexual minorities. In particular, previous population-based studies in the United States have found mixed results in past-year rates of alcohol and drug dependence based on sexual behavior [4,5,31]. These inconsistencies are probably due to the fact that some studies used the past 5 years [5,31] while others used the past 12 months [4] in assessments of sexual behavior. The time-frame used in assessing sexual orientation and related health risks is also important because sexual orientation is not static and may change over time, especially in women [62–65]. Furthermore, assessment of life-time sexual behavior did not specify the number of sexual partners, nor did it differentiate between consensual and forced sex—a factor that may have been particularly important.

In conclusion, the results of this exploratory study provide compelling evidence of heightened risk for substance use and substance dependence among some sexual minority populations in the United States. Although this elevated risk is noteworthy and important, it should not obscure the fact that most sexual minorities neither engaged in substance use nor met the criteria for substance dependence. Future research should explore whether the associations between sexual orientation and substance dependence remain after controlling for other psychopathology, such as mood and anxiety disorders, and how such associations may vary in response to sexual orientation discrimination.

The findings highlight a critical health disparity among some sexual minority populations and illuminate the importance of considering sexual orientation when assessing the risk of substance dependence in health

research and in health-care settings. Based on the variation in risk for substance dependence across the sexual orientation dimensions, it is important that clinicians move beyond reliance upon single questions to assess sexual orientation and consider all three dimensions when conducting comprehensive clinical assessments for substance use disorders. Further, understanding health risks across sexual orientation dimensions, and how these risks differ by gender, is critical for developing prevention and intervention strategies that address the characteristics and needs of those who are most vulnerable. Prevention and intervention strategies will also be strengthened by research that examines individual and environmental characteristics associated with heightened risk of substance use disorders among sexual minorities.

Declarations of interest

None.

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