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Sexual-orientation differences in alcohol use trajectories and disorders in emerging adulthood: results from a longitudinal cohort study in the United States

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Abstract

Aims—We estimated sexual-orientation differences in alcohol use trajectories during emerging adulthood, and tested whether alcohol use trajectories mediated sexual-orientation differences in alcohol use disorders (AUDs).

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Declaration of interests

None.

Supporting Information

Additional Supporting Information may be found online in the supporting information tab for this article.

Design—Longitudinal self-reported survey data from the Growing Up Today Study.

Setting—United States.

Participants—A total of 12 493 participants aged 18–25 during the 2003, 2005, 2007 or 2010 surveys.

Measurements—Stratified by gender, longitudinal latent class analyses estimated alcohol use trajectories (using past-year frequency, quantity and binge drinking from 2003 to 2010). Multinomial logistic regression tested differences in trajectory class memberships by sexual orientation [comparing completely heterosexual (CH) participants with sexual-minority subgroups: mainly heterosexual (MH), bisexual (BI) and gay/lesbian (GL) participants]. Modified Poisson regression and mediation analyses tested whether trajectories explained sexual-orientation differences in AUDs (past-year DSM-IV abuse/dependence in 2010).

Findings—Six alcohol use trajectory classes emerged for women and five for men: these included heavy (23.5/36.9% of women/men), moderate (31.8/26.4% of women/men), escalation to moderately heavy (9.7/12.0% of women/men), light (17.0% for women only), legal (drinking onset at age 21; 11.1/15.7% of women/men) and non-drinkers (7.0/9.1% of women/men). Compared with CH women, MH and BI women had higher odds of being heavy, moderate, escalation to moderately heavy and light drinkers versus non-drinkers (odds ratios = 2.02–3.42; *P*-values < 0.01–0.04). Compared with CH men, MH men had higher odds of being heavy, moderate and legal drinkers versus non-drinkers (odds ratios = 2.24–3.34; *P*-values < 0.01–0.01). MH men and women, BI women and GLs had higher risk of AUDs in 2010 than their same-gender CH counterparts (risk ratios = 1.34–2.17; *P*-values < 0.01). Alcohol use trajectories mediated sexual-orientation differences in AUDs for MH and GL women (proportion of effect mediated = 30.8–31.1%; P-values < 0.01–0.02), but not for men.

Conclusions—In the United States, throughout emerging adulthood, several sexual-minority subgroups appear to have higher odds of belonging to heavier alcohol use trajectories than completely heterosexuals. These differences partially explained the higher risk of alcohol use disorders among mainly heterosexual and gay/lesbian women but not among sexual-minority men.

Keywords

Alcohol use disorder; alcohol use trajectories; cohort study; emerging adulthood; longitudinal latent class analysis; sexual orientation

INTRODUCTION

Alcohol use and binge drinking (i.e. consuming at least four drinks for women or five drinks for men on one occasion [1]) in the United States is highest during the emerging adulthood period (i.e. ages 18–25) [2–4]. Nevertheless, emerging adults have diverse alcohol use trajectories (AUTs). This diversity is often characterized using statistical approaches well-suited for identifying homogeneous subgroups of AUTs [5–7]. A recent review of longitudinal alcohol use throughout emerging adulthood found common trajectories, such as consistently heavy drinkers, escalation drinkers and non-drinkers [8]. Importantly, consistently heavy or escalating AUTs place emerging adults at greater risk for acquiring

alcohol use disorders- [9–12], which are associated with morbidity, mortality and economic burden [13,14].

Alcohol use behaviors are not equal across all populations of emerging adults. For example, some sexual-minority subgroups (e.g. gay/lesbian, bisexual and those who describe their sexual orientation as 'mostly heterosexual') have higher alcohol use than their completely heterosexual peers, according to both cross-sectional [15–20] and longitudinal [21–26] research. Sexual-minority women are at greater risk of alcohol use and binge drinking than completely heterosexual women [15–24]. Contrastingly, findings among men are mixed: most studies found no sexual-orientation differences in the prevalence of alcohol use or binge drinking [15–18,21,22,26]; some studies found a higher prevalence of drinking and binge drinking for sexual-minority versus heterosexual men [20,22,23,26,27], while others found a lower prevalence of heavy drinking among sexual-minority men [15,18,19]. However, there is little information about how sexual orientation is related to membership in different AUT groups throughout emerging adulthood, which is a focus of the current study. Understanding sexual-orientation differences in AUTs throughout emerging adulthood can inform the need for and design of future alcohol use interventions, a sentiment echoed by researchers and the Institute of Medicine [28,29].

Sexual-minority adults are also at higher risk than heterosexual adults for having alcohol use disorders (AUDs; i.e. abuse or dependence) [30–32]. Scant research suggests that this is also true during emerging adulthood [33], when people in the United States are at greatest risk for AUDs [34]. Generally, the development of AUDs is associated positively with earlier or concurrent high AUTs [8,35,36]; therefore, sexual-orientation differences in AUTs may partially explain sexual-orientation differences in subsequent AUDs. Support for this hypothesis would suggest that interventions reducing sexual-orientation differences in AUTs may also decrease differences in AUDs. Additionally, theory and prior literature suggest that minority stressors and social stigma related to minority sexual orientations are contributors to elevated alcohol use and AUDs among sexual-minority populations [30,37–48].

This paper addressed gaps in knowledge about how sexual orientation is related to AUTs and AUDs using data from a prospective cohort study. First, we estimated longitudinal AUTs during the emerging adulthood period. Secondly, we tested for sexual-orientation differences in AUT memberships. Thirdly, we estimated sexual-orientation disparities in AUDs in late emerging adulthood and tested whether longitudinal AUTs throughout emerging adulthood mediated these disparities in AUDs. The results of this study can help to identify sexual-orientation subgroups at risk for having heavy AUTs and AUDs and can inform public health strategies aimed at reducing sexual-orientation disparities in AUTs and AUDs.

METHODS

Study design and population

We analysed data from participants in the Growing Up Today Study (GUTS), which began in 1996. GUTS initially enrolled 16 875 participants aged 9–14 years who were children of women participating in the Nurses' Health Study II (NHS2)—a cohort study of 116 430 registered nurses from 14 US states begun in 1989. The GUTS sample is similar in racial/

ethnic distribution as the NHS2 (93.4 and 93.8% non-Hispanic White, respectively). Additional information about GUTS is reported elsewhere [24,49]. The Brigham and Women's Hospital Institutional Review Board approved original study procedures.

The current study included participants who were aged 18–25 years when they responded to at least one alcohol use item during the 2003, 2005, 2007 or 2010 survey waves, and who provided information on sexual orientation and did not select 'unsure' for their sexual orientation (11 participants were missing or 'unsure' of their sexual orientation). We selected these waves because they assessed alcohol use and contained the age range focus on in this analysis. Our analytical sample included 12 493 participants (7465 women; 5027 men), representing 74.0% of the cohort. Compared to cohort participants excluded from our analyses, participants in our analytical sample were: more likely to be female (59.8 versus 35.8%, respectively; $P < 0.001$); more likely to live in the western region of the United States at baseline (14.7 versus 11.5%, respectively; $P < 0.001$); more likely to have a mother who reported her household income as ≥ $100 000 in year 2001 (33.2 versus 27.4%, respectively); and less likely to have a mother who did not report her household income in 2001 (18.9 versus 29.1%, respectively; $P < 0.001$). Participants included versus excluded in our analytical sample did not differ by age at baseline ($P = 0.094$), their own race/ethnicity ($P = 0.838$) or their mother's race/ethnicity ($P = 0.5459$).

Participants' mean age in our analytical sample was 18.8 years in 2003 and 25.2 years in 2010. Among participants in our analytical sample, 84.2% responded to the 2003 survey, 83.3% in 2005, 78.1% in 2007 and 68.2% in 2010. Overall, 53.3% responded to all four waves, 19.7% responded to three waves, 14.6% responded to two waves and 12.5% responded to one wave. A higher number of completed surveys was associated with being female ($P < 0.0001$), younger age at baseline ($P < 0.0001$), living in the western region of the United States at baseline ($P < 0.0001$), having a mother who reported her household income as ≥ $100 000 in 2001 ($P < 0.0001$) and with having a minority sexual orientation (for most subgroups, see Table 1)—but was not associated with participant's race/ethnicity ($P = 0.6762$) or mother's race/ethnicity ($P = 0.3943$).

Measures

Alcohol use—Three indicators assessed alcohol use in 2003, 2005, 2007 and 2010. These indicators were distributed non-normally, hence we modeled them as ordinal variables. We assessed past-year average frequency: 'On average, in the past year, how often did you drink beer, wine or liquor? don't drink; less than once a month; less than once a week; 1–2 days per week; 3–5 days per week; almost every day; or daily'. We combined daily and almost every day because of small cell sizes, and coded this variable from 0 ('don't drink') to 6 ('daily or almost every day'). We assessed past-year average quantity: 'When you drink alcohol, how much do you usually drink at one time? don't drink; less than 1; 1; 2; 3; 4; 5; or 6 or more drinks'. We coded this variable from 0 ('don't drink') to 7 ('6 drinks'). We assessed past-year binge drinking: 'Over the past year, how many times did you drink four (for women) or five (for men) or more alcohol drinks over a few hours? none; 1; 2; 3–5; 6–8; 9–11; or 12 or more times'. We coded this from 0 ('none') to 6 ('12 or more times').

Alcohol use disorders—We measured criteria for probable AUD during the past 12 months for the first time in 2010, with items assessing symptoms based on the DSM-IV [50], adapted from the National Survey on Drug Use and Health [51]. The DSM-IV described two distinct disorders, alcohol abuse and alcohol dependence. If participants met criteria for alcohol abuse or dependence, we coded them as having a probable AUD, creating a single binary variable. We made this analytical decision based on prior research [30,40,52] and because the DSM-5 [53] integrates abuse and dependence into a single disorder. We conducted sensitivity analyses with the original DSM-IV categorizations, which yielded similar results (not shown) to the single binary AUD variable.

Sexual orientation—Sexual orientation was assessed at each survey wave included in this analysis. We classified participants' sexual orientation based on their last report. An adapted item [54] assessed sexual orientation: 'Which one of the following best describes your feelings?'. Completely heterosexual (attracted to people of the opposite sex); mostly heterosexual; bisexual (equally attracted to men and women); mostly homosexual; completely homosexual (attracted to persons of the same sex); or unsure'. Like prior research [24], we combined mostly and completely homosexual into a single group (henceforth gay/lesbian) to increase statistical power.

Covariates—Covariates included race/ethnicity (white versus non-white; measured at baseline), region of residence (West versus midwest, southwest and northeast; measured in 2010), mothers' household income (reported in the 2001 NHS2 survey), number of completed surveys from 2003 to 2010 and age (we used age in 2010 because this is when AUD was assessed). We assessed college attendance in 2010 using the adapted item [55]: 'What is the highest grade of school you have completed or the highest degree you have received?'. We dichotomized the response options into any college attendance versus none (i.e. high/trade/vocational school graduate or less). We prospectively assessed life-time pregnancy (yes/no) from 1999 to 2010 for women. We used the missing indicator method [56] for college attendance, pregnancy and mothers' household income, which creates an additional 'missing' category for each variable, allowing us to analyze all available data and preserve statistical power.

Analyses

We used a classify-analyze approach to characterize longitudinal AUT classes and estimate predictors and outcomes associated with these classes [7].

Alcohol use trajectory classes—We estimated AUTs using longitudinal latent class analyses in Mplus version 7.2 (Muthén & Muthén, Los Angeles, CA, USA), allowing for the estimation of subgroup populations who differ across multiple indicators of alcohol use over time. We estimated the unconditional model (i.e. no covariates) with the three ordinal alcohol use variables at each participant's age using a cohort-sequential design [57]. We used full information maximum likelihood estimation (to use all available observations [5,58]), the robust maximum likelihood estimator (to account for non-normality [59,60]) and the complex survey command (to account for non-independence of sibling clusters [58]).

We estimated the trajectory classes separately by gender because men drink higher quantities of alcohol on average than women [61,62]. We estimated 1–9-class solution models for women, and 1–7-class solution models for men. To determine the best-fitting number of classes, we examined several fit statistics, including the Bayesian information criterion (BIC), the Bayes factor (BF) and the correct model probability (cmP) [7,58,63,64]. We considered the best-fitting model to have the lowest BIC, BF > 10, the greatest cmP and highest interpretative validity [7,60,63]. We examined entropy and other classification qualities, i.e. average posterior probabilities (AvePP) and odds of correct classification (OCC) [7,65]. We considered good latent class separation and classification precision as classes that had AvePP > 0.7 and OCC > 5 [65]. We assigned participants to the class for which they had the highest posterior probability of membership.

Disparities in alcohol use trajectory class membership—Using SAS version 9.4 (SAS Institute, Cary, NC, USA), we used Rao–Scott χ^2 tests adjusting for sibling clusters to examine the bivariate associations of trajectory groups with sexual orientation and covariates. We fitted multinomial logistic regression models to test for sexual-orientation differences in trajectory class membership (polytomous variables), controlling for covariates, using generalized estimating equations (GEE) to account for sibling clusters. Reference groups were non-drinkers (versus other trajectory classes) and completely heterosexuals (versus sexual-minority subgroups).

Alcohol use disorders—Because AUD prevalence was greater than 10%, we fitted modified Poisson regression models using GEE [66]. First, we estimated sexual-orientation differences in AUDs, controlling for covariates. Secondly, we estimated the effects of sexual orientation and alcohol trajectory classes on AUD, controlling for covariates. Subsequently, we tested whether the AUT classes mediated sexual-orientation differences in AUDs using the publicly available %MEDIATE macro, which computes the mediation proportion (i.e. indirect effect) of exposure effects explained by the effect of the exposure on proposed mediator variable (i.e. AUTs) [67]. Using the difference method, the mediation proportion is calculated as $1 - \left(\frac{\beta}{\alpha}\right)$, where β is the coefficient of the exposure variable on the outcome variable when controlling for the proposed mediator, and α is the coefficient for the exposure variable on the outcome variable when not controlling for the proposed mediator [68].

RESULTS

Overall, 81.1% of women identified as completely heterosexual [CH], 15.0% as mostly heterosexual [MH], 2.3% as bisexual and 1.5% as lesbian (Table 1). Among men, 90.4% identified as CH, 6.0% as MH, 0.7% as bisexual and 2.9% as gay.

We selected the six-class model for women and the five-class model for men because these models met our selection criteria (i.e. thresholds for certain values), had agreement throughout the most fit statistics (Table 2) and had theoretical and meaningful interpretations. These classes had good separation and adequate assignment (all AvePP > 0.77 and OCC > 11).

Supporting information, Fig. S1 depicts the latent classes for women. Non-drinkers (7.0%) mostly abstained from drinking. Heavy drinkers (23.5%) used 1–2 days/week, consumed four to five drinks/occasion, and 55–80% of them engaged in monthly binge drinking. Moderate drinkers (31.8%) increased their frequency slightly from ages 18–21 to 1–2 days/week, and then plateaued until age 25. Their average quantity increased slightly from ages 18 to 19 at three drinks, and decreased to two drinks by age 25. Their binge drinking increased slightly from 18–21 to 6–8 times/year, and then plateaued until age 25. Legal drinkers (11.1%) abstained from alcohol use from ages 18–20, and nearly all of them drank alcohol from ages 21–25. Escalation to moderately- heavy drinkers (9.7%) abstained from drinking at age 18, and escalated to moderately heavy use by age 21, plateauing thereafter. Light drinkers (17.0%) consumed two drinks/occasion less than once a month and engaged in one binge drinking episode/year, on average, from ages 18 to 25.

Supporting information, Fig. S2 depicts the latent classes for men. Non-drinkers (9.1%) mostly abstained from drinking. Heavy drinkers (36.9%) consumed alcohol 1–2 days/week at age 18, which increased slightly to age 21, plateauing thereafter. Most heavy drinkers consumed six drinks/occasion at age 18, decreasing slightly from ages 19 to 25. Fifty per cent of heavy drinkers engaged in monthly binge drinking at age 18, and 75–95% engaged in monthly binge drinking from ages 19–25. Moderate drinkers (26.4%) increased their frequency slightly from ages 18–21 to 1–2 days/week and then plateaued until age 25. Their quantity was three to four drinks/occasion from ages 18 to 22, decreasing slightly thereafter. Their binge drinking remained consistent from ages 19 to 25 at approximately three to five binge drinking episodes/year. Legal drinkers (15.7%) largely abstained from alcohol use from ages 18 to 20, and nearly all drank from ages 21 to 25. Escalation to moderately heavy drinkers (12.0%) abstained from drinking at age 18, and escalated to moderately heavy use by age 20, plateauing thereafter.

Sexual orientation and covariates were associated with AUT classes (Table 3). For women, MH and bisexual participants had significantly higher odds [odds ratios (ORs) range = 2.02–3.42; *P*-values range < 0.0001–0.0351; Table 4] than CH participants of being heavy, moderate, escalation to moderately heavy and light drinkers versus non-drinkers. For men, MH participants had significantly higher odds (ORs range = 2.24–3.34; *P*-values range < 0.0001–0.0084) than CH participants of being heavy, moderate and legal drinkers versus non-drinkers. Gay men had 3.38 times the odds ($P = 0.0027$) of CH men of being moderate drinkers versus non-drinkers.

Among women, the prevalence of probable AUD was 17.2% (8.7% with abuse only and 8.5% with dependence). Sexual-minority subgroups were 2.00–2.17 times more likely (*P*-values < 0.0001) than CHs to meet criteria for probable AUD in 2010 (Table 5; multivariable model 1). Heavy, moderate and escalation to moderately heavy drinkers were more likely than non-drinkers to evidence AUD [risk ratios (RRs) range = 11.79–29.82; *P*-values < 0.0001; multivariable model 2]. AUT classes mediated differences in AUD for MH and lesbian women (mediated proportions range = 30.8–31.1%; *P*-values range < 0.0001–0.0180). After controlling for AUT classes, MH, bisexual, and lesbian women remained more likely than CH women to evidence AUD (RRs range: 1.71–1.85; *P*-values range < 0.0001–0.0013).

Among men, the prevalence of probable AUD was 28.0% (13.1% with abuse only and 14.9% with dependence). Compared with CH men, MH men were 1.34 times more likely (P = 0.0044), and gay men were 1.59 times more likely (P = 0.0001) to evidence AUD (Table 5; multivariable model 1). Heavy, moderate, legal and escalation to moderately heavy drinkers were more likely than non-drinkers to meet criteria for AUD (RRs range = 5.60–38.69; P-values range < 0.0001–0.0037; multivariable model 2). AUT classes did not mediate sexual-orientation differences in probable AUD for men. After controlling for AUTs, MH (RR = 1.40; P = 0.0002) and gay men (RR = 1.72; P < 0.0001) were more likely than CH men to meet criteria for AUD.

DISCUSSION

We found distinct AUT classes for women and men: this includes heavy, moderate, escalation to moderately heavy, legal, light (for women only) and non-drinkers. While our trajectories were similar to previous research [8], our study extended previous literature by simultaneously modeling three indicators of alcohol use for each year of the emerging adulthood period, providing rich longitudinal descriptions of alcohol use. Moderate and heavy drinkers comprised the largest classes for both men and women (55–63%), suggesting moderate to heavy alcohol use during emerging adulthood is normative. Chronic heavy and moderate alcohol use have myriad short- and long-term consequences, such as AUDs, reduced neurocognitive functioning, alcohol-impaired driving, high-risk sexual behaviors, cardiovascular diseases and cancers [20,69–81]. Non-drinkers were the smallest class. We also found a small class of legal drinkers which, to our knowledge, only emerged in a study conducted in Sweden [82]; this small AUT class may be related to minimum legal drinking age laws in the United States, which prohibit drinking before age 21.

We also found that several sexual-minority subgroups had greater odds of being in higher AUT classes than CHs, and these disparities were larger for women than men. Our longitudinal study extends prior research [15–26] by showing that certain sexual-minority subgroups have greater odds of having higher AUTs across emerging adulthood. This probably places sexual-minority emerging adults at greater risk than CHs for numerous alcohol-related problems [20,69–81]. Additionally, long-term problems may be heightened among sexual-minority populations because they begin drinking alcohol at earlier ages than CHs [24,43].

Several sexual-minority subgroups were at greater risk than CHs for probable AUDs. While AUDs are usually higher among sexual-minority adults [30–32], we corroborated the little research [33] quantifying sexual-orientation differences in AUDs during the emerging adulthood period. Furthermore, we added novel contributions by examining whether sexual-orientation differences in AUDs were mediated by longitudinal AUTs. We found longitudinal AUTs explained 30.8–31.1% of sexual-orientation disparities in AUDs for MH and lesbian women, but did not explain these associations for men. Therefore, decreasing sexual-minority populations' alcohol use may reduce some of the burden of AUDs in MH and lesbian women, but not among sexual-minority men.

Social ecological factors may be determinants of sexual-orientation disparities in AUTs and AUDs. Prior research shows that minority stress—internalized, interpersonal or structural stigma—may influence sexual-orientation disparities in alcohol use and disorders [30,37–48]. For example, sexual-minority populations face chronic and acute stressors because of their minority sexual orientation, which can lead to drinking as a coping mechanism [37]. Furthermore, sexual-minority stressors and cultural norms (e.g. gay bar attendance) may interact with alcohol use to place sexual-minority populations at greater risk for AUDs, as posited by differential vulnerability models of health [83,84]. This may be particularly relevant for the paradoxical finding among gay men, wherein they had a higher risk of probable AUD than CH men but in most circumstances did not have higher odds of heavier AUTs. Alternatively, sexual-minority populations may be more likely than CHs to report AUD symptoms because they are more likely to be in mental health treatment [85], thereby increasing their awareness about how alcohol negatively impacts their wellbeing.

Our study has limitations. GUTS participants were sampled non-probabilistically from the United States, were predominantly college-attending non-Hispanic white and were children of mothers who were NHS2 participants; our results may not generalize to more globally, racially, ethnically or socio-economically diverse populations. For example, AUD prevalence in our sample was slightly higher in our study than national US estimates in 2010 [86]. Additional research on this topic is needed with more diverse and representative samples. Attrition bias may be present if non-response was related differentially to sexual orientation, AUT classes or AUD; however, the extent of this bias is unknown. Despite using prospective cohort data, we cannot confirm causality or temporality. Additionally, sexual orientation was measured using each participant's last report of sexual identity/attraction; thus, our findings may not be generalizable to other operationalizations of sexual orientation (e.g. sexual behavior, sexual orientation trajectories). Some sexual-orientation subgroups were small, limiting statistical power. We also removed the few people who reported being 'unsure' of their sexual orientation (limiting our knowledge of this subgroup), and had few bisexual men in our study (limiting statistical power). GUTS measured past-year AUD for the first time in 2010 (precluding us from solely examining incident AUDs) using self-reported items (not clinical assessments) based on the DSM-IV criteria and not DSM-5, which slightly revised the definition of AUD [50,53]. There may be measurement error attributable to the classification of longitudinal latent classes. However, a sensitivity analysis comparing the results from classification-error corrected analyses (not shown) to our reported findings did not differ substantively. As such, we expect that classification error-corrected results of AUD analyses would be similar to our reported findings, even in the presence of minimal non-differential misclassification. We may have residual confounding, despite controlling for several covariates.

Our study extended the literature by investigating sexual-orientation differences in AUTs and AUDs in emerging adulthood. Our findings can inform future intervention and epidemiological studies. Given the sexual-orientation disparities in our study, sexual-minority emerging adults should be a priority target population for interventions aimed at reducing alcohol use and AUDs. However, scant intervention research aims to reduce alcohol use and disorders among sexual-minority populations [29]. Sexual-orientation disparities in AUDs were explained partially by AUTs for MH and lesbian women but not

for men, highlighting the need for research testing additional causal mechanisms that can serve as modifiable targets for interventions. Epidemiological and intervention research can help to understand and eliminate sexual-orientation disparities in AUTs and AUDs, thereby fostering health equity for sexual-minority populations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Characteristics of the sample by sexual orientation, stratified by gender: Growing Up Today Study, 2003–2010.

	Sexual orientation										
	Completely heterosexual		Mostly heterosexual			Bisexual			Gay/lesbian		
	n	(%)	n	(%)	P-value	n	(%)	P-value	n	(%)	P-value
Women											
Total, row percentage	6057	(81.1)	1121	(15.0)		174	(2.3)		113	(1.5)	
Race/ethnicity											
White	5691	(94.0)	1026	(91.5)	0.0065	156	(89.7)	0.0661	105	(92.9)	0.6707
Non-white	366	(6.0)	95	(8.5)		18	(10.3)		8	(7.1)	
Region											
West	898	(14.8)	247	(22.0)	<0.0001	31	(17.8)	0.2348	20	(17.7)	0.1907
Midwest	2039	(33.7)	296	(26.4)		46	(26.4)		27	(23.9)	
South	1092	(18.0)	179	(16.0)		32	(18.4)		21	(18.6)	
Northeast	2028	(33.5)	399	(35.6)		65	(37.4)		45	(39.8)	
College attendance											
Never attended	119	(2.7)	36	(4.2)	0.0397	14	(9.6)	0.0059	2	(2.2)	0.7270
Attended	4316	(97.3)	817	(95.8)		132	(90.4)		91	(97.8)	
Life-time pregnancy											
No	3515	(77.5)	666	(75.8)	0.2603	104	(68.9)	0.0245	84	(88.4)	0.0020
Yes	1018	(22.5)	213	(24.2)		47	(31.1)		11	(11.6)	
Age in 2010, median (interquartile range)	25	(24–27)	25	(24–27)	0.5648	25	(24–27)	0.9518	26	(24–27)	0.1537
Mother’s household income in 2001											
<$50 000	613	(12.7)	105	(11.3)	0.7291	38	(26.2)	0.0002	13	(13.4)	0.1495
$50000–74 999	1164	(24.1)	227	(24.5)		33	(22.8)		18	(18.6)	
$75 000–99 999	1078	(22.3)	209	(22.6)		23	(15.9)		16	(16.5)	
≥ $100000	1976	(40.9)	386	(41.6)		51	(35.2)		50	(51.6)	
Number of survey waves completed from 2003 to 2010											
1	597	(9.6)	79	(7.1)	0.0003	7	(4.0)	0.0050	7	(6.2)	0.5197
2	769	(12.7)	124	(11.1)		16	(9.2)		17	(15.0)	
3	1060	(17.5)	244	(21.8)		41	(23.6)		18	(15.9)	

	Sexual orientation									
	Completely heterosexual		Mostly heterosexual			Bisexual			Gay/lesbian		
	n	(%)	n	(%)	P-value	n	(%)	P-value	n	(%)	P-value
4	3649	(60.2)	674	(60.1)		110	(63.2)		71	(62.8)	
Men											
Total, row percentage	4546	(90.4)	301	(6.0)		34	(0.7)		146	(2.9)	
Race/ethnicity											
White	4254	(93.6)	262	(87.0)	0.0017	33	(97.1)	0.2431	129	(88.4)	0.0538
Non-white	292	(6.4)	39	(13.0)		1	(2.9)		17	(11.6)	
Region											
West	751	(16.5)	69	(22.9)	0.0543	5	(14.7)	0.2664	24	(16.4)	0.3276
Midwest	1532	(33.7)	94	(31.2)		10	(29.4)		41	(28.1)	
South	765	(16.8)	46	(15.3)		3	(8.8)		23	(15.8)	
Northeast	1498	(33.0)	92	(30.6)		16	(47.1)		58	(39.7)	
College attendance											
Never attended	121	(4.7)	5	(2.2)	0.0251	1	(4.8)	0.9865	4	(3.5)	0.5239
Attended	2462	(95.3)	218	(97.8)		20	(95.2)		109	(96.5)	
Age in 2010, median	25	(24–26)	25	(24–26)	0.9189	25	(23–26)	0.2997	25	(24–27)	0.5756
(interquartile range)											
Mother's household income in 2001											
< $50000	475	(12.8)	28	(10.9)	0.5587	3	(9.7)	0.2043	14	(11.6)	0.9604
$50000–74999	873	(23.4)	66	(25.8)		5	(16.1)		27	(22.3)	
$75 000–99 999	868	(23.3)	53	(20.7)		5	(16.1)		29	(24.0)	
≥ $100 000	1510	(40.5)	109	(42.6)		18	(58.1)		51	(42.2)	
Number of survey waves completed from 2003 to 2010											
1	841	(18.5)	26	(8.6)	< 0.0001	6	(17.7)	0.4472	16	(11.0)	<0.0001
2	844	(18.6)	36	(12.0)		3	(8.8)		11	(7.5)	
3	984	(21.7)	78	(25.9)		8	(23.5)		26	(17.8)	
4	1877	(41.3)	161	(53.5)		17	(50.0)		93	(63.7)	

Using completely heterosexuals as the referent, *P*-values were derived using Rao–Scott χ^2 tests for categorical variables and univariable models with generalized estimating equations for continuous variables, both of which were adjusted for sibling clusters. Missing data for college attendance, pregnancy and mother's household income were excluded from this table, including the Rao–Scott χ^2 tests.

Table 2

Class enumeration fit indices and qualities for longitudinal latent class analyses, stratified by gender: Growing Up Today Study, 2003–2010.

Classes	Free parameters	BIC	BF	cmP	AWE	Entropy
Women						
1	144	200031	<1	0.00	201 895	NA
2	289	177553	<1	0.00	181 296	0.875
3	434	170 637	<1	0.00	176 256	0.848
4	579	168055	<1	0.00	175 553	0.828
5	724	167337	<1	0.00	176 712	0.817
6	**869**	**167 004**	**> 10**	**1.00**	**178 257**	**0.798**
7	1014	167091	> 10	0.00	180 222	0.779
8	1159	167369	> 10	0.00	182 376	0.777
9[a]	1304	167 720	NA	0.00	184 605	0.778
Men						
1	144	111 869	<1	0.00	113 791	NA
2	289	99 323	<1	0.00	103 180	0.860
3	434	95437	<1	0.00	101 228	0.838
4	579	94 504	<1	0.00	102 229	0.818
5	**724**	**94 380**	**>10**	**1.00**	**104 040**	**0.779**
6	869	94518	>10	0.00	106 113	0.762
7	1014	94953	NA	0.00	108 484	0.754

Models were estimated with samples of 7470 women and 5033 men. Bold type indicates the model we selected for each gender (i.e., the 6 class model for women, and the the 5 class model for men). BIC = Bayesian information criterion; BF = Bayes factor; cmP = correct model probability; AWE = approximate weight of evidence criterion; NA = not applicable. The likelihood ratio χ^2 goodness-of-fit tests could not be computed in Mplus because the latent class indicator model was too large. Bootstrap likelihood ratio test could not be estimated because we employed the COMPLEX command in Mplus to adjust for non-independence within sibling clusters.

[a]Model was not well identified.

Table 3

Bivariate sociodemographic characteristics of longitudinal alcohol use trajectories, stratified by gender: Growing Up Today Study, 2003–2010.

	Alcohol use trajectory groups						
	Class 1. Nondrinkers	**Class 2. Heavy drinkers**	**Class 3. Moderate drinkers**	**Class 4. Legal drinkers**	**Class 5. Escalation to moderately heavy drinkers**	**Class 6. Light drinkers**	
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**P-value**
Women							
Total	521 (7.0)	1754 (23.5)	2373 (31.8)	830 (11.1)	723 (9.7)	1264 (17.0)	
Sexual orientation							
Completely heterosexual	467 (7.7)	1337 (22.1)	1903 (31.4)	738 (12.2)	580 (9.6)	1032 (17.0)	<0.0001
Mostly heterosexual	43 (3.8)	339 (30.2)	379 (33.8)	74 (6.6)	109 (9.7)	177 (15.8)	
Bisexual	7 (4.0)	50 (28.7)	55 (31.6)	12 (6.9)	19 (10.9)	31 (17.8)	
Lesbian	4 (3.5)	28 (24.8)	36 (31.9)	6 (5.3)	15 (13.3)	24 (21.2)	
Race/ethnicity							
White	480 (6.9)	1670 (23.9)	2228 (31.9)	763 (10.9)	675 (9.7)	1162 (16.7)	0.0038
Non-white	41 (8.4)	84 (17.3)	145 (29.8)	67 (13.8)	48 (9.9)	102 (20.9)	
Region							
West	102 (8.5)	258 (21.6)	378 (31.6)	157 (13.1)	100 (8.4)	201 (16.8)	<0.0001
Midwest	183 (7.6)	536 (22.3)	757(31.4)	305 (12.7)	231 (9.6)	396 (16.5)	
South	123 (9.3)	255 (19.3)	412 (31.1)	145 (11.0)	135 (10.2)	254 (19.2)	
Northeast	113 (4.5)	705 (27.8)	826 (32.6)	223 (8.8)	257 (10.1)	413 (16.3)	
College attendance							
Never attended	36 (21.1)	36 (21.1)	34 (19.9)	19 (11.1)	16 (9.4)	30 (17.5)	<0.0001
Attended	383 (7.2)	1227 (22.9)	1704 (31.8)	606 (11.3)	545 (10.2)	891 (16.6)	
Missing	102 (5.3)	491 (25.3)	635 (32.8)	205 (10.6)	162 (8.4)	343 (17.7)	
Life-time pregnancy							
No	280 (6.4)	1030 (23.6)	1424 (32.6)	509 (11.7)	450 (10.3)	676 (15.5)	<0.0001
Yes	156 (12.1)	250 (19.4)	349 (27.1)	131 (10.2)	125 (9.7)	278 (21.6)	
Missing	85 (4.7)	474 (26.2)	600 (33.2)	190 (10.5)	148 (8.2)	310 (17.2)	
Mother’s household income in 2001							
< $50000	75 (9.8)	157 (20.4)	234 (30.4)	84 (10.9)	76 (9.9)	143 (18.6)	<0.0001

	Alcohol use trajectory groups						
	Class 1. Nondrinkers	**Class 2. Heavy drinkers**	**Class 3. Moderate drinkers**	**Class 4. Legal drinkers**	**Class 5. Escalation to moderately heavy drinkers**	**Class 6. Light drinkers**	
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**P-value**
$50000–74999	128 (8.9)	291 (20.2)	445 (30.9)	185 (12.8)	142 (9.9)	251 (17.4)	
$75 000–99 999	81 (6.1)	300 (22.6)	437 (33.0)	148 (11.2)	137 (10.3)	223 (16.8)	
≥ $100 000	131 (5.3)	681 (27.7)	816 (33.1)	221 (9.0)	229 (9.3)	385 (15.6)	
Missing	106 (7.2)	325 (22.2)	441 (30.1)	192 (13.1)	139 (9.5)	262 (17.9)	
Number of survey waves completed from 2003 to 2010							
1	29 (4.3)	195 (29.0)	227 (33.8)	73 (10.9)	40 (6.0)	108 (16.1)	<0.0001
2	63 (6.8)	228 (24.6)	292 (31.5)	106 (11.5)	68 (7.3)	169 (18.3)	
3	80 (5.9)	350 (25.7)	457 (33.5)	121 (8.9)	125 (9.2)	230 (16.9)	
4	349 (7.8)	981 (21.8)	1397 (31.0)	530 (11.8)	490 (10.9)	757(16.8)	
Men							
Total	458 (9.1)	1853 (36.9)	1326 (26.4)	788 (15.7)	602 (12.0)		
Sexual orientation							
Completely heterosexual	437 (9.6)	1696 (37.3)	1148 (25.3)	716 (15.8)	549 (12.1)		<0.0001
Mostly heterosexual	13 (4.3)	105 (34.9)	104 (34.6)	49 (16.3)	30 (10.0)		
Bisexual	1 (2.9)	12 (35.3)	15 (44.1)	3 (8.8)	3 (8.8)		
Gay	7 (4.8)	40 (27.4)	59 (40.4)	20 (13.7)	20(13.7)		
Race/ethnicity							
White	422 (9.0)	1738 (37.2)	1248 (26.7)	715 (15.3)	555 (11.9)		0.0290
Non-white	36 (10.3)	115 (33.0)	78 (22.4)	73 (20.9)	47 (13.5)		
Region							
West	105 (12.4)	290 (34.2)	232 (27.3)	132 (15.6)	90 (10.6)		<0.0001
Midwest	145 (8.7)	607 (36.2)	430 (25.6)	285 (17.0)	210 (12.5)		
South	89 (10.6)	251 (30.0)	233 (27.8)	158 (18.9)	106 (12.7)		
Northeast	119 (7.2)	705 (42.4)	431 (25.9)	213 (12.8)	196 (11.8)		
College attendance							
Never attended	26 (19.9)	35 (26.7)	39 (29.8)	23 (17.6)	8 (6.1)		<0.0001
Attended	245 (8.7)	1009 (35.9)	706 (25.1)	471 (16.8)	378 (13.5)		
Missing	187 (9.0)	809 (38.8)	581 (27.8)	294 (14.1)	216 (10.4)		

	Alcohol use trajectory groups						
	Class 1. Nondrinkers	**Class 2. Heavy drinkers**	**Class 3. Moderate drinkers**	**Class 4. Legal drinkers**	**Class 5. Escalation to moderately heavy drinkers**	**Class 6. Light drinkers**	
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**P-value**
Mother's household income in 2001							
< $50000	65 (12.5)	165 (31.7)	130 (25.0)	93 (17.9)	67 (12.9)		<0.0001
$50000–74999	107 (11.0)	322 (33.2)	260 (26.8)	171 (17.6)	111 (11.4)		
$75 000–99 999	76 (8.0)	361 (37.8)	256 (26.8)	151 (15.8)	111 (11.6)		
≥ $100 000	119 (7.1)	702 (41.6)	450 (26.7)	216 (12.8)	201 (11.9)		
Missing	91 (10.2)	303 (33.9)	230 (25.8)	157 (17.6)	112 (12.5)		
Number of survey waves completed from 2003 to 2010							
1	56 (6.3)	379 (42.6)	264 (29.7)	143 (16.1)	47 (5.3)		<0.0001
2	91 (10.2)	344 (38.5)	256 (28.6)	105 (11.7)	98 (11.0)		
3	100 (9.1)	389 (35.5)	288 (26.3)	166 (15.2)	153 (14.0)		
4	211 (9.8)	741 (34.5)	518 (24.1)	374 (17.4)	304 (14.2)		

P-values were derived using Rao–Scott χ^2 tests for categorical variables and adjusted for sibling clusters. The light drinking class only emerged for women.

Table 4

Results of multinomial logistic regression models predicting longitudinal alcohol use trajectory class memberships, stratified by gender: Growing Up Today Study, 2003–2010.

	Heavy drinkers versus non-drinkers		Moderate drinkers versus non-drinkers		Legal drinkers versus non-drinkers		Escalation to moderately heavy drinkers versus non-drinkers		Light drinkers versus non-drinkers	
	OR (95% CI)	**P-value**	**OR (95% CI)**	**P-value**	**OR (95% CI)**	**P-value**	**OR (95% CI)**	**P-value**	**OR (95% CI)**	**P-value**
Women										
Sexual orientation										
Completely heterosexual	1.00 (referent)		1.00 (referent)		1.00 (referent)		1.00 (referent)		1.00 (referent)	
Mostly heterosexual	**3.07 (2.15,4.40)**	**<0.0001**	**2.40 (1.68, 3.41)**	**<0.0001**	1.19 (0.79, 1.79)	0.4154	**2.24 (1.51, 3.31)**	**< 0.0001**	**2.02 (1.40, 2.93)**	**0.0002**
Bisexual	**3.42 (1.49, 7.83)**	**0.0037**	**2.61 (1.15, 5.90)**	**0.0215**	1.41 (0.54, 3.65)	0.4843	**2.80 (1.14, 6.86)**	**0.0248**	**2.47 (1.07, 5.72)**	**0.0351**
Lesbian	2.24 (0.75, 6.66)	0.1470	2.08 (0.71’ 6.08)	0.1823	0.93 (0–26, 3.42)	0.9182	2.91 (0.95, 8.95)	0.0622	2.70 (0.92, 7.97)	0.0719
Men										
Sexual orientation										
Completely heterosexual	1.00 (referent)		1.00 (referent)		1.00 (referent)		1.00 (referent)			
Mostly heterosexual	**2.24 (1.23,4.09)**	**0.0084**	**3.34 (1.83, 6.08)**	**<0.0001**	**2.29 (1.22,4.29)**	**0.0101**	1.76 (0–90, 3.44)	0.0982		
Bisexual	2.62 (0.35, 19.71)	0.3491	5.27(0.71, 39.20)	0.1046	1.79 (0–18, 17.89)	0.6202	2.12 (0–21, 21.11)	0.5227		
Gay	1.48 (0.66, 3.35)	0.3444	**3.38 (1.53, 7.48)**	**0.0027**	1.64 (0–68,3.95)	0.2682	2.06 (0.86,4.93)	0.1053		

Bold type indicates $P < 0.05$. Models were estimated with samples of 7465 women and 5027 men. OR = odds ratio; CI = confidence interval. The light drinking class only emerged for women. Models were adjusted for race/ethnicity, age, region, lifetime college attendance, number of surveys completed from 2003 to 2010 and mother’s household income. Models for women were also adjusted for life-time pregnancy.

Table 5

Mediational effects of longitudinal alcohol use trajectory classes on sexual-orientation differences in alcohol use disorders, stratified by gender: Growing Up Today Study, 2003–2010.

	Alcohol use disorder						
	Univariable		**Multivariable model 1**		**Multivariable model 2**		**Proportion mediated**
	%	**P-value**	**RR (95% CI)**	**P-value**	**RR (95% CI)**	**P-value**	**% (P-value)**
Women							
Sexual orientation							
Completely heterosexual	14.0	<0.0001	1.00 (referent)		1.00 (referent)		
Mostly heterosexual	30.8		**2.17(1.91, 2.47)**	**<0.0001**	**1.78 (1.57, 2.01)**	**<0.0001**	**30.8 (<0.0001)**
Bisexual	29.5		**2.12 (1.59, 2.83)**	**<0.0001**	**1.85 (1.43, 2.38)**	**<0.0001**	**16.7 (0.0609)**
Lesbian	29.3		**2.00 (1.41, 2.83)**	**<0.0001**	**1.71 (1.23, 2.38)**	**0.0013**	**31.1 (0.0180)**
Alcohol use trajectory classes							
Non-drinkers	1.3	<.0001			1.00 (referent)		
Heavy drinkers	40.3				**29.82 (12.34, 72.08)**	**<0.0001**	
Moderate drinkers	17.4				**13.09 (5.40, 31.71)**	**<0.0001**	
Legal drinkers	3.4				2.61 (0.98, 6.94)	0.0538	
Escalation- to moderately heavy drinkers	16.3				**11.79 (4.80, 28.94)**	**<0.0001**	
Light drinkers	3.4				2.56 (0.99, 6.61)	0.0519	
Men							
Sexual orientation							
Completely heterosexual	26.6	0.0015	1.00 (referent)		1.00 (referent)		
Mostly heterosexual	36.7		**1.34 (1.10, 1.64)**	**0.0044**	**1.40 (1.18, 1.67)**	**0.0002**	not mediated
Bisexual	38.9		1.54(0.84, 2.80)	0.1604	1.67 (0.93, 3.01)	0.0859	not mediated
Gay	41.4		**1.59 (1.25, 2.02)**	**0.0001**	**1.72 (1.41, 2.10)**	**<0.0001**	not mediated
Alcohol use trajectory classes							
Non-drinkers	1.3	<0.0001			1.00 (referent)		
Heavy drinkers	50.8				**38.69 (12.69, 117.94)**	<0.0001	
Moderate drinkers	19.2				**13.72 (4.46, 42.21)**	<0.0001	
Legal drinkers	7.6				**5.60 (1.75, 17.89)**	0.0037	
Escalation to moderately heavy drinkers	29.6				**22.39 (7.28, 68.90)**	<0.0001	

Bold type indicates $P < 0.05$. Models were estimated with samples of 5122 women and 2510 men. Univariable P-values were derived using Rao–Scott χ^2 tests for categorical variables and adjusted for sibling clusters. Multivariable models were adjusted for race/ethnicity, age, region, life-time college attendance (yes/no), number of surveys completed from 2003 to 2010 and mother's household income. Models for women were also adjusted for life-time pregnancy (yes/no). RR = rate ratio; CI = confidence interval.