

# Substance Use Among a National Sample of Sexual and Gender Minority Adolescents: Intersections of Sex Assigned at Birth and Gender Identity

Ryan J. Watson, PhD,<sup>1</sup> Jessica N. Fish, PhD,<sup>2</sup> Timothy McKay, MFT,<sup>1</sup> Samuel H. Allen, MS,<sup>2</sup> Lisa Eaton, PhD,<sup>1</sup> and Rebecca M. Puhl, PhD<sup>1</sup>

## Abstract

**Purpose:** We examined how substance use differed as a function of sex assigned at birth and gender identity (cisgender, transgender, or nonbinary/genderqueer) by type of substance. We sought to test whether current gender identity and sex assigned at birth were key factors in substance use among a large contemporary sample that included transgender and nonbinary/genderqueer adolescents.

**Methods:** We analyzed data from a large national U.S. sample of sexual and gender minority (SGM) adolescents ( $n = 11,129$ ) collected between April and December 2017. Chi-square tests of independence were used to test whether substance use behaviors varied by sex assigned at birth and gender identity. A series of multivariate logistic regression models tested the odds of substance use by sex assigned at birth and gender identity, as well as the interaction between sex assigned at birth and gender identity.

**Results:** More than half of our sample reported lifetime alcohol use, and one-fourth of the sample reported lifetime marijuana use. Adolescents assigned male at birth had higher prevalence of substance use compared with adolescents assigned female at birth (AFAB). Multivariate models elucidated greater risk for most substance use outcomes for transgender adolescents compared with cisgender adolescents. We found significant interaction effects between gender identity and sex assigned at birth for recent alcohol use and lifetime and recent cigarette use among adolescents AFAB.

**Conclusions:** These findings have implications for stakeholders who develop nationally representative surveys, researchers who examine substance use disparities among SGM adolescents, and mental health professionals who treat underage substance use among vulnerable populations.

**Keywords:** alcohol use, gender identity, sexual and gender minority, substance use

## Introduction

ELEVATED RATES OF SUBSTANCE USE remain a problem among sexual and gender minority (SGM) adolescents<sup>1–3</sup>; higher rates of substance use affect this population disproportionately.<sup>4,5</sup> Although a growing number of studies have examined the use of alcohol,<sup>6,7</sup> tobacco,<sup>8</sup> and illicit substances<sup>9–11</sup> among SGM populations, large-scale data that allow for within-group comparisons to elucidate potential differences across a spectrum of gender identities and sex assigned at birth have been largely unavailable.<sup>12</sup> Consequently, we are unaware of subgroup differences in substance use across a heterogeneous population of transgender and nonbinary adolescents (e.g., nonbinary adolescents

assigned male at birth (AMAB), nonbinary adolescents assigned female at birth (AFAB), genderqueer adolescents, transgender boys, and transgender girls). Potential heterogeneity across gender identity, sex assigned at birth, and sexual identity among young people with respect to their substance use experiences is underexplored.<sup>6</sup> Knowledge of substance use differences across multiple identities may alert stakeholders to subgroups at particular risk.

Gender identity is distinct from sexual identity,<sup>12</sup> and preliminary evidence shows that health behaviors can differ appreciably across intersecting SGM identities.<sup>8,10</sup> Only by studying the heterogeneity among SGM adolescents are we able to obtain tools for targeted prevention and intervention strategies to reduce the higher rates of compromised health

<sup>1</sup>Department of Human Development and Family Sciences, University of Connecticut, Storrs, Connecticut.

<sup>2</sup>Department of Family Science, School of Public Health, University of Maryland, College Park, Maryland.

for this population. To address this, we aim to contribute to a more accurate and nuanced understanding of how health behaviors, specifically substance use, differ across diverse gender identities, including among nonbinary adolescents. That is, do differences in substance use prevalence emerge as a factor of sex assigned at birth and gender identity among SGM adolescents?

#### *Prevalence of and disparities in substance use across sexual and gender identity*

There exists a robust and growing body of literature that documents elevated risk for substance use among sexual minority adolescents.<sup>4,5,13</sup> Studies that have traced trends in sexual orientation-related disparities in substance use have found that these disparities in alcohol, tobacco, and marijuana use have remained stable and in some cases widened over the past 15 years.<sup>2,14,15</sup> The 2015 Youth Risk Behavior Survey (YRBS)—the first U.S. national survey to include sexual orientation—revealed stark disparities in alcohol, tobacco, and other drug use between heterosexual and sexual minority adolescents.<sup>16</sup>

Studies that document rates of substance use among gender minority adolescents are far less common. In a large national study of 5542 13- to 18-year old adolescents, Reisner et al.<sup>17</sup> examined differences in rates of substance use between gender minority and cisgender adolescents. The authors found elevated rates of substance use for gender minority adolescents compared to their cisgender peers (up to two times the risk of substance use).<sup>17</sup> In the first representative study of substance use among transgender adolescents, which used the Biennial Statewide California Healthy Kids Survey (CHKS; 2013–2015), Day et al.<sup>1</sup> found that transgender adolescents reported higher prevalence of lifetime and past 30-day substance use (alcohol use, heavy episodic drinking, cigarette use, marijuana use, use of other drugs, and polysubstance use) than their cisgender peers. Comparatively, 30-day heavy episodic drinking was 3-times higher and marijuana use was 2.5 times higher for transgender adolescents compared to cisgender adolescents.<sup>1</sup>

#### *Improving specificity in documenting SGM substance use*

SGM-related disparities are oftentimes explained by the minority stress model,<sup>18,19</sup> although empirical support for the application of the model to transgender-specific health risk is still emerging.<sup>17</sup> Despite a growing body of SGM substance use literature, studies are slow to systematically explore patterns of substance use across distinct identities.<sup>20</sup> Given the need for population-specific prevention and intervention efforts, we aimed to address this gap in the field by identifying unique patterns of substance use across subcategories of SGM adolescents. We estimated the prevalence of alcohol, tobacco, and marijuana use behaviors across groups defined by diverse gender identities and sex assigned at birth.

## **Methods**

### *Study design, participant recruitment, and data cleaning procedures*

Data are from the LGBTQ National Teen Survey, which was designed to better understand the day-to-day experi-

ences of SGM racially diverse adolescents, collected between April and December 2017. Adolescents were eligible if they reported being ages 13–17 years, had a sexual and/or gender minority identity, resided in the United States, could complete an online survey, and could read English. The survey was hosted on Qualtrics.com (Provo, Utah and Seattle, Washington) and was used to collect data from anonymous participants recruited through social media with marketing assistance from social influencers. The Human Rights Campaign (HRC) posted Facebook and Twitter messages with a link to the survey. Informed assent was achieved through the Study Information sheet presented before the Qualtrics survey; all study protocols, including a waiver of parental consent, were approved by the University of Connecticut Institutional Review Board. More information regarding the study design can be found elsewhere.<sup>21,22</sup>

In total, 20,306 eligible participants started the survey. Among those, 3006 (14.8%) participants did not complete the initial demographic information and were excluded from all data analyses. Open-ended responses were examined; we deleted suspicious entries not previously captured by the mischievous responders screening process (e.g., referring to oneself as Donald Trump;  $n = 79$ ). Although the survey was designed to prevent bots from completing the survey, a *post hoc* mischievous responder's sensitivity analysis<sup>23</sup> was also conducted on the data from eligible responders ( $n = 74$  removed). Duplicate surveys ( $n = 12$ ) and those where a participant began a survey but terminated it before completion and then completed a new survey ( $n = 23$ ) were deleted by manually identifying identical survey responses. Completion time for participants who reached the end of the survey was on average 43.3 minutes (median = 28.2 minutes).

Participants were eligible for HRC wristbands and entry into an Amazon.com gift card drawing for completing the survey. Of the larger study, a final total of 17,112 participants was represented by 4740 (27.7%) adolescents AMAB, 12,372 (72.3%) adolescents AFAB, a majority of White adolescents ( $n = 10,225$ ; 59.8%), 4079 (23.8%) cisgender boys, 7396 (43.2%) cisgender girls, 1404 (8.2%) transgender boys, 185 (1.1%) transgender girls, 3573 (20.9%) nonbinary adolescents AFAB, and 475 (2.8%) nonbinary adolescents AMAB. The sample for this article included adolescents who provided valid data on gender identity measures and who were not missing on all substance use outcomes ( $n = 11,129$  adolescents).

### *Measures*

**Sex assigned at birth.** Participants were asked, “What sex were you assigned at birth?” Response options were male and female.

**Gender identity.** Participants were asked, “What is your current gender identity?” Response options were male, female, trans male/boy, trans female/girl, nonbinary, genderqueer/gender nonconforming, and different identity, with a write-in response. From these options we created three mutually exclusive groups of adolescents—cisgender, transgender, and nonbinary/genderqueer. Adolescents with concordant sex assigned at birth and gender identities were coded as cisgender. Adolescents who reported a gender identity that was different from their sex assigned at birth and exclusively

chose the “trans male/boy” or “trans female/girl” options were coded as transgender—we conceptualize these adolescents as “binary” transgender youth. A third group of adolescents was coded as “nonbinary/genderqueer” given that they chose a gender identity that was different from their sex assigned at birth and selected “nonbinary,” “genderqueer/gender nonconforming,” or a combination of gender identities that included a nonbinary response (e.g., trans male/boy and nonbinary). Adolescents who reported a write-in response were back-coded when appropriate and, if not, analyzed to determine if their identity was to be characterized as binary or nonbinary.

**Substance use.** We measured alcohol, marijuana, and cigarette smoking in a way that mirrored questions asked in the 2015 YRBS.<sup>16</sup> All substance use items were recoded to reflect no use = 0 and any use = 1.

**Lifetime marijuana use.** One question asked, “During your life, on how many days have you had marijuana?” Response options ranged from 0 (0 days) to 6 (100 or more days).

**Lifetime alcohol use.** One question asked, “During your life, on how many days have you had at least one drink of alcohol?” Response options ranged from 0 (0 days) to 6 (100 or more days).

**Lifetime cigarette use.** We asked, “Have you ever tried cigarette smoking, even one or two puffs?” Response options were 0 (no) and 1 (yes).

**Recent marijuana use.** One item asked, “During the past 30 days, how many times did you use marijuana?” Response options ranged from 0 (0 times) to 4 (40 or more times).

**Recent alcohol use.** One item asked, “During the past 30 days, on how many days did you have at least one drink of alcohol?” Response options ranged from 0 (0 days) to 6 (all 30 days).

**Recent cigarette use.** One item asked, “During the past 30 days, on how many days did you smoke cigarettes?” Response options ranged from 0 (0 days) to 6 (all 30 days).

**Recent binge drinking.** One item asked, “During the past 30 days, on how many days did you have five or more drinks of alcohol in a row, that is, within a couple of hours?” Response options ranged from 0 (0 days) to 6 (all 30 days).

### *Covariates*

**Sexual identity.** One item asked, “How do you describe your sexual identity?” Participants could choose one of the following options, “Gay or Lesbian,” “Bisexual,” “Straight, that is, not gay,” or “Something else.” In this study, “straight” adolescents were included in the “Something else” group.

**Race/ethnicity.** One check-all-that-applies item asked participants, “How would you describe yourself?” Response options were “White, non-Hispanic,” “Non-Latino Black or African American,” “American Indian or Alaska Native,” “Asian or Pacific Islander,” “Latino, Hispanic, or Mexican

American,” and “Other.” When participants checked more than one box, they were categorized as having “Multiple Identities.”

**Parental education.** Parental education was measured by the highest value from one of two items that stated, “Please indicate the highest level of education of your first [second] parent/primary caregiver.” Response options were, “Less than high school or GED,” “High school or GED,” “Vocational/Technical School (2 years),” “Some college,” “College graduate,” and “Postgraduate degree or higher.” These values were recoded to less than high school, high school, some college (including some college and vocational/technical school), and college graduate or more (including college graduate and postgraduate degree or higher).

**Age.** Participants’ age was measured in years.

**Region.** Participants’ region of residence was measured by coding their response to “What state do you live in?” to one of four options: “Northeast,” “Midwest,” “South,” and “West.”

### *Plan of analysis*

All analyses were conducted in Stata 15 (2017; StataCorp LLC, College Station, TX). We first estimated the prevalence of each specific substance use behavior in the full sample. Next, using chi-square tests of independence, we tested whether the prevalence of substance use behaviors (e.g., alcohol, marijuana, and cigarette) varied by sex assigned at birth and gender identity. We then conducted a series of multivariate logistic regression models to test the odds of substance use by sex assigned at birth and gender identity, as well as the interaction between sex assigned at birth and gender identity. Given significant interactions, we also estimated sex assigned at birth stratified models to assess gender identity differences in substance use behaviors. Following the testing of interactions, we calculated predicted probabilities of substance use for subgroups from significant interactions. All models were adjusted for sexual identity, race/ethnicity, parental education, age, and region. Statistical tests at  $p < 0.05$  were deemed statistically significant for all analyses. We used multiple imputations with 50 replications to account for missing data on covariates.

### **Results**

Demographic characteristics of the participants are presented in Table 1. Respondents represented diverse subgroups of SGM adolescents from all 50 states across the United States. Among adolescents AMAB, 85.71% identified as cisgender, 4.61% as transgender, and 9.69% as nonbinary/genderqueer. Among adolescents AFAB, 58.57% identified as cisgender, 11.46% as transgender, and 29.97% as nonbinary/genderqueer. The majority of the sample was White (65%); the most common racial minority groups were multiple identities (13%) and Latinx (10%). The sample was geographically diverse, with 18% living in the Northeast, 23% in the Midwest, 36% in the South, and 21% in the West. Approximately two-thirds of respondents’ parents had at least a college degree (66.9%). The largest

TABLE 1. DEMOGRAPHIC CHARACTERISTICS OF THE SAMPLE

	<i>Total Sample</i>		<i>AMAB</i>		<i>AFAB</i>	
	n	%	n	%	n	%
Sex assigned at birth						
Male	2736	24.58				
Female	8393	75.42				
Gender identity						
Cisgender	7261	65.24	2345	85.71	4916	58.57
Transgender	1088	9.78	126	4.61	962	11.46
Nonbinary/genderqueer	2780	24.98	265	9.69	2515	29.97
Sexual identity						
Gay/lesbian	4084	37.30	1821	67.25	2263	27.46
Bisexual	3741	34.17	654	24.15	3087	37.46
Something else	3124	28.53	233	8.60	2891	35.08
Race/ethnicity						
White	7281	65.49	1712	62.60	5569	66.44
Black	505	4.54	148	5.41	357	4.26
Latinx	1147	10.32	344	12.58	803	9.58
Asian	429	3.86	121	4.42	308	3.67
Multiple identities	1516	13.64	349	12.76	1167	13.92
Other	239	2.15	61	2.23	178	2.12
Parental education						
Less than high school	321	3.08	116	4.50	205	2.61
High school	1325	12.71	369	14.3	956	12.19
Some college	1801	17.28	436	16.9	1365	17.40
College degree or more	6976	66.93	1659	64.3	5317	67.79
Age						
13	829	7.45	92	3.36	737	8.78
14	1652	14.84	289	10.56	1363	16.24
15	2323	20.87	529	19.33	1794	21.37
16	2913	26.17	793	28.98	2120	25.26
17	3412	30.66	1033	37.76	2379	28.35
Region						
Northeast	2028	18.22	512	18.71	1516	18.06
Midwest	2584	23.22	623	22.77	1961	23.36
South	4080	36.66	987	36.07	3093	36.85
West	2437	21.90	614	22.44	1823	21.72

AFAB, assigned female at birth; AMAB, assigned male at birth.

proportion of respondents was identified as gay/lesbian (37%) followed by bisexual (34%) and something else (28%).

#### *Prevalence of substance use by sex assigned at birth and gender identity*

Table 2 presents the prevalence of substance use by sex assigned at birth and gender identity. Among the full sample, ~55% of SGM adolescents reported lifetime alcohol use, 27% reported recent alcohol use, and nearly 10% had recently engaged in binge drinking. Nearly 27% of adolescents indicated lifetime marijuana use, 14% reported recent marijuana use, 22% of adolescents reported lifetime cigarette use, and 7% reported recent cigarette use.

We found significant differences in recent alcohol use, recent binge drinking, lifetime and recent marijuana use, and lifetime cigarette use by sex assigned at birth (Table 2). Adolescents AMAB indicated greater prevalence of substance use relative to adolescents AFAB. Gender identity was significantly related to all substance use behaviors. Generally,

transgender adolescents evidenced higher prevalence rates of lifetime alcohol, as well as lifetime and recent marijuana and cigarette use, compared to cisgender and nonbinary/genderqueer adolescents, who did not differ from one another. Conversely, nonbinary/genderqueer adolescents reported the lowest prevalence of recent alcohol use and binge drinking relative to cisgender and transgender adolescents.

Substance use behavior differences across groups simultaneously defined by sex assigned at birth and gender identity are presented in Table 3. Generally, transgender adolescents AFAB and cisgender adolescents AMAB reported the highest prevalence rates of lifetime and recent alcohol use, although transgender and cisgender adolescents AMAB reported the highest prevalence of recent binge drinking. Transgender adolescents AMAB and AFAB reported the highest rates of lifetime and recent marijuana use relative to other groups, and transgender adolescents AFAB reported the highest rates of cigarette use relative to all other groups defined by sex assigned at birth and gender identity. Nonbinary/genderqueer adolescents AFAB typically reported lower

TABLE 2. SUBSTANCE USE IN THE FULL SAMPLE, BY SEX ASSIGNED AT BIRTH AND BY GENDER IDENTITY

	Full sample						Sex assigned at birth						Gender identity					
	Male		Female		p	$\chi^2$	Cisgender		Transgender		Nonbinary/genderqueer		$\chi^2$	p				
	n	%	n	%			n	%	n	%	n	%			n	%		
Lifetime alcohol use	4987	44.81	1188	43.42	3799	45.26	2.83	0.092	3268	45.01	450	41.36	1269	45.65	<b>6.14</b>	<b>0.046</b>		
No	6142	55.19	1548	56.58	4594	54.74			3993	54.99	638	58.64	1511	54.35				
Recent alcohol use	8114	72.99	1918	70.18	6196	73.91	<b>14.56</b>	<b>&lt;0.001</b>	5216	71.92	787	72.53	2111	75.96	<b>16.74</b>	<b>&lt;0.001</b>		
No	3002	27.01	815	29.82	2187	26.09			2036	28.08	298	27.47	668	24.04				
Recent binge drinking	10,040	90.28	2408	88.08	7632	91.00	<b>20.05</b>	<b>&lt;0.001</b>	6500	89.58	973	89.51	2567	92.4	<b>19.06</b>	<b>&lt;0.001</b>		
No	1081	9.72	326	11.92	755	9.00			756	10.42	114	10.49	211	7.6				
Lifetime marijuana use	8142	73.16	1934	70.69	6208	73.97	<b>11.30</b>	<b>0.001</b>	5378	74.07	704	64.71	2060	74.1	<b>43.90</b>	<b>&lt;0.001</b>		
No	2987	26.84	802	29.31	2185	26.03			1883	25.93	384	35.29	720	25.9				
Recent marijuana use	9575	86.06	2319	84.79	7256	86.47	<b>4.87</b>	<b>0.027</b>	6262	86.25	881	81.12	2432	87.48	<b>26.97</b>	<b>&lt;0.001</b>		
No	1551	13.94	416	15.21	1135	13.53			998	13.75	205	18.88	348	12.52				
Lifetime cigarette use	8686	78.05	2098	76.68	6588	78.49	<b>3.96</b>	<b>0.047</b>	5795	79.81	734	67.46	2157	77.59	<b>84.65</b>	<b>&lt;0.001</b>		
No	2443	21.95	638	23.32	1805	21.51			1466	20.19	354	32.54	623	22.41				
Recent cigarette use	10,361	93.12	2529	92.47	7832	93.34	2.44	0.118	6822	93.98	942	86.58	2597	93.45	<b>81.51</b>	<b>&lt;0.001</b>		
No	765	6.88	206	7.53	559	6.66			437	6.02	146	13.42	182	6.55				

Bold coefficients indicate statistical significance at  $p < 0.05$ .

TABLE 3. SUBSTANCE USE BY GENDER IDENTITY, STRATIFIED BY SEX ASSIGNED AT BIRTH

	Cisgender AMAB		Cisgender AFAB		Transgender AMAB		Transgender AFAB		Nonbinary/genderqueer AMAB		Nonbinary/genderqueer AFAB		$\chi^2$	p
	n	%	n	%	n	%	n	%	n	%	n	%		
Lifetime alcohol use													<b>13.50</b>	<b>0.019</b>
No	1006	42.90	2262	46.01	57	45.24	393	40.85	125	47.17	1144	45.49		
Yes	1339	57.10	2654	53.99	69	54.76	569	59.15	140	52.83	1371	54.51		
Recent alcohol use													<b>30.53</b>	<b>&lt;0.001</b>
No	1620	69.17	3596	73.24	92	73.02	695	72.47	206	77.74	1905	75.78		
Yes	722	30.83	1314	26.76	34	26.98	264	27.53	59	22.26	609	24.22		
Recent binge drinking													<b>32.99</b>	<b>&lt;0.001</b>
No	2058	87.84	4442	90.41	110	87.30	863	89.80	240	90.57	2327	92.60		
Yes	285	12.16	471	9.59	16	12.70	98	10.20	25	9.43	186	7.40		
Lifetime marijuana use													<b>64.21</b>	<b>&lt;0.001</b>
No	1670	71.22	3708	75.43	84	66.67	620	64.45	180	67.92	1880	74.75		
Yes	675	28.78	1208	24.57	42	33.33	342	35.55	85	32.08	635	25.25		
Recent marijuana use													<b>33.00</b>	<b>&lt;0.001</b>
No	1989	84.85	4273	86.92	101	80.16	780	81.25	229	86.42	2203	87.59		
Yes	355	15.15	643	13.08	25	19.84	180	18.75	36	13.58	312	12.41		
Lifetime cigarette use													<b>33.00</b>	<b>&lt;0.001</b>
No	1801	76.80	3994	81.24	102	80.95	632	65.70	195	73.58	1962	78.01		
Yes	544	23.20	922	18.76	24	19.05	330	34.30	70	26.42	553	21.99		
Recent cigarette use													<b>120.82</b>	<b>&lt;0.001</b>
No	2164	92.32	4658	94.77	117	92.86	825	85.76	248	93.58	2349	93.44		
Yes	180	7.68	257	5.23	9	7.14	137	14.24	17	6.42	165	6.56		

Bold coefficients indicate statistical significance at  $p < 0.05$ .

TABLE 4. ADJUSTED LOGISTIC REGRESSION MODELS TESTING THE ASSOCIATION AMONG SEX, GENDER IDENTITY, AND SUBSTANCE USE

	Alcohol			Marijuana			Cigarette					
	Lifetime use		Recent use	Lifetime use		Recent use	Lifetime use		Recent use			
	aOR (95% CI)	p	aOR (95% CI)	p	aOR (95% CI)	p	aOR (95% CI)	p	aOR (95% CI)	p		
<b>FULL SAMPLE MAIN EFFECTS</b>												
<i>Sex assigned at birth</i>												
Assigned male	1.00											
Assigned female	1.06 (0.97–1.17)	0.212	0.97 (0.87–1.08)	0.578	0.146	0.860	0.98 (0.85–1.12)	0.736	0.92 (0.82–1.03)	0.149	0.84 (0.70–1.01)	0.071
<i>Gender identity</i>												
Cisgender	1.00											
Transgender	<b>1.25</b> <b>(1.09–1.43)</b>	<b>0.002</b>	1.07 (0.92–1.24)	0.412	1.11 (0.89–1.38)	0.366	<b>1.55</b> <b>(1.30–1.85)</b>	<b>0.001</b>	<b>1.95</b> <b>(1.68–2.26)</b>	<b>&lt;0.001</b>	<b>2.35</b> <b>(1.89–2.91)</b>	<b>&lt;0.001</b>
Nonbinary/ genderqueer	1.10 (1.00–1.21)	0.062	0.93 (0.83–1.04)	0.195	<b>0.82</b> <b>(0.69–0.98)</b>	<b>0.025</b>	1.01 (0.87–1.16)	0.937	<b>1.27</b> <b>(1.13–1.43)</b>	<b>&lt;0.001</b>	1.17 (0.96–1.43)	0.111
<b>FULL SAMPLE INTERACTION</b>												
<i>Sex assigned at birth</i>												
Assigned male	1.00											
Assigned female	1.02 (0.91–1.13)	0.744	0.92 (0.82–1.03)	0.165	0.90 (0.76–1.06)	0.205	0.96 (0.83–1.12)	0.642	<b>0.85</b> <b>(0.75–0.97)</b>	<b>0.014</b>	<b>0.72</b> <b>(0.58–0.89)</b>	<b>0.002</b>
<i>Gender identity</i>												
Cisgender	1.00											
Transgender	1.04 (0.72–1.50)	0.848	0.93 (0.61–1.40)	0.726	1.22 (0.71–2.13)	0.471	1.58 (0.99–2.51)	0.055	0.84 (0.53–1.34)	0.470	0.95 (0.47–1.93)	0.891
Nonbinary/ genderqueer	0.89 (0.69–1.16)	0.387	<b>0.68</b> <b>(0.50–0.92)</b>	<b>0.013</b>	0.80 (0.52–1.24)	0.319	0.91 (0.63–1.33)	0.636	1.21 (0.90–1.63)	0.215	0.80 (0.48–1.35)	0.405
<i>Sex assigned at birth</i> × <i>gender identity</i>												
AMAB × cisgender	1.00											
AFAB × transgender	1.24 (0.84–1.85)	0.282	1.18 (0.76–1.84)	0.453	0.89 (0.49–1.62)	0.698	0.99 (0.60–1.63)	0.955	<b>2.60</b> <b>(1.59–4.25)</b>	<b>&lt;0.001<sup>a</sup></b>	<b>2.84</b> <b>(1.36–5.97)</b>	<b>0.006<sup>b</sup></b>
AFAB × nonbinary/ genderqueer	1.27 (0.96–1.69)	0.089	<b>1.44</b> <b>(1.04–2.00)</b>	<b>0.029<sup>c</sup></b>	1.03 (0.64–1.64)	0.915	1.12 (0.75–1.67)	0.587	1.08 (0.78–1.49)	0.645	1.61 (0.92–2.82)	0.096
<i>AMAB only</i>												
Cisgender	1.00											
Transgender	0.95 (0.65–1.40)	0.804	0.82 (0.54–1.26)	0.373	1.09 (0.62–1.92)	0.769	1.27 (0.79–2.05)	0.326	0.72 (0.44–1.16)	0.176	0.78 (0.37–1.63)	0.514
Nonbinary/ genderqueer	0.84 (0.64–1.11)	0.220	<b>0.63</b> <b>(0.46–0.86)</b>	<b>0.004</b>	0.75 (0.48–1.18)	0.220	0.78 (0.52–1.15)	0.203	1.08 (0.79–1.47)	0.630	0.71 (0.40–1.21)	0.209
<i>AFAB only</i>												
Cisgender	1.00											
Transgender	<b>1.30</b> <b>(1.12–1.50)</b>	<b>0.001</b>	1.10 (0.94–1.30)	0.246	1.08 (0.85–1.38)	0.506	<b>1.59</b> <b>(1.31–1.93)</b>	<b>&lt;0.001</b>	<b>2.23</b> <b>(1.90–2.62)</b>	<b>&lt;0.001</b>	<b>2.82</b> <b>(2.23–3.56)</b>	<b>&lt;0.001</b>
Nonbinary/ genderqueer	<b>1.15</b> <b>(1.03–1.28)</b>	<b>0.009</b>	0.99 (0.88–1.12)	0.867	0.83 (0.69–1.00)	0.052	1.05 (0.90–1.23)	0.555	<b>1.33</b> <b>(1.17–1.52)</b>	<b>&lt;0.001</b>	<b>1.34</b> <b>(1.08–1.66)</b>	<b>0.008</b>

All models were adjusted for sexual identity, race/ethnicity, parental education, age, and region. Missing data on covariates were handled using multiple imputation with 50 imputations. Bold coefficients indicate statistical significance at  $p < 0.05$ . Referent group for “Sex assigned at birth × Gender identity” interactions is cisgender AMAB adolescents.

<sup>a</sup>See Figure 1, panel C.

<sup>b</sup>See Figure 1, panel A.

<sup>c</sup>See Figure 1, panel B.

aOR, adjusted odds ratio; CI, confidence interval.

prevalence rates of all substances relative to transgender adolescents and similar or lower prevalence rates of all substances relative to cisgender adolescents of the same sex assigned at birth.

Table 4 displays results from adjusted logistic regression models, across all substance use outcomes, testing (1) the independent effects of sex assigned at birth and gender identity, (2) interaction effects of sex assigned at birth and gender identity, and (3) the independent effect of gender identity in models that are stratified by sex assigned at birth. Among the full sample, gender identity was significantly associated with increased odds of substance use. Specifically, compared to cisgender sexual minority adolescents, transgender adolescents had greater odds of lifetime alcohol use, as well as lifetime and recent marijuana and cigarette use. Nonbinary/genderqueer adolescents had lower odds of recent binge drinking, but greater odds of lifetime marijuana and cigarette use than cisgender sexual minority adolescents.

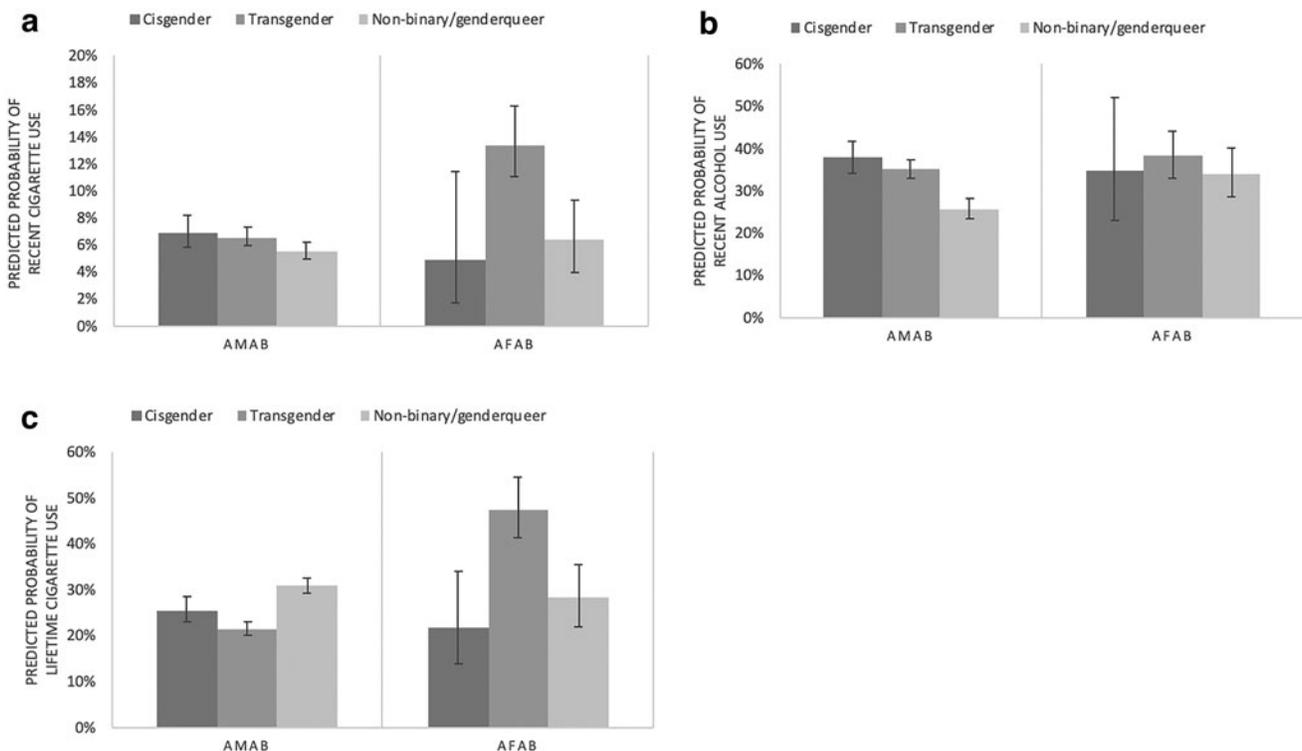
Interaction effects between sex assigned at birth and gender identity were significant for recent alcohol use, as well as lifetime and recent cigarette use. Nonbinary/genderqueer adolescents AFAB were more likely to report recent alcohol use than their cisgender AMAB counterparts. Transgender adolescents AFAB were more than twice as likely to report both lifetime and recent cigarette use than their cisgender AMAB peers (Table 4).

Given significant interaction effects between sex assigned at birth and gender identity, we also tested gender identity differences in the odds of substance use in models stratified by sex assigned at birth. No statistically significant gender identity differences were found in the odds of substance

use behaviors between adolescents AMAB with the exception of recent alcohol use, where nonbinary/genderqueer adolescents AMAB had lower odds of recent alcohol use than their cisgender AMAB peers. Conversely, among adolescents AFAB, both transgender and nonbinary/genderqueer respondents had greater odds of lifetime alcohol use, lifetime marijuana use, and lifetime and recent cigarette use compared to their cisgender AFAB counterparts. In addition, transgender adolescents AFAB had greater odds of recent marijuana use than cisgender adolescents AFAB. Finally, Figure 1 illustrates the predicted probabilities of recent cigarette use, recent alcohol use, and lifetime cigarette use based on odds ratio interactions (i.e., Sex assigned at birth  $\times$  Gender identity) from Table 4.

## Discussion

We assessed the prevalence of lifetime and recent alcohol, marijuana, and cigarette use by sex assigned at birth and gender identity using a large national sample of SGM adolescents. Our findings suggest that there are distinct differences in the prevalence of substance use on the basis of sex assigned at birth and gender identity and at the intersection of sex assigned at birth and gender identity. It is important to note that cisgender AMAB and AFAB sexual minority adolescents constituted our referent group for AMAB and AFAB models, respectively, and that cisgender sexual minority adolescents are already at elevated risk for substance use above and beyond cisgender heterosexual adolescents. In addition to this established risk, we also found that the pattern of risk on the basis of sex assigned at birth



**FIG. 1.** Predicted probabilities of substance use outcomes by sex assigned at birth and gender identity, adjusted for sexual identity, race/ethnicity, parental education, age, and region. (a) Predicted probabilities of recent cigarette use, (b) predicted probabilities of recent alcohol use, and (c) predicted probabilities of lifetime cigarette use.

and gender identity among gender minority adolescents varied depending on the type of substance. Notably, we observed elevated risk for cigarette smoking (lifetime and recent) for transgender adolescents AFAB (collapsed across sexual identities). These different patterns underscore the need for scholars to continue examining health behaviors at the intersection of sex assigned at birth and gender identity and the mechanisms that drive these differences.

Partly to assess the utility and validity of these data, we compared our findings to other national datasets and found both noteworthy similarities and differences. Two datasets allowed us to contextualize the findings from this study, including statewide data from the 2013–2015 CHKS<sup>1</sup> and the statewide 2016 Minnesota Student Survey (MSS).<sup>24</sup> Overall, we found that transgender adolescents in our study reported a lower prevalence of lifetime substance use than that reported in representative population-based samples of adolescents. Using data from the CHKS, Day et al.<sup>1</sup> found that 56% of transgender adolescents reported lifetime alcohol use, 35% reported cigarette use, and 40% reported marijuana use; among transgender adolescents in our sample, prevalence rates were 59%, 33%, and 35%, respectively. In addition, Eisenberg et al.<sup>24</sup> used the MSS (9th and 11th graders) and found that 16% of transgender and gender nonconforming girls and 9% of boys reported past-30-day binge drinking; we found that 13% of transgender girls and 10% of transgender boys reported recent binge drinking. Because the CHKS only asked about transgender identity and the MSS study combined adolescents with transgender or gender nonconforming identities, these comparisons only include our findings for transgender adolescents (i.e., exclude nonbinary/genderqueer adolescents).

Our study is unique in that we disaggregated (binary) transgender adolescents from nonbinary/genderqueer adolescents, the latter of whom were at lower risk for binge drinking, but higher risk for lifetime marijuana and cigarette use compared to their cisgender counterparts (Table 4, full sample main effects). Taken together, we found that transgender adolescents in our study were at lower risk for using substances compared to transgender/gender-nonconforming adolescents in other representative samples.<sup>1,24</sup> This is perhaps because the adolescents who responded to our online survey may have been better connected to social networks, such as those targeted as part of our recruitment. Online samples might reach adolescents who are less at risk, as this sampling technique typically misses adolescents who are homeless or do not have consistent access to the Internet.

These findings have implications for stakeholders interested in reducing disparities and improving health among SGM individuals. First, our study implies that a dual understanding of sex in combination with gender identity is important for the proper identification of substance use risk and potential intervention among SGM adolescents. Therefore, stakeholders (e.g., physicians, practitioners, and researchers) need to be aware of and properly assess for both when engaging SGM adolescents in research and practice. Second, relative to cisgender sexual minority adolescents, we found several instances where transgender and nonbinary/genderqueer adolescents were at elevated risk for substance use. Physicians and intervention scholars should recognize that transgender adolescents may require specific substance use-related prevention strategies. Finally, our study

confirms the importance for researchers to include comprehensive and diverse measures of sexual orientation and gender identities in their studies. Given that our findings underscore significant differences among SGM subgroups, scholars who study substance use should consider measuring the diversity of SGM identities in their epidemiological, prevention, and intervention scholarship.

### Limitations

Although the present study uses a large dataset and provides a unique perspective on the heterogeneity of substance use behaviors among SGM adolescents, the data are not nationally representative. In addition, the data are cross-sectional, which limits our ability to explore substance use across time and within the context of the gender transition process or general age-related changes in substance use. The online data collection process likely prevented SGM adolescents who were experiencing homelessness or living in shelters without Internet access to participate. We were also underpowered to detect differences in substance use behaviors between cisgender and gender minority adolescents who were AMAB. With greater power, we might expect to see interaction effects between sex assigned at birth and gender identity that enumerate differences among adolescents AMAB—hopefully future work can address this. Although necessary to retain power, the decision to dichotomize substance use measures eliminated our ability to test differences in the frequency of alcohol, marijuana, and cigarette use among SGM adolescents. Future studies should consider models that assess frequencies as a unique indicator risk above and beyond general reports of use. Finally, we did not include other illicit substances as outcomes in this article—yet there are serious concerns about opioid and other “hard drug” use among vulnerable populations. This deserves focused attention moving forward.

### Conclusion

Our findings offer novel insights through a comprehensive and systematic assessment of patterns of substance use among gender minority adolescents using a large sample of SGM adolescents; they also provide a first step in understanding within-group differences in SGM substance use and, in particular, differential risk for distinct substance use outcomes across groups defined by sex assigned at birth and gender identity. Our findings can inform future studies by serving as a framework for the assessment and recognition of the multiplicity of sexual identity, gender identity, and sex assigned at birth. Population-based surveys should continue their commitment to measuring sexual orientation and gender identity and the diversity therein.

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No competing financial interests exist.

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Address correspondence to:  
Ryan J. Watson, PhD

Department of Human Development and Family Sciences  
University of Connecticut  
348 Mansfield Road, U-1058  
Storrs, CT 06269

E-mail: ryanwatson@uconn.edu