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Longitudinal associations between minority stressors and substance use among sexual and gender minority individuals

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Abstract

Background: Sexual and gender minority individuals (SGM) are at increased risk for substance use and substance use problems compared to heterosexual individuals. A growing cross-sectional literature has demonstrated that minority stressors are associated with higher risk for substance use among SGM individuals. However, longitudinal research in this area is limited and existing longitudinal studies have focused almost exclusively on one type of substance use (alcohol) and one minority stressor (SGM victimization).

Methods: To extend the longitudinal body of research on associations between minority stressors and substance use, we utilized seven waves of data from a longitudinal cohort study of 1,091 SGM individuals assigned male at birth to examine associations between three minority stressors, general stress, and marijuana and alcohol use.

Results: At the within-person level, results indicated that when individuals experienced more internalized stigma, microaggressions, victimization, or general stress than usual, they reported more concurrent alcohol problems. Further, when individuals experienced more microaggressions or general stress than usual, they also experienced more concurrent marijuana use problems. However, stressors were not prospectively associated with higher rates of alcohol or marijuana problems six months later.

Conclusions: Findings indicate that minority stressors are consistently associated with more concurrent alcohol problems, while these associations may be less consistent for marijuana problems. The lack of prospective effects of minority stress on substance use points to the need for innovative methods for examining these effects, such as daily or weekly diary studies.

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Contributors

CD developed the research question, conducted all analyses, drafted all sections of the manuscript, and created tables and figures. BM and MN reviewed and edited the entire manuscript. All authors approved of the final manuscript before submission.

Conflicts of Interest

No conflict declared.

Keywords

Sexual Minority; Substance Use; Minority Stress; Longitudinal

1. Introduction

Sexual and gender minority (SGM) individuals are at increased risk for substance use (SU) and related problems compared to heterosexual individuals (Bränström et al., 2016; McCabe et al., 2009). Minority stress theory posits that SGM's increased risk is due to chronic stress they experience as a result of the stigmatization of SGM (Meyer, 2003). This stress is theorized to deplete SGM's coping resources, increasing emotion dysregulation and negative affect (Hatzenbuehler, 2009), which may increase reliance on substances to cope (Hatzenbuehler et al., 2011). Cross-sectional studies have provided support for the theorized associations between minority stressors and SU (Goldbach et al., 2014; Kidd et al., 2018). However, few longitudinal studies have examined these associations and have focused predominately on alcohol and tobacco.

A recent meta-analysis and systematic review compiled literature on associations between minority stress and SU – noting the predominance of cross-sectional studies (Goldbach et al., 2014; Kidd et al., 2018). Enacted stigma (e.g., victimization) has been cross-sectionally linked with higher likelihood of SU (Lowry et al., 2017; Marshal et al., 2013). Felt stigma (e.g., internalized stigma) has been linked with drug use (Goldbach et al., 2015; Kelly et al., 2015). Evidence for the association between felt stigma and alcohol use is mixed, with some finding felt stigma was associated with more alcohol problems (Feinstein and Newcomb, 2016) and others finding no association (Flood et al., 2013; Lea et al., 2014). These results indicate which SGM are at increased risk for SU but do not provide information about change within individuals over time, such as whether SU is more likely when SGM experience more minority stress than usual. Longitudinal research can provide data about within-person change and indicate directionality of associations (Bolger and Laurenceau, 2013).

Despite their advantages, few studies have used longitudinal methods to examine minority stress and SU. Those that have focus on enacted stigma and alcohol use. Findings indicate that when individuals experience more SGM victimization, they report more concurrent alcohol use (Newcomb et al., 2012), increases in binge drinking over the next 6 months (Dermody et al., 2016), and increases in quantity of cigarette use over the next 6 months (Newcomb, Heinz, et al., 2014). Additionally, when individuals experience more minority stress, they are more likely to experience greater alcohol use consequences one year later (Wilson et al., 2016) but not necessarily greater alcohol use. Findings provide evidence that SGM victimization is concurrently associated with alcohol and cigarette use, but longitudinal associations between other minority stressors and SU remain understudied.

Existing research is also limited by the operationalization of SU. Studies have often measured SU with binary variables (i.e., use vs. no use) or continuous measures of frequency of use and/or severity of SU problems (Goldbach et al., 2014; Kidd et al., 2018). Both approaches have limitations. Binary outcomes provide no information about severity of

use. Continuous and count outcomes confound likelihood of use with severity of use in samples including substance users and non-users (Atkins et al., 2013). For example, on the Alcohol and Cannabis Use Disorders Identification Tests (AUDIT/CUDIT), individuals who do not use the relevant substance receive scores of 0, while those who use alcohol/marijuana cannot have scores lower than 1. A score of 0 is qualitatively distinct from scores greater than 1 – which reflect severity of SU problems among users. This conflation can obscure associations between risk factors and SU/problems. Longitudinal hurdle models avoid this conflation by simultaneously modeling predictors of use (zero vs. non-zero value) and severity of SU problems among users (range of non-zero values), making them ideal for examining predictors of SU (Atkins et al., 2013).

1.1. Current Study

The goal of the current study is to extend existing literature by examining associations between three minority stressors (internalized stigma, microaggressions, victimization) and alcohol and marijuana use and problems using longitudinal hurdle modeling. Additionally, we examined associations between general stress and SU to allow for comparison to associations with minority stress. To examine duration of effects of stressors on SU and problems, we tested concurrent and prospective associations. We made the following hypotheses. Within-persons, when individuals experienced more minority or general stress than usual, they would be more likely to use alcohol and marijuana. Among those who used substances, experiencing more stress than usual would be associated with more alcohol and marijuana problems. Between-persons, individuals who tend to experience more stress would be more likely to use alcohol and marijuana at least once during the study and report more SU problems on average than those who tend to experience less stress. We explored whether minority stress predicted SU and problems when general stress was controlled.

2. Method

2.1. Participants and Procedures

Current analyses used data from an ongoing longitudinal cohort study of multilevel influences on HIV and SU among young men who have sex with men (YMSM) and transgender women (TW). Data collection began in February 2015 and is ongoing. Current analyses used data through November 2018. To achieve a multiple cohort, accelerated longitudinal design, YMSM/TW from two previous cohort studies were invited to join the current study, and a new cohort of YMSM/TW was recruited using venue-based recruitment, social media, and incentivized snowball sampling. At original cohort enrollment, participants were 16–20 years old, assigned male at birth, spoke English, and had a sexual encounter with a man in the previous year or identified as SGM. Participants could recruit serious partners at each visit; those who met eligibility criteria and were aged 16–29 were invited to join the cohort, while those who did not were invited to participate in a one-time visit (not included in current analyses). Cohort members could refer three peers. Participants completed study visits at 6-month intervals.

At the time of current analyses, participants had completed between 1 and 7 visits and data from all completed visits were used. The analytic sample included 4,932 observations from 1,091 individuals. See Table 1 for completion rates and demographics.

2.2. Measures

2.2.1. General Stress.—The 10-item Perceived Stress Scale (Roberti et al., 2006) assessed general stress. Participants were asked, "In the past month, how often have you [item]?" Example: "Felt difficulties were piling up so high that you could not overcome them." Items were rated from 0 (*never*) to 4 (*very often*) and summed. Cronbach's alphas ranged from .78–.81 across timepoints. General stress was missing for 8 observations.

2.2.2 Victimization.—Six items assessed victimization (Mustanski et al., 2016). Participants were asked, "In the past six months, how many times [item] because you are or were thought to be gay, bisexual, or transgender?" Example: "have you had an object thrown at you." Items were rated from 0 (*never*) to 3 (*three times or more*) and averaged (α=.76–.90). No data were missing.

2.2.3. Microaggressions.—Nine items from the Sexual Orientation Microaggression Inventory (Swann et al., 2016) assessed microaggressions. Participants were asked, "In the past 6 months, how often have you had the following experiences?" Example: "You heard someone say 'that's so gay' in a negative way." Items were rated from 1 (*not at all*) to 5 (*about every day*) and averaged (α=.88–.91). No data were missing.

2.2.4. Internalized Stigma.—The 8-item desire to be heterosexual subscale (Puckett et al., 2017) from a measure adapted from the Homosexual Attitudes Inventory (Nungesser, 1983) and the Internalized Homosexual Stigma Scale (Ramirez-Valles et al., 2010) assessed internalized stigma. Participants were asked how much they agreed with statements such as "Sometimes I wish I were not gay" on a scale of 1 (*strongly disagree*) to 4 (*strongly agree*). Items were averaged (α=.84–.89). Data on this variable was available for 4292 of 4932 observations because it was not administered at every visit.

2.2.5. Alcohol Problems.—The AUDIT (Saunders et al., 1993) assessed alcohol use and problems in the past six months. The AUDIT includes 10 items rated on different scales. For example, "How often do you have a drink containing alcohol?" was rated from 1 (*never*) to 5 (*4 or more times a week*). Responses were summed (α=.77–.82). No data was missing.

2.2.6. Marijuana Problems.—The revised CUDIT (Adamson et al., 2010) assessed marijuana use and problems in the past six months. CUDIT includes eight items rated on different scales. Responses were summed (α=.73–.74). No data was missing.

2.3. Data Analysis

Analyses were conducted in Mplus version 8.1. Analyses indicates that data were missing at random and full information maximum likelihood was used to handle this missingness. We used generalized linear mixed models (GLMMs) with negative binomial hurdle distributions to test associations between minority stressors and SU. In each model, a logistic regression

estimated the odds ratio (OR) for likelihood of having a zero versus non-zero value on AUDIT or CUDIT (i.e., use vs. no use) and a truncated negative binomial model estimated rate ratios (RRs) for the non-zero count (i.e., severity of SU problems among users). This parses the association between a stressor and SU into four associations (Atkins et al., 2013). At the between-person level, association between an individuals' average level of stress (across waves) and: (1) their likelihood of using the substance at least once during the study and (2) their average level of SU problems (non-zero count; aggregated across waves) are modeled. At the within-person level, association between an individuals' deviation from their usual level of stress (e.g., experiencing more/less stress than their average) and (3) their likelihood of using the substance during the same/next six-month period and (4) their deviation from their average level of SU problems during the same/next period are modeled.

Minority and general stressors were separated into within- and between-persons components by person-mean centering (within-persons) and grand-mean centering person-means (between-persons) (Enders and Tofighi, 2007). In each model, within and between-person components of one stress variable (e.g., internalized stigma) predicted AUDIT or CUDIT scores. Associations between within-person stressors and AUDIT/CUDIT were allowed to vary across individuals. In all models, the linear association between within-person age and SU was included to control for developmental changes in SU. This effect was modeled as fixed due to non-convergence when the effect was random. Age at Visit 1, sexual identity, race/ethnicity, and gender were controlled. AUDIT/CUDIT score at Visit 1 was also controlled for in prospective analyses. We tested concurrent and prospective (stressors predicting SU 6 months later) associations. We tested a second set of GLMMs in which we examined concurrent associations between minority stressors and SU/problems controlling for general stress.

3. Results

25.3% of participants reported no alcohol consumption at 12.5% of observations. 46.9% of participants reported no marijuana use at 30.2% of observations. Excluding observations with no alcohol or marijuana use respectively, the average AUDIT and CUDIT scores were 5.96 (*SD*=4.74) and 8.26 (*SD*=5.59). Bivariate multilevel correlations between stressors and demographics (Table 2) and GLMMs of associations between demographics and SU/problems (Table 3) were examined to identify demographic covariates. Results indicated that age, sexual identity, gender identity, and race/ethnicity were associated with both predictors and outcomes and should be controlled for in subsequent analyses. Next, concurrent (Table 4) and prospective (Table 5) GLMMs are discussed together in text.

3.1. Internalized Stigma

At the *within-persons level*, internalized stigma was not associated with likelihood of alcohol or marijuana use, concurrently (Table 4) or prospectively (Table 5). Internalized stigma was associated with more concurrent alcohol problems among drinkers (*OR*=1.04), such that when an individual experienced more internalized stigma than usual (i.e., than they experience on average), they reported more alcohol problems. Internalized stigma did not

predict alcohol problems six months later and was not concurrently or prospectively associated with marijuana problems.

At the *between-persons level*, internalized stigma was not associated with the likelihood of alcohol or marijuana use but was associated with more alcohol problems (*OR*=1.19; Table 4) and marijuana problems among users (*OR*=1.11).

3.2. Microaggressions

At the *within-persons level*, microaggressions were not associated with likelihood of alcohol or marijuana use, concurrently or prospectively. Microaggressions were associated with more concurrent alcohol and marijuana problems among those who consumed alcohol or marijuana, such that when an individual experienced more microaggressions than usual, they reported more alcohol and marijuana problems. Microaggressions did not predict alcohol or marijuana problems six months later.

At the *between-persons level*, microaggressions were associated with an increased likelihood of alcohol and marijuana use and with more alcohol and marijuana problems among users.

3.3. SGM Victimization

At the *within-persons level*, SGM victimization was not associated with likelihood of alcohol or marijuana use, concurrently or prospectively. SGM victimization was associated with more concurrent alcohol problems among drinkers, such that when an individual experienced more SGM victimization than usual, they also reported more alcohol problems. SGM victimization did not predict alcohol problems six months later and was not concurrently or prospectively associated with marijuana problems.

At the *between-persons level*, SGM victimization was associated with an increased likelihood of alcohol and marijuana use and with more alcohol and marijuana problems among users.

3.4. General Stress

At the *within-persons level*, general stress was not associated with likelihood of alcohol or marijuana use, concurrently or prospectively. General stress was associated with more concurrent alcohol and marijuana problems among those who consumed alcohol or marijuana, such that when an individual experienced more general stress than usual, they also reported more alcohol and marijuana problems. General stress did not predict alcohol or marijuana problems six months later.

At the *between-persons level*, general stress was not associated with likelihood of alcohol use but was associated with more alcohol problems among drinkers. General stress was associated with higher likelihood of marijuana use and more marijuana problems among those who used marijuana between-persons.

3.5. Minority Stress and SU – Controlling for General Stress

Next, we tested whether concurrent within-person associations between minority stressors and SU problems remained significant when we controlled for general stress (Table 6). In all

models, general stress continued to predict more SU problems within-persons. Microaggressions continued to predict more alcohol and marijuana problems and victimization continued to predict alcohol problems within-persons. Internalized stigma no longer predicted alcohol problems within-persons.

4. Discussion

This study used longitudinal hurdle models to examine concurrent and prospective associations between minority stress, likelihood of SU, and severity of SU problems among substance users. Experiencing more minority stress than usual was concurrently associated with more alcohol problems among drinkers. Only one minority stressor (microaggressions) predicted marijuana problems. There was a lack of within-person associations between minority stress and *likelihood* of SU. This suggests that minority stress may not increase risk for SU but may increase SU problems among substance users.

4.1. Within-Person Associations

We found that when individuals experiencing more minority stress than usual, they reported more concurrent alcohol problems. The association between SGM victimization and concurrent alcohol problems aligns with results of Newcomb and colleagues (2012). Although we are not aware of any longitudinal studies examining associations between other minority stressors and alcohol use, the association between microaggressions and concurrent alcohol problems is consistent with cross-sectional findings (Livingston et al., 2016; Lowry et al., 2017). Additionally, results linking internalized stigma and more alcohol problems provide added clarity to mixed cross-sectional findings (Feinstein and Newcomb, 2016; Lea et al., 2014). As many studies conflate likelihood of alcohol use with related problems, current findings contribute to a more nuanced understanding of associations between minority stress and alcohol use.

These results suggest that minority stress is not associated with increased risk of using alcohol but may increase problematic drinking among drinkers. This study is one of the first to demonstrate that minority stress is differentially associated with alcohol use versus problems, a pattern previously demonstrated by Wilson and colleagues (2016). This provides support for theories that minority stress increases SU problems by depleting coping resources (Hatzenbuehler, 2009). When an individual experience more minority stress than usual, they may be less able to effectively cope with this additional stress because their coping resources are taxed by their usual level of minority stress. This may lead those experiencing more stress than usual to be more likely to use substances to cope, which is associated with more SU problems but not more frequent use (Feinstein and Newcomb, 2016; Hatzenbuehler et al., 2011).

We found less consistent evidence for longitudinal associations between minority stress and marijuana problems, with only microaggressions being associated with concurrent marijuana problems. While there is limited research to compare findings to, there is some cross-sectional evidence that internalized stigma and victimization are associated with marijuana use (Goldbach et al., 2014; Kidd et al., 2018). However, we did not find evidence that individuals are more likely to use marijuana or have marijuana problems when they were

experiencing more internalized stigma or SGM victimization. As the same processes are theorized to link minority stress with alcohol and marijuana problems, the lack of within-person associations between internalized stigma or SGM victimization and marijuana problems is surprising. No marijuana use was reported at 30% of observations, likely resulting in lower power to detect effects for marijuana than alcohol problems (no use at 12% of observations).

Of note, minority stress did not predict SU problems six-months later, suggesting that the effects for these prospective associations may have been too small to detect across the six-month lag. However, there is limited existing evidence for long-term effects of minority stress on SU. We are aware of only two studies to find effects of minority stress on alcohol use/problems after 6 months or longer (Dermody et al., 2016; Wilson et al., 2016). Studies with longer lags between waves are ideal for examining trajectories of SU (e.g., Hatzenbuehler et al., 2008) and cumulative effects of stress on SU (e.g., Mustanski et al., 2016). However, some processes theorized to link minority stress and SU play out over shorter intervals. For example, if an individual experiences discrimination, they would be expected to increase SU when negative affect from that event is at its peak – soon after the stressor. While an increase in SU or problems may persist for some, others are likely to return to their usual level of SU, resulting in a weakening of the effect as temporal distance increases. Therefore, studies with short lags between assessments, like daily diary studies, may be more effective for detecting prospective associations between minority stress and SU. To further our understanding of the directionality and duration of these associations, additional longitudinal research using daily diary methods is needed.

4.2. Between-Person Associations

We found that individuals who tended to experience more minority stress experienced more alcohol and marijuana problems on average. Individuals who tended to experience more enacted stigma also were more likely to use alcohol and marijuana at least once during the study. This is consistent with cross-sectional research linking internalized stigma with alcohol problems (Feinstein and Newcomb, 2016; Slater et al., 2017) but not frequency of use (Flood et al., 2013; Slater et al., 2017) and two studies that demonstrated a cross-sectional link between enacted stigma and marijuana problems (Feinstein and Newcomb, 2016; Lee et al., 2016). Existing evidence for an association between internalized stigma and marijuana use is mixed (Feinstein and Newcomb, 2016; Goldbach et al., 2015), our findings provide added clarity to our understanding of these associations.

4.3. General Stress and SU

When individuals experienced more general stress than usual, they experienced more alcohol and marijuana problems, consistent with associations for minority stressors. Individuals who tended to experience more stress tended to report more alcohol and marijuana problems and were more likely to use marijuana. Overall, this pattern is generally consistent with that for associations between minority stressors and SU/problems, although some differences emerged in associations between minority vs. general stress and alcohol/marijuana use between-persons. Of note, the general stress measure assessed *perceived stress* from any source (including minority and non-minority stressors) including respondents' self-report of

the amount of stress they experienced *and* whether they felt capable of coping with it. Measures of minority stress assessed frequency of objectively stressful experiences but not subjective or perceived stress from these experiences. Despite these differences, there was overall similarity in associations between general versus minority stress and SU/problems.

Although differences in the aspects of stress assessed by general and minority stress measures make for a limited examination of the unique effects of general stress compared to minority stress, we examined concurrent associations between minority stressors and SU/problems controlling for general stress. General stress continued to predict alcohol and marijuana problems at both within and between-person levels. Three of the four concurrent within-person associations between minority stressors and SU problems remained significant. Experiencing more microaggressions or victimization than usual was associated with more alcohol problems and experiencing more microaggressions than usual was associated with more marijuana use problems when general stress was controlled for. However, internalized stigma no longer predicted alcohol problems. This indicates that objectively stressful experiences of enacted stigma continued to predict more alcohol problems even when perceived stress from any source (including minority stressors) was controlled for. Future research should continue to examine unique associations between objectively stressful experiences of minority stress, perceived stress arising from these experiences, non-minority stressors and SU problems.

4.4. Demographic Differences in SU

Consistent with prior research (e.g., Newcomb, Birkett, et al., 2014), SGM of color were at lower risk for alcohol and marijuana use compared to White SGM. However, Black SGM who used marijuana experienced more SU problems than White SGM. SGM who were older at Visit 1 were less likely to use marijuana, but being older at Visit 1 was associated with more SU problems among users. Alcohol and marijuana problems tended to decrease as individuals aged. Examination of developmental trajectories of SU among SGM across this age range is rare, with most studies examining early adolescence to late adolescence/emerging adulthood and finding an increase in SU across this period (e.g., Marshal et al., 2009). Given our sample's Visit 1 age range (16–29), the linear decrease in SU problems is also somewhat at odds with one study of heterosexuals, which found that alcohol problems increased in adolescence (12–17) and early emerging adulthood (18–21) and level off in late emerging and early adulthood (22–30)(Marmorstein, 2009). Further research on trajectories of SU among SGM is needed.

4.5. Limitations

Findings should be considered in light of limitations. First, the current sample included only SGM assigned male at birth, and there is a need for to determine whether findings generalize to SGM assigned female at birth. Second, the six-month lag between visits may have been too long to observe prospective effects of minority stress on SU. Therefore, we were unable to establish the directionality of associations between minority stress and SU. Future longitudinal research with shorter lags is needed to determine the directionality of these associations.

4.6. Conclusion

Despite limitations, the current study adds to limited longitudinal research on minority stress and SU. To our knowledge, this is the first study to longitudinally examine associations between minority stress and marijuana use. Findings indicate that minority stress was consistently associated with more concurrent alcohol problems, but this pattern was less consistent for marijuana problems. The presence of concurrent within-person associations between minority stress and SU and lack of prospective associations across a six-month lag have important implications. This suggest that a six-month lag may not be the most effective design for examining prospective associations between minority stress and SU as these effects may not last six months or may be too small to be detected so long after the stressor. Concurrent within-person associations between minority stress and SU have potentially important clinical implications as they suggest minority stress may contribute to SU problems among SGM. This highlights the need for interventions, like ESTEEM (Pachankis et al., 2015), that teach SGM skills for effectively coping with minority stress. It will be important for future research utilizing shorter lags to examine prospective associations between minority stress and SU.

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Highlights

- Minority stress was not associated with risk for substance use within-persons.
- More minority stress was associated with concurrent alcohol use problems.
- More microaggressions were associated with concurrent marijuana use problems.
- Minority stressors did not predict substance use problems six-months later.

Table 1.

Demographics and Completion Rates

Variable	***n***	***%***
Gender Identity		
Cisgender men	1004	92.0%
Transgender/non-binary	87	8.0%
Race/Ethnicity		
Black	368	33.7%
Latinx	326	29.9%
White	277	25.4%
Other	120	11.0%
Sexual Orientation		
Gay	762	69.8%
Bisexual	229	21.0%
Other	100	9.2%
Education		
Less than high school	186	17.0%
High school	273	25.0%
Some college	524	48.0%
Undergraduate degree	81	7.4%
Graduate school	27	2.5%
Age at Visit 1 *(M, SD)*	21.35 (3.03); range 16–30	
Visit Completed		
Visit 1	1091	100.0%
Visit 2	943	86.4%
Visit 3	871	79.8%
Visit 4	816	74.8%
Visit 5	611	56.0%
Visit 6	427	39.1%
Visit 7	173	15.9%
Number of Visits Completed		
1 Visit	88	8.1%
2 Visits	78	7.1%
3 Visits	105	9.6%
4 Visits	236	21.6%
5 Visits	219	20.1%
6 Visits	215	19.7%
7 Visits	146	13.4%

Note - data collection is ongoing.

Table 2.

Bivariate Multilevel Correlations and Descriptive Statistics for Minority and General Stress Variables

		Internalized Stigma	Microaggressions	Victimization	General Stress
Within-Person	Internalized Stigma	-			
Correlations	Microaggressions	.20**	-		
	Victimization	.12**	.24**	-	
	General Stress	.22**	.15**	.10**	-
Between-Person	Internalized Stigma	-			
Correlations	Microaggressions	.28**	-		
	Victimization	.16**	.37**	-	
	General Stress	.30**	.19**	.21**	-
	Age at Baseline	.001	−.08*	.02	−.06
	Sexual Identity: Bisexual	.28**	.04	−.02	.04
	Sexual Identity: Other	.07	−.06*	.12**	.14**
	Gender Minority	−.03	−.02	.01	−.01
	Race: Black	.17**	.09*	.08*	− 20**
	Race: Latinx	.02	.03	−.02	−.09*
	Race: Other	.13**	.08*	.07*	−.07
	Mean	1.60	1.93	.13	15.95
	Standard Deviation	.64	.80	.37	6.73
	Intraclass Correlation	.68	.50	.39	.50

Note. Sexual identity is dummy coded with gay as the reference group. Race is dummy coded with White as the reference group. Standardized coefficients for sexual identity and race variables were derived from multilevel regression models in which all dummy coded variables for either sexual identity or race were entered as simultaneous predictors.

* $p < .05$;

** $p < .01$.

Table 3.

Multilevel Bivariate Associations between Demographics and Substance Use

		AUDIT		CUDIT	
Predictor	**Level**	***Any Alcohol Use (OR)***	***Alcohol Use Problems (RR)***	***Any Cannabis Use (OR)***	***Cannabis Use Problems (RR)***
Within-Person Associations	Age	1.05	.93**	1.11	.96**
Between-Person	Age at Baseline	1.16	1.06**	.85*	1.02*
Associations	Sexual Identity: Bisexual	.74	.98	1.27	1.09*
	Sexual Identity: Other	.69	.88	.70	1.23**
	Gender Minority	.16**	1.07	1.07	1.03
	Race: Black	.19**	.74**	.56*	1.09*
	Race: Latinx	.38**	.93*	.73	1.02
	Race: Other	.41*	.87*	.71	1.08

Note. Sexual identity is dummy coded with gay as the reference group. Race is dummy coded with White as the reference group. Standardized coefficients for sexual identity and race variables were derived from multilevel regression models in which all dummy coded variables for sexual identity or race were entered as predictors.

* $p < .05$;

** $p < .01$.

Table 4.

Generalized mixed-effects hurdle models: Concurrent associations between stress and substance use

		AUDIT		CUDIT	
Predictor	**Level**	***Any Alcohol Use (OR)*** [a]	***Alcohol Use Problems (RR)*** [b]	***Any Marijuana Use (OR)*** [a]	***Marijuana Use Problems (RR)*** [b]
Internalized stigma	Within	.97	1.04 *	.96	1.03
	Between	1.09	1.19 *	1.04	1.11 *
Microaggressions	Within	1.00	1.06 *	.93	1.04 *
	Between	1.62 *	1.22 *	1.26 *	1.15 *
Victimization	Within	1.23	1.11 *	.96	1.03
	Between	1.79 *	1.46 *	2.56 *	1.39 *
General Stress	Within	1.01	1.01 *	1.00	1.01 *
	Between	.98	1.01 *	1.04 *	1.02 *

All models were estimated controlling for linear change in likelihood of substance use and substance use problems over time, age at baseline, sexual identity, gender identity, and race/ethnicity.

[a] coefficient for hurdle portion of model (likelihood of using substance);

[b] coefficient for count portion of model (count of substance use problems).

* $p < .05$.

Table 5.

Generalized mixed-effects hurdle models: Prospective associations between stress and substance use

		AUDIT		CUDIT	
Predictor	**Level**	***Any Alcohol Use (OR)*** [a]	***Alcohol Use Problems (RR)*** [b]	***Any Marijuana Use (OR)*** [a]	***Marijuana Use Problems (RR)*** [b]
Internalized stigma	Within	.83	.98	.84	1.00
	Between	.97	1.12 *	.97	1.04
Microaggressions	Within	1.15	.99	.94	1.02
	Between	1.49 *	1.06 *	1.09	1.06
Victimization	Within	.85	1.07	1.19	1.04
	Between	1.31	1.02	1.15	1.15
General Stress	Within	1.00	.99	1.00	1.00
	Between	.98	1.01 *	1.01	1.01 *

All models were estimated controlling for linear change in likelihood of substance use and substance use problems over time, age at baseline, sexual identity, gender identity, race/ethnicity, and AUDIT or CUDIT score at baseline.

[a] coefficient for hurdle portion of model (likelihood of using substance);

[b] coefficient for count portion of model (count of substance use problems).

* $p < .05$.

Table 6.

Generalized mixed-effects hurdle models: Concurrent associations between minority stress and substance use controlling for general stress

			AUDIT		CUDIT	
Model	**Predictor**	**Level**	***Any Alcohol Use (OR)*** [a]	***Alcohol Use Problems (RR)*** [b]	***Any Marijuana Use (OR)*** [a]	***Marijuanc Use Problems (RR)*** [b]
Model 1	Internalized stigma	Within	1.03	1.01	1.01	1.00
		Between	1.08	1.08 *	.93	1.05
	General Stress	Within	.99	1.01 *	1.00	1.01 *
		Between	1.00	1.03 *	1.03 *	1.02 *
Model 2	Microaggressions	Within	1.01	1.05 *	.99	1.04 *
		Between	1.62 *	1.17 *	1.20	1.12 *
	General Stress	Within	.99	1.01 *	1.01	1.01 *
		Between	1.00	1.03 *	1.03 *	1.02 *
Model 3	Victimization	Within	1.14	1.08 *	1.06	1.01
		Between	1.65	1.31 *	2.34 *	1.32 *
	General Stress	Within	.99	1.01 *	1.01	1.01 *
		Between	1.01	1.03 *	1.03 *	1.02 *

All models were estimated controlling for linear change in likelihood of substance use and substance use problems over time, age at baseline, sexual identity, gender identity, and race/ethnicity.

[a] coefficient for hurdle portion of model (likelihood of using substance);

[b] coefficient for count portion of model (count of substance use problems).

* $p < .05$;

** $p < .01$.