Drug and Alcohol Dependence 227 (2021) 109015

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Risk factors for elevations in substance use and consequences during the COVID-19 pandemic among sexual and gender minorities assigned female at birth

Christina Dyar [a,*], Ethan Morgan [a,b], Debra Kaysen [c], Michael E. Newcomb [d,e], Brian Mustanski [d,e]

[a] College of Nursing, The Ohio State University, United States
[b] Infectious Disease Institute, College of Nursing, The Ohio State University, United States
[c] Department of Psychiatry and Behavioral Sciences, Stanford University School of Medicine, United States
[d] Department of Medical Social Sciences, Feinberg School of Medicine, Northwestern University, United States
[e] Institute for Sexual and Gender Minority Health and Wellbeing, Northwestern University, United States

ARTICLE INFO

Keywords:
Sexual and gender minorities
COVID
Substance use
Contexts of use

ABSTRACT

Background: Problematic substance use (SU) has increased substantially during the COVID-19 pandemic. While studies have identified risk factors for problematic SU during the pandemic (e.g., anxiety, depression, using substances to cope), these studies have been predominately cross-sectional, rarely examined changes in SU contexts during the pandemic as potential risk factors, and neglected sexual and gender minorities (SGM) – a health disparity population disproportionately impacted by substance use disorders and the pandemic.
Method: We utilized two waves of data collected one month apart from a sample of 212 SGM assigned female at birth who used alcohol and/or cannabis (18–25 years old) collected between August 2020-February 2021. We examined associations between potential risk factors (i.e., retrospectively reported changes in anxiety/depression and in using substances in different contexts since before the pandemic): and 1) retrospectively reported changes in alcohol and cannabis consumption; 2) coping motives for use and SU consequences; and 3) subsequent changes in coping motives and consequences.
Results: An increase in solitary SU was a robust risk factor for concurrent and prospective increases in SU, coping motives, and consequences. Increases in SU with romantic partners were associated with concurrent increases in alcohol/cannabis consumption and consequences. Increases in anxiety and depression were associated with concurrent increases in SU and higher coping motives and consequences.
Conclusions: Results indicate that solitary SU and increases in SU with romantic partners are robust risk factors for increases in SU and consequences in the context of the pandemic. Further, findings provide support for the self-medication theory of substance use.

1. Introduction

Substance use (SU) patterns have changed during the COVID-19 pandemic (Graupensperger et al., 2021; Pollard et al., 2020; Rolland et al., 2020), with individuals who used substances prior to the pandemic experiencing increases in quantity and frequency of SU and related consequences (Dumas et al., 2020; Gritsenko et al., 2020; Janulis et al., 2021). In the general population, several risk factors for increases in SU during the pandemic have been identified, including COVID anxiety, anxious and depressive symptoms, and using substances to cope (Dumas et al., 2020; Wardell et al., 2020). Sexual and gender minorities (SGM) were at heightened risk for SU disorders pre-pandemic (Kerridge et al., 2017) and may be disproportionately burdened by psychosocial impacts of the pandemic, such as COVID anxiety (Kamal et al., 2021; Ruprecht et al., 2021). Among sexual minorities, disparities in SU are particularly pronounced for those assigned female at birth (AFAB; Krueger et al., 2020) and the pandemic may have a more detrimental impact on their SU than sexual minorities assigned male at birth (Salerno et al., 2021). This makes SGM-AFAB a particularly high risk population with regard to SU during the pandemic; however, little is known

* Corresponding author at: College of Nursing, The Ohio State University, 393 Newton Hall, 1585 Neil Ave, Columbus, OH, 43210, United States.
E-mail addresses: dyar.13@osu.edu, dyar.christina@northwestern.edu (C. Dyar).

https://doi.org/10.1016/j.drugalcdep.2021.109015
Received 13 May 2021; Received in revised form 9 July 2021; Accepted 11 July 2021
Available online 1 September 2021

about their risk factors for SU in this context.

The literature on risk factors for SU problems during the pandemic is limited by its infrequent consideration of SU contexts and reliance on cross-sectional methods. Pre-pandemic studies have demonstrated that SU contexts (e.g., who an individual uses substances with) influence SU behaviors among the general population (Connor et al., 2014; Keough et al., 2018) and SGM (Dyar et al., 2021; Fairlie et al., 2018). While social distancing has led to dramatic changes in SU contexts for many, few studies have examined the effects of these changes (for an exception see Dumas et al., 2020), and we are not aware of any to have done so among SGM. Second, most studies of risk factors for problematic SU during the pandemic have been cross-sectional. The few existing longitudinal studies have focused on changes from pre-pandemic to during the pandemic (Bartel et al., 2020) but not changes in SU from earlier to later in the pandemic, limiting our understanding of how SU has continued to change as the pandemic progresses. The current study aims to address these limitations by examining associations between retrospectively reported changes in anxiety, depression, and SU contexts since before the pandemic and: a) concurrent changes in alcohol and cannabis use quantity and frequency; b) recent coping motives for use and SU consequences; and c) changes in coping motives and SU consequences over a one-month period in a sample of SGM-AFAB (data collected August 2020-February 2021).

1.1. COVID anxiety and SU outcomes

Self-medication theory posits that stress may overburden individuals' coping resources and increase reliance on substances to cope, which in turn contributes to the development of problematic use (Khantzian, 1997). Consistent with self-medication theory, COVID anxiety and elevations in anxious and depressive symptoms during the pandemic have been linked to elevations in SU and coping motives (Lechner et al., 2020; McPhee et al., 2020). While these studies provide important insights, they have not examined how COVID anxiety and anxious/depressive symptoms may prospectively predict further elevations in SU, coping motives, or consequences of use as the pandemic progresses. Further, these studies have focused predominately on alcohol, with few examining cannabis.

Despite elevated rates of SU among SGM and evidence that they may experience disproportionate negative effects of the pandemic, few studies have examined correlates of changes in SU among SGM. In an exception, Salerno et al. (2021) found that higher psychological distress was associated with retrospectively reported increases in alcohol consumption since before the pandemic among SGM-AFAB, but not among SGM assigned male at birth. Further research is needed to advance our understanding of risk factors for elevations in SU and consequences during the pandemic for SGM.

1.2. SU contexts and SU outcomes

The pre-pandemic literature demonstrates that SU contexts are associated with SU quantity, frequency, and consequences in the general population. For example, drinking with friends has been associated with more alcohol consumption and consequences than drinking with family members (Connor et al., 2014). There is mixed evidence for the effects of drinking with romantic partners, with some finding it to be associated with less alcohol consumption (Rodriguez et al., 2016) and others finding no association (Keough et al., 2015). Solitary drinking has been consistently linked to more drinking consequences (Keough et al., 2018), and this has been attributed to higher coping motives for solitary drinking (Creswell et al., 2014). Studies of cannabis use contexts are less common; however, solitary cannabis use has been linked with more problematic use (Creswell et al., 2015).

Despite high rates of problematic use among SGM, few studies have examined SU contexts in this population. It has been theorized that SU contexts may be particularly important for SGM due to perceptions that SU is more normative in this population and the centrality of alcohol-centric contexts for socialization within the SGM community (e.g., bars; Condit et al., 2011). Among SGM-AFAB, solitary alcohol and cannabis use and using substances in multiple contexts have been linked to more problematic use and consequences (Dyar et al., 2021; Fairlie et al., 2018). Thus, similar associations between some SU contexts and problematic use are present in both general population and SGM samples. However, it is unclear whether other associations between contexts and problematic use may generalize across populations.

Despite links between drinking contexts and outcomes and dramatic changes in drinking contexts experienced by many during the pandemic, few studies have examined changes in SU contexts or how these changes may be associated with SU outcomes during the pandemic. Jackson et al. (2021) found that college students reported decreases in drinking with friends and roommates, increases in drinking with family members, and little change in drinking with romantic partners during the pandemic. Retrospectively reported increases in solitary drinking since before the pandemic have been linked to concurrent increases in alcohol use problems (Wardell et al., 2020), while Dumas et al. (2020) found that COVID anxiety was associated with retrospectively reported increases in solitary drinking since before the pandemic. One qualitative study found that SGM-AFAB reported drinking more with roommates and partners in order to cope with negative affect due to the pandemic (Cerezo et al., 2021). Further research is necessary to understand how changes in SU contexts during the pandemic may be associated with increases in negative SU outcomes documented during this period.

1.3. Current study

The current study aimed to further our understanding of risk factors for increases in SU and consequences during the COVID-19 pandemic among a high risk population – SGM-AFAB. Specifically, Aim 1 was to examine associations between hypothesized risk factors (i.e., COVID anxiety; retrospectively reported changes in anxiety and depression; retrospectively reported changes in SU contexts) and retrospectively reported changes in alcohol and cannabis consumption. Aim 2 was to examine associations between hypothesized risk factors and recent coping motives and SU consequences. Aim 3 was to examine prospective associations between these potential risk factors and subsequent changes in coping motives, consequences, and SU quantity and frequency over a one-month period (i.e., changes in motives in the month between the baseline and follow-up assessments).

We hypothesized that higher COVID anxiety and higher retrospectively reported increases in anxiety and depression since before the pandemic would be associated with retrospectively reported increases in alcohol and cannabis consumption since before the pandemic (Aim 1); higher coping motives for SU and consequences (Aim 2); and subsequent increases in coping motives, consequences, and SU quantity and frequency over the next month (Aim 3). We expected that retrospectively reported increases in drinking and using cannabis with friends and alone would be associated with retrospectively reported increases in alcohol and cannabis consumption (Aim 1); higher coping motives and consequences (Aim 2); and increases in coping motives, consequences, and SU quantity and frequency over the next month (Aim 3). We expected that retrospectively reported increases in drinking and using cannabis with family members would be associated with retrospectively reported decreases in alcohol and cannabis consumption (Aim 1) and lower coping motives and consequences (Aims 2 and 3). We also examined associations between retrospectively reported changes in SU with romantic partners, but we did not make hypotheses regarding the direction of these associations given mixed evidence.

2. Method

2.1. Participants and procedures

The current analyses used data from an ongoing longitudinal study of SU among SGM-AFAB. Participants were recruited via online advertisements on social media. Recruitment began in August 2020 and is ongoing. The study included a baseline assessment (day 0), a 30-day ecological momentary assessment study (days 1–30), and a follow-up assessment (completed within two weeks of day 30). This study uses data from the baseline and follow-up assessments. Eligible participants were living in the U.S., 18–25 years old, identified as lesbian, bisexual, pansexual, or queer, were assigned female at birth, and met alcohol or cannabis use criteria (i.e., reported having 4 or more drinks on a single occasion at least twice and/or using cannabis on at least three days in the past month). As of February 2021, a total of 212 individuals had participated. All participants completed the baseline assessment and 200 (94.3 %) completed the follow-up. 170 of the 200 participants who completed the follow-up survey did so on the day after the last daily diary surveys was sent, and all but one participant completed the survey less than one week after the final daily diary survey. Participants were paid $20 for the baseline and $20 for the follow-up.

The 212 participants who had participated as of February 2021 were included in the current analyses. See Table 1 for demographic information. The sample was comprised predominately of people of color, with 40.6 % of the analytic sample identifying as non-Latinx White. There were a sizeable number of gender minority participants (26.4 %).

2.2. Measures

2.2.1. COVID anxiety

COVID Anxiety was measured at baseline using five-items (α = .81) that included questions about how worried participants had been over the past 30 days about: being infected by the coronavirus, friends or family being infected, having one's own or friends'/family member's physical or mental health affected by the pandemic (Merikangas et al., 2020). Items were measured on a scale of 1 (not at all) to 5 (extremely).

2.2.2. Retrospective changes in anxiety, depression, alcohol and cannabis use quantity and frequency

Retrospective changes in anxiety, depression, alcohol and cannabis use quantity and frequency were assessed using one item each at baseline. Participants were asked to "indicate the extent to which you have experienced the following due to the COVID-19 pandemic." Individual items included: increase in anxiety, increase in depression, increases in frequency of drinking, increase in number of drinks you have on a typical day when you drink, increase in frequency of cannabis use, and increase in quantity of cannabis you use. Items were measured in a scale of 1 (not at all) to 6 (very large increase).

Table 1
Demographics of Analytic Sample at Baseline (N = 212).

Demographic Variable	*n*	%
Sexual Identity		
Lesbian	55	25.9%
Bisexual	65	30.7%
Pansexual	51	24.1%
Queer	41	19.3%
Race/Ethnicity		
White	86	40.6%
Black	37	17.5%
Latinx	52	24.5%
Other Race/Ethnicity	37	17.5%
Gender Identity		
Cisgender Women	156	73.6%
Genderqueer/Non-Binary	38	17.9%
Another Identity	18	8.5%
Substance Use Criteria Met		
Alcohol Only	54	25.5%
Cannabis Only	68	32.1%
Alcohol and Cannabis Use	90	42.5%
Age (*M, SD*)	22.35 (2.07)	

2.2.3. Retrospective changes in alcohol and cannabis use contexts

Retrospective changes in alcohol and cannabis use contexts were assessed at baseline by asking participants "During the past 30 days, how has your engagement in the following activities changed relative to *before* the COVID-19 pandemic?" Items asked about drinking and using cannabis with friends, romantic partners, family members, and alone. Items were measured on a scale ranging from 1 (I have not done this at all because of COVID) to 6 (I do this much more than before COVID). Participants could also select a not-applicable option (I did not do this before COVID and do not do this now). Those who selected not applicable were excluded from analyses of that specific context.

2.2.4. Alcohol and cannabis use motives

Alcohol and cannabis use coping motives were assessed at baseline and follow-up by asking participants to think about the past 30 days and did not refer to the pandemic. *Coping motives for alcohol use* were assessed using a six-item version (α = .80) of the coping motives subscale of the Drinking Motives Measure (Grant et al., 2007). *Coping motives for cannabis use* were assessed using a 2 item version (α = .87) of the coping motives subscale of the Comprehensive Marijuana Motives Measure (Lee et al., 2009). Responses for both measures were assessed on a scale of 1 (almost never/never) to 5 (almost always/always).

2.2.5. Alcohol and cannabis use consequences

Alcohol and cannabis use consequences were assessed at baseline and follow-up using the Brief Young Adult Alcohol Consequences Questionnaire (24 items; Kahler et al., 2005) and the Brief Marijuana Consequences Measure (21 items; Simons et al., 2012). Participants were asked to indicate whether they had experienced each consequence in the past 30 days on a scale of 0 (no) and 1 (yes). Cronbach's alphas indicated high internal consistency (α = .86–.87).

2.2.6. Alcohol and cannabis use quantity and frequency

Alcohol and cannabis use quantity and frequency were assessed using four items from the AUDIT and CUDIT-R (Alcohol/Cannabis Use Disorder Identification Test) (Adamson et al., 2010; Saunders et al., 1993). Frequency was assessed by the items: "How often do you [have a drink containing alcohol]/[use marijuana]?" on a scale of 0 (never) to 4 (4 or more times a week). Quantity was assessed by the items: "How many drinks containing alcohol do you have on a typical day when you are drinking?" on a scale of 0 (1 or 2) to 4 (10 or more) and "How many hours were you stoned or high on a typical day when you had been using marijuana?" on a scale of 0 (less than 1) to 4 (7 or more).

2.3. Analytic plan

Analyses were conducted in Mplus Version 8.4 and utilized robust maximum likelihood estimation. Less than 1% of data were missing and were handled using pairwise deletion. First, a series of regressions examined the concurrent associations between an independent variable at baseline (i.e., COVID anxiety, retrospectively reported changes in anxiety or depression, retrospectively reported changes in SU contexts) and a dependent variable at baseline (i.e., retrospectively reported changes in drinking or cannabis consumption). All analyses included the following covariates: age at baseline, months since beginning of pandemic, sexual identity, gender identity, and race/ethnicity. The number of individuals included in regressions examining associations

that included SU contexts varied based on the number of individuals who indicated that each context was not applicable to them (i.e., they did not use a substance in a specific context prior to or during the pandemic; see Table 2).

Second, a series of regressions examined the prospective associations between an independent variable at baseline (i.e., COVID anxiety, retrospectively reported changes in anxiety or depression, retrospectively reported changes in SU contexts) and SU consequences and coping motives at baseline. Third, a series of prospective models that paralleled the second set of regressions was conducted. In these analyses, the association between the independent variable at baseline and SU consequences, coping motives, and SU quantity and frequency at follow-up were examined, controlling for the outcome at baseline.

3. Results

Descriptive information is presented in Table 2. Participants completed their baseline assessment between August 2020 and February 2021 (5–11 months since the start of the pandemic; $M = 6.73$ months, $SD = 1.59$ months). At baseline, 88.3% of participants reported using cannabis in the past month and endorsed use on an average of 12.5 days in the past 30 days ($SD = 10.8$). A total of 98.1% of participants reporting drinking alcohol in the past month, with an average frequency of 2.39 (between 2–4 times a month [2] and 2–3 times a week [3]; $SD = .95$). Participants drank an average of 3 or 4 drinks on a typical drinking day ($M = .88$; $SD = .84$; between 1 or 2 [0] and 3 or 4 [1]) and reported heavy episodic drinking (4 or more drinks on one occasion) on 2.7 days in the past month ($SD = 3.0$). At baseline, most participants reported experiencing increases in anxiety and depression since before the pandemic (91.0%–95.3%). Fewer participants reported increases in drinking (54.7% increased frequency; 43.4 % increased quantity; 40 % increased both quantity and frequency). Slightly more participants reported increases in cannabis use frequency (67.0%) or quantity (54.2%) and 53.8% reported increases in both cannabis frequency and quantity. Most participants reported decreases in drinking with friends (82.5%) and family members (54.3%) and increases in drinking alone (53.4%). Change in drinking with romantic partners was more variable, with 37.3% decreased frequency, 40.3% no change, and 22.4% increased frequency. A similar pattern was observed for changes in cannabis use contexts, with most cannabis using participants reporting decreases in using with friends (60.8%) and increases in using alone (63.1%). Although only 67 participants reported using cannabis with family members, the largest proportion reported decreases in use with family (40.3%), followed by no change (32.8%), and increases (26.9%). As with drinking with partners, changes in cannabis use with romantic partners was variable, with 20.2% reporting decreased frequency, 42.3% no change, and 37.5% increased frequency.

Table 2
Descriptive Statistics at Baseline.

Variable	M	SD	Range	Not Applicable (*n*)	Valid *n*
COVID anxiety	3.61	.83	1–5	–	212
Change in anxiety	4.30	1.38	1–6	–	212
Change in depression	4.17	1.55	1–6	–	212
Change in drinking with friends	2.29	1.26	1–6	18	194
Change in drinking with romantic partner	3.49	1.49	1–6	78	134
Change in drinking with family	3.03	1.74	1–6	83	129
Change in drinking alone	4.36	1.39	1–6	66	146
Change in using cannabis with friends	3.06	1.62	1–6	31	181
Change in using cannabis with romantic partner	4.07	1.46	1–6	108	104
Change in using cannabis with family	3.27	1.76	1–6	145	67
Change in using cannabis alone	4.66	1.34	1–6	52	160
Change in drinking frequency	2.44	1.56	1–6	–	212
Change in drinking quantity	2.04	1.46	1–6	–	212
Change in cannabis use frequency	2.95	1.77	1–6	–	212
Change in cannabis use quantity	2.51	1.71	1–6	–	212
Drinking consequences	5.37	4.48	0–23	–	212
Drinking to cope	2.17	.88	1–5	–	212
Cannabis consequences	5.01	4.51	0–20	–	212
Using cannabis to cope	2.36	1.26	1–5	–	212
Drinking frequency	2.39	.95	0–4	–	212
Drinking quantity	.88	.84	0–4	5	207
Cannabis use frequency	2.53	1.34	0–4	–	212
Cannabis use quantity	1.97	.97	0–4	24	188

Not applicable refers to individuals who indicated not using alcohol/cannabis in each context prior to or during the pandemic.

3.1. Concurrent associations with retrospectively reported changes in SU consumption

First, we conducted a series of regressions to examine associations between hypothesized risk factors at baseline and retrospectively reported changes in alcohol and cannabis consumption since before the pandemic (Table 3). Retrospectively reported increases in anxiety and depression since before the pandemic were associated with retrospectively reported increases in alcohol and cannabis use quantity and frequency. However, COVID anxiety was only significantly associated with increases in drinking (but not cannabis) quantity and frequency. Retrospectively reported increases in using cannabis with friends were associated with increases in cannabis use quantity and frequency. Changes in drinking with friends, however, were not associated with changes in drinking quantity or frequency. Changes in SU with family members was not significantly associated with changes in alcohol or cannabis use. Increases in drinking with a romantic partner and alone were both associated with increases in drinking quantity and frequency. Similarly, increases in using cannabis with a romantic partner or alone were associated with increases in cannabis use quantity and frequency.

3.2. Concurrent associations with drinking consequences and coping motives

Next, we conducted a series of regressions to examine associations between hypothesized risk factors at baseline and recent SU consequences and coping motives at baseline (Table 4). Retrospectively reported increases in anxiety and depression since before the pandemic and higher COVID anxiety were associated with more alcohol and cannabis use consequences and more motivation to drink and use cannabis to cope. Changes in using substances with friends and family or changes in drinking with romantic partners were not significantly associated with changes in SU consequences or motives for use. Increases in use of cannabis with romantic partners were associated with more cannabis use consequences but not with coping motives for cannabis use. However, increases in solitary alcohol and cannabis use were associated with more drinking consequences and higher coping motives for alcohol and cannabis use.

3.3. Prospective associations with changes in drinking consequences and coping motives

Next, we conducted a series of regressions to examine associations between hypothesized risk factors at baseline and changes in SU consequences, coping motives, and SU quantity and frequency over the subsequent month (assessed at follow-up, one month after baseline). COVID anxiety and changes in depression since before the pandemic were not significantly associated with subsequent changes in consequences or motives for use. Surprisingly, increases in anxiety since

Table 3
Associations with Self-Reported Change in Substance Use Frequency and Quantity.

	Change in Drinking Frequency			Change in Drinking Quantity			Change in CU Frequency			Change in CU Quantity		
Predictor	β	*p*	95% *CI*	β	*p*	95% *CI*	β	*p*	95% *CI*	β	*p*	95% *CI*
COVID anxiety	**.24**	**.001**	**.11, .37**	**.15**	**.03**	**.02, .52**	.13	.06	−.01, .27	.08	.27	−.06, .22
Change in anxiety	**.22**	**.001**	**.09, .35**	**.21**	**.001**	**.08, .33**	**.30**	**< .001**	**.18, .43**	**.28**	**< .001**	**.15, .42**
Change in depression	**.22**	**< .001**	**.10, .33**	**.20**	**.001**	**.09, .33**	**.36**	**< .001**	**.23, .49**	**.28**	**< .001**	**.14, .42**
Change in using with friends	.12	.08	−.01, .26	.06	.43	−.09, .20	**.16**	**.03**	**.02, .31**	**.17**	**.03**	**.02, .32**
Change in using with romantic partner	**.30**	**.001**	**.14, .46**	**.27**	**.003**	**.10, .45**	**.28**	**.01**	**.08, .47**	**.23**	**.02**	**.04, .42**
Change in using with family	.10	.26	−.08, .29	.04	.68	−.15, .24	.22	.06	−.01, .45	.13	.29	−.11, .37
Change in using alone	**.38**	**< .001**	**.20, .56**	**.27**	**.003**	**.09, .45**	**.56**	**< .001**	**.41, .71**	**.46**	**< .001**	**.30, .62**

All models controlled for age, months since COVID, sexual identity, gender identity, and race/ethnicity. Standardized regression coefficients are presented.

Table 4
Associations between Self-Reported Change in Substance Use Contexts and Concurrent Outcomes.

	Drinking Consequences			Drinking to Cope			Cannabis Consequences			Using Cannabis to Cope		
Predictor	β	*p*	95% *CI*	β	*p*	95% *CI*	β	*p*	95% *CI*	β	*p*	95% *CI*
COVID anxiety	**.14**	**.02**	**.02, .26**	**.19**	**.01**	**.05, .33**	**.17**	**.01**	**.04, .31**	**.21**	**.01**	**.06, .36**
Change in anxiety	**.13**	**.04**	**.01, .25**	**.19**	**.002**	**.07, .31**	**.19**	**.002**	**.07, .31**	**.22**	**.002**	**.08, .35**
Change in depression	**.14**	**.04**	**.01, .27**	**.26**	**< .001**	**.14, .38**	**.26**	**< .001**	**.12, .39**	**.30**	**< .001**	**.18, .43**
Change in using with friends	−.02	.76	−.15, .11	−.06	.35	−.19, .07	−.02	.83	−.16, .13	−.15	.05	−.29, .01
Change in using with romantic partner	−.04	.65	−.21, .13	.03	.78	−.17, .22	**.18**	**.02**	**.02, .33**	.08	.38	−.11, .27
Change in using with family	−.05	.57	−.22, .12	−.02	.81	−.22, .17	−.06	.60	−.30, .17	−.08	.56	−.34, .19
Change in using alone	**.32**	**< .001**	**.18, .46**	**.22**	**.03**	**.02, .42**	.14	.08	−.01, .29	**.18**	**.04**	**.002, .36**

All models controlled for age, months since COVID, sexual identity, gender identity, and race/ethnicity. Standardized regression coefficients are presented.

before the pandemic were associated with decreases in drinking frequency over the next month (β = -.11, p = .02; 95% CI: -.20, -.02). Further, changes in SU with friends or family were not prospectively associated with changes in consequences or motives for use, frequency of cannabis use, or quantity of alcohol or cannabis use. Increases in drinking with romantic partners were associated with increases in drinking frequency over the subsequent month (β = .26, p < .001, 95% CI: .12, .40) and marginally associated with increases in drinking consequences (β = .12, p = .06, 95% CI: -.004, .24). Increases in using cannabis alone were associated with subsequent increases in cannabis use consequences (β = .14, p = .02; 95% CI: .02, .27) and using cannabis to cope (β = .16, p = .04; 95% CI: .01, .30) one month later. Changes in drinking alone were not prospectively associated with drinking consequences or coping motives for drinking.

4. Discussion

The current study furthers our understanding of risk factors for increased SU and consequences during the COVID-19 pandemic among SGM-AFAB – a health disparity population disproportionately impacted by SU and the pandemic (Kamal et al., 2021). Nearly all participants reported more anxiety and depression in the past month compared to before the pandemic, while approximately half also reported increases in alcohol and cannabis use. Increases in solitary alcohol and cannabis use were strong risk factors for increases in quantity and frequency of SU, coping motives, and consequences. Increases in SU with romantic partners were associated with increases in alcohol and cannabis consumption and consequences but not coping motives for use. Interestingly, changes in using substances with friends were generally not associated with changes in SU, consequences, or coping motives.

Results indicate that increases in solitary drinking were associated with concurrent increases in alcohol consumption and higher levels of drinking to cope and consequences. These findings are consistent with the few studies to have examined solitary drinking during the pandemic in the general population (Wardell et al., 2020), and thus, indicate that this association generalizes to SGM-AFAB. Our findings build upon these studies by demonstrating a similar pattern of associations for solitary cannabis use, which has not previously been examined in the context of the pandemic and examining prospective associations. Our prospective models indicate that increases in solitary cannabis use since before the pandemic were not only associated with higher coping motives and cannabis use consequences, but were also associated with continued increases in these outcomes over the next month. This indicates that despite being 6–11 months into the pandemic, SGM who had increased their solitary cannabis use were continuing to experience increases in their coping motives and cannabis use consequences. These findings suggest that solitary cannabis use is a strong risk factor for developing more problematic cannabis use during the pandemic and that SGM who use cannabis alone may be at risk for developing problematic use that could require intervention. Given that solitary cannabis use and coping motives for cannabis use are noted to be a risk factor for the development of problematic use both in the context of the pandemic and in pre-pandemic research, clinicians may want to examine patterns of cannabis use contexts and motives for cannabis use with clients who are experiencing problematic cannabis use and work with clients who use cannabis to cope to implement alternative coping strategies.

Interestingly, increases in drinking alone were not associated with subsequent increases in drinking to cope or consequences. It is possible that this may indicate that solitary use is a stronger risk factor for cannabis than for alcohol. Alternatively, this pattern of findings may have resulted from the sample's inclusion of more heavy cannabis users (33.5% reported using cannabis four or more times a week) than heavy alcohol users (12.9% reported drinking four or more times a week), which may have resulted in higher power to detect associations with cannabis than alcohol outcomes.

Increases in SU with romantic partners were associated with concurrent increases in quantity and frequency of SU during the pandemic as well as alcohol and cannabis use consequences, but were not associated with coping motives. Associations between changes in SU with romantic partners and related consequences were nuanced, with increases in cannabis use with partners being associated with concurrently elevated cannabis use consequences while increases in drinking with partners were marginally associated with subsequent increases in drinking consequences. The reason for the different temporal associations for alcohol and cannabis use consequences is unclear and should be replicated in future studies. Research indicates that partners influence each other's substance use behavior over time, with partners' levels of substance use tending to converge (Fleming et al., 2010; Homish and

Leonard, 2005; Homish et al., 2007). This may help to explain why increases in using substances with partners demonstrated some of the most consistent associations with increases in quantity, frequency, and consequences of alcohol and cannabis use. Notably, changes in substance use have been linked to intimate partner violence risk, with increases in substance use predicting an increased likelihood of IPV victimization and perpetration and vice versa (Easton and Crane, 2016; Jennings et al., 2012; Testa et al., 2003). Therefore, the changes in substance use reported in the current study may be linked to increased rates of intimate partner violence reported in the context of the pandemic (Boserup et al., 2020).

Contrary to expectations, changes in using with friends were not associated with changes in alcohol consumption, coping motives, or SU consequences. This is inconsistent with pre-pandemic research, which has linked drinking with friends to higher alcohol consumption and consequences (Connor et al., 2014). However, it is notable that most participants reported decreases in how frequently they drank with friends, likely as a result of government restrictions and CDC guidelines encouraging social distancing. Taking this into consideration, one interpretation of this finding is that despite decreases in SU with friends, participants did not experience decreases in alcohol consumption or alcohol or cannabis use consequences. This may be because participants increased their solitary SU or use with romantic partners to compensate.

Consistent with self-medication theory (Khantzian, 1997), we found that increases in anxiety and depression and COVID anxiety were associated with increases in alcohol and cannabis use since before the pandemic as well as higher concurrent coping motives and consequences. These findings expand upon the results of several existing studies to demonstrate similar associations in the general population (Rogers et al., 2020; Wardell et al., 2020) by examining prospective associations and exploring these associations in a high risk population. Our findings indicate that while SGM individuals who experienced larger increases in anxiety and depression since before the pandemic were at higher risk for increases in SU and consequences, they were not, on average, continuing to experience increases in coping motives or consequences of SU 6–11 months into the pandemic.

4.1. Limitations

Results of the current study should be considered in light of its limitations. First, several variables were assessed by asking participants to retrospectively report changes in their mental health and SU since prior to the start of the pandemic. Retrospective reports are subject to recall biases and are not as accurate as non-retrospective reports. As data collection began 6 months into the pandemic, our retrospective variables may have been more negatively impacted by recall bias than data collected closer to the start of the pandemic. However, participants are regularly asked to recall and answer questions about their experiences over the past 6–12 months in behavioral health surveys and therefore a great deal of behavioral health data is subject to similar levels of recall bias. Second, only SGM-AFAB were included in the current sample. Therefore, it is unclear whether the results will generalize to SGM assigned male at birth. Third, all participants were current alcohol or cannabis users and thus findings may not generalize to the initiation of SU. While SU criteria for the study were relatively low, this may have affected our results. Fourth, our measure of retrospectively reported changes in anxiety, depression, alcohol, and cannabis use did not assess decreases in symptoms or use. While the majority of participants endorsed increases in these variables during the pandemic, our lack of measurement of decreases in these constructs may have biased results. Fifth, as we did not assess solitary substance use at follow-up, we were unable to test for the presence of a bi-directional association between solitary substance use and coping motives. Sixth, we used a brief two-item measure of coping motives for cannabis use, which may not have fully captured the range of coping motives for cannabis use, and several other measures used in the current study have not been validated among SGM-AFAB. Finally, the one-month timeframe may have been too short to detect significant prospective associations for some variables, given limited change in outcomes over this brief period. Associations between an outcome at baseline and the same outcome at follow-up ranged from $r = .64–.82$, indicating that much of the variance in the outcomes at follow-up was explained by the outcome at baseline. Further research with longer lags between assessments may provide more insight into these prospective associations.

4.2. Conclusion

Despite these limitations, the current study substantially expands our understanding of risk factors for increases in alcohol and cannabis use and consequences in the context of the pandemic among SGM-AFAB – a health disparity population disproportionately impacted by the pandemic. Results indicate that solitary SU is a strong risk factor for increases in SU, coping motives, and consequences. Unexpected patterns of findings were revealed for using substances with friends, demonstrating that the changes in available SU contexts during the pandemic may have affected the impact of using in these contexts. Further, findings provide support for self-medication theory as increases in anxiety and depression and higher COVID anxiety were associated with increases in SU and more coping motives and consequences.

Role of funding source

This work was supported by grants from the National Institute on Drug Abuse (K01DA046716, PI: Christina Dyar). The content is solely the responsibility of the authors and does not necessarily represent the official views of the funding agencies.

Contributors

CD developed the research question, conducted all analyses, drafted all sections of the manuscript, created tables and figures, and obtained funding for study. EM drafted portions of the introduction. DK, MN, and BM reviewed and edited the manuscript. All authors approved of the final manuscript before submission.

Declaration of Competing Interest

The authors report no declarations of interest.

Acknowledgements

We would like to thank Shariell Crosby and Sophia Pirog for their work on this project as it would not have been possible without their assistance. We also thank Project QuEST participants for their invaluable contributions to understanding substance use among sexual and gender minority individuals assigned female at birth.

References

Adamson, S.J., Kay-Lambkin, F.J., Baker, A.L., Lewin, T.J., Thornton, L., Kelly, B.J., Sellman, J.D., 2010. An improved brief measure of cannabis misuse: the Cannabis use Disorders Identification Test-Revised (CUDIT-R). Drug Alcohol Depend. 110 (1), 137–143.

Bartel, S., Sherry, S., Stewart, S., 2020. Self-isolation: a significant contributor to cannabis use during the COVID-19 pandemic. Subst. Abuse 41 (4), 409–412.

Boserup, B., McKenney, M., Elkbuli, A., 2020. Alarming trends in US domestic violence during the COVID-19 pandemic. Am. J. Emerg. Med. 38 (12), 2753–2755.

Cerezo, A., Ramirez, A., O'Shaughnessy, T., Sanchez, A., Mattis, S., Ross, A., 2021. Understanding the power of social media during COVID-19: forming social norms for drinking among sexual minority gender expansive college women. J. Homosex. 68 (4), 560–576. https://doi.org/10.1080/00918369.2020.1868183.

Condit, M., Kitaji, K., Drabble, L., Trocki, K., 2011. Sexual-minority women and alcohol: intersections between drinking, relational contexts, stress, and coping. J. Gay Lesbian Soc. Serv. 23 (3), 351–375.

Connor, J., Cousins, K., Samaranayaka, A., Kypri, K., 2014. Situational and contextual factors that increase the risk of harm when students drink: case–control and case-crossover investigation. Drug Alcohol Rev. 33 (4), 401–411.
Creswell, K.G., Chung, T., Clark, D.B., Martin, C.S., 2014. Solitary alcohol use in teens is associated with drinking in response to negative affect and predicts alcohol problems in young adulthood. Clin. Psychol. Sci. 2 (5), 602–610.
Creswell, K.G., Chung, T., Clark, D.B., Martin, C.S., 2015. Solitary cannabis use in adolescence as a correlate and predictor of cannabis problems. Drug Alcohol Depend. 156, 120–125.
Dumas, T.M., Ellis, W., Litt, D.M., 2020. What does adolescent substance use look like during the COVID-19 pandemic? Examining changes in frequency, social contexts, and pandemic-related predictors. J. Adolesc. Health 67 (3), 354–361. https://doi.org/10.1016/j.jadohealth.2020.06.018.
Dyar, C., Feinstein, B.A., Albright, J., Newcomb, M.E., Whitton, S.W., 2021. Associations between drinking contexts, minority stress, and problematic alcohol use among sexual minority individuals assigned female at birth. Psychol. Sex. Orientat. Gend. Divers. In press.
Easton, C.J., Crane, C.A., 2016. Interventions to reduce intimate partner violence perpetration among people with substance use disorders. Int. Rev. Psychiatry 28 (5), 533–543.
Fairlie, A.M., Feinstein, B.A., Lee, C.M., Kaysen, D., 2018. Subgroups of young sexual minority women based on drinking locations and companions and links with alcohol consequences, drinking motives, and LGBTQ-related constructs. J. Stud. Alcohol Drugs 79 (5), 741–750.
Fleming, C.B., White, H.R., Oesterle, S., Haggerty, K.P., Catalano, R.F., 2010. Romantic relationship status changes and substance use among 18-to 20-year-olds. J. Stud. Alcohol Drugs 71 (6), 847–856.
Grant, V.V., Stewart, S.H., O'Connor, R.M., Blackwell, E., Conrod, P.J., 2007. Psychometric evaluation of the five-factor Modified Drinking Motives Questionnaire—revised in undergraduates. Addict. Behav. 32 (11), 2611–2632.
Graupensperger, S., Fleming, C.B., Jaffe, A.E., Rhew, I.C., Patrick, M.E., Lee, C.M., 2021. Changes in young adults' alcohol and marijuana use, norms, and motives from before to during the COVID-19 pandemic. J. Adolesc. Health 68 (4), 658–665.
Gritsenko, V., Skugarevsky, O., Konstantinov, V., Khamenka, N., Marinova, T., Reznik, A., Isralowitz, R., 2020. COVID 19 fear, stress, anxiety, and substance use among Russian and Belarusian university students. Int. J. Ment. Health Addict. https://doi.org/10.1007/s11469-020-00330-z.
Homish, G.G., Leonard, K.E., 2005. Spousal influence on smoking behaviors in a US community sample of newly married couples. Soc. Sci. Med. 61 (12), 2557–2567.
Homish, G.G., Leonard, K.E., Cornelius, J.R., 2007. Predictors of marijuana use among married couples: the influence of one's spouse. Drug Alcohol Depend. 91 (2–3), 121–128. https://doi.org/10.1016/j.drugalcdep.2007.05.014.
Jackson, K.M., Merrill, J.E., Stevens, A.K., Hayes, K.L., White, H.R., 2021. Changes in alcohol use and drinking context due to the COVID-19 pandemic: a multimethod study of college student drinkers. Alcohol. Clin. Exp. Res. 45 (4), 752–764.
Janulis, P., Newcomb, M.E., Mustanski, B., 2021. Decrease in prevalence but increase in frequency of non-marijuana drug use following the onset of the COVID-19 pandemic in a large cohort of young men who have sex with men and young transgender women. Drug Alcohol Depend., 108701
Jennings, W.G., Reingle, J.M., Staras, S.A., Maldonado-Molina, M.M., 2012. Substance use as a risk factor for intimate partner violence overlap: generational differences among Hispanic young adults. Int. Crim. Just. Rev. 22 (2), 139–152.
Kahler, C.W., Strong, D.R., Read, J.P., 2005. Toward efficient and comprehensive measurement of the alcohol problems continuum in college students: the Brief Young Adult Alcohol Consequences Questionnaire. Alcohol. Clin. Exp. Res. 29 (7), 1180–1189.
Kamal, K., Li, J.J., Hahm, H.C., Liu, C.H., 2021. Psychological impacts of the COVID-19 global pandemic on US sexual and gender minority young adults. Psychiatry Res., 113855
Keough, M.T., O'Connor, R.M., Sherry, S.B., Stewart, S.H., 2015. Context counts: solitary drinking explains the association between depressive symptoms and alcohol-related problems in undergraduates. Addict. Behav. 42, 216–221.
Keough, M.T., O'Connor, R.M., Stewart, S.H., 2018. Solitary drinking is associated with specific alcohol problems in emerging adults. Addict. Behav. 76, 285–290.
Kerridge, B.T., Pickering, R.P., Saha, T.D., Ruan, W.J., Chou, S.P., Zhang, H., Jung, J., Hasin, D.S., 2017. Prevalence, sociodemographic correlates and DSM-5 substance use disorders and other psychiatric disorders among sexual minorities in the United States. Drug Alcohol Depend. 170, 82–92. https://doi.org/10.1016/j.drugalcdep.2016.10.038.
Khantzian, E.J., 1997. The self-medication hypothesis of substance use disorders: a reconsideration and recent applications. Harv. Rev. Psychiatry 4 (5), 231–244.
Krueger, E.A., Fish, J.N., Upchurch, D.M., 2020. Sexual orientation disparities in substance use: investigating social stress mechanisms in a national sample. Am. J. Prev. Med. 58, 59–68. https://doi.org/10.1016/j.amepre.2019.08.034.
Lechner, W.V., Laurene, K.R., Patel, S., Anderson, M., Grega, C., Kenne, D.R., 2020. Changes in alcohol use as a function of psychological distress and social support following COVID-19 related University closings. Addict. Behav. 110, 106527 https://doi.org/10.1016/j.addbeh.2020.106527.
Lee, C.M., Neighbors, C., Hendershot, C.S., Grossbard, J.R., 2009. Development and preliminary validation of a comprehensive marijuana motives questionnaire. J. Stud. Alcohol Drugs 70 (2), 279–287.
McPhee, M.D., Keough, M.T., Rundle, S., Heath, L.M., Wardell, J.D., Hendershot, C.S., 2020. Depression, environmental reward, coping motives and alcohol consumption during the COVID-19 pandemic [original research]. Front. Psychiatry 11 (1128). https://doi.org/10.3389/fpsyt.2020.574676.
Merikangas, K., Milham, M., Stringaris, A., 2020. The Coronavirus Health Impact Survey (CRISIS). https://www.phenxtoolkit.org/toolkit_content/PDF/CRISIS_Baseline_Adult.pdf.
Pollard, M.S., Tucker, J.S., Green, H.D., 2020. Changes in adult alcohol use and consequences during the COVID-19 pandemic in the US. JAMA Netw. Open 3 (9) e2022942-e2022942.
Rodriguez, L.M., Young, C.M., Tomkins, M.M., DiBello, A.M., Krieger, H., Neighbors, C., 2016. Friends in low places: the impact of locations and companions on 21st birthday drinking. Addict. Behav. 52, 52–57. https://doi.org/10.1016/j.addbeh.2015.08.009.
Rogers, A.H., Shepherd, J.M., Garey, L., Zvolensky, M.J., 2020. Psychological factors associated with substance use initiation during the COVID-19 pandemic. Psychiatry Res. 293, 113407 https://doi.org/10.1016/j.psychres.2020.113407.
Rolland, B., Haesebaert, F., Zante, E., Benyamina, A., Haesebaert, J., Franck, N., 2020. Global changes and factors of increase in caloric/salty food intake, screen use, and substance use during the early COVID-19 containment phase in the general population in France: survey study [original paper]. JMIR Public Health Surveill. 6 (3), e19630 https://doi.org/10.2196/19630.
Ruprecht, M.M., Wang, X., Johnson, A.K., Xu, J., Felt, D., Ihenacho, S., Stonehouse, P., Curry, C.W., DeBroux, C., Costa, D., Phillips Ii, G., 2021. Evidence of social and structural COVID-19 disparities by sexual orientation, gender identity, and race/ethnicity in an urban environment. J. Urban Health 98 (1), 27–40. https://doi.org/10.1007/s11524-020-00497-9.
Salerno, J.P., Shrader, C.H., Algarin, A.B., Lee, J.Y., Fish, J.N., 2021. Changes in alcohol use since the onset of COVID-19 are associated with psychological distress among sexual and gender minority university students in the U.S. Drug Alcohol Depend. 221, 108594 https://doi.org/10.1016/j.drugalcdep.2021.108594.
Saunders, J.B., Aasland, O.G., Babor, T.F., De la Fuente, J.R., Grant, M., 1993. Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. Addiction 88 (6), 791–804.
Simons, J.S., Dvorak, R.D., Merrill, J.E., Read, J.P., 2012. Dimensions and severity of marijuana consequences: development and validation of the Marijuana Consequences Questionnaire (MACQ). Addict. Behav. 37 (5), 613–621.
Testa, M., Livingston, J.A., Leonard, K.E., 2003. Women's substance use and experiences of intimate partner violence: a longitudinal investigation among a community sample. Addict. Behav. 28 (9), 1649–1664.
Wardell, J.D., Kempe, T., Rapinda, K.K., Single, A., Bilevicius, E., Frohlich, J.R., Hendershot, C.S., Keough, M.T., 2020. Drinking to cope during COVID-19 pandemic: the role of external and internal factors in coping motive pathways to alcohol use, solitary drinking, and alcohol problems. Alcohol. Clin. Exp. Res. 44 (10), 2073–2083.