

**IMPACTS OF ISOLATION, LONELINESS, AND FAMILY RELATIONSHIPS ON
PROBLEMATIC SUBSTANCE USE DURING THE COVID-19 PANDMEIC:
COMPARING SEXUAL MINORITY AND HETEROSEXUAL YOUNG ADULTS**

Amanda K. Haik

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Approved by:

Andrea M. Hussong

Stacey B. Daughters

Melissa J. Cox

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ABSTRACT

Amanda K. Haik: Impacts of isolation, loneliness, and family relationships on problematic substance use during the COVID-19 pandemic: Comparing sexual minority and heterosexual young adults

(Under the direction of Andrea M. Hussong)

Sexual minority young adults (SMYA), compared to heterosexual young adults (HYA), are a uniquely high-risk population for problematic substance use and this disparity may have been exacerbated during the pandemic. Participants (N=141) aged 23-29 completed self-report surveys in 2014-2015 as college students and summer 2021 as young adults (59% White, 26% Black/African American, 9% Asian/Middle Eastern, 6% Hispanic/Latino, and <1% American Indian/Alaska Native). Results of multivariate regression and multiple group path analyses showed that SMYA did not have greater increases in problematic substance use compared to HYA; isolation and loneliness were not significant mediators; and the quality of family relationships was not a significant moderator. However, SMYA, as compared to HYA, experienced increased loneliness and decreased quality of family relationships. Further research is needed to investigate both the impact and underlying processes of this decreased social safety on SMYA well-being beyond the pandemic to better inform tailored supports and interventions.

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PREFACE

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Impacts of isolation, loneliness, and family relationships on problematic substance use during the COVID-19 pandemic: Comparing sexual minority and heterosexual young adults

Sexual minority young adults (SMYA) are a high-risk population for problematic substance use, mental health disorders, and co-occurring disorders (Cochran et al., 2003; Demant et al., 2016; Fergusson et al., 1999; Hatzenbuehler et al., 2015; Mereish et al., 2017; Ott et al., 2013; Painter et al., 2018; Reed et al., 2010). In particular, some studies find that SMYA are about 2 times more likely to meet criteria for a substance use disorder in the past 12 months compared to heterosexual young adults (HYA) (Kerridge et al., 2017; Painter et al., 2018). This risk may be particularly true in context of high ecological stress, such as the COVID-19 pandemic. Emerging studies demonstrated that the psychological impact of pandemic-related quarantine has been pervasive and persistent, especially for individuals with a history of mental health concerns that include acute stress, PTSD symptoms, depression, and alcohol abuse (Brooks et al., 2020). Currently, pandemic-related research regarding impacts on SMYA has focused primarily on aggravated mental health concerns, such as increases in anxiety and depression (Kamal et al., 2021), with minimal research exploring the possible exacerbation of problematic substance use as a primary outcome even though problematic substance use may have increased during the pandemic more generally (Hoyt et al., 2021; Kamal et al., 2021; Mitchell et al., 2022; Moore et al., 2021; Scroggs et al., 2020; Somé et al., 2022). Continuing to understand how and why problematic substance use patterns among SMYA may have shifted during the pandemic is needed to support pandemic recovery among this marginalized

population, especially as long-lasting mental health concerns persisted beyond the acute phase of COVID-19, as with other major ecological stressors (Brooks et al., 2020).

In the current study, we drew on Minority Stress Theory to test how exacerbated stressors (e.g., isolation due to pandemic imposed restrictions) and depleted protective factors (e.g., lack of access to community and interpersonal support systems) during COVID-19 may have disproportionately impacted risk for problematic substance use among SMYA as compared to HYA. To our knowledge, such associations have yet to be examined. Thus, the current study filled a notable gap in the literature by identifying factors that may explain and heighten risk for problematic substance use among the SMYA population particularly during periods of increased ecological stress. These findings may be used to inform the development of culturally sensitive interventions targeting problematic substance use patterns in SMYA that may persist beyond the acute phase of the pandemic or other forms of ecological stress.

Minority Stress Theory

A potential explanation for increased risk of problematic substance use within the sexual minority community can be found in Minority Stress Theory (Meyer, 2003). Minority Stress Theory posits that two categories of stressors – minority stressors and general stressors – cumulate and lead to increased problematic substance use among SMYA. Minority stressors refer to the unique and chronic stressors encountered by sexual minority individuals that link sexual stigma (i.e., stigma due to one’s sexual identity) and problematic substance use (Meyer, 2003). They are experienced both on distal and proximal levels and often overlap with general life stressors, magnifying their intensity. Distal minority stressors are those that are experienced by the individual based on outside perception of their sexual minority status (e.g., discrimination, prejudice). Proximal minority stressors are those that result largely from distal stressors, where

the individual subjectively interprets and internalizes those negative experiences and makes judgments about themselves based on their minoritized self-identity (e.g., internalized homophobia, expectations of rejection) (Meyer, 2003).

According to Minority Stress Theory, the cumulative stressors (distal and proximal minority stressors and general stressors) are salient contributors to disparities in problematic substance use outcomes between SMYA and HYA (Goldbach et al., 2014; Meyer, 2003). This cumulative experience of stressors is compounded by additional mechanisms known to be related to problematic substance use in general adult populations that are heightened among SMYA (Hatzenbuehler, 2009). For example, stressors may have a bigger impact on SMYA when they occur alongside mechanisms, such as using substances to cope, that are generally related to problematic substance use (Gottfredson & Hussong, 2013; Hussong et al., 2011; Shadur et al., 2015). The mechanism of using substances to cope with stress and a lack of social support relates to problematic substance use in the general population but is specifically relevant to and heightened among SMYA due to the cumulative effect of minority and general stressors per Minority Stress Theory (Hatzenbuehler, 2009; Meyer, 2003).

Additionally, Minority Stress Theory refers to how adaptive coping mechanisms and social supports are protective factors decreasing the strength of the association between the cumulative effect of minority and general stressors and problematic substance use (Meyer, 2003). Thus, they serve as protective factors in the mechanism of using substances to cope with stress and a lack of social support.

SMYA Risk for Problematic Substance Use during the COVID-19 Pandemic

Young adults were an especially vulnerable group regarding risk behavior during the COVID-19 pandemic (Huckins et al., 2020; Liu et al., 2020; Son et al., 2020). Emerging

adulthood is identified as a distinct period of life transition with large amounts of change and instability, both positive and negative, as individuals explore life's possibilities, newfound independence, and identity formation. Subsequently, young adults often engage in higher rates of risk behavior (i.e., substance use) as they explore themselves and the world (Arnett, 2000, 2007). Pandemic control policies, such as social distancing and restriction of in-person gatherings, were experienced by many as a major life stressor leading to pervasive social isolation, loneliness, and disconnection from communities that may particularly impact a young adult's psychological well-being (Horigian et al., 2021). Current pandemic-focused research has highlighted young adults as a uniquely high-risk population for isolation (Horigian et al., 2021), loneliness (Horigian et al., 2021; Lee et al., 2020), and increased problematic substance use (Horigian et al., 2021).

However, whether the disparity in problematic substance use between SMYA and HYA persisted or increased during the pandemic remains unclear. Adaptive coping mechanisms and social supports are often points of resilience and protective factors following disasters (Whittaker & Kingston, 2022). The unique nature of the social distancing guidelines within the COVID-19 pandemic compromised many established social supports and adaptive coping mechanisms often utilized (Saltzman et al., 2020). As a result, the additive stress from the COVID-19 pandemic along with the reduction in protective factors makes associated outcomes, such as problematic substance use, more of a significant public health concern, especially for marginalized and vulnerable populations, like SMYA. Of the few studies exploring problematic substance use during the COVID-19 pandemic among SMYA, the majority did not use a HYA comparison group. In these studies, evidence for increased problematic substance use during the pandemic was found among SMYA, either with retrospective self-report surveys (Salerno et al., 2021a) or

longitudinal surveys with pre- and post-pandemic onset time points (Scroggs et al., 2020). In a cross-sectional study from the summer of 2020 (i.e., a few months after the first restrictions of the COVID-19 pandemic hit the US broadly), roughly 32% of SMYA reported increasing their alcohol use when asked if their alcohol use had changed since the start of the pandemic, and this increase in alcohol use was associated with greater current psychological distress (Salerno et al., 2021a). Thus, these studies suggest that SMYA did increase their problematic substance use (or at least alcohol use) during the pandemic, but the studies did not address unique risk or protective factors for this population.

Of the studies exploring group differences in problematic substance use during the pandemic among SMYA and HYA, the results are mixed. Akre et al. (2021) found in a cross-sectional study from the summer of 2020 that SMYA reported more problems from drinking as compared to HYA. Additionally, SMYA participants were more likely to report they were drinking “more than usual” as compared to HYA participants, which suggested a potentially growing substance use disparity during the pandemic (Akre et al., 2021). However, Fish (2021) did not find any statistically significant differences in rates of alcohol use between SMYA and HYA in the summer of 2020; though SMYA mental health, loneliness, and stress were significantly increased as compared to heterosexual peers (Fish et al., 2021). Therefore, exploring factors that are part of the mechanism of using substances to cope with stress and a lack of social support (i.e., isolation, loneliness, quality of family relationships) was key for understanding how and why substance use disparities between SMYA and HYA may have persisted or exacerbated during the pandemic.

Impacts of Isolation and Loneliness before and during the COVID-19 Pandemic

Isolation is generally defined as a lack of supportive resources and interactions, and loneliness as the subjective feeling of loss of close connection with others (Leigh-Hunt et al., 2017). COVID-19 was a unique opportunity to explore these constructs as social distancing guidelines may have heightened contexts leading to both (Horigian et al., 2021; Whittaker & Kingston, 2022). Across all age ranges, both social isolation and loneliness were linked to worse mental health and substance use outcomes both in and out of the pandemic (Horigian et al., 2021; Ingram et al., 2020; Leigh-Hunt et al., 2017; Liu et al., 2020; McIntyre et al., 2018; Rodriguez-Seijas et al., 2020). When comparing age groups, young adults reported higher levels of loneliness at the start of the pandemic compared to older adults (Luchetti et al., 2020). Furthermore, among young adults who reported increased feelings of loneliness, the majority also reported an increase in drinking and drug use during the pandemic (Horigian et al., 2021). Therefore, COVID-19-related isolation and loneliness were not only stressful experiences in and of themselves, but they also may have exacerbated the impact of stress on individuals, increasing the likelihood of using substances to cope with stress and a lack of social support, leading to overall increased rates of problematic substance use.

However, there is a noticeable gap in the literature for exploring how isolation and loneliness contribute to the mechanism of using substances to cope with stress and a lack of social support among SMYA, which is a population with heightened vulnerability to this mechanism for problematic substance use as indicated by Minority Stress Theory. A pre-pandemic meta-analysis by Gorczynski and Fasoli (2021) found only four published studies on loneliness comparing sexual minority and heterosexual individuals – 25 articles were excluded for not including a heterosexual comparison group. Furthermore, only one of the four articles

focused on the young adult age group, and it only explored mental health outcomes (Gorczyński & Fasoli, 2021; Westefeld et al., 2001). Thus, no pre-pandemic study to our knowledge explored the effects of isolation and loneliness on problematic substance use as the primary outcome among SMYA and HYA. This gap in knowledge persisted in pandemic-focused research, even though SMYA, in particular, likely experienced increased levels of isolation and loneliness during the pandemic due to losses of sexual-minority specific community supports and spaces (e.g., community centers and gay bars), along with depleted protective factors, such as connection to affirming peer and community support (Fish et al., 2020a; Hoyt et al., 2021; Shilo et al., 2015).

Furthermore, the impacts of social isolation and loneliness on mental health problems can extend years into the future (Loades et al., 2020). Long-term negative health outcomes of isolation and loneliness can include prolonged activation of the sympathetic nervous system due to increased vulnerability to and intensity of external stressors, decreased cardiovascular health, and other physiological deficits (e.g., slower wound healing and poorer sleep efficiency) (Cacioppo & Hawkley, 2003; Hawkley et al., 2003; Hawkley & Cacioppo, 2010). Thus, given the long-term negative health outcomes of isolation and loneliness (Cacioppo & Hawkley, 2003; Hawkley et al., 2003; Hawkley & Cacioppo, 2010), the vulnerability of SMYA to isolation and loneliness (Westefeld et al., 2001), and the heightened levels of isolation and loneliness during the pandemic (Horigian et al., 2021), the pandemic was an appropriate contextual opportunity to explore the impacts of isolation and loneliness on problematic substance use, especially among SMYA. Therefore, the current study filled this noticeable gap in the field by exploring how increased rates of COVID-19-related isolation and loneliness, likely through the mechanism of

using substances to cope with stress and a lack of social support, may have mediated increased rates of problematic substance use among SMYA as compared to HYA.

Impacts of Family Relationships before and during the COVID-19 Pandemic

Social support can often serve as a buffer in the relationship between increased stress and problematic substance use as it both alleviates stress and serves as a point of resilience by allowing individuals to cope more adaptively (Meyer, 2003; Thoits, 1982, 1986; Wills et al., 1992). One specific domain of social support is family relationships, which pre-pandemic research has demonstrated is a particularly impactful form of social support among SMYA both as a risk and protective factor (Ryan et al., 2010). In prior studies, SMYA with compromised family relationships (e.g., lack of acceptance) were at greater risk for problematic substance use, often using substances as a method to cope with unsupportive family (Felner et al., 2020; Fish et al., 2020b; Ryan et al., 2010). In a meta-analysis by Goldbach et al. (2014) examining correlates of substance use among SMYA, parental support was significantly correlated with substance use – those who perceived less support from parents reported higher levels of substance use compared to those who perceived more support (Goldbach et al., 2014). Thus, family relationships can potentially buffer problematic substance use among SMYA by increasing feelings of social support and functioning as an adaptive coping resource. Alternatively, family relationships can also potentially heighten problematic substance use among SMYA by being a source of further general and minority stressors (e.g., experiences of discrimination and stigma). Therefore, the quality of family relationships is a part of the underlying mechanism of using substances to cope with stress and a lack of social support, as it buffers or heightens levels of problematic substance use depending on perceived family closeness and discord.

During the COVID-19 pandemic, the structure and nature of family interactions may have changed due to social distancing guidelines and other COVID stressors (e.g., financial stress, health concerns, etc.) (Saltzman et al., 2020). For example, some young adults may have quarantined or increased virtual communication with family due to social distancing guidelines, while others may have decreased frequency of interactions with family. These potentially changed family dynamics during the pandemic may have impacted SMYA more than HYA due to prior research suggesting the importance of family relationships as a unique risk or protective factor for SMYA. Extant research supported this hypothesis, demonstrating that SMYA had more compromised family relationships as compared to HYA during the pandemic (Kamal et al., 2021). However, these pandemic-related studies only investigated the impact of family relationships on mental health outcomes (Gato et al., 2020; Gonzales et al., 2020; Salerno et al., 2021b).

Therefore, the current study filled a notable gap in the literature by focusing on the impact of quality of family relationships on the mediating pathway from sexual orientation through isolation and loneliness to problematic substance use during the pandemic. In the first part of the mediating pathway, quality of family relationships may impact the association between sexual orientation and isolation and loneliness per Minority Stress Theory – social support is a protective factor decreasing levels of general and minority stressors among SMYA. In the second part of the mediating pathway, quality of family relationships may impact the association between isolation and loneliness and problematic substance use. Higher quality family relationships alleviate stress and serve as a point of resilience by allowing individuals to cope more adaptively with feelings of isolation and loneliness, rather than using substances to cope. No studies to our knowledge have explored the differences in these associations between

SMYA and HYA during the pandemic. Therefore, given the salience of family relationships among SMYA in and out of the pandemic, we explored how quality of family relationships (i.e., closeness and discord) served as a moderator in the underlying mechanism of using substances to cope with stress and a lack of social support.

Current Study

The current study addressed whether there is a growing substance use disparity between SMYA and HYA during the COVID-19 pandemic and identified factors that may explain and heighten problematic substance use, particularly among SMYA. Following Minority Stress Theory, we explored how COVID-19 related isolation, loneliness, and quality of family relationships may be part of the underlying mechanism of using substances to cope with stress and a lack of social support, leading to increased problematic substance use during the pandemic. The pandemic posed a unique opportunity to explore the associations between these factors which previous research suggested to be impactful independently among SMYA. Furthermore, most pandemic research up until this point has not focused on problematic substance use as a primary outcome, and when it does, mechanisms leading to heightened risk are not considered, especially among SMYA. In response, this study sought to understand what factors explain and heighten the possibly exacerbated problematic substance use disparity between SMYA and HYA during the COVID-19 pandemic-era.

Specifically, we examined group differences between SMYA and HYA with self-report data collected before and during the pandemic. We tested the following three hypotheses (see Figure 1). First, we posited that SMYA would have greater increases of problematic substance use compared to HYA during the COVID-19 pandemic (*hypothesis 1*). Second, we believed that SMYA would have higher levels of isolation and loneliness during the COVID-19 pandemic,

which would partially account for the greater increases in problematic substance use (*hypothesis 2*). Third, we tested whether quality of family relationships during the COVID-19 pandemic would moderate the mediational model in hypothesis 2, such that greater family closeness and lower discord would both weaken the association between sexual orientation and isolation and loneliness and weaken the association between isolation and loneliness and problematic substance use (*hypothesis 3*).

Understanding more about the mechanism of using substances to cope with stress and a lack of social support through this constellation of factors is critical for guiding healing and improved well-being within the SMYA community post-pandemic, especially as the negative mental health effects from the pandemic may be long-lasting (Brooks et al., 2020). Additionally, having a sexual minority identity was significantly correlated with expressing a need for and experiencing barriers to care during the COVID-19 pandemic (Chaiton et al., 2021; Gorfinkel et al., 2023). Gorfinkel et al. (2023) found unmet need for mental health support was between 15-45% higher among SMYA as compared to HYA (Gorfinkel et al., 2023). Therefore, not only were SMYA possibly experiencing increased rates of problematic substance use during the pandemic (Moore et al., 2021), but they were also having trouble accessing and receiving care to cope with their heightened distress (Chaiton et al., 2021; Gorfinkel et al., 2023). Subsequently, this study was a key next step in guiding targeted research and interventions to support this community, especially through lingering pandemic effects.

Methods

Sample

Data for the current study comes from the Real Experiences and Lives in the University Study (REAL-U) (Hussong et al., 2021a). Recruited in 2014-2015, the original REAL-U sample

(“Time 1”) was drawn from a pool of 8995 undergraduates who were randomly sampled from the university registrar records (with oversampling for males and African Americans to account for underrepresentation in the student body) and 57 undergraduates who contacted the team directly about the study. Of these 9052 students, 1403 (15.4%) completed the screening survey. Based on the inclusion criteria of being 18-23 years old, reporting alcohol use in the past year, 1141 (81.3%) students were eligible to participate. Of those eligible to participate, 854 (75%) completed the first survey prior to meeting enrollment goals and 840 completed both surveys, which were separated by two weeks.

At the second survey session, participants were invited to participate in a separate Text Messaging Study, where participants consented to provide researchers with download access to their SMS text data from the previous two weeks (Hussong et al., 2021b). Of the 840 students who completed the second survey at Time 1, 779 were eligible for the Text Message Study (i.e., had an Android or iPhone with them during the testing session) and 528 consented to participate (67.8% of those eligible) and text message data were successfully downloaded for 267 students (50.6% of those consenting). Follow-up analyses showed that the those who participated in the Text Message Study did not differ from those who did not participate on deviant behavior (i.e., externalizing symptoms, past 10-day substance use), social approval (i.e., social desirability, self-reported honesty of substance use reporting), psychological distress (i.e., anxiety, depression, general distress), network deviance (i.e., Greek affiliation, peer use, parent alcohol-related consequences), social vulnerability (i.e., racial or ethnic minority, age, women, parent education), and impulsivity (Hussong et al., 2021b). The text study subsample only differed demographically from the entire undergraduate student body by being more ethnically diverse, consistent with the original oversampling.

In the summer of 2021 (“Time 2”), participants from the text study subsample (N=267) received a recruitment email or call to complete a follow-up survey. Participants lost to follow-up included 7 who were contacted and refused to participate, 60 who did not respond to any contact attempts despite having correct contact information, and 34 who were not located. Ultimately, of the 267 participants eligible from the text study subsample, 166 participants enrolled in Time 2 (62%). Of those enrolled, 142 participants completed the follow-up survey (86%). One participant was excluded from the final analysis sample because they did not answer the sexual orientation question, resulting in 141 participants in the final analysis sample. See appendix for a consort diagram (see Figure 2). As shown in Table 1, participants were 141 young adults ($M_{\text{age}} = 25.98$, $SD = 1.43$). Participants identified as 20% sexual minority, 61% women, and multiethnic (59% White, 26% Black or African American, 9% Asian/Middle Eastern, 6% Hispanic/Latino, and <1% American Indian or Alaska Native). In addition, 85% were employed and 60% lived in their own residence, 33% in a shared residence, and 7% in the residence of a family member.

Procedure

After consenting to participate in the Time 1 survey, participants completed two test sessions separated by two weeks. In session 1, participants completed one of two randomly assigned primary batteries in approximately 75 minutes. In session 2, participants completed one of four randomly assigned batteries along with an addendum and lab task in approximately 90 minutes. Participants were compensated a \$20 and a \$25 incentive for completing each session, respectively.

After consenting to participate in the Time 2 survey, participants completed a 45-minute online survey administered remotely via Qualtrics. Participants were compensated with a \$30

Amazon gift card for completing the entire survey or a \$10 Amazon gift card for completing at least half of the survey. All procedures were approved by The University of North Carolina at Chapel Hill Institutional Review Board.

Measures

Sociodemographic Variables

Participants reported their age at time 1, and race/ethnicity, employment status, residential status, and gender at time 2. Participants were asked to indicate if they were Hispanic or Latino and to indicate their racial identity by selecting all the applicable response options (National Center for Health Statistics, 2008). To characterize the sample, we created a race indicator with the following values: 0=White (with no other race selections), 1=Black or African American, 2=American Indian or Alaska Native, 3=Asian/Middle Eastern (combines Guamanian, Samoan, other Pacific Islander, Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, other Asian), and 4=Hispanic/Latino (with no other race selections). For analyses, we included a single indicator of 0=White and 1=identifies as part of a racial/ethnic Minority group.

Participants reported their current employment status (Presley & Meilman, 1994). To characterize the sample, current employment status values were assigned as follows: 0=Not working, 1=Volunteer position, 2=Part-time paid position, and 3=Full-time paid position. For analyses, we created an employment indicator with the following values: 0=employed (combines full-time paid position and part-time paid position) and 1=unemployed (combines volunteer position and no job).

Participants reported their current residential status. To characterize the sample, residential status values were assigned as follows: 1=living in own residence (e.g., house,

apartment alone or with your partner/kids), 2=living in a shared residence (e.g., in a house or apartment with roommates), and 3=living in the residence of a family member. For analyses, we included a single indicator with the following values: 0=living in own residence and 1=living in a shared or family residence.

Because all gender diverse individuals also identified as having a sexual minority identity, gender was not used in analyses but was measured as a descriptive statistic for the sample. We created a gender indicator following Badgett et al. (2014) with the following values: 0=Woman, 1=Man, 2=Gender diverse (combines Non-binary, Transgender, Trans man/Transgender Man/FTM, Trans woman/Transgender Woman/MTF, Genderqueer, Genderfluid, Gender Variant, Questioning or unsure of your gender identity, and the self-reporting option) (Badgett et al., 2014).

Sexual orientation

Sexual orientation was only assessed at time 2. We assessed sexual orientation by asking “Which of the following best represents how you think of yourself?” (Badgett et al., 2014; Perron et al., 2017). Due to limited sample size, sexual orientation was dichotomized into sexual minority young adults (“SMYA”; n=28; combines gay, lesbian, bisexual, queer, polysexual/omnisexual/sapiosexual/pansexual, asexual, and two-spirit) and 0=heterosexual young adults (“HYA”; n=113; straight (that is, not gay, lesbian, etc.), having not figured out or are in the process of figuring out your sexuality, mostly straight but sometimes attracted to people of your own sex, not thinking of themselves as having sexuality, do not use labels to identify themselves, don’t know the answer, or other). We put undefined sexuality (e.g., questioning, mostly straight, etc.) individuals in the HYA group to preserve the shared experience of fully identifying with a minoritized sexual identity in the SMYA group. Within the

HYA group, we conducted t-tests across the primary outcomes (i.e., time 2 alcohol use and time 2 substance use involvement) to determine whether there were any systematic differences between the straight (n=98) and undefined sexuality (n=15) individuals that would make combining them problematic. No significant differences were found between these groups.

Isolation

Participants reported isolation experiences due to COVID-19 at time 2 with a subset of items from the COVID Stress and Coping measure (108-items total; 7-item isolation-related subset). The overall measure assessed the impact of the COVID-19 pandemic on various facets of participants' lives (e.g., mental health, physical health, financial hardship, and professional lives) (Grasso et al., 2020). The isolation subset of items assessed the degree to which participants experienced being physically isolated or separated from their social network or communities during the pandemic (coded as 0=No, 1=Yes). Using 14 face valid isolation related items from this measure, I conducted an exploratory factor analysis that supported a two-factor solution. Based on this, I decided to create two scale scores: disease-oriented isolation and social network-oriented isolation.

Disease-oriented isolation scores were created by averaging the scores of three separate items assessing isolation or quarantine due to disease exposure or symptoms (M=0.36, SD=0.36, Cronbach's $\alpha=0.63$). Social network-oriented isolation scores were created by averaging the scores of four separate items assessing separation from friends, family celebrations cancelled or restricted, planned travel or vacations cancelled, and inability to participate in social clubs, sports teams, or usual volunteer activities (M=0.78, SD=0.26, Cronbach's $\alpha=0.55$). As has been argued for stressful life events measures of other kinds, low reliability estimates may not pose a particular problem because these types of measures are not governed by an underlying latent

factor. Therefore, in our measure, the items are predictive of isolation, rather than caused by isolation (as in effect- rather than causal-indicator models), which helps explain the low reliability estimates (Bollen & Lennox, 1991).

Loneliness

Participants reported levels of loneliness at time 2 with the 20-item UCLA Loneliness measure (Russell et al., 1978), which assessed the frequency of subjective feelings of loneliness and social isolation among participants within the past month. The scale has demonstrated strong reliability in prior studies (Cronbach's $\alpha=0.96$) (Russell et al., 1978). Furthermore, the correlation between the UCLA loneliness scale and a subjective self-report question about current loneliness was strong in prior research ($r=0.79$), supporting the validity of the measure (Russell et al., 1978). Participants reported the extent to which the items described themselves on a 4-point scale coded as follows: 1=I never feel this way, 2=I rarely feel this way, 3=I sometimes feel this way, and 4=I often feel this way. Scores were calculated by averaging ratings across items, with higher scores reflecting higher levels of loneliness ($M=1.91$, $SD=0.68$, Cronbach's $\alpha=0.95$).

Quality of Family Relationships

Participants reported quality of family relationships at time 2 with the Parent-Child Relationship Quality self-report measure (separately for mother-figures and father-figures), which was adapted from the 30-item Network of Relationships Inventory: Relationship Qualities Version (Furman & Buhrmester, 1985). The original 30-item measure was adapted to include 17-items that assessed the participants' perceived relationship quality with their mother-figure, and then the same 17-items were repeated regarding the participants' perceived relationship quality with their father-figure. The items measured the domains of companionship, intimate disclosure,

emotional support, approval, satisfaction, conflict, criticism, and exclusion. Participants reported the frequency with which they experienced each of the items on a 5-point scale. Response options were coded as follows: 0=Little or none, 1=Somewhat, 2=Very much, 3=Extremely much, and 4=The most.

The domains were then collapsed into two subscales: closeness (12-items assessing companionship, intimate disclosure, emotional support, approval, and satisfaction) and discord (5-items total assessing conflict, criticism, and exclusion). Scores for each of the subscales were calculated by averaging ratings across the combined mother and father figure items, with higher scores reflecting more endorsement of closeness ($M=1.56$, $SD=0.73$, Cronbach's $\alpha=0.94$) and discord ($M=0.46$, $SD=0.46$, Cronbach's $\alpha=0.82$). Family closeness and family discord were found to be only weakly negatively correlated, $r(129) = -0.17$, $p = .047$, so we did not average the subscales into one scale.

Separate median splits for family closeness and family discord, high and low groups, were created for each variable (i.e., those with “low” family closeness being below the median split and those with “high” family closeness being above the median split; those with “low” family discord being below the median split and those with “high” family discord being above the median split). The family closeness grouping variable was coded as follows: 1=high family closeness ($n=66$), 0=low family closeness ($n=65$). The family discord grouping variable was coded as follows: 1=high family discord ($n=50$), 0=low family discord ($n=81$).

Alcohol and Substance Use Involvement

Participants reported heavy drinking with an item from the Monitoring the Future survey at time 1 and time 2 (Johnston et al., 2013). They indicated their frequency of heavy drinking (i.e., 5 or more drinks in a row) in the past year on a 7-point scale, ranged from 0 to 40 or more

occasions in the past year. Response options were coded as follows: 0=0 occasions, 1=1-2, 2=3-5, 3=6-9, 4=10-19, 5=20-39, and 6=40 or more (time 1: M=2.36, SD=1.89; time 2: M=2.31, SD=2.01). Participants reported average number of drinks using an item from the Monitoring the Future survey at time 1 and time 2 (Johnston et al., 2013). They indicated their average number of drinks on any one occasion as a write-in response. For write-in responses that included a range rather than a single number (e.g., 3-4 drinks), we used the maximum amount listed. With winsorizing, we capped responses at the 99th percentile, which excluded n=1 (time 1: M=3.64, SD=1.92; time 2: M=2.67, SD=1.72).

Participants also completed the Rutgers Alcohol Problem Index (RAPI) to assess alcohol problems. This unidimensional instrument has shown strong internal consistency in prior studies (Cronbach's $\alpha=0.92$) (White & Labouvie, 1989) and good to excellent test-retest reliability at 1-month, 6-months, and 1-year testing intervals ($r=0.89-0.92$) (Miller et al., 2002). Participants reported the number of times they experienced a negative consequence related to their alcohol use in the past year on a 4-point scale coded as follows: 0=None, 1=1-2 Times, 2=3-5 Times, and 3=More than 5 times. Participants only indicated whether they experienced the problem in the past year if they previously indicated experiencing the negative consequence in their lifetime. Scores were calculated by averaging ratings across the 23 items, with higher scores reflecting more endorsement of alcohol problems (time 1: M=0.21, SD=0.29, Cronbach's $\alpha=0.74$; time 2: M=0.13, SD=0.22, Cronbach's $\alpha=0.87$).

Participants reported their past year substance use from the Monitoring the Future survey at time 1 and time 2 (Johnston et al., 2013). Items assessed 1) frequency of cannabis use (i.e., one item for weed, pot, hash, and hash oil), 2) frequency of cigarette use (i.e., maximum reported frequencies on four separate items for cigarettes, smokeless tobacco, cigars/pipe tobacco, and

electronic cigarettes), 3) frequency of hallucinogen use (i.e., one item for LSD, MDMA, and other hallucinogens), and 4) frequency of stimulant use (i.e., maximum reported frequencies on three separate items for cocaine, amphetamines, and Adderall (without a doctor's orders)). Participants reported frequency of substance use in the past year for each item on a 7-point scale, coded as follows: 0=0 occasions, 1=1-2, 2=3-5, 3=6-9, 4=10-19, 5=20-39, and 6=40 or more. We retained the original response scale in variables for cannabis use (time 1: M=1.83, SD=2.09; time 2: M=1.99, SD=2.36) and cigarette use (time 1: M=1.01, SD=1.64; time 2: M=0.96, SD=1.81) because they met distributional assumptions for skew and kurtosis. Distributions evidenced skew below two and kurtosis under seven, suggesting that data do not meaningfully violate assumptions of normality for using confirmatory factor analyses and multivariate regression models (Cain et al., 2017; B. Muthen & Kaplan, 1985). Due to low base rates and violations of normality in the distributions, we collapsed hallucinogen and stimulant use by using the maximum reported frequencies, creating a variable indexing "other drug use." We then dichotomized the response scale of "other drug use" (0=no use and 1=1+ use) (time 1: M=0.25, SD=0.43; time 2: M=0.25, SD=0.43). Frequencies of all substance use indicators at time 1 and time 2 reported in Table 2.

Statistical Analysis Approach

First, in the preliminary analyses, we reviewed distributions of all variables for normality and examined descriptive statistics and bivariate correlations among the primary variables. Second, to reduce dimensionality of the set of variables assessing alcohol and substance use, we conducted confirmatory factor analyses for alcohol and substance use at time 1 and time 2, using Mplus 8.0 (Muthen & Muthen, 2017). In one model, indicators of time 1 alcohol use involvement and time 1 substance use involvement were included. The two factors were

correlated, and factor score regression composites were exported for each factor. A parallel model was conducted for time 2 outcomes. Time 1 alcohol use involvement and time 1 substance use involvement were included in subsequent regression analyses predicting time 2 alcohol and substance use outcomes. This predicted residualized change in substance use over time. By using this approach, we can predict the part of the time 2 primary outcomes that was not already explained by the time 1 primary outcomes, creating a change indicator. Third, we conducted covariate analyses. We tested a single multivariate regression model to establish covariates. The model included all potential covariates (i.e., age, race/ethnicity, employment status, residential status, time 1 alcohol use involvement, and time 1 substance use involvement) predicting both the primary outcomes (i.e., time 2 alcohol use involvement and time 2 substance use involvement). All covariates that were nonsignificant were trimmed from hypothesis testing. We checked model assumptions, including tests of linearity (for continuous outcomes), homoscedasticity, outliers, and residual normality.

Fourth, we tested hypotheses with multivariate regression (hypothesis 1) and path analysis (hypotheses 2 and 3) using multiple imputation to account for missing data (with 100 imputations), as estimated in Mplus 8.0 (Muthen & Muthen, 2017). Fit indices were assessed for models testing hypotheses 1-3 and included the comparative fit index (CFI), the Tucker–Lewis index (TLI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). The fit of the models was considered acceptable when the CFI and TLI values are above 0.90, and the RMSEA and SRMR values were below 0.08 (Hu & Bentler, 1999). Each model used for hypothesis testing was checked for model assumptions, including tests of linearity (for continuous outcomes), homoscedasticity, outliers, and residual normality.

A single multivariate regression model for hypothesis 1 tested whether SMYA, compared to HYA, had higher increases of alcohol and substance use involvement at time 2. We regressed time 2 alcohol use involvement and time 2 substance use involvement on sexual orientation, controlling for the significant covariates (i.e., age and the respective time 1 primary outcome). The multivariate regression was conducted with linear link functions for the continuous outcome and logistic link functions for the dichotomous outcome.

A single path analysis model for hypothesis 2 tested whether isolation and loneliness mediated the association between sexual orientation and time 2 alcohol and substance use involvement. To do this, we added disease-oriented isolation, social network-oriented isolation, and loneliness as mediators to the multivariate regression model from hypothesis 1 in a path analysis. Both direct and indirect effects were tested. Time 2 alcohol use involvement and time 2 substance use involvement were each regressed on sexual orientation, disease-oriented isolation, social network-oriented isolation, and loneliness, controlling for age and the respective time 1 primary outcome. Then, disease-oriented isolation, social network-oriented isolation, and loneliness were each regressed only on sexual orientation. Finally, indirect pathways were tested from sexual orientation through mediators predicting both time 2 alcohol use involvement and time 2 substance use involvement.

For hypothesis 3, to test whether the strength of the associations in hypothesis 2 were conditional on levels of family closeness and discord, we tested the mediational model from hypothesis 2 within a multiple group framework in four separate models –1) primary outcome time 2 alcohol use involvement with family closeness as the grouping variable, 2) primary outcome time 2 alcohol use involvement with family discord as the grouping variable, 3) primary outcome time 2 substance use involvement with family closeness as the grouping variable, and

4) primary outcome time 2 substance use involvement with family discord as the grouping variable. We used these four separate models to test hypothesis 3 due to the complexity of the models and the limited sample size. Each path model regressed the time 2 primary outcome (i.e., time 2 alcohol use involvement or time 2 substance use involvement) on disease-oriented isolation, social network-oriented isolation, and loneliness, controlling for age and the respective time 1 primary outcome. In the same models, disease-oriented isolation, social network-oriented isolation, and loneliness were each regressed only on sexual orientation. The multiple group framework tested whether the mediational model held across the high/low family closeness groups and the high/low family discord groups. For each of the four models described here, χ^2 difference tests were used to evaluate whether the model with unconstrained moderation pathways fit the data significantly better than the model in which the covariate pathways (i.e., age and the respective time 1 outcome) were constrained to be equal across groups, testing whether the covariates were significantly different across groups. Then, χ^2 difference tests were used to evaluate whether the model with only covariate constrained pathways fit the data significantly better than the model in which every pathway in the mediational model were constrained to be equal across groups.

Power Analysis

There is no single analysis to test power for the most complex model in this study (i.e., hypothesis 3). Therefore, we chose to calculate power for the multiple group comparison tests which focus on the moderated mediation hypothesis. This statistical test is a chi square difference test with 6 degrees of freedom (i.e., the number of degrees of freedom differentiating the covariate only constrained multiple group model and the covariate plus mediational pathway constrained model). To test this model, we looked at power for a chi-square test with 6 degrees

of freedom and a non-centrality parameter of 0.1 with sample size of 141. Results showed that we had power of at least .80 to detect small to medium (effect size) group differences in at least one of the mediational pathways (given that the null holds). This suggests that this model is adequately powered to correctly reject the null hypothesis that SMYA and HYA differ in any of these mediational pathways. Furthermore, since this is the most complex model in the study, there is adequate power for all other proposed models as well.

Results

Preliminary Analyses

Means, standard deviations, estimates of internal reliability, and bivariate correlations among continuous study variables are presented in Table 3. Differences between SMYA and HYA groups in study predictors and outcome variables were assessed using t-tests. Differences across sexual orientation were found such that SMYA compared to HYA have higher levels of loneliness ($t(129)=-2.59$; $p<0.05$) and family discord ($t(33.87)=-2.08$; $p<0.05$) and lower levels of family closeness ($t(129)=2.58$; $p<0.05$). No differences were found in disease-oriented isolation, social network-oriented isolation, time 1 and time 2 alcohol use involvement, and time 1 and time 2 substance use involvement. Paired-samples t-tests were conducted to compare substance use indicators (i.e., heavy drinking, average number of drinks, alcohol problems, cannabis use, cigarette use, and other drug use) at time 1 and time 2. Differences in substance use indicators were found across time points suggesting higher rates of general substance use at time 1 compared to time 2. Specifically, there were significant differences in the average number of drinks at time 1 ($M=3.64$, $SD=1.92$) and time 2 ($M=2.67$, $SD=1.72$); $t(135)=5.50$, $p<0.001$; and alcohol problems at time 1 ($M=0.21$, $SD=0.29$) and time 2 ($M=0.13$, $SD=0.22$); $t(140)=2.95$, $p<0.01$.

We created four factor-score regression composite indices for alcohol use involvement and substance use involvement at time 1 and time 2. Alcohol use involvement scores were created from three separate variables assessing heavy drinking, average number of drinks, and alcohol problems. Substance use involvement scores were created from three separate variables assessing cannabis use, cigarette use, and other drug use. Modification indices suggested local dependence between the indicators of cannabis use and other drug use accounted for poor model fit and when this covariance was added to the two measurement models, fit indices were all acceptable to strong for both time 1 ($\chi^2(7)=7.45, p=0.38$; RMSEA=0.02, CFI=1.0, TLI=0.99) and time 2 ($\chi^2(7)=7.54, p=0.37$; RMSEA=0.02, CFI=1.0, TLI=0.99). All items loaded significantly on each factor ($p<0.01$) in each model. Then, we extracted factor score regression composites for the two-factor solution of alcohol use involvement (three indicators: heavy drinking, average number of drinks, alcohol problems) and substance use involvement (three indicators: cannabis use, cigarette use, other drug use) at time 1 (Alcohol use involvement: mean=0.00, SD=0.94; Substance use involvement: mean=0.00, SD=0.91) and time 2 (Alcohol use involvement: mean=0.00, SD=0.90; Substance use involvement: mean=0.01, SD=0.84).

Given the restricted sample size, we conducted a multivariate regression analysis to establish covariates to test study hypotheses. Results are reported in Table 4, Model 1. Older participants had less time 2 alcohol use involvement ($b=-0.12, t=-2.50, p<0.05$) and time 2 substance use involvement ($b=-0.11, t=-2.42, p<0.05$). Additionally, participants with greater time 1 alcohol use involvement had greater time 2 alcohol use involvement ($b=0.81, t=3.14, p<0.01$) and participants with greater time 1 substance use involvement had greater time 2 substance use involvement ($b=1.02, t=3.98, p<0.001$). No other covariates served as significant predictors. Therefore, age was included as a covariate in hypothesis testing while race/ethnicity,

employment status, and residential status were trimmed as covariates. Time 1 alcohol use involvement and time 1 substance use involvement were included as factors to assess residualized change in problematic substance use over time.

Hypothesis 1: SMYA have greater increases in problematic substance use

To test hypothesis 1, a single multivariate regression analysis was conducted. Results are reported in Table 4, Model 2. Sexual orientation was not significantly related to changes in time 2 alcohol use involvement ($b=0.15$, $t=0.95$, $p=0.34$) or time 2 substance use involvement ($b=0.03$, $t=0.19$, $p=0.85$).

Hypothesis 2: Isolation and loneliness mediate the association between sexual orientation and problematic substance use

A single path analysis model was used to test hypothesis 2. Results are reported in Figure 3. As before, age predicted greater increases in time 2 alcohol use involvement and time 2 substance use involvement as did the respective time 1 outcome on time 2 outcome. We also found two other effects. Participants with greater endorsement of disease-oriented isolation had less time 2 substance use involvement ($b=-0.14$, $t=-2.16$, $p<0.05$). SMYA participants had increased loneliness as compared to HYA participants ($b=0.55$, $t=2.74$, $p=0.01$). No other pathways were significant. There were no significant indirect effects from sexual orientation to time 2 alcohol use involvement or time 2 substance use involvement.

Hypothesis 3: Quality of family relationships moderate the associations in hypothesis 2

To test hypothesis 3, the path analysis from hypothesis 2 was tested within a multiple group framework based on family closeness and family discord grouping variables. Results are reported in Table 5. All eight of the χ^2 difference tests – the unconstrained vs. covariate constrained models and covariate constrained vs. fully constrained models for both time 2 alcohol use involvement and time 2 substance use involvement across family closeness and

family discord grouping variables – were non-significant. Thus, family closeness and family discord do not moderate the mediational model in hypothesis 2.

Sensitivity Analyses

We tested each of the above models again without controlling for the time 1 respective primary outcomes to further explore why we may not have seen effects due to high stabilities in substance use over time. Results held consistent even without the respective time 1 primary outcomes in the models. Therefore, there were no disparities in time 2 alcohol and substance use involvement between groups along with no disparities in amount of change (i.e., comparing time 1 and time 2 alcohol and substance use involvement) between groups.

Discussion

Following Minority Stress Theory, the current study explored how exacerbated stressors (e.g., isolation due to pandemic imposed restrictions) and depleted protective factors (e.g., lack of access to community and interpersonal support systems) during COVID-19 may have disproportionately impacted risk for problematic substance use among SMYA as compared to HYA. Specifically, we tested how COVID-19 related isolation, loneliness, and quality of family relationships may be part of the underlying mechanism of using substances to cope with stress and a lack of social support. Understanding how this constellation of factors may have increased risk for problematic substance use among SMYA, especially while these factors were likely more salient during COVID-19, was critical for better understanding how best to support this marginalized population in the post-covid era as pandemic effects persisted (Brooks et al., 2020).

COVID-19-specific research has found mixed results regarding substance use disparities between SMYA and HYA (Fish et al., 2021; Salerno et al., 2021a; Scroggs et al., 2020; Somé et al., 2022). This study aligned with results demonstrating no group difference in problematic

substance use between SMYA and HYA during COVID-19, as we found no differences in amount of change of problematic substance use between pre-pandemic and during-pandemic time points comparing SMYA and HYA. This may be due to a couple of different reasons. First, among the broader young adult population, substance use increased during the pandemic, which may have led to a lessening in the disparity between SMYA and HYA patterns of use (Horigian et al., 2021). Perhaps the pandemic exacerbated stressors (e.g., financial burden, relationship strain, etc.) for young adults in general due to losses of social support and community access given social distancing guidelines - this effect may not have been unique or intensified in one group over another. Subsequently, young adults in general may have been using substances to cope with stress and a lack of social support from the pandemic (Gottfredson & Hussong, 2013; Hussong et al., 2011; Shadur et al., 2015), leading to no disparity in the amount of change of problematic substance use from time 1 to time 2 between SMYA and HYA. Second, pandemic control policies, such as social distancing and restriction of in-person gatherings, may have particularly restricted access to substances and substance-oriented spaces for SMYA. There was the loss of queer spaces (e.g., gay bars), which were often drinking-oriented spaces catered to SMYA (Hunt et al., 2019; Phillips et al., 2020). As a result, alcohol use may have decreased among SMYA due to the lack of access and socialization opportunities, again lessening the disparity between SMYA and HYA.

In the sensitivity analyses, we also found no differences in problematic substance use at either the pre-pandemic or during-pandemic time points between SMYA and HYA, which does not align with the Minority Stress Theory. Following the theory, we would expect SMYA to have increased rates of problematic substance use at both time points compared to HYA due to the cumulative effect of general and minority stressors compounded by an increased

vulnerability to the mechanism of using substances to cope with stress and a lack of social support. In particular, the lack of group differences at the pre-pandemic time point is particularly unusual considering how well-founded pre-pandemic group differences in problematic substance use are between SMYA and HYA (Demant et al., 2016; Hatzenbuehler et al., 2015; Mereish et al., 2017; Ott et al., 2013; Reed et al., 2010). This could be due to the small, diverse sample of SMYA (n=28) used in this study. The SMYA group consisted of multiple different identities (e.g., bisexual, gay, queer, lesbian, pansexual, and asexual individuals) that each hold unique risk (Borgogna et al., 2019; Schuler et al., 2018; Schuler & Collins, 2020). For example, literature suggests bisexual individuals hold more unique risk when compared to other SMYA subgroups (e.g., gay or lesbian). As a result, internal validity may have been weakened due to the small, diverse SMYA subsample, thereby diluting the possibility of significant between group differences.

Even though we did not find disparities in substance use, we did find differences between SMYA and HYA in isolation and loneliness. First, SMYA experienced increased loneliness, but not isolation, as compared to HYA during the COVID-19 pandemic. This finding was consistent with existing pre-pandemic research showing that SMYA generally experience heightened levels of loneliness as compared to HYA (Westefeld et al., 2001). However, it is curious that SMYA would experience increased loneliness, but not isolation, as compared to HYA during the pandemic. Perhaps, isolation, which is the lack of supportive resources and interactions (Leigh-Hunt et al., 2017), was experienced by young adults in general due to pandemic control policies (e.g., social distancing guidelines). While, loneliness, which is the subjective feeling of loss of close connection with others (Leigh-Hunt et al., 2017), may have been more salient to SMYA due to the particular importance of social support as a protective factor (Diamond & Alley, 2022;

Meyer, 2003). SMYA experienced the loss of sexual minority-specific peer and community supports during the pandemic, limiting connection with “safe” spaces, both physical and relational (Diamond & Alley, 2022). Therefore, SMYA may have experienced an exacerbated lack of social safety (i.e., reliable connection, inclusion, and protection in social relationships), which may have led to increased levels of loneliness as compared to HYA (Diamond & Alley, 2022). Future work should continue to not only tease out the pervasive effects of loneliness on SMYA psychosocial well-being, but also explore ways of facilitating and increasing connection among this population vulnerable to disconnection, especially during forms of ecological stress (e.g., exploring sources and types of social support to increase social safety).

Second, participants with greater isolation (i.e., disease-oriented isolation), but not loneliness, resulted in less time 2 problematic substance use. This finding did not align with what we hypothesized as exacerbated stress from pandemic-related isolation was not a part of the underlying mechanism of using substances to cope with stress and a lack of social support. Instead, this result seems to align with the rationale that one of the main motivators of substance use is access, so when access is restricted, substance use decreases (Guttmanova et al., 2022). Therefore, experiencing isolation due to quarantine from disease exposure or symptoms predicted decreased problematic substance use, possibly due to the lack of access both to the substances themselves and the spaces to use substances socially.

This study also explored the moderating role of the quality of family relationships on the mediating pathway from sexual orientation to problematic substance use through isolation and loneliness. Several findings emerged from this analysis. First, we did find that SMYA reported increased family discord and decreased family closeness as compared to HYA during the COVID-19 pandemic. This was consistent with prior research finding SMYA have decreased

quality of family relationships as compared to HYA (Felner et al., 2020; Fish et al., 2020b; Ryan et al., 2010). Furthermore, for some young adults, pandemic controls meant more time with families due to the COVID “bubbles” (i.e., interactions with only a small group of individuals to limit disease transmission), decreasing engagement in typical social and extracurricular contexts. This time spent with family may have differentially impacted levels of stress for different groups of young adults. For SMYA, prior pandemic-focused research suggested the family context may have heightened stress levels as these individuals are forced to isolate with unsupportive families, thereby decreasing family closeness and increasing family discord (Fish et al., 2020b).

Additional findings showed that the two parts of the mediating pathway were not moderated by family relationship quality. In the first part of the mediating pathway, we found that quality of family relationships did not impact experiences of loneliness and isolation related to being SMYA, which does not align with Minority Stress Theory. Even though SMYA had lower quality family relationships as compared to HYA, this decrease in social support did not pose any unique risk of isolation and loneliness. However, perhaps for SMYA, there are more significant and impactful sources of social support besides family (e.g., general peers, SMYA-specific peers, SMYA-specific community groups). For example, Parra et al. (2018) found peer social support buffered the link between poor family support and internalizing symptoms (Parra et al., 2018). Consequently, if these more salient sources of social support are compromised, they may be more strongly linked to stress and problematic substance use among SMYA. Given this possibility, it is important to explore the impact of different sources of social support within the SMYA community (e.g., peers, sexual and gender minority community specific, religious communities, school communities, virtual etc.). Investigating how these different sources of social support are perceived by SMYA is key as it is not just “any” support but “desired” support

that matters to this population to increase feelings of social safety (Diamond & Alley, 2022), which is suggested through our finding that quality of family relationships, even when compromised, did not impact feelings of isolation and loneliness among SMYA.

In the second part of the mediating pathway, we found that quality of family relationships also did not moderate the association between isolation and loneliness and problematic substance use. This result does not align with quality of family relationships being a part of the underlying mechanism of using substances to cope with stress and a lack of social support. Perhaps, quality of family relationships did not act as a moderator in the proposed mechanism due to the age of the sample. Young adults are exploring newfound independence and identity formation, thereby potentially distancing themselves generally from family relationships (Arnett, 2000, 2007). In our sample, only 10% lived in the residence of a family member. Thus, perhaps family relationships are not particularly impactful to this population and future research should investigate other forms of social support more salient to this age group (e.g., peers and romantic partners).

Overall, the current study showed that though SMYA did not experience heightened levels of problematic substance use during the pandemic, they experienced a lack of social safety (e.g., increased loneliness and decreased quality of family relationships), which future research should continue exploring to better understand the underlying processes involved in decreased social safety to better inform culturally sensitive support and interventions. Yet, the current study has strengths and limitations. First, though a power analysis did reveal that the study was sufficiently powered at ($\beta=.80$) for our most complex analysis, the sample was limited by only including 28 sexual minority-identifying individuals. This limits the external validity of this study as we are generalizing from a small subset of SMYA. Additionally, we were unable to

explore heterogeneity within the group. Based on existing literature, certain subgroups may experience more severe mental health and substance use symptomologies within the sexual and gender minority community, so identifying such vulnerability within an already marginalized population is key (Borgogna et al., 2019). Bisexual women and gender diverse individuals are often the most vulnerable subgroups within the sexual and gender minority population for problematic substance use (Borgogna et al., 2019; Schuler et al., 2018; Schuler & Collins, 2020). Furthermore, disparities are often exacerbated by race/ethnicity, as studies have found disparities in problematic substance use were greater in magnitude for Black and Hispanic sexual and gender minority individuals as compared to White sexual and gender minority individuals (Schuler et al., 2020). Future work would benefit from including a larger, heterogeneous sexual and gender minority sample, allowing for stratification across subgroups when exploring effects of identified factors on problematic substance use. Second, internal reliability estimates for disease-oriented isolation (Cronbach's $\alpha=0.63$) and social network-oriented isolation (Cronbach's $\alpha=0.55$) were low. Though we argued that for stressful life events measures of this kind low reliability estimates are not a problem in and of themselves because these types of measures are not governed by an underlying latent factor (Bollen & Lennox, 1991), there is still the possibility that the measures may not have appropriately assessed the desired constructs.

Strengths of the study lie in the novelty of the question. We are one of the first studies to explore problematic substance use as a primary outcome during COVID-19 among SMYA. Furthermore, we are the first to our knowledge to explore this specific constellation of variables associated with problematic substance use that are both exacerbated stressors and depleted protective factors during the pandemic, particularly for SMYA. Additionally, this study was a

between group comparison between SMYA and HYA, and many studies do not include HYA as a comparison group.

In conclusion, the current study was the first to our knowledge to explore how and why specific stressors impact the potentially exacerbated substance use disparity between SMYA and HYA during the COVID-19 pandemic-era. Novel findings highlighted how feelings of social safety decreased among SMYA as compared to HYA, though this did not explain or impact problematic substance use. Therefore, this study highlighted points of vulnerability to target in interventions with SMYA even well beyond the acute phase of the pandemic as effects of the pandemic (Brooks et al., 2020) and loneliness (Loades et al., 2020) may persist long-term. This is especially important as existing literature shows having a sexual minority identity was significantly correlated with expressing a need for and experiencing barriers to care during the COVID-19 pandemic (Chaiton et al., 2021; Gorfinkel et al., 2023). Thus, focusing research to support clinical efforts for this uniquely vulnerable population during the pandemic was highly important to advancing quality of care.

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Table 1. Sociodemographic characteristics of the study sample (N = 141).

Sociodemographic Characteristics	N (%)	M (SD)
Age (Range: 23-29; Median = 26)		25.98 (1.43)
Race/ethnicity^a		
White	83 (59.29)	
Black or African American	36 (25.71)	
American Indian or Alaska Native	1 (0.71)	
Asian/Middle Eastern	12 (8.57)	
Hispanic/Latino	8 (5.71)	
Current Employment Status		
Full-time paid position	105 (74.47)	
Part-time paid position	15 (10.64)	
Volunteer position	1 (0.71)	
Not working	20 (14.18)	
Current Residential Status		
Living in own residence	85 (60.28)	
Living in a shared residence	46 (32.62)	
Living in the residence of a family member	10 (7.09)	
Gender^a		
Woman	86 (60.99)	
Man	48 (34.04)	
Gender Diverse	7 (4.96)	
Sexual Orientation^a		
SMYA	28 (19.86)	
HYA	113 (80.14)	

Note. Percentages may not equal 100 due to missing data.

^a Participants could select more than one response option.

Table 2. Frequencies of substance use indicators at Time 1 and Time 2 in the study sample (N = 141).

Substance Use Indicator	TIME 1		TIME 2	
	N (%)	M (SD)	N (%)	M (SD)
Heavy drinking (5+ drinks in a row in past year)		2.36 (1.89)		2.31 (2.01)
0 times	26 (18.57)		38 (26.95)	
1-2 times	32 (22.86)		23 (16.31)	
3-5 times	25 (17.86)		21 (14.89)	
6-9 times	13 (9.29)		12 (8.51)	
10-19 times	22 (15.71)		20 (14.18)	
20-39 times	11 (7.86)		17 (12.06)	
40 or more times	11 (7.86)		10 (7.09)	
Average number of drinks on any one occasion		3.64 (1.92)		2.67 (1.72)
1 drink	12 (8.63)		26 (18.98)	
2 drinks	28 (20.14)		53 (38.69)	
3 drinks	36 (25.90)		29 (21.17)	
4 drinks	25 (17.99)		7 (5.11)	
5-10 drinks	27 (26.62)		19 (13.87)	
Alcohol problems in past year		0.21 (0.29)		0.13 (0.22)
0 problems	63 (44.68)		63 (45.00)	
1+ problems	78 (55.32)		77 (55.00)	
Cannabis use in past year		1.83 (2.09)		1.99 (2.36)
0 times	62 (43.97)		61 (43.57)	
1-2 times	18 (12.77)		22 (15.71)	
3-5 times	13 (9.22)		10 (7.14)	
6-9 times	11 (7.80)		10 (7.14)	
10-19 times	16 (11.35)		4 (2.86)	
20-39 times	9 (6.38)		7 (5.00)	
40 or more times	12 (8.51)		26 (18.57)	
Cigarette use in past year		1.01 (1.64)		0.96 (1.81)
0 times	84 (59.57)		96 (68.09)	
1-2 times	26 (18.44)		17 (12.06)	
3-5 times	6 (4.26)		6 (4.26)	
6-9 times	10 (7.09)		6 (4.26)	
10-19 times	7 (4.96)		2 (1.42)	
20-39 times	2 (1.42)		4 (2.84)	
40 or more times	6 (4.26)		10 (7.09)	
Other drug use in past year		0.25 (0.43)		0.25 (0.43)
0 times	106 (75.18)		106 (75.18)	
1+ times	35 (24.82)		35 (24.82)	

Note. Percentages may not equal 100 due to missing data.

Table 3. Means, standard deviations, internal reliability estimates, and bivariate correlations among continuous study variables.

	M	SD	α	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Age	25.98	1.43	--	1									
2. Disease-oriented Isolation	0.36	0.36	0.63	-0.16	1								
3. Social network-oriented Isolation	0.78	0.26	0.55	-0.02	0.04	1							
4. Loneliness	1.91	0.68	0.95	-0.00	-0.02	0.04	1						
5. Family Closeness	1.56	0.73	0.94	0.01	0.08	-0.01	-0.22*	1					
6. Family Discord	0.46	0.46	0.82	-0.06	-0.00	0.01	0.03	-0.17*	1				
7. Time 1 Alcohol Use Involvement	0.00	0.94	0.81	-0.03	-0.05	0.11	-0.04	0.04	-0.23**	1			
8. Time 1 Substance Use Involvement	0.00	0.91	0.72	-0.09	-0.02	0.10	-0.01	0.04	-0.24**	0.96***	1		
9. Time 2 Alcohol Use Involvement	0.00	0.90	0.76	-0.18*	-0.08	0.04	0.13	0.01	-0.07	0.61***	0.58***	1	
10. Time 2 Substance Use Involvement	0.01	0.84	0.67	-0.23**	-0.13	0.02	0.10	-0.00	-0.10	0.58***	0.64***	0.82***	1

Notes. * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 4. Multivariate regression results: Associations between covariates and problematic substance use (model 1) and between sexual orientation and problematic substance use (model 2).

MODEL 1						
Predictors	TIME 2 ALCOHOL USE INVOLVEMENT			TIME 2 SUBSTANCE USE INVOLVEMENT		
	Estimate (b)	Test Statistic (t)	P-value (p)	Estimate (b)	Test Statistic (t)	P-value (p)
Age	-0.12	-2.50	0.01*	-0.11	-2.42	0.02*
Race/Ethnicity	0.03	0.19	0.85	-0.06	-0.42	0.68
Employment Status	0.12	0.64	0.52	-0.14	-0.78	0.44
Residential Status	-0.02	-0.16	0.88	0.03	0.25	0.80
Time 1 Alcohol Use Involvement	0.81	3.14	0.002**	-0.33	-1.32	0.19
Time 1 Substance Use Involvement	-0.18	-0.67	0.51	1.02	3.98	0.000***

MODEL 2						
Predictors	TIME 2 ALCOHOL USE INVOLVEMENT			TIME 2 SUBSTANCE USE INVOLVEMENT		
	Estimate (b)	Test Statistic (t)	P-value (p)	Estimate (b)	Test Statistic (t)	P-value (p)
Age	-0.10	-2.26	0.02*	-0.12	-2.64	0.01*
Time 1 Alcohol Use Involvement	0.67	14.06	0.000***			
Time 1 Substance Use Involvement				0.71	14.51	0.000***
Sexual Orientation	0.15	0.95	0.34	0.03	0.19	0.85

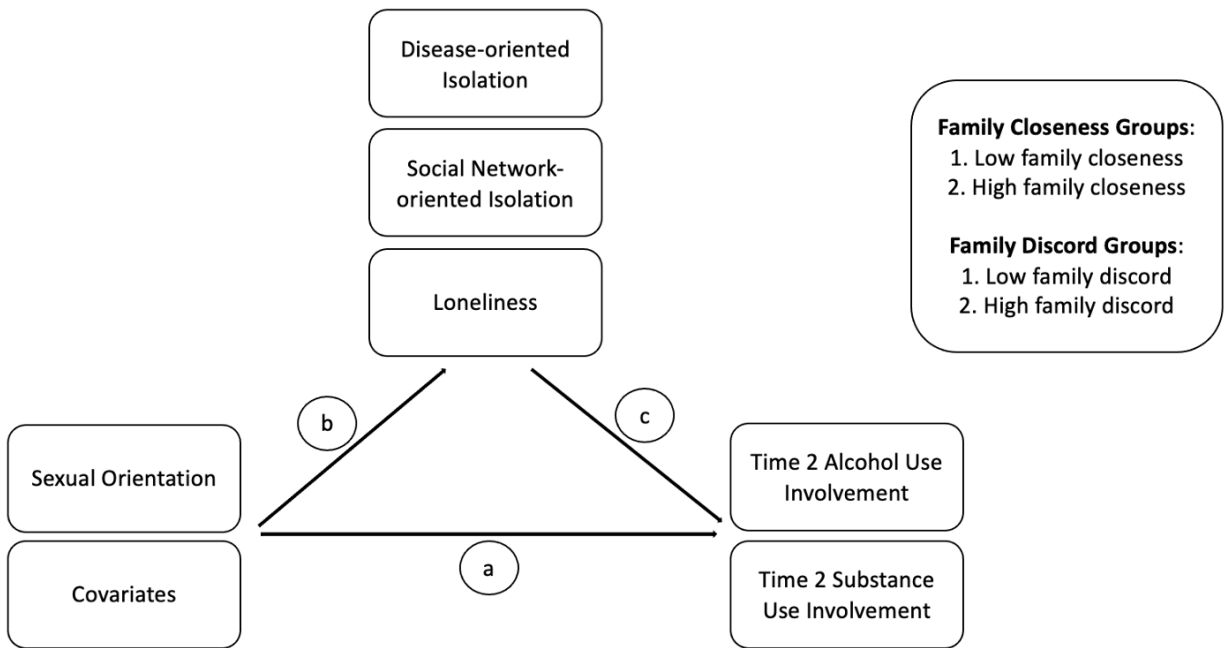
Note. * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 5. Multiple group path analysis results: Moderated mediation by family closeness and family discord.

	T2 Alcohol Use Involvement with FC Grouping	T2 Alcohol Use Involvement with FD Grouping	T2 Substance Use Involvement with FC Grouping	T2 Substance Use Involvement with FD Grouping
Unconstrained	$\chi^2(20)=14.66$ p = 0.80	$\chi^2(20)=12.50$ p = 0.90	$\chi^2(20)=14.27$ p = 0.82	$\chi^2(20)=13.24$ p = 0.87
Covariates Constrained	$\chi^2(22)=14.77$ p = 0.87	$\chi^2(22)=12.74$ p = 0.94	$\chi^2(22)=14.74$ p = 0.87	$\chi^2(22)=13.76$ p = 0.91
Fully Constrained	$\chi^2(28)=18.11$ p = 0.92	$\chi^2(28)=20.57$ p = 0.84	$\chi^2(28)=19.06$ p = 0.90	$\chi^2(28)=19.61$ p = 0.88
Unconstrained vs. Covariate constrained chi-square difference	$\chi^2(2)=0.11$ p = 0.95	$\chi^2(2)=0.24$ p = 0.87	$\chi^2(2)=0.47$ p = 0.79	$\chi^2(2)=0.52$ p = 0.77
Covariate constrained vs. Fully constrained chi-square difference	$\chi^2(6)=3.34$ p = 0.77	$\chi^2(6)=7.83$ p = 0.25	$\chi^2(6)=4.32$ p = 0.63	$\chi^2(6)=5.85$ p = 0.44

Note. The unconstrained model was the model depicted in Figure 3. The covariates constrained model constrained the covariate pathways (i.e., age and the time 1 outcomes) in the model depicted in Figure 3. The fully constrained model constrained every pathway in the model depicted in Figure 3. In each of the unconstrained, covariates constrained, and fully constrained models, time 2 alcohol use involvement and time 2 substance use involvement were grouped separately in two groups by each family closeness and family discord. FC = Family closeness grouping variable. FD = Family discord grouping variable. Shading = chi square difference tests not full model estimates. Critical values at $\alpha = .05$.

Figure 1. Visual of study model.



Note. Path “a” represents the effect of sexual orientation and the covariates on the primary outcomes (i.e., time 2 alcohol use involvement and time 2 substance use involvement). Path “b” represents the effect of sexual orientation on disease-oriented isolation, social network-oriented isolation, and loneliness. Path “c” represents the effect of disease-oriented isolation, social network-oriented isolation, and loneliness on the primary outcomes. Paths “b” and “c” combine to create a mediational pathway to explain the indirect effect through which path “a” (the effect of sexual orientation on the primary outcomes) functions. Family closeness and family discord are considered moderators that potentially amplify the strength of the mediational pathway (paths “b” and “c”).

Figure 2. Consort diagram of the flow of participants through each portion of the REAL-U study.

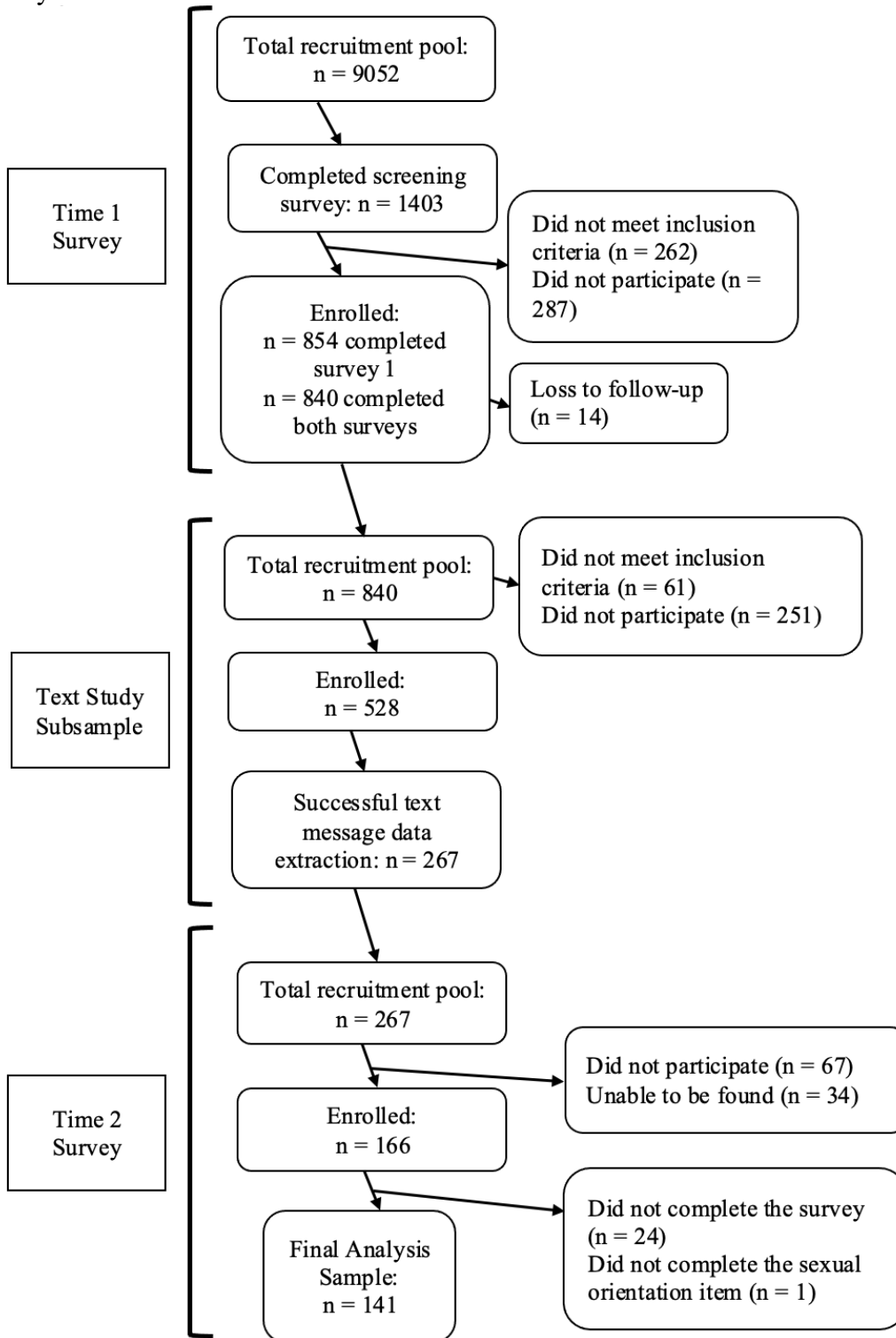
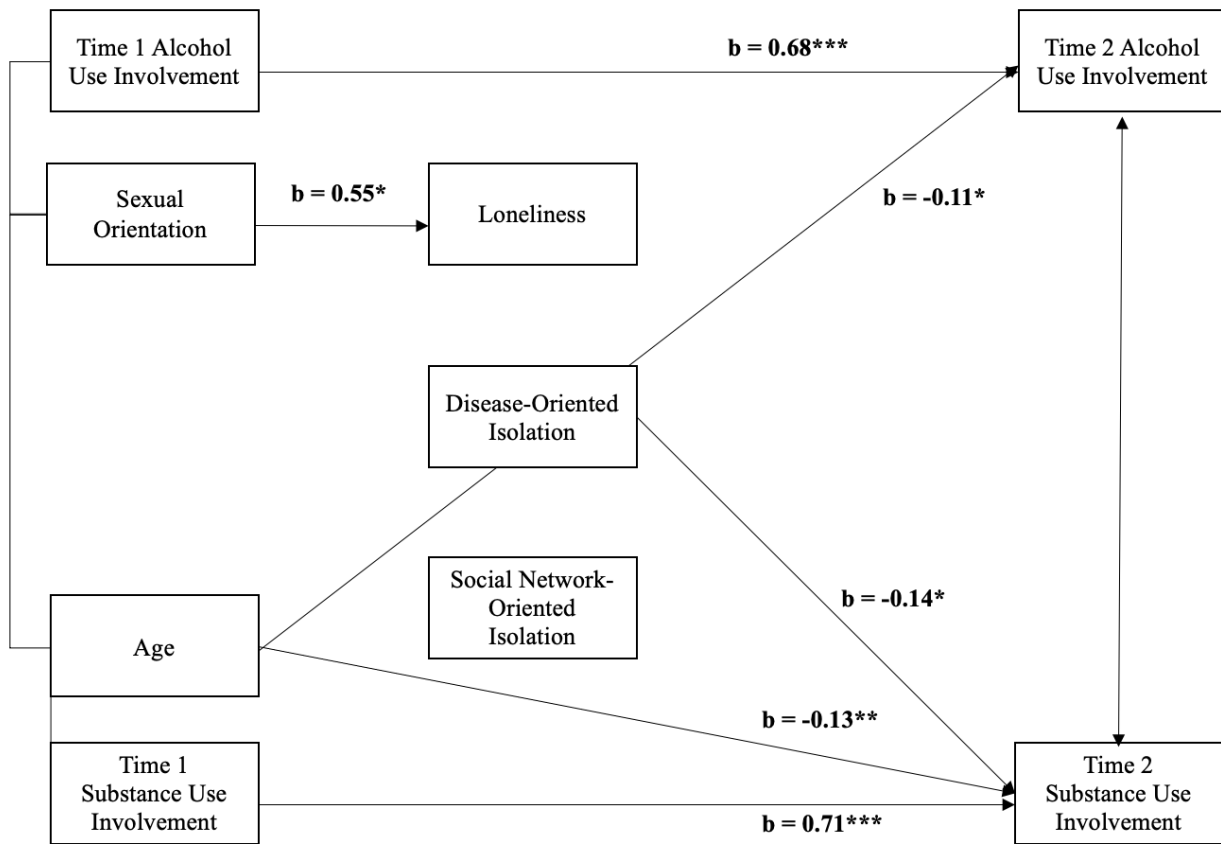


Figure 3. Full mediational path analysis: Isolation and loneliness as mediators between sexual orientation and problematic substance use.



Note. All pathways are estimated. Only pathways significant at $p < .05$ are depicted. $^*p < .05$; $^{**}p < .01$; $^{***}p < .001$.