Running head: MINORITY STRESS, EMOTION REGULATION, AND SUBSTANCE USE

Substance use and sexual minority status: examining the mediating roles of stress and emotion
dysregulation in young adult women

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Abstract

Sexual minority women (SMW) report higher rates of substance use and disorder across the lifespan, and greater levels of minority stress in adolescence and young adulthood. Minority stress mediation models propose that higher levels of social stressors may increase emotion dysregulation, which in turn increases the propensity toward substance misuse. Few studies, however, have prospectively examined the impact of stressors and emotion dysregulation among SMW on early and escalating substance use. This longitudinal study examined whether emotion dysregulation and social stress mediated the association between sexual minority status and developing substance use (ages 17 through 22 years) in a sample of 2,201 heterosexual and 246 SMW participants in the Pittsburgh Girls Study. Results supported serial mediation processes of marijuana use risk: SMW reported higher levels of social stress in late adolescence, which in turn predicted greater emotion dysregulation that was associated with greater marijuana use by young adulthood.

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1. Introduction

Rates of substance use disorder (SUD) among sexual minority women (SMW) are elevated relative to heterosexual populations (Marshall et al., 2008; McCabe, Hughes, Bostwick, West, & Boyd, 2009; McCabe, Hughes, Bostwick, & Boyd, 2005; Meyer, 2003; Vrangalova & Savin-Williams, 2014). For instance, meta-analytic reviews (Meyer, 2003) and large, nationally-representative samples suggest that SMW are 3.5 times more likely to have a lifetime occurrence of an SUD relative to heterosexual women (Cochran, Ackerman, Mays, & Ross, 2004). Relative to heterosexual women, SMW are also between two and four times as likely to report alcohol dependence, between two and five times as likely to report cigarette use, and eleven times as likely to report marijuana dependence (Marshall et al., 2008; McCabe et al., 2005; Meyer, 2003).

Adolescence and young adulthood are especially crucial periods for the initiation and progression of substance use among SMW. Across sexual orientation populations, young adulthood (ages 18-25 years) is a developmental period during which problem and heavy substance use reaches a lifetime peak (Chassin, Ritter, Trim, & King, 2003), and substance use patterns during this period are among the most robust predictors of substance misuse and disorder across the lifespan (Chassin, Pitts, & Prost, 2002; McGue & Iacono, 2005). Moreover, racial differences in the development of substance use suggest that substance use disparities may vary as a function of intersecting racial and other marginalized identities (Bowleg, 2008; Crenshaw, 1991). For instance, whereas Black youth have historically reported relatively lower levels of substance use compared to White youth (McCabe et al., 2007), this gap may be closing

for marijuana use (Lanza, Vasilenko, Dziak, & Butera, 2015), and some evidence suggests that Black women may report greater marijuana use by young adulthood (Keyes et al., 2015).

This developmental window may also be particularly crucial in explaining SUD risk among sexual minority populations, especially for SMW. Multiple prior studies have shown that heightened substance use in SMW first emerges in adolescence (Coker, Austin, & Schuster, 2010; Marshal et al., 2008; Needham, 2012). Longitudinal studies indicate that disparities in use either persist or increase (Dermody, McGinley, Eckstrand, & Marshal, 2020; Marshal, Friedman, Stall, & Thompson, 2009) through young adulthood. For instance, prior work involving the Pittsburgh Girls Study data had shown that, relative to heterosexual youth, SMW reported greater frequency of alcohol, marijuana, and cigarette use in adolescence and young adulthood. SMW also increased more quickly in use through young adulthood than their heterosexual peers, with disparities in growth rates between SMW and heterosexual peers most pronounced in early adolescence compared to later adolescence and young adulthood (Dermody et al., 2020). Among studies addressing intersections of race and sexual minority status, findings have been somewhat inconsistent. For instance, though studies have shown that women of color report greater substance use problems than White SMW (Mereish & Bradford, 2014), others suggest no such differences in substance-related problems (Hughes et al., 2006; Parks & Hughes, 2005). The goal of the current study is to therefore understand the factors explaining early and escalating substance use among SMW, and to explore differences in these associations by race.

1.1. Stress, Emotion Dysregulation, and Developing Substance Use

Sexual minority stress theories suggest that SMW may report higher rates of substance use and SUD due to greater exposure to stigma-related social stressors, such as minority-related victimization, discrimination, and peer rejection (Hatzenbuehler, 2009; Meyer, 2003; Newcomb

& Mustanski, 2010). The link between stress and increased risk for SUD in both the general population (Grant et al., 2003) and among sexual minority individuals (McCabe, Bostwick, Hughes, West, & Boyd, 2010) is well-established. Among SMW, for instance, approximately 46% who reported victimization experiences within the past year also reported a past-year diagnosis of SUD, a figure that is four times as high as SMW who report no victimization (McCabe et al., 2010). Moreover, meta-analytic findings suggest that a higher level of general social stress is the strongest predictor of subsequent substance use among sexual minority adolescents compared to other common risk factors, including co-occurring internalizing and externalizing problems and reports of general distress (Goldbach, Tanner-Smith, Bagwell, & Dunlap, 2014). Stress experiences in adolescence have also partly explained the observed disparity in substance use outcomes (tobacco and alcohol use) between heterosexual women and SMW in prior research (Austin et al., 2008; McLaughlin, Hatzenbuehler, Xuan, & Conron, 2012). Together, these findings suggest that stress-related processes that heighten risk for substance use behaviors may be intervening factors in the association between sexual minority status and SUD.

Current models of SUD risk among SMW indicate that emotion dysregulation may be a principal mechanism linking stress with the development of SUD (Hatzenbuehler, 2009). Emotion dysregulation has been conceptualized as difficulty in modulating emotions in order to respond appropriately to demands in the environment (Aldao, Nolen-Hoeksema, & Schweizer, 2010). For instance, individuals with greater emotion dysregulation may have poorer emotional awareness and understanding of emotion; have limited access to emotion coping resources and adaptive strategies; and may be more likely to engage in maladaptive patterns of responding to emotion such as rumination, among other characteristics (Gratz & Roemer, 2004). Stress

experiences have been directly linked with emotion dysregulation behaviors (Aldao et al., 2010; Ward, Lyubomirsky, Sousa, & Nolen-Hoeksema, 2003), and are thought to heighten emotion dysregulation by both increasing emotional reactivity and disrupting the use of effective regulation strategies (Cohen, Kessler, & Gordon, 1995; Pechtel & Pizzagalli, 2011; Sheridan & McLaughlin, 2014).

The effect of stress on emotion dysregulation may in turn increase risk for substance use initiation and escalation through young adulthood. Both sexual minority stress theory (Hatzenbuehler, 2009) and general developmental theories of early substance use risk (Hussong, Jones, Stein, Baucom, & Boeding, 2011) propose that experiences of marginalization tax an individual's coping resources, such that substances are used as a strategy for down-regulating negative affect. Supporting evidence from the general population has shown a robust relation between coping motives (for review, see Cooper, Kuntsche, Levitt, Barber, & Wolf, 2016), as well as emotion dysregulation (Aldao et al., 2010; Giombini, 2015; Nolen-Hoeksema, Stice, Wade, & Bohon, 2007) with substance use behavior. Moreover, research has shown that individuals with histories of early stress may be particularly sensitized to the reinforcing properties of substance use within adolescence and young adulthood (Andersen & Teicher, 2009; Brady & Sinha, 2005; Enoch, 2011; Sapolsky, 2003), such that stress-related motivation toward use progresses more rapidly into heavier and disordered use over time (Andersen & Teicher, 2009). As such, minority stress experiences and emotion dysregulation may characterize increased risk for a more rapid progression from substance use experimentation into heavier use through young adulthood. Although evidence has supported emotion dysregulation as a mediator of the effects of sexual minority stress on internalizing symptomatology (e.g., Hatzenbuehler, McLaughlin, & Nolen-Hoeksema, 2008; Hatzenbuehler, Nolen-Hoeksema, & Dovidio, 2009;

Szymanski & Henrichs-Beck, 2014), we know of no studies that have prospectively examined whether the effect of minority stress on emotion dysregulation in turn predicted substance use among SMW, or whether this pathway resulted in a trajectory of increasingly severe use.

1.2. Current Study

The goal of this study was to examine whether and how stress experiences and emotion dysregulation among SMW explain changes in substance use from late adolescence into young adulthood. Using longitudinal data on 2,447 women (5.9% SMW) followed from age 17 years to age 22 years, we pursued these questions by first establishing whether sexual minority status was associated with level and change in emotion dysregulation through young adulthood, and whether this in turn was associated with escalating substance use (alcohol, cigarette, and marijuana). We then tested social stress as a mechanism in these relations by examining whether the effect of stress on emotion dysregulation mediated the relation between sexual minority status and alcohol, cigarette, and marijuana use in the sample. We hypothesized that greater social stress among SMW in late adolescence would predict subsequently higher levels of emotion dysregulation, greater frequency of substance use, and steeper increases in substance use by young adulthood. We further posited that higher levels and faster growth in substance use among SMW will be explained by the mediating effects of adolescent social stress on level and change in emotion dysregulation. Finally, we examined exploratory hypotheses about whether these effects differed among White and Black women.

2. Methods

2.1. Research Design

This study used existing data from the longitudinal Pittsburgh Girls Study comprising a large, urban community-based sample designed to assess the development of behavioral and

emotional disorders and substance use from middle childhood to young adulthood (Keenan et al., 2010). Data were collected using an accelerated longitudinal design in which four age-based cohorts were recruited, ranging from ages 5 to 8 years, and were followed annually. This design resulted in planned missingness patterns ranging up to 37.3% in variables involved in the current study (see Supplemental Table A), which were accommodated using a multiple imputation approach (described in the Analytic Strategy section). At the time of the current analyses, data for the sample were collected through age 22 years in the oldest cohort. We conducted secondary data analysis using six waves of data (ages 17-22), examining sexual minority status (age 18 years) and social stress experiences in late adolescence (age 17 years), and levels and growth in emotion dysregulation from age 19 years to age 21 years¹ and alcohol, cigarette, and marijuana use from age 17 years to age 22 years. Retention rates for the study were high across annual time points, ranging from 85.4% to 97.2%. More detailed descriptions of the Pittsburgh Girls Study sample, recruitment, and retention are provided elsewhere (Hipwell et al., 2002; Keenan et al., 2010).

For these analyses, a total of 2,447 women were in the sample at the initial time point (age 17), and 246 women reported sexual minority status at age 18 years. Although sexual minority status was collected at earlier time points, age 18 years was the first age at which women were the sole informants of sexual orientation. Approximately half of the young women were Black (53%), 41% were White, and the remaining participants self-identified as another race or multi-racial. Low-income neighborhoods were oversampled with approximately 40% of

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¹The emotion regulation variables used in this study were introduced at a later phase of data collection in the Pittsburgh Girls Study, resulting in a larger degree of missingness at ages 17, 18, and 22 in the sample due to missing data for several cohorts (see Supplemental Table A). Thus, we were unable to use these measures in a broader age range for the current study.

families receiving public assistance at wave 1. Approximately 47% of caregivers in the sample at wave 1 reported 12 or fewer years of education.

Study Measures

Annual interviews were conducted in the home and were completed by trained interviewers using a laptop computer. The current study included measures of sexual orientation, childhood and adolescent social stress, emotion dysregulation, and alcohol, cigarette, and marijuana use. Nearly all measures were adapted from previously existing measures used in prior studies.

Sexual Minority Status. Self-report of sexual orientation was assessed using the following question: “Do you consider yourself to be (a) Heterosexual or straight; (b) Gay or lesbian; or (c) bisexual?”, asked at age 18. Given the relatively small number of lesbian ($n = 64$) and bisexual ($n = 182$) respondents and that both groups are at similar risk for alcohol and other drug use disorders (e.g., Green & Feinstein, 2012), these groups were combined to form a single SMW group.

Social Stress. Stressors were measured as a composite index derived from three social domains measured at age 17 years: peer victimization, discriminatory experiences, and harsh parenting.

Reports of victimization by peers were measured using the Peer Experience Questionnaire (PEQ; Vernberg, Jacobs, & Hershberger, 1999) at age 17 years. This 9-item scale includes items measuring victimization by verbal aggression, confrontive physical aggression, and ostracism or relational aggression, rated on a scale ranging from never to a few times per week in the past year. Reliability for this scale in the current sample across data collection cohorts was high ($\alpha = 0.777 - 0.787$).

Harsh parenting at age 17 years was assessed using the child-report version of the 19-item Conflict Tactics Scale – Parent/Child Version (CTS; Straus, 1979) which measures the level of child-directed harsh parenting practices from the parent. Subscales of this measure included items reflecting psychological aggression and spanking. Straus and colleagues (Straus, 1998) report adequate discriminant and construct validity on all subscales, and adequate reliability coefficients are reported in the current sample across data collection cohorts ($\alpha = 0.742 - 0.753$).

Discrimination at age 17 years was measured using the Everyday Discrimination Scale (EDS; Williams, Yan Yu, Jackson, & Anderson, 1997). The EDS is a 9-item measure of chronic and routine experiences of unfair treatment, such as being treated with less respect than others, experienced in the past year. The EDS was computed as a sum and demonstrated high reliability across cohorts ($\alpha = 0.837 - 0.839$).

We combined victimization, harsh parenting, and discrimination using a latent variable specification. We used confirmatory factor analysis (CFA) to assess whether these measures could be reasonably combined in a latent measurement model. Noting that fit measures are not informative in saturated structural equation models (i.e., a CFA with three manifest variables), we examined factor loadings produced by this model to determine whether this specification was feasible as a latent variable model. Standardized factor loadings were 0.66 for peer victimization, 0.80 for discrimination, and 0.32 for harsh parenting practices. This suggested that each social stress measure was a reasonable indicator of a latent social stress construct at age 17 years.

Emotion Dysregulation. Annual assessments of emotion dysregulation from age 19 to age 21 were measured using two subscales from the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) and the Rumination subscale of the Perfectionism Inventory (Hill et al., 2004). The DERS is designed to assess clinically-relevant difficulties in emotion

regulation with six subscales, although only two (Awareness; 6 items, Strategies; 8 items; Gratz & Roemer, 2004) were available in the present study. Both Awareness ($\alpha = 0.868 - 0.939$) and Strategies ($\alpha = 0.823 - 0.907$) demonstrated high reliability across the study period and across data collection cohorts. The 7-item Rumination subscale from the Perfectionism Inventory measures intrusive worrying about past errors, imperfect performance, or future mistakes, and has adequate reliability across study ages and cohorts ($\alpha = 0.908 - 0.916$).

Similar to our social stress measure, we used CFA to justify a latent emotion dysregulation measure comprised of Awareness, Strategies, Rumination subscales, particularly given some prior work demonstrating poor psychometric properties of several DERS subscales (especially Awareness; e.g., Hallion, Steinman, Tolin, & Diefenbach, 2018; Osborne, Michonski, Sayrs, Welch, & Anderson, 2017). We specified CFA models using the observed data in which Awareness, Strategies, and Rumination were indicated by latent factors, conducted at each respective time point (ages 19, 20, and 21 years). Standardized factor loadings indicated that, whereas Rumination and Strategies were strongly and similarly correlated with each latent factor (ranging from 0.56 to 0.91), Awareness correlated weakly with these factors at each time point (ranging from 0.11 to 0.15). Given comparable factor loadings and moderate correlation between Rumination and Strategies at each time point (ranging from $r = 0.45$ to $r = 0.50$), we therefore quantified emotion dysregulation as a sum of the standardized Rumination and Strategies subscales at each time point. Prior to summing, each of these variables had been standardized across all time points to ensure that standardization did not remove time trends in these variables (Bollen & Curran, 2006; King et al., 2018).

Substance Use. Past year alcohol, cigarette, and marijuana use were assessed annually from age 17 to age 22 using the Nicotine, Alcohol and Drug Substance Use scale (NADU),

adapted from an instrument of the Rutgers Health and Human Services Project (Pandina, Labouvie, & White, 1984). This scale contains items measuring frequency of use of each substance within the past year, assessed on an 8-point scale ranging from 0 ('I did not within the past year') to 7 ('every day or more than once a day').

2.2. Analytic Strategy

2.3.1. Missing Data

We used multiple imputation to estimate missing data (Graham, Taylor, Olchowski, & Cumsille, 2006; Little & Rhemtulla, 2013) using Blimp (Enders, Mistler, & Keller, 2016; Keller, Enders, & Levy, 2017) to generate a total of 20 imputed datasets. We conducted imputations on two Markov chains simultaneously and computed potential scale reduction factors (Gelman & Rubin, 1992) as a means of diagnosing the convergence of the estimation procedure. Potential scale reduction factors assess convergence by comparing the estimated between-chains and within-chain variances for each model parameter in order to determine whether both chains are producing similar means and variances for a given parameter (i.e., a posterior distribution).

We specified alcohol, cigarette, and marijuana use as ordinal, sexual minority status as nominal, and all remaining variables with missingness as continuous. This produced a maximum potential scale reduction factor of 1.070 across all fixed and error parameters, well within the acceptable range (Enders, 2017). To accommodate the ordinal nature of our substance use outcomes, we used diagonally weighted least squares estimation in all analyses. This provided more accurate and robust parameter estimation for discrete outcomes compared to standard maximum likelihood estimation and alternatives (e.g., weighted least squares; Mîndrilă, 2010; Rhemtulla, Brosseau-Liard, & Savalei, 2012; Schumacker & Beyerlein, 2000).

2.3.2. Primary Analyses

All analyses were conducted in R (R Core Team, 2017) using ‘lavaan’ (Rosseel, 2012). We conducted these in parallel across imputed datasets using the ‘semTools’ package (Jorgensen et al., 2019), which pooled parameter estimates by computing arithmetic means of these values across datasets (e.g., Baraldi & Enders, 2010) and applied Rubin’s rules (Rubin, 2004) to compute the standard errors for each pooled estimate.

Primary hypotheses were addressed using parallel process growth curve modeling (Cheong, MacKinnon, & Khoo, 2003; Preacher, Wichman, MacCallum, & Briggs, 2011; Singer & Willett, 2009). We evaluated model fit using the adjusted χ^2 difference test, where a non-significant result was an indication of adequate model fit. We supplemented this test with a number of alternative fit indices (Chen, 2007; Cheung & Rensvold, 2002; Meade, Johnson, & Braddy, 2008), including 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). Recommended approximate cutoffs for these fit indices were CFI values greater than 0.95, TLI values greater than 0.95, RMSEA values less than 0.06, and SRMR values less than 0.08 (Chen, 2007; Hu & Bentler, 1999; Yu, 2002). In our comprehensive final model, we included race as a covariate to control for confounding effects of racial majority identity. This was represented as a set by a dummy variable indicating Black and a dummy variable indicating other or mixed race, each coded relative to a White reference group.

We used the product-of-the-coefficients approach (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002) to test two-path and three-path (e.g., Taylor, MacKinnon, & Tein, 2008) indirect effects. To establish temporal precedence for mediation effects, we set the intercept of emotion dysregulation at age 19; intercept for alcohol, cigarette, and marijuana use at age 20, and

used self-report sexual minority status at age 18 so that indirect effects reflected appropriate temporal sequencing to the extent possible (e.g., age 18 sexual minority status → age 17 social stress → age 19 emotion dysregulation → age 20 substance use)². We used the Monte Carlo method (MacKinnon, Lockwood, & Williams, 2004) to compute confidence intervals for each effect to evaluate whether these effects were significantly different from zero, carried out using the ‘Rmediation’ package (Tofighi & MacKinnon, 2011). Given the large number of indirect effects examined, we used 99% confidence intervals to conduct more stringent tests of statistical significance for each effect.

2.3.3. Exploratory Analyses

After estimating the above models using the entire sample, we conducted follow-up analyses to ensure the robustness and generalizability of our findings among racial and sexual minority subgroups in our sample. First, we conducted a sensitivity analysis in which we limited our final model to heterosexual and bisexual women only. Sensitivity analyses were limited to bisexual women (n=182) given only 64 women identified as lesbian in the sample. This was done to ensure that combining lesbian and bisexual women into a single group was a tenable decision for our data.

Second, we explored differences in key parameter estimates in our final growth curve model across White and Black women by estimating our final model separately by race. We

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²We note that, in tests of mediation, the temporal sequencing is ideally established such that the independent variable is measured prior to the mediator, with the dependent variable following subsequently. Although sexual minority status was measured after social stress at age 17 years, it is well-established that sexual identity is a fluid developmental process during which same-sex attraction emerges prior to sexual orientation identity and disclosure (Grov, Bimbi, Nanin, & Parsons, 2006; Herdt & McElintock, 2000; McClelland, Rubin, & Bauermeister, 2016). As such, we conceptualized sexual minority status as an indicator of a developmental process that includes the presence of same-sex attraction in childhood, such that status reported at age 18 years was likely an indicator of attraction across a developmental window spanning younger ages. Thus, we considered the temporal sequencing of our measures reasonable, particularly given the strengths of validity in using an indicator of sexual minority identity without the influence of the presence of a guardian described above.

limited these analyses to White and Black women given sample size limitations among other/mixed race participants (5.8%). These post hoc analyses were pursued to ensure that model estimates were generalizable to both White and Black participants, and to describe differences between these racial groups in the pattern of results. We estimated this model by stratifying our final growth curve model by White and Black participants using a multigroup framework, in which all parameters were estimated freely across groups. To test for differences in path coefficients by race, we defined parameters within this model quantifying the difference in path estimates between Black and White women. Significance of these difference parameters provided a test of whether these parameters were equal across groups (i.e., were moderated by race). We limited these analyses to direct effects given the exploratory nature of these analyses, and that we are unaware of reliable methods for computing asymmetric confidence intervals on indirect effect difference scores. Parameter estimates provided by these analyses are provided in Supplemental Tables E and F, and are described below.

3. Results

3.1. Descriptive Statistics

Table 1 provides a summary of key study measures based upon the observed data, stratified by sexual orientation group. Supplemental Table B also provides a sample correlation matrix and descriptive statistics of the study variables. Here, we describe general trends present in the observed data, though results reported in the sections below provide a more detailed account based on the imputed dataset solutions.

Insert Table 1 about here

Overall, lesbian and bisexual women reported higher mean levels of stress and emotion dysregulation across study measures, and none of the emotion dysregulation measures appeared to change substantially over time. Although alcohol, cigarette, and marijuana use tended to increase over time, little evidence indicated that growth differed across sexual orientation groups, though lesbian and bisexual women tended to report higher levels of cigarette and marijuana use at each age. There was evidence of zero-inflation and positive skew in alcohol and marijuana use variables, particularly at younger ages (see Supplemental Table B), suggesting modeling approaches that accommodate these data features may be most optimal. Though modeling strategies such as zero-inflated count models may be appropriate (e.g., Atkins, Baldwin, Zheng, Gallop, & Neighbors, 2013), they are presently unavailable for the analytic approaches used here. We alternatively used diagonally weighted least squares estimation procedures that can adequately accommodate non-normal continuous data (Míndrilă, 2010; Rhemtulla, Brosseau-Liard, & Savalei, 2012; Schumacker & Beyerlein, 2000).

3.2. Unconditional Growth Curve Models

Analyses began with unconditional latent growth curve models for emotion dysregulation and substance use to describe whether and how each changed over time. Factor loadings for alcohol, cigarette, and marijuana use at age 21 and 22 years were freed to account for anticipated non-linear increases in use from age 20 to age 21 years upon reaching legal drinking age. Linear unconditional growth models for emotion dysregulation and substance use fit well (see models 1 through 4 of Table 2). Results are summarized in Supplemental Table C and described below.

Insert Table 2 about here

The estimated level of emotion dysregulation at age 19 years was -0.038 with no evidence indicating that emotion dysregulation changed over time ($b = 0.022$, 95% CI = [-0.029, 0.073]). Emotion dysregulation varied in intercept ($\psi_{11} = 2.121$, 95% CI = [1.768, 2.475]) but not in slope ($\psi_{22} = 0.058$, 95% CI = [-0.137, 0.253]). There was no evidence of covariation between the intercept and slope of emotion dysregulation ($\psi_{21} = 0.048$, 95% CI = [-0.174, 0.271], $r = 0.137$).

Frequency of alcohol use was indicated by a mean score of 1.790 at age 17 years (slightly fewer than “less than 5” instances of alcohol use per year) and increased by 0.381 categories each year from age 17 to 22 years (95% CI = [0.355, 0.408]), with substantial variation in the intercept ($\psi_{11} = 1.356$, 95% CI = [1.23, 1.48]) and slope ($\psi_{22} = 0.097$, 95% CI = [0.082, 0.112]). Nonzero covariance between the intercept and slope ($\psi_{21} = -0.149$, 95% CI = [-0.182, -0.116], $r = -0.411$) suggested that those with higher levels of alcohol use at age 17 years exhibited less growth through age 22 years, reflecting that those with greater use at age 17 years remained high through age 22 years and those lower at age 17 years “caught up” by age 22 years (see Figure 1).

Insert Figure 1 about here

Frequency of cigarette use was indicated by a mean score of 2.11 at age 17 years (slightly more than “less than 5” instances of cigarette use per year) and increased by 0.175 categories from age 17 to age 22 years (95% CI = [0.134, 0.216]). As with alcohol use, there was substantial variation in the intercept ($\psi_{11} = 4.792$, 95% CI = [4.237, 5.348]) and slope ($\psi_{22} = 0.350$, 95% CI = [0.235, 0.465]), and a negative correlation between the slope and age 17 years

intercept ($\psi_{21} = -0.326$, 95% CI = $[-0.547, -0.105]$, $r = -0.252$). Those reporting lower use at age 17 years “caught up” in use by age 22 years (see Figure 1).

Frequency of marijuana use was indicated by a mean score of 1.845 at age 17 years (slightly fewer than “less than 5” instances of marijuana use per year) and increased by 0.173 categories from age 17 to age 22 years (95% CI = $[0.142, 0.204]$). There was substantial variation in the intercept ($\psi_{11} = 2.553$, 95% CI = $[2.204, 2.902]$) and slope ($\psi_{22} = 0.260$, 95% CI = $[0.194, 0.326]$), and a negative correlation between the slope and age 17 years intercept ($\psi_{21} = -0.268$, 95% CI = $[-0.390, -0.146]$, $r = -0.329$) suggesting those reporting lower use at age 17 years “caught up” in use by age 22 years (see Figure 1).

3.3. *Parallel Process Growth Curve Models*

For these models, we set the intercept of emotion dysregulation to age 19 years (i.e., growth rate factor loadings set to $[0 \ 1 \ 2]$) and intercept of both substance use variables to age 20 years (i.e. growth rate factor loadings set to $[-3 \ -2 \ -1 \ 0 \ * \ *]$) to ensure that the indirect effects reflected an appropriate temporal sequencing to the extent possible (that is, sexual minority status at age 18 predicting social stress at age 17 years, in turn predicting emotion dysregulation at age 19 years and substance use at age 20 years). Model fit remained adequate for all parallel process growth curve models (see models 5 and 6 of Table 2).

3.3.1. Emotion Dysregulation as a Link between Sexual Minority Status and Substance Use

We first specified a parallel process growth curve model regressing level and change in emotion dysregulation and level and change in substance use on sexual minority status (see Supplemental Table D). This was done to evaluate correlations between these variables while examining differences across sexual orientation groups. Emotion dysregulation at age 19 years was modestly associated with more marijuana ($b = 0.217$, 95% CI = $[0.178, 0.257]$, $\beta = 0.180$),

cigarette ($b = 0.170$, 95% CI = [0.119, 0.221], $\beta = 0.103$), and alcohol use ($b = 0.086$, 95% CI = [0.060, 0.112], $\beta = 0.111$) at age 20 years, as well as more rapid growth in marijuana use ($b = 0.025$, 95% CI = [0.005, 0.045], $\beta = 0.076$). Relative to White women, Black women reported higher levels of emotion dysregulation ($b = 0.202$, 95% CI = [0.056, 0.348], $\beta = 0.068$), faster marijuana use growth ($b = 0.061$, 95% CI = [0.004, 0.119], $\beta = 0.063$), and higher levels of marijuana use by age 20 ($b = 0.350$, 95% CI = [0.237, 0.463], $\beta = 0.098$), but reported lower levels of alcohol ($b = -0.680$, 95% CI = [-0.756, -0.603], $\beta = -0.294$) and cigarette use ($b = -0.478$, 95% CI = [-0.657, -0.300], $\beta = -0.098$). Those identifying as other or mixed race reported more marijuana use ($b = 0.330$, 95% CI = [0.056, 0.603], $\beta = 0.043$) and less alcohol use ($b = -0.467$, 95% CI = [-0.666, -0.267], $\beta = -0.094$) compared to White women.

Relative to heterosexual women, sexual minority women reported about a half a standard deviation greater emotion dysregulation at age 19 years ($b = 0.509$, 95% CI = [0.278, 0.739]), about one category more frequent marijuana use at age 20 years ($b = 1.028$, 95% CI = [0.806, 1.252], $\beta = 0.182$), and about 1.3 categories more frequent cigarette use at age 20 years ($b = 1.353$, 95% CI = [1.010, 1.697], $\beta = 0.174$). Regarding group differences in growth for each construct, sexual minority women reported slightly less growth in alcohol use through age 22 years ($b = -0.063$, 95% CI = [-0.121, -0.005], $\beta = -0.064$), though they were no different from their heterosexual peers in growth in marijuana or cigarette use. Tests of indirect effects suggested that greater emotion dysregulation partially mediated relations between sexual minority status and alcohol ($ab = 0.044$, 99% CI = [0.017, 0.078]), cigarette ($ab = 0.086$, 99% CI = [0.036, 0.145]), and marijuana use ($ab = 0.110$, 99% CI = [0.046, 0.176]).

3.3.2. Stress and Emotion Dysregulation as Serial Mediators linking Sexual Minority Status and Substance Use

We then included sexual minority status as an exogenous predictor of social stress and growth factors for emotion dysregulation and alcohol, cigarette, and marijuana use. These analyses allowed us to examine direct and indirect effects on these outcomes with the inclusion of social stress. Results are provided in Table 3 and Figure 2. Results were largely identical when analyses were limited to only heterosexual and bisexual women (see Supplemental Table E).

Insert Table 3 about here

Insert Figure 2 about here

Direct effects indicated that Black women reported 0.95 standard deviations greater social stressors compared to White women. Moreover, each standard deviation increase in social stress was associated with a 0.195 standard unit increase in marijuana use, a 0.198 standard unit increase in cigarette use, and a 0.229 standard unit increase in alcohol use at age 20 years. Tests of two-path indirect effects indicated mediating effects of social stress in the relation between sexual minority status and alcohol use, marijuana use, and emotion dysregulation. Tests of three-path effects, in turn, indicated a serial mediation pathway of sexual minority status on marijuana use at age 20 via social stress and emotion dysregulation. Specifically, sexual minority status was associated with a 0.182 standard deviation increase in social stress at age 17 years, which in turn was associated with a 0.515 standard deviation increase in emotion dysregulation at age 19 years. Emotion dysregulation was in turn associated with a 0.080 standard unit increase in marijuana use at age 20 years, with this serial pathway explaining approximately 2.2% of the effect of sexual minority status marijuana use, suggesting a modest effect. Sexual minority status

remained a direct predictor of cigarette and marijuana use when social stress was included as a mediator (see Table 3), suggesting partial mediation of these associations via social stress. In contrast, the relation between sexual minority status and emotion dysregulation was fully mediated by social stress, and status was only related to greater alcohol use through its associations with social stress.

Examining this model separately for White and Black women provided comparable fit among the imputed datasets used in analysis³, suggesting this model fit appropriately for both groups. We noted two differences in path estimates across groups (see Supplemental Table F). First, whereas there was no association between SM status and alcohol use in the full sample, this association differed across races, such that SM status predicted *greater* alcohol use among Black women ($b = 0.216$, 95% CI = [0.045, 0.388], $\beta = 0.069$), but was associated with *less* alcohol use among White women ($b = -0.299$, 95% CI = [-0.530, -0.068], $\beta = -0.074$). Second, emotion dysregulation (and not social stress) predicted cigarette use among Black women ($b = 0.167$, 95% CI = [0.062, 0.273], $\beta = 0.110$), whereas social stress (and not emotion dysregulation) predicted cigarette use among White women ($b = 0.902$, 95% CI = [0.511, 1.293], $\beta = 0.276$). There was no evidence that the magnitude of any other direct effects differed between Black and White women.

4. Discussion

We examined whether and how stress-related mechanisms of psychopathology – including experiences of social stressors and emotion dysregulation – explained relations between sexual minority status and substance use in a population-based sample of young women. Prior studies found that emotion dysregulation mediated relations between sexual minority status

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³Due to the complexity of this model, model convergence could only be achieved in 15 of the 20 multiply-imputed datasets.

and internalizing symptoms (Hatzenbuehler et al., 2008) and stigma-related stress and psychological distress among sexual minority populations (Hatzenbuehler, 2009; Szymanski & Henrichs-Beck, 2014). The current study extended this work to prospectively examine stress as a link between sexual minority identity and later emotion dysregulation among youth, and to test whether and how these associations explained substance use through young adulthood. Notably, our results showed that stress and emotion dysregulation were intervening factors in the relation between sexual minority status and substance use. Our results suggested that social stressors explained the relation between sexual minority status and alcohol, cigarette, and marijuana use. Above and beyond this pathway, stress-related increases in emotion dysregulation further explained elevations in the levels (but not growth rates) of marijuana use among SMW in adolescence and young adulthood.

Although alcohol, cigarette, and marijuana use increased through young adulthood in the sample, SMW reported higher levels of cigarette and marijuana use, and only Black SMW reported higher levels of alcohol use. Moreover, we found no evidence that growth rates across substances differed among sexual minority versus heterosexual women from age 17 to 22 years. These findings clarify some equivocal results in prior longitudinal studies examining rates of substance use growth across sexual orientation populations, particularly among SMW, across this developmental period. First, prior work using the present sample suggested alcohol, cigarette, and marijuana use increased more rapidly among SMW from age 13 to 20 years, with the growth rate disparity tending to lessen through later adolescence (particularly for alcohol and cigarette use; Dermody et al., 2020). Given this study focused on a later age range (ages 17 to 22 years), our results were consistent with these estimates, adding that little evidence supports a growth disparity between groups in later adolescence and young adulthood.

We note further that our results clarify disparate findings addressing substance use trajectories among sexual minority youth reported in prior studies. Several studies utilizing three waves of data from the National Longitudinal Study of Adolescent Health (“Add Health”) have suggested that individuals who identified as sexual minority at age 28 reported more alcohol, cigarette, and marijuana use at age 15 and increased use of these substances more rapidly through age 21 follow-up compared to heterosexual peers (Marshal et al., 2009). Subsequent work had shown further that SMW specifically showed more rapid increase in alcohol and tobacco use from age 15 through age 28 (Marshal et al., 2012). However, although other research using the same dataset has replicated that SMW reported higher levels of heavy drinking, smoking, and marijuana use, this work had found no such differences in growth rates for these outcomes (Needham, 2012). Taking these results together with ours and prior estimates provided using the Pittsburgh Girls Study data (Dermody et al., 2020), evidence tends to indicate that growth disparities in substance use may be most pronounced in earlier adolescence (e.g., ages 13 to 17 years) versus later adolescence through young adulthood (e.g., beyond age 17 years). Future longitudinal work should therefore focus on the early-to-mid adolescence period to optimally study the antecedents and consequences of the initiation and escalation of substance use among sexual minority youth.

Exploring differences across race highlighted several disparities in rates of substance use. First, non-White women (Black and other/mixed race women) relative to White women reported higher levels of marijuana use, but lower levels of alcohol and cigarette use. Consistent with some prior work (Keyes et al., 2015), Black women also increased relatively more rapidly in marijuana use compared to White women through young adulthood. These findings highlight that women of color may be at greater risk for certain substance-related problems despite general

trends suggesting greater substance use among Whites (e.g., McCabe et al., 2007). Our findings add that these associations may further differ across substances, such that the nature of risk for specific substance disorders may vary as a complex function of intersecting race, sex, and substance (Evans, Grella, Washington, & Upchurch, 2017; Vu, Li, Haardörfer, Windle, & Berg, 2019).

We note further that the intersection between SM status and race differentiated risk for alcohol use among women, such that SM status was a risk factor among Black women and a protective factor among White women in predicting alcohol use by young adulthood. This finding is consistent with intersectional theories of substance use risk, highlighting in particular that the confluence of Black, SM, and female identity may represent a unique risk context (Bowleg, 2008; Crenshaw, 1991; Greene, 1996). We emphasize that these analyses were conducted post-hoc in an effort to ensure the generalizability of our findings for majority racial groups in our sample (i.e., White and Black women). We also note that the complexity of the models employed in this work raise caution in drawing definitive race moderation effects. Nonetheless, we consider intersectionality an essential extension of this research, tested more formally using methods and design most optimally suited for addressing intersectional theories of risk (Bauer, 2014; Else-Quest & Hyde, 2016). Specifically, we encourage that this work use samples with more equal sample sizes among racial and sexual minority subgroups to bolster statistical power in detecting interactions quantifying these intersecting identities (Aguinis, 1995). We further advocate that researchers use stress measures that more directly quantify the unique experiences of SM women of color (Bowleg, 2008).

To our knowledge, this research is the first to prospectively investigate the mechanistic roles of social stress and emotion dysregulation in the relation between sexual minority status

and later substance use. Results generally supported intervening processes of risk via social stress and emotion dysregulation, suggesting that interventions promoting stress resilience and emotion regulation may be crucial targets in the remission of problematic substance use behaviors among SMW with substance use disorder. Several behavioral interventions such as cognitive behavioral therapy (McHugh, Votaw, Sugarman, & Greenfield, 2018) or dialectical behavior therapy (Linehan, 1993) provide skills designed explicitly to improve emotion regulation. Given that such interventions have been shown effective in treating substance use disorders in adolescence (e.g., Babowitch & Antshel, 2016; Dimeff & Linehan, 2008), these may be particularly well-suited treatment modalities for the remission of substance use among sexual minority young women. Moreover, one particular emotion regulation resource is access to positive social supports, which has been established as among the most robust factors that have buffered mental health risk among sexual minority youth (Kwon, 2013). Several studies have shown a mitigating role of social support on substance use risk in sexual minority samples, including reducing the effect of rejection experiences on substance use (Rosario, Schrimshaw, & Hunter, 2004) and buffering the relation between psychological distress and cigarette smoking (Rosario, Schrimshaw, & Hunter, 2011). Interventions that facilitate social connectedness (e.g., Tsai, Yard, & Kohlenberg, 2014) may therefore play an especially crucial role in treatment among sexual minority youth with presenting substance use problems. Relatedly, community resources promoting social support, including the availability of community resources supporting sexual minority health, may help reduce substance use involvement among sexual minority youth (e.g., Heck et al., 2014).

4.1.Limitations

There were several limitations in the current study. Due to limited statistical power, we were unable to test our hypotheses evaluating lesbian and bisexual women as separate groups, although there may be heterogeneity in substance use behaviors across sexual minority subgroups. For instance, prevalence rates of alcohol and other drug use behaviors among sexual minority sub-populations indicate that bisexual individuals may represent the highest-risk sexual minority group for substance-related problems (e.g., Schuler & Collins, 2020), with multiple studies suggesting that both bisexual identity and behavior increased risk for alcohol and drug use problems (Green & Feinstein, 2012). Further evidence is needed to determine whether and how the effects reported in the current study differ when examined within each of these sexual minority subgroups.

Moreover, a careful consideration of how and when minority status is quantified is essential in addressing these questions with greater nuance in future research. The majority of prior studies (as well as the current study) used a binary indicator sexual identity (e.g., endorsing “not 100% heterosexual”) at a single time point, yet different methods of quantifying sexual minority identity may produce differing results (e.g., Marshal et al., 2012; Needham, 2012). For instance, one prior study (Talley, Sher, & Littlefield, 2010) tested changes in substance use through adulthood using three separate measures of orientation (identity, attraction, and behavior) reported at either the initial or the final time point of the study and found that different measures and time points revealed different patterns of how marijuana and alcohol use changed over time. We acknowledge that using sexual minority identity at the time point following our measurement of social stress may have biased our results somewhat compared to the use of an indicator of status at earlier ages (i.e., we could not determine definitively whether sexual minority participants had come out prior to reporting social stressors). Indeed, some research has

suggested that coming out as a sexual minority earlier in development may confer positive health benefits in some contexts but health risk factors in others (D’Augelli, 2006; Legate, Ryan, & Weinstein, 2012); it is possible that the age of coming out may have a significant impact on both the experiences of minority stress and substance use risk.

Finally, we note several potential limitations to our study measures and sample that we hope will be addressed in future research. First, the current study utilized general social stress measures, such that none of the items within these measures were stressors due specifically to sexual minority status or gender. Although we found that sexual minority women reported higher levels of social stress relative to heterosexual women, studies utilizing measures that more directly quantify sexual minority-related stressors will provide a more direct test of mediation proposed in sexual minority stress models. Second, though assessing change-over-time in emotion dysregulation was central to study hypotheses, we were only able to examine a relatively narrow developmental period of emotion dysregulation (ages 19 to 21 years). This may have limited our power to detect individual differences in change-over-time in this measure as it corresponds with developing substance use. Third, this study focused on analysis of past year alcohol and marijuana use frequency, yet whether these findings generalize to other forms of substance use – including problem, or disordered use – is an essential avenue of future research. Fourth, this study focused on an urban population-based sample of women. However, it remains an empirical question whether and how the findings reported here generalize to other sexual minority populations at risk for substance use disorder, including SMW living in rural settings, gay and bisexual men (e.g., McCabe et al., 2009), and transgender youth and adults (e.g., Day, Fish, Perez-Brumer, Hatzenbuehler, & Russell, 2017).

4.2. Future Directions

Although we found evidence of a direct mediating role of emotion dysregulation for all substance use outcomes in building to our final model, we highlight that social stressors explained this relation when it was included as a mediator for alcohol and cigarette use. We note further that the serial mediation effect for stress and emotion dysregulation was found for only marijuana use, suggesting that social stressors may remain a central intervening factor that explains the link between sexual minority status and substance use. For instance, it may be that SM women self-medicate using substances in direct response to social stressors (e.g., Johnson et al., 2013). Though our findings support this link at a protracted time course, this question may be most optimally addressed in the context of an ecological momentary assessment design (e.g., Dworkin, Cadigan, Hughes, Lee, & Kaysen, 2018). For instance, a crucial extension of our findings may be examining whether heightened substance use immediately following experiences of social stressors explains disparity in use among SMW relative to heterosexual women.

These findings also imply that the link between stress and substance use risk among SMW may be explained by other stress-related mechanisms of risk. The current study focused on emotion dysregulation as a mechanism of risk, though theory describing early substance use risk in the general youth population (Hussong et al., 2011) and among sexual minority populations (e.g., Hatzenbuehler, 2009; Pachankis et al., 2015) have proposed several other stress-related pathways. In addition to addressing limitations described above, we encourage future work to examine these additional pathways, including the presence of co-occurring psychopathology (e.g., internalizing symptoms) or social factors influencing substance use propensity. We note that to date, prospective research examining these mediators remains sparse (McCabe & King, under review). For instance, two prior studies reporting disparate findings (Dermody, Marshal,

Burton, & Chisolm, 2016; Huebner, Thoma, & Neilands, 2015) have tested whether affiliation with deviant peers explained the relation between victimization and substance use among sexual minority youth, and we know of only two studies (Feinstein & Newcomb, 2016; Marshal et al., 2013) that tested negative affect mechanisms (e.g., coping, enhancement motives and/or depressive symptoms) as mediators between sexual minority stress and substance use. Given the dearth of mediation studies addressing these intervening processes, it is essential that future research examine the confluence of these additional mediating processes to best characterize the progression of substance use across development. Nonetheless, the current study highlighted that stress-related increases in emotion dysregulation may serve as one mediating process in the relation between sexual minority status and marijuana use.

Author Contributions

C.J.M. developed the study concept. All authors contributed to the study design. Data collection were performed by A.E.H., K.K., S.H., and T.C. and/or their research team. C.J.M. performed the data analysis and interpretation under the supervision of K.M.K. C.J.M. drafted the paper, and all authors provided critical revisions. All authors approved the final version of the paper for submission.

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Table 1. Descriptive Statistics for Study Variables by Sexual Minority Status and Age.

	Age	Lesbian and Bisexual Women (n = 246)						Heterosexual Women (n = 2,201)					
		n	Min	Max	Mean	SD	Skew	n	Min	Max	Mean	SD	Skew
Harsh Parenting	17	199	1.00	11.00	3.59	2.23	0.86	1695	1.00	13.00	3.10	2.16	1.26
Peer Victimization	17	213	1.00	22.00	3.08	3.59	2.58	1733	1.00	20.00	2.09	2.16	3.15
Everyday Discrimination	17	171	1.00	19.00	6.15	4.73	0.86	1287	1.00	22.00	4.73	3.84	1.30
DERS Awareness	19	186	1.00	24.00	10.06	5.68	0.21	1331	1.00	24.00	9.06	5.51	0.44
	20	231	1.00	25.00	9.58	5.68	0.30	1753	1.00	25.00	8.95	5.54	0.45
	21	153	1.00	25.00	9.40	5.62	0.47	1343	1.00	25.00	8.72	5.42	0.54
DERS Strategies	19	186	1.00	28.00	9.52	5.96	0.80	1331	1.00	28.00	7.57	5.29	1.07
	20	231	1.00	28.00	9.95	6.38	0.63	1753	1.00	31.00	7.71	5.35	1.22
	21	153	1.00	28.00	9.07	5.72	0.64	1343	1.00	29.00	7.76	5.30	1.15
Rumination	19	231	1.00	5.00	2.68	1.06	-0.06	1793	1.00	5.00	2.58	1.04	-0.03
	20	231	1.00	5.00	2.77	1.07	-0.07	1753	1.00	5.00	2.63	1.04	-0.05
	21	153	1.00	5.00	2.75	1.04	-0.12	1343	1.00	5.00	2.67	1.08	-0.06
Past Year Alcohol Use	17	213	1.00	6.00	1.93	1.34	1.50	1731	1.00	7.00	1.71	1.14	1.81
	18	246	1.00	6.00	2.55	1.61	0.76	1845	1.00	7.00	2.16	1.44	1.15
	19	231	1.00	8.00	2.61	1.70	0.87	1793	1.00	8.00	2.51	1.61	0.83
	20	231	1.00	8.00	2.78	1.80	0.85	1753	1.00	8.00	2.82	1.68	0.56
	21	226	1.00	8.00	3.38	1.74	0.24	1725	1.00	8.00	3.52	1.74	0.05
Past Year Marijuana Use	22	222	1.00	8.00	3.67	1.82	0.19	1692	1.00	8.00	3.63	1.71	-0.01
	17	213	1.00	8.00	2.56	2.26	1.22	1731	1.00	8.00	1.71	1.64	2.50
	18	246	1.00	8.00	3.18	2.60	0.69	1843	1.00	8.00	1.92	1.82	2.08
	19	231	1.00	8.00	3.20	2.70	0.70	1793	1.00	8.00	2.07	2.00	1.86
	20	231	1.00	8.00	3.32	2.75	0.68	1753	1.00	8.00	2.21	2.17	1.68
	21	226	1.00	8.00	3.51	2.83	0.54	1725	1.00	8.00	2.32	2.21	1.55
	22	221	1.00	8.00	3.42	2.81	0.61	1692	1.00	8.00	2.44	2.34	1.42
Past Year Cigarette Use	17	213	1.00	8.00	3.11	2.89	0.78	1730	1.00	8.00	1.88	2.11	2.20
	18	246	1.00	8.00	3.94	3.11	0.27	1844	1.00	8.00	2.16	2.36	1.76
	19	231	1.00	8.00	3.69	3.10	0.45	1793	1.00	8.00	2.31	2.48	1.57
	20	231	1.00	8.00	3.69	3.11	0.44	1753	1.00	8.00	2.39	2.54	1.48
	21	226	1.00	8.00	3.80	3.03	0.38	1725	1.00	8.00	2.44	2.58	1.43
	22	222	1.00	8.00	3.56	3.07	0.54	1691	1.00	8.00	2.49	2.62	1.38

Note: DERS = Difficulties in Emotion Regulation Scale, Min = minimum, Max = maximum, SD = standard deviation.

Table 2. Summary fit measures for estimated growth curve models.

Model	χ^2	CFI	TLI	RMSEA [90% CI]	SRMR
<i>Unconditional GCMs</i>					
1. Emotion dysregulation	1.72	1.000	0.999	0.017 [0.00, 0.06]	0.009
2. Past year alcohol use	231.18	0.969	0.967	0.079 [0.07, 0.09]	0.066
3. Past year marijuana use	25.27	0.998	0.998	0.018 [0.00, 0.03]	0.029
4. Past year cigarette use	48.24	0.996	0.996	0.032 [0.02, 0.04]	0.036
<i>PPGCMs</i>					
5. Emotion dysregulation, substance use, and SM status	3907.65	0.905	0.884	0.081 [0.08, 0.08]	0.072
6. Model 4 + social stress	4425.89	0.903	0.885	0.074 [0.07, 0.08]	0.069

Note. GCM = growth curve model, PPGCM = parallel process growth curve model, SM = sexual minority, CFI = comparative fit index, TLI = Tucker-Lewis index, RMSEA = root mean squared error of approximation, SRMR = standardized root-mean square residual.

Table 3. Sexual Minority Status and Social Stress Predicting Alcohol, Marijuana, and Cigarette Use Growth Factors.

	Estimate	SE	CI	Standardized Estimate
<i>Intercepts</i>				
Age 19 Emotion Dysregulation	-2.365	0.239	[-2.833, -1.897]	-
Age 20 Alcohol Use	2.121	0.139	[1.847, 2.394]	-
Age 20 Marijuana Use	1.293	0.212	[0.878, 1.709]	-
Age 20 Cigarette Use	1.132	0.306	[0.532, 1.732]	-
<i>Growth Rates</i>				
Emotion Dysregulation Slope	0.058	0.108	[-0.154, 0.271]	0.183
Alcohol Use Slope	0.444	0.052	[0.342, 0.545]	1.423
Marijuana Use Slope	0.282	0.093	[0.101, 0.464]	0.575
Cigarette Use Slope	0.342	0.131	[0.084, 0.599]	0.581
<i>Fixed Effects of Sexual Minority Status</i>				
Sexual Minority Status→Social Stress	0.430	0.080	[0.273, 0.586]	0.182
Sexual Minority Status→Age 19 Emotion Dysregulation	0.068	0.151	[-0.228, 0.364]	0.014
Sexual Minority Status→Emotion Dysregulation Change	0.029	0.091	[-0.148, 0.207]	0.029
Sexual Minority Status→Age 20 Alcohol Use	-0.007	0.074	[-0.151, 0.137]	-0.002
Sexual Minority Status→Alcohol Use Change	-0.055	0.030	[-0.114, 0.004]	-0.055
Sexual Minority Status→Age 20 Marijuana Use	0.887	0.119	[0.654, 1.121]	0.157
Sexual Minority Status→Marijuana Use Change	0.052	0.061	[-0.067, 0.171]	0.033
Sexual Minority Status→Age 20 Cigarette Use	1.158	0.189	[0.787, 1.529]	0.150
Sexual Minority Status→Cigarette Use Change	0.025	0.08	[-0.133, 0.182]	0.013
<i>Fixed Effects of Social Stress</i>				
Social Stress→Age 19 Emotion Dysregulation	1.030	0.107	[0.821, 1.239]	0.515
Social Stress→Emotion Dysregulation Change	-0.016	0.047	[-0.107, 0.075]	-0.037
Social Stress→Age 20 Alcohol Use	0.355	0.060	[0.238, 0.473]	0.229
Social Stress→Alcohol Use Change	-0.029	0.021	[-0.071, 0.013]	-0.070
Social Stress→Age 20 Marijuana Use	0.468	0.092	[0.287, 0.648]	0.195
Social Stress→Marijuana Use Change	-0.051	0.039	[-0.128, 0.026]	-0.078
Social Stress→Age 20 Cigarette Use	0.650	0.133	[0.390, 0.911]	0.198
Social Stress→Cigarette Use Change	-0.076	0.056	[-0.185, 0.034]	-0.096
<i>Fixed Effects of Emotion Dysregulation Growth Factors</i>				
Age 19 Emotion Dysregulation→Age 20 Alcohol Use	-0.011	0.021	[-0.053, 0.032]	-0.014
Emotion Dysregulation Change→Age 20 Alcohol Use	0.231	0.226	[-0.212, 0.675]	0.064

Age 19 Emotion Dysregulation → Alcohol Use Change	-0.001	0.009	[-0.019, 0.018]	-0.003
Emotion Dysregulation Change → Alcohol Use Change	0.092	0.109	[-0.122, 0.307]	0.094
Age 19 Emotion Dysregulation → Age 20 Marijuana Use	0.096	0.035	[0.027, 0.164]	0.080
Emotion Dysregulation Change → Age 20 Marijuana Use	0.200	0.335	[-0.457, 0.856]	0.036
Age 19 Emotion Dysregulation → Marijuana Use Change	0.039	0.017	[0.006, 0.072]	0.119
Emotion Dysregulation Change → Marijuana Use Change	0.116	0.178	[-0.233, 0.466]	0.076
Age 19 Emotion Dysregulation → Age 20 Cigarette Use	-0.001	0.046	[-0.092, 0.089]	-0.001
Emotion Dysregulation Change → Age 20 Cigarette Use	1.033	0.677	[-0.295, 2.361]	0.135
Age 19 Emotion Dysregulation → Cigarette Use Change	0.037	0.024	[-0.009, 0.084]	0.094
Emotion Dysregulation Change → Cigarette Use Change	0.048	0.241	[-0.424, 0.519]	0.026

Growth Factor Variances

Emotion Dysregulation Intercept	1.587	0.087	[1.416, 1.758]	0.719
Emotion Dysregulation Slope	0.100	0.056	[-0.009, 0.210]	0.983
Alcohol Use Intercept	1.158	0.031	[1.097, 1.220]	0.868
Alcohol Use Slope	0.094	0.008	[0.079, 0.109]	0.966
Marijuana Use Intercept	2.846	0.121	[2.609, 3.083]	0.896
Marijuana Use Slope	0.239	0.030	[0.179, 0.298]	0.992
Cigarette Use Intercept	5.303	0.224	[4.864, 5.742]	0.894
Cigarette Use Slope	0.330	0.053	[0.225, 0.434]	0.953

Two-Path Indirect Effects

SM Status → Social Stress → Age 19 Emotion Dysregulation	0.443	0.096	[0.216, 0.712]	-
SM Status → Social Stress → Emotion Dysregulation Change	-0.007	0.020	[-0.063, 0.047]	-
SM Status → Social Stress → Age 20 Marijuana Use	0.200	0.050	[0.087, 0.345]	-
SM Status → Age 19 Emotion Dysregulation → Age 20 Marijuana Use	0.006	0.015	[-0.038, 0.053]	-
SM Status → Emotion Dysregulation Change → Age 20 Marijuana Use	0.001	0.036	[-0.128, 0.127]	-
SM Status → Social Stress → Marijuana Use Change	-0.022	0.018	[-0.074, 0.022]	-
SM Status → Age 19 Emotion Dysregulation → Marijuana Use Change	0.001	0.004	[-0.010, 0.014]	-
SM Status → Emotion Dysregulation Change → Marijuana Use Change	0.002	0.020	[-0.063, 0.076]	-
SM Status → Social Stress → Age 20 Cigarette Use	0.278	0.072	[0.117, 0.487]	-
SM Status → Age 19 Emotion Dysregulation → Age 20 Cigarette Use	0.000	0.008	[-0.029, 0.025]	-
SM Status → Emotion Dysregulation Change → Age 20 Cigarette Use	0.021	0.111	[-0.346, 0.381]	-
SM Status → Social Stress → Cigarette Use Change	-0.033	0.025	[-0.107, 0.03]	-
SM Status → Age 19 Emotion Dysregulation → Cigarette Use Change	0.001	0.004	[-0.011, 0.015]	-
SM Status → Emotion Dysregulation Change → Cigarette Use Change	0.001	0.023	[-0.080, 0.087]	-
SM Status → Social Stress → Age 20 Alcohol Use	0.153	0.039	[0.066, 0.266]	-

SM Status→Age 19 Emotion Dysregulation→Age 20 Alcohol Use	0.000	0.004	[-0.014, 0.013]	-
SM Status→Emotion Dysregulation Change→Age 20 Alcohol Use	0.008	0.030	[-0.081, 0.124]	-
SM Status→Social Stress→Alcohol Use Change	-0.013	0.010	[-0.04, 0.012]	-
SM Status→Age 19 Emotion Dysregulation→Alcohol Use Change	0.000	0.001	[-0.003, 0.003]	-
SM Status→Emotion Dysregulation Change→Alcohol Use Change	0.003	0.013	[-0.039, 0.053]	-
<i>Three-Path Indirect Effects</i>				
SM Status→Social Stress→Age 19 Emotion Dysregulation→Age 20 Alcohol Use	-0.005	0.010	[-0.036, 0.019]	-
SM Status→Social Stress→Emotion Dysregulation Change→Age 20 Alcohol Use	-0.002	0.007	[-0.031, 0.016]	-
SM Status→Social Stress→Age 19 Emotion Dysregulation→Alcohol Use Change	0.000	0.004	[-0.012, 0.012]	-
SM Status→Social Stress→Emotion Dysregulation Change→Alcohol Use Change	0.000	0.003	[-0.010, 0.011]	-
SM Status→Social Stress→Age 19 Emotion Dysregulation→Age 20 Marijuana Use	0.042	0.017	[0.002, 0.093]	-
SM Status→Social Stress→Emotion Dysregulation Change→Age 20 Marijuana Use	-0.003	0.009	[-0.043, 0.017]	-
SM Status→Social Stress→Age 19 Emotion Dysregulation→Marijuana Use Change	0.017	0.009	[-0.002, 0.045]	-
SM Status→Social Stress→Emotion Dysregulation Change→Marijuana Use Change	0.000	0.004	[-0.016, 0.016]	-
SM Status→Social Stress→Age 19 Emotion Dysregulation→Age 20 Cigarette Use	-0.001	0.021	[-0.061, 0.053]	-
SM Status→Social Stress→Emotion Dysregulation Change→Age 20 Cigarette Use	-0.006	0.025	[-0.094, 0.075]	-
SM Status→Social Stress→Age 19 Emotion Dysregulation→Cigarette Use Change	0.017	0.012	[-0.010, 0.052]	-
SM Status→Social Stress→Emotion Dysregulation Change→Cigarette Use Change	0.000	0.005	[-0.019, 0.020]	-

Note. Fixed parameter estimates, covariate effects, and residual variances are omitted for parsimony. CI = Confidence Interval, SM = Sexual Minority. CIs provided are at the 95% level for parameter estimates and the 99% level for indirect effects. Significant effects of substantive interest are indicated in bold.

Figure 1. Slope-Intercept Correlations of Frequency of Alcohol, Cigarette, and Marijuana Use from Age 17 to Age 22.

Figure 2. Final parallel process growth curve model regressing growth factors on stress and sexual minority status.

Note. SM = Sexual minority, MJ = Marijuana, Alc. = Alcohol, Cig. = Cigarette, ED = Emotion Dysregulation. Coefficients presented are unstandardized estimates and their standard errors (in parentheses). Non-significant paths, manifest indicators of age 17 stress, and latent variable covariances were omitted for parsimony.