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E-cigarette, cigarette, and cannabis use patterns as a function of sexual identity in a sample of Southern California young adults

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ABSTRACT

Purpose: Sexual minority young adults report greater cigarette and cannabis use. Emerging evidence suggests this trend may extend to e-cigarettes. The current study evaluated the relationship between sexual identity and prevalence of e-cigarette, cigarette, and cannabis use and whether such associations differ by gender.
Methods: Cross-sectional, regionally representative data of young adults ($M[SD]_{age}$ = 20.02 [0.60] years; $n_{heterosexual}$ = 1314; $n_{bisexual}$ = 77; $n_{lesbian/gay}$ = 28) from Wave III (2016) of the Southern California Children's Health Study were analyzed in 2019. Logistic regression analyses were conducted with sexual identity as the predictor and product use (never, prior, infrequent past 30-day [1-2 days], frequent past 30-day [3-5+ days]) as the outcome in separate models by substance (e-cigarettes, cigarettes, cannabis).
Results: Bisexual individuals were the highest-risk sub-group for nearly all outcomes, with over five times the odds of reporting frequent past 30-day use for e-cigarettes (Odds Ratio [OR]: 6.68; 95% Confidence Interval [CI]: 2.80, 15.9), cigarettes (OR: 5.42; 95% CI: 2.37, 12.4), and cannabis (OR: 8.43; 95% CI: 4.40, 16.1) compared to heterosexual individuals. Although the sample size for lesbian/gay participants was small, bisexual (vs. lesbian/gay) participants also had greater odds of reporting prior use of nicotine products and frequent past 30-day cannabis use. A significant sexual identity × gender interaction emerged for lifetime cigarette use, wherein bisexual (vs. heterosexual) identity was only associated with greater odds of use for females ($p < .01$).
Conclusions: Sexual minority-related disparities in substance use among young adults appear to generalize to e-cigarettes, with bisexual young adults exhibiting especially high profiles of risk.

1. Introduction

Key shifts in regulatory policy and technological innovation in recent years have dramatically changed the nicotine and cannabis product landscape in the U.S. These changes appear to be particularly salient to shifting patterns of nicotine and cannabis use among young adults (i.e., 18–25 years of age; Yu, Chen, & Wang, 2018) Since the early 2000s, cigarette use has declined among young adults, while cannabis use has steadily increased (Odani et al., 2019). Over this same period, perceptions of risk associated with regular use of cannabis among young adults have declined considerably (Carliner, Brown, Sarvet, & Hasin, 2017). Moreover, electronic cigarettes are widely popular among young adults, both as a means of consuming nicotine (Ramo, Young-Wolff, & Prochaska, 2015) and cannabis (Jones, Hill & Pardini, 2016). For example, Ramo, Young-Wolff, and Prochaska (Ramo et al., 2015) found that prevalence of past-month e-cigarette use among young adults increased from 6% in 2009 to 41% in 2013 (Ramo et al., 2015). Of concern, e-cigarette use among young adults is prospectively associated with subsequent initiation of both cigarettes (National Academies of Sciences Engineering and Medicine, 2018) and cannabis (Chadi, Schroeder, Jensen, & Levy, 2019). The public health significance of e-cigarette use is further underscored by the recent surge in acute vaping-related respiratory illness and death across the U.S. (Centers for Disease Control and Prevention, 2020).

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Public health concerns around evolving patterns of nicotine and cannabis product use may be particularly relevant for sexual minority (i.e., lesbian, gay, bisexual, or queer [LGBQ]-identified) young adults, who report considerably higher rates of cigarette and cannabis use (Marshal et al., 2008) and dependence (Goldberg, Strutz, Herring, & Halpern, 2013; Schuler, Rice, Evans-Polce, & Collins, 2018) compared to their heterosexual peers. Longitudinal data show that sexual minority adolescents not only initiate cigarette and cannabis use at an earlier age than heterosexual adolescents, but also increase their use of both products into adulthood at a faster rate (Marshal, Friedman, Stall, & Thompson, 2009). This trend appears to be especially pronounced among bisexual females (Marshal et al., 2012).

The state of the literature on sexual minority-related disparities in e-cigarette use among young adults (Delahanty et al., 2019; Fallin-Bennett, Lisha, & Ling, 2017; Gerend, Newcomb, & Mustanski, 2017; Li, Haardörfer, Vu, Windle, & Berg, 2018) is lacking relative to other popular substances used by this population (e.g., alcohol, cannabis, cigarettes; Goldberg et al., 2013; Marshal et al., 2008; Marshal et al., 2009; Marshal et al., 2012; Needham & Austin, 2010; Reed et al., 2010; Schuler et al., 2018). Moreover, the bulk of existing research on e-cigarette use among sexual minority individuals focuses predominantly on adolescent (Caputi, 2018; Coulter, Bersamin, Russell, & Mair, 2018; Dermody, 2018; Goldbach, Mereish, & Burgess, 2017) or adult (Hoffman, Delahanty, Johnson, & Zhao, 2018; Johnson et al., 2016; Nayak, Salazar, Kota, & Pechacek, 2017) populations, leaving the interim developmental window of young adulthood (i.e., age 18–25) largely neglected with limited exception (Delahanty et al., 2019; Fallin-Bennett et al., 2017; Gerend et al., 2017; Li et al., 2018). The few studies that have assessed e-cigarette use among sexual minority individuals during young adulthood have utilized selective, circumscribed samples (e.g., men who have sex with men (Gerend et al., 2017), college students (Li et al., 2018), and frequent bar patrons (Fallin-Bennett et al., 2017). These studies generally indicate greater prevalence of e-cigarette use among sexual minority (vs. heterosexual) young adults (Fallin-Bennett et al., 2017; Gerend et al., 2017; Li et al., 2018), with especially high profiles of risk observed for bisexual and lesbian women (Delahanty et al., 2019; Li et al., 2018).

Young adulthood can be an especially challenging developmental window, which may partially explain its association with peak risk for substance use in the general population (Arnett, 2005). Given that processes of sexual identity formation typically unfold during this period, risk for substance use among sexual minority young adults may be further compounded by feelings of confusion, repression, and internalized shame that accompany the integration of a stigmatized sexual identity into one's self-concept (Greene & Britton, 2012). Recent evidence indicates that substance use disparities among sexual minorities are most pronounced during young adulthood (Schuler et al., 2018), which further underscores the need for additional empirical evidence characterizing sexual minority individuals' use of e-cigarettes during this formative developmental window.

Beyond limitations stemming from the relative dearth of research on e-cigarette use, extant literature on sexual-minority-related disparities in nicotine and cannabis product use during young adulthood often collapse different identities into a single "sexual minority" group (Fallin-Bennett et al., 2017; Goldberg et al., 2013; Marshal et al., 2008). This practice precludes any analysis of within-group variance in substance use outcomes, which is not ideal given growing evidence of especially high-risk profiles for nicotine and cannabis use among young sexual minority individuals who are female (vs. male) and/or bisexual (vs. lesbian/gay; Caputi, 2018; Delahanty et al., 2019; Li et al., 2018; Marshal et al., 2008; Marshal et al., 2012; Needham & Austin, 2010; Reed et al., 2010; Schuler et al., 2018; Tucker et al., 2008). The current study used 2016 data from young adults in the Southern California Children's Health study to evaluate the association of sexual identity (i.e., heterosexual, bisexual, lesbian/gay) with use of e-cigarettes, cigarettes, and cannabis, and to determine whether these associations differed by gender.

2. Materials and methods

2.1. Participants and procedure

The current report used cross-sectional data collected from 1467 participants ($M[SD]_{age} = 20.22$ [0.60] years) of the Southern California Children's Health Study (CHS), a cohort originally developed to study the health consequences of air pollution (McConnell et al., 2006). The design of the CHS was based upon the selection of 12 residential communities throughout southern California; a representative sample of youth (i.e., representative of the community) were recruited from entire classrooms in schools within each of the selected communities. The CHS cohort has been followed annually since enrollment in 2002–2003 (i.e., kindergarten and first grade). The data presented here correspond with Wave III (2016–2017) of the CHS (i.e., approximately 1–2 years following graduation from high school); the response rate for this wave and cohort was 71.63%. Data were collected online via-self-report surveys that assessed sexual identity and history of use of e-cigarettes, cigarettes, and cannabis.

Of 1550 respondents, 88 were excluded from analyses due to missing sexual identity data ($n = 35$), missing data for all three products ($n = 5$), and for reporting "Something" or "Don't Know" to the sexual identity question ($n = 48$), leaving a final analytic sample of 1467 participants ($n_{heterosexual} = 1314$; $n_{bisexual} = 77$; $n_{lesbian/gay} = 28$). Although the sample size for lesbian- and gay-identified participants was very small, we included these individuals in our analyses given the lack of existing research characterizing e-cigarette use in this population and the importance of capturing the robust variance observed among sexual minority sub-groups in prior work (Caputi, 2018; Delahanty et al., 2019; Li et al., 2018; Marshal et al., 2008, 2012; Needham & Austin, 2010; Schuler et al., 2018; Tucker, Ellickson, & Klein, 2008). The study was approved by the university's Institutional Review Board. Written informed consent was obtained before data collection.

2.2. Measures

Gender (male, female), age, race/ethnicity (Hispanic white, non-Hispanic white, other), and parental education (high school diploma or lower, some college, college degree or higher) were collected by self-report questionnaires.

2.2.1. Sexual identity

To assess sexual identity, participants were asked, via self-report: "*Do you consider yourself to be…*" and were provided with the following response options: "Straight," "Lesbian or gay," "Bisexual," "Something else," and "Don't know." Those who responded with "Something else," or "Don't know" ($n = 48$, 3.27%) were omitted from analyses.

2.2.2. Current and past use of nicotine products and cannabis

Participants completed self-report surveys assessing use of e-cigarettes, cigarettes, and cannabis. Participants were asked–for each substance separately–whether they had ever tried a product ("How old were you when you first tried [product], even one or two puffs?" with an option to select "I have never tried this product"); participants who had "never tried" e-cigarettes, cigarettes, or cannabis (i.e., not "even one or two puffs") were classified as "never users" of that product. Participants reporting any use of a product were also queried as to the number of days each product was used in the past 30 days ("During the past 30 days, on how many days did you use [product]?") for cigarettes ("cigarette, even one or two puffs"), e-cigarettes ("electronic or e-cigarette, even one or two puffs"), and cannabis ("smoking or vaping marijuana"), in separate items. Those who had used e-cigarettes, cigarettes, or cannabis in their lifetime but not in the past 30 days were classified as "prior users." In line with past work (Barrington-Trimis

et al., 2018), individuals who endorsed use of a product within the past 30 days were classified as "infrequent past 30-day users" (i.e., used product on 1–2 of the past 30 days) or "frequent past 30-day users" (i.e., used product on ≥ 3–5 of the past 30 days) of a product.

2.3. Statistical analyses

Multinomial logistic regression models were used with the GLOGIT link function to evaluate associations of sexual identity (heterosexual [ref], lesbian/gay, bisexual) with substance use (never, prior, infrequent past 30-day, frequent past 30-day), in separate models by substance (e-cigarettes, cigarettes, cannabis). Odds ratios (ORs) and 95% confidence intervals (CIs) were used to describe estimates. Post-hoc tests were used to evaluate whether the magnitude of OR for comparisons between bisexual vs. heterosexual and lesbian/gay vs. heterosexual participants differed statistically. Based on a growing body of evidence that gender is a significant modifier of the association of sexual minority status with nicotine and cannabis product use (Li et al., 2018; Marshal et al., 2008, 2012; Needham & Austin, 2010; Schuler et al., 2018), we employed formal tests of interaction to evaluate whether effect estimates for lifetime product use differed by gender; we also opted to stratify findings for this analysis by gender based on recommendations advanced in response to this well-replicated finding (McCabe, Hughes, Bostwick, & Boyd, 2005; Mustanski, 2015). All models were adjusted for age, gender, race, and parental education as fixed effects, and community of residence during adolescence as a random effect. A level of significance of $\alpha = 0.05$ was used for all statistical analyses. Data were analyzed in 2019 using SAS version 9.4.

3. Results

3.1. Sample characteristics

Overall, the sample included a slightly greater proportion of females (52.7%) and a large percentage of Hispanic young adults (49.1% Hispanic White, 38.0% non-Hispanic White, 12.9% Other; Table 1). The sample was comprised of predominantly heterosexual-identified young adults (n = 1314, 92.6%), with 2.0% of the sample identifying as lesbian/gay ($n = 28$) and 5.4% of the sample identifying as bisexual ($n = 77$). Bisexual young adults were more commonly female than male (81.8% vs. 18.2%).

Table 1
Sample characteristics overall and by sexual identity, N = 1467.

		Sexual Identity		
	Overall Sample *N* (%)	Heterosexual *N* = 1314 (*N*, col %)	Lesbian/ Gay *N* = 28 (*N*, col %)	Bisexual *N* = 77 (*N*, col %)
Demographic Characteristics				
Age	20.22 (0.59)	20.22 (0.59)	20.18 (0.52)	20.20 (0.65)
Gender				
Male	694 (47.3)	653 (49.7)	18 (64.3)	14 (18.2)
Female	773 (52.7)	661 (50.3)	10 (35.7)	63 (81.8)
Race/ethnicity				
Hispanic White	721 (49.1)	638 (48.6)	19 (67.9)	37 (48.1)
Non-Hispanic White	557 (38.0)	511 (38.9)	5 (17.9)	27 (35.1)
Other	189 (12.9)	165 (12.6)	4 (14.3)	13 (16.9)
Highest parental education				
High school diploma or lower	435 (29.7)	384 (29.2)	10 (35.7)	28 (36.4)
Some college	523 (35.7)	474 (36.1)	9 (32.1)	24 (31.2)
College degree or higher	421 (28.7)	379 (28.8)	7 (25.0)	17 (22.1)
Missing	88 (6.0)	77 (5.9)	2 (7.1)	8 (10.4)

Note. Col % = Column percentage. Values for age represent *M* (*SD*).

3.2. Prevalence of lifetime use in overall sample

E-cigarettes were the most commonly used product across the lifetime in this sample, with 39.2% ($n = 572$) reporting prior use, 3.7% ($n = 54$) reporting infrequent past 30-day use, and 5.8% ($n = 85$) reporting frequent past 30-day use (Table 2). Lifetime cannabis use was also commonly endorsed; 23.1% ($n = 334$) of young adults reported prior use, 6.3% ($n = 92$) reported infrequent past 30-day use, and 15.3% ($n = 222$) reported frequent past 30-day use. For lifetime cigarette use, 23.5% ($n = 344$) of the sample reported prior use, 4.5% ($n = 66$) reported infrequent past 30-day use, and 6.5% ($n = 96$) reported frequent past 30-day use.

3.3. Associations of sexual identity and nicotine and cannabis product use

Compared to heterosexual young adults, bisexual young adults had statistically significantly greater odds of endorsing prior use (OR: 3.53; 95% CI: 2.04, 6.13) and frequent past 30-day use (OR: 6.68; 95% CI: 2.80, 15.9) of e-cigarettes (vs. no use; Table 2). Similar results were observed for cigarettes (OR_{prior}: 3.88; 95% CI: 2.26, 6.65; $OR_{infrequent}$: 5.29; 95% CI: 2.13, 13.1; $OR_{frequent}$: 5.42; 95% CI: 2.37, 12.4) and cannabis (OR_{prior}: 3.29; 95% CI: 1.71, 6.35; $OR_{infrequent}$: 4.33; 95% CI: 1.77, 10.6; $OR_{frequent}$: 8.43; 95% CI: 4.40, 16.1). The odds of use of any substance at any frequency did not differ for lesbian/gay (vs. heterosexual) individuals (Table 2). Post-hoc analyses indicated that, compared to lesbian/gay individuals, bisexual individuals had greater odds of endorsing prior (but not past 30-day) use of both nicotine products ($OR_{e\text{-}cigarettes} = 3.39$; 95% CI: 1.26, 9.16; $OR_{cigarettes} = 2.96$; 95% CI: 1.08, 8.10); with respect to cannabis, the only category of use that bisexual (vs. lesbian/gay) individuals had statistically greater odds of endorsing was frequent past 30-day use (OR = 17.85; 95% CI: 3.53, 90.14).

3.4. Sexual identity × gender interaction on lifetime history of product use

Gender moderated the association of sexual identity with lifetime history of cigarette use such that the association of bisexual (vs. heterosexual) identity with cigarette use was stronger for female than male young adults (Table 3). Specifically, bisexual (vs. heterosexual) females had over six times the odds of reporting lifetime use of cigarettes (OR: 6.51; 95% CI: 3.68, 11.52), while no association was observed for bisexual vs. heterosexual males (OR = 0.89; 95% CI: 0.29, 2.72; $p_{interaction} \leq 0.01$). Although the interactive effect of gender × sexual identity on e-cigarette use was not statistically significant ($p_{interaction} = 0.06$), gender-stratified analyses showed that bisexual (vs. heterosexual) females had over five times the odds of reporting any lifetime use of e-cigarettes (OR: 5.18; 95% CI: 2.78, 9.64), while no statistically significant difference was observed for bisexual males (vs. heterosexual males; OR = 1.16; 95% CI: 0.39, 3.42). No interaction between sexual identity and gender was observed for lifetime cannabis use.

4. Discussion

The present study found that bisexual young adults, compared to other sexual identity sub-groups, had the greatest odds of use for nearly all nicotine and cannabis product use history outcomes evaluated. In addition to being more likely than heterosexual participants to report nicotine and cannabis product use, bisexual participants also exhibited higher odds of product use in comparison to lesbian and gay participants. Although the small sample sizes for the bisexual (vs. lesbian/gay) comparisons likely reduced the power to detect statistically significant differences in prevalence estimates (apart from prior use of cigarettes/e-cigarettes and frequent past 30-day use of cannabis), these findings

Table 2
Association of sexual identity with prior, infrequent, and frequent use of e-cigarettes, cigarettes, and cannabis.

		History of Product Use				Adjusted OR[a] (95% CI)		
	Total, *N* (col %)	Never *N* (row %)	Prior *N* (row %)	Infrequent Past 30-day *N* (row %)	Frequent Past 30-day *N* (row %)	Prior Vs. Never	Infrequent Past 30-day vs. Never	Frequent Past 30-day vs. Never
E-cigarettes (*N* = 1412)								
Heterosexual	1307 (92.6)	687 (52.6)	503 (38.5)	47 (3.6)	70 (5.4)	Ref	Ref	Ref
Lesbian/Gay	28 (1.98)	13 (46.4)	10 (35.7)	3 (10.7)	2 (7.1)	1.04 (0.45, 2.41)	3.45 (0.93, 12.8)	1.58 (0.34, 7.35)
Bisexual	77 (5.45)	20 (26.0)	45 (58.4)	3 (3.9)	9 (11.7)	3.53 (2.04, 6.13)	2.60 (0.73, 9.29)	6.68 (2.80, 15.9)
Cigarettes (*N* = 1418)								
Heterosexual	1313 (92.6)	880 (67.0)	296 (22.5)	56 (4.3)	81 (6.2)	Ref	Ref	Ref
Lesbian/Gay	28 (1.97)	17 (60.7)	8 (28.6)	1 (3.6)	2 (7.1)	1.31 (0.55, 3.13)	0.79 (0.10, 6.12)	1.24 (0.27, 5.64)
Bisexual	77 (5.43)	29 (37.7)	32 (41.6)	7 (9.1)	9 (11.7)	3.88 (2.26, 6.65)	5.29 (2.13, 13.1)	5.42 (2.37, 12.4)
Cannabis (*N* = 1401)								
Heterosexual	1299 (92.7)	743 (55.3)	294 (22.6)	79 (6.1)	183 (14.1)	Ref	Ref	Ref
Lesbian/Gay	27 (1.93)	16 (59.3)	7 (25.9)	2 (7.4)	2 (7.4)	1.16 (0.47, 2.86)	1.16 (0.25, 5.32)	0.47 (0.11, 2.11)
Bisexual	75 (5.35)	17 (22.7)	22 (29.3)	8 (10.7)	28 (37.3)	3.29 (1.71, 6.35)	4.33 (1.77, 10.6)	8.43 (4.40, 16.1)

Note. OR = Odds Ratio; CI = Confidence Interval; Col % = Column percentage; Ref = reference; Never = no history of lifetime use; Prior = history of lifetime use but no use in past 30 days; Infrequent Past 30-day = history of current use on 1–2 of the past 30 days; Frequent Past 30-day = history of current use on ≥3–5 of the past 30 days.

[a] Adjusted for community and co-adjusted for gender, ethnicity, and parental education, as appropriate.

Table 3
Association of sexual identity with prior, infrequent, and frequent use of products, by gender.

	Total, *N* (col%)	E-cigarette Use *N* (row%)	Adjusted[a] OR (95% CI)	*P*[b]	Cigarette Use *N* (row%)	Adjusted[a] OR (95% CI)	*P*[b]	Cannabis Use *N* (row%)	Adjusted[a] OR (95% CI)	*P*[b]
Males (*N* = 694)										
Heterosexual	653 (94.1)	339 (51.9)	Ref	0.06	254 (38.9)	Ref	<0.01	278 (42.6)	Ref	0.69
Gay	18 (2.6)	10 (55.6)	1.20 (0.46, 3.13)		7 (38.9)	0.96 (0.36, 2.57)		7 (38.9)	0.86 (0.33, 2.30)	
Bisexual	14 (2.0)	8 (57.1)	1.16 (0.39, 3.42)		5 (35.7)	0.89 (0.29, 2.72)		10 (71.4)	3.15 (0.92, 10.3)	
Females (*N* = 773)										
Heterosexual	661 (85.5)	281 (42.7)	Ref		179 (27.1)	Ref		278 (42.2)	Ref	
Lesbian	10 (1.3)	5 (50.0)	1.38 (0.39, 4.88)		4 (40.0)	1.90 (0.52, 6.94)		4 (40.0)	1.02 (0.26, 3.98)	
Bisexual	63 (8.2)	49 (77.8)	5.18 (2.75, 9.64)		43 (68.3)	6.51 (3.68, 11.5)		48 (76.2)	5.62 (2.96, 10.7)	

Note. OR = Odds Ratio; CI = Confidence Interval.

[a] Adjusted for community and co-adjusted for gender, ethnicity, and parental education, as appropriate.

[b] Indicates *p*-value for interaction between sexual identity and gender on odds of lifetime use for each respective product.

suggest that collapsing data across all sexual minority identities may mask the considerable variability that exists within this diverse population. As such, our results underscore the need for researchers and clinicians to move away from treating separate sexual minority identities as a monolithic group.

Results from the current study cohere with previous cross-sectional studies demonstrating that bisexual adolescents' and young adults' risk for nicotine and cannabis product use is not only disproportionately high relative to heterosexual individuals, but to other sexual minority individuals as well (Delahanty et al., 2019; Li et al., 2018; Marshal et al., 2008, 2012; Needham & Austin, 2010; Schuler et al., 2018; Tucker et al., 2008). Additionally, examining the relation of sexual identity to separate categories of "prior use" (i.e., use in lifetime but not in past 30 days), "infrequent past 30-day use" (i.e., use on 1–2 of past 30 days), and "frequent past 30-day use" (i.e., use on ≥3–5 of past 30 days), we provide important nuance to understanding gradients of hazardousness that characterize sexual minority young adults' use of nicotine and cannabis products as well as the attendant risk for developing dependence on them. For example, prior studies have shown that bisexual young adults are more likely than heterosexual young adults to report any (vs. no) history of past 30-day nicotine and cannabis product use (Delahanty et al., 2019; Fallin-Bennett et al., 2017; Li et al., 2018; Needham & Austin, 2010; Schuler et al., 2018; Tucker et al., 2008). Although we observed disparities between bisexual and heterosexual young adults for nearly every nicotine and cannabis product use history outcome evaluated, it is notable that the greatest of such disparities consistently emerged for the "frequent past 30-day" use category. Importantly, this finding not only suggests that bisexual (vs. heterosexual) young adults are more likely to report any history of current nicotine and cannabis product use, but also that they may be more likely to report high-risk patterns of current use.

There are several possible explanations as to why bisexual young adults exhibited a higher risk profile for nicotine and cannabis product use than any other sexual identity sub-group in our study. Along with their gay and lesbian peers, bisexual young adults face stressors beyond those common to the emerging adulthood experience (e.g., minority

stress, internalized homophobia, social rejection, low parental support; Meyer, 2003). Exposure to this type of sexual minority-specific stress has been implicated in the substance use of sexual minority young adults. For example, qualitative data demonstrate that sexual minority young adults report using substances to cope with internalized stigma, familial rejection, and structural stigma (Felner et al., 2019). In quantitative studies, exposure to sexual minority-specific stressors has been found to mediate disparities in substance use among sexual minority young adults (Needham & Austin, 2010; Reed, Prado, Matsumoto, & Amaro, 2010). Beyond having to navigate homophobia, bisexual individuals also regularly confront stigma and erasure *within* the sexual minority community, where the legitimacy of bisexuality as a stable and authentic sexual identity is often dismissed (Alarie & Gaudet, 2013). Prior work demonstrates that this kind of "double discrimination" routinely encountered by bisexual individuals in heterosexual and queer contexts alike exacerbates their motivation to smoke as a means of coping with uncomfortable situations related to their bisexuality (McQuoid, Thrul, Ozer, Ramo, & Ling, 2019). A similar mechanism may account for the elevated prevalence of nicotine and cannabis product use observed among bisexual young adults in our study.

With respect to cigarette use only, we also found that bisexual identity was significantly associated with higher odds of lifetime use among female, but not male, young adults in our sample. While it did not reach statistical significance, there was a non-significant trend of sexual identity × gender interaction with lifetime history of e-cigarette use ($p = .06$). It will be important for future studies to further investigate this interaction to see if this this trend generalizes to other nicotine products. Although we were surprised that this interaction was not also observed for lifetime cannabis use, these findings align with an emergent trend in the literature showing compounded risk for substance use among sexual minority females (vs. males; Caputi, 2018; Delahanty et al., 2019; Li et al., 2018; Marshal et al., 2008; Marshal et al., 2012; Needham & Austin, 2010; Reed et al., 2010; Schuler et al., 2018; Tucker et al., 2008). Bisexual-identified adolescent females report stronger pro-drug beliefs, lower resistance self-efficacy, higher perceived parental approval of their substance use, and greater exposure to substance-using peers than heterosexual-identified adolescent females—all of which have been found to prospectively predict disparities in substance use observed in emerging adulthood (Tucker et al., 2008). It is likely that these factors play a role in the elevated odds of nicotine product use observed among bisexual female young adults here and in prior work.

We found no significant differences in reported use of any nicotine and cannabis product between heterosexual (vs. gay/lesbian) young adults. However, given the small sample size of lesbian/gay individuals in this study, it is possible that it was underpowered to detect group differences for this particular comparison. Nevertheless, this finding is surprising as it does not align with minority stress theory, which suggests that substance use is one coping mechanism that sexual minority individuals may utilize as a consequence of their disproportionate exposure to stigma-related stress (Meyer, 2003). Although it also conflicts with prior evidence of disparities in nicotine and cannabis product use observed among lesbian and gay (vs. heterosexual) adolescents (Marshal et al., 2008) and young adults (Li et al., 2018; Schuler et al., 2018), it does align with two recent studies in which bisexual-identified, but not lesbian- or gay-identified adults, reported higher current use of some tobacco products relative to heterosexual-identified adults (Emory et al., 2016; Krueger, Fish, & Upchurch, 2019).

4.1. Limitations

The findings of the current study should be considered in the context of its limitations. One limitation is the relatively low representation of sexual minority (particularly lesbian and gay) young adults in our sample. While the percentage of sexual minority participants in the current report is comparable to other studies of sexual orientation and young adult substance use (Fallin-Bennett et al., 2017; Li et al., 2018; Marshal et al., 2008; Needham & Austin, 2010; Reed et al., 2010), a judicious interpretation of our findings is therefore encouraged, particularly for prevalence estimates that had wide confidence intervals. The small sample size also limited our ability to examine sexual identity differences in poly-substance use of nicotine and cannabis products, which we would expect to be high among sexual minority young adults (Hinds, Loukas, & Perry, 2020). An additional study limitation relates to our inability to assess all three dimensions of sexual orientation (i.e., sexual identity, sexual behavior, sexual attraction), a practice that is increasingly normative in research with young adults, who may still be establishing their sexual identity. Although the data that correspond with the current analyses did not include items assessing sexual behavior or sexual attraction, these items will be administered to participants at the next wave of data collection for the Southern California Children's Health Study. Our assessment of sexual identity is further limited by our inability to assess sexual minority identity labels that are non-traditional but increasingly common (e.g., queer, pansexual) among sexual minority individuals, which will also be assessed in subsequent waves of the study.

There are also several limitations to the generalizability of our findings to sexual minority young adults outside of the current study. First, school-based studies necessarily exclude high school dropouts, homeschooled students, and adolescents not in attendance at the time of survey administration. Given that sexual minority (vs. heterosexual) adolescents are more likely to drop out of school, face housing instability, and have poor school attendance (Baams, Wilson, & Russell, 2019; Robinson & Espelage, 2011), the school-based design of initial enrollment into the Southern California Children's Health Study may be a source of sampling bias. Additionally, our findings may not generalize to sexual minority young adults outside of the Southern California region. Many of the prevalence estimates for nicotine and cannabis product use for bisexual (vs. heterosexual and lesbian/gay) young adults reported here are larger than estimates observed for sexual minority (vs. heterosexual) young adults in similar cross-sectional studies (Fallin-Bennett et al., 2017; Li et al., 2018; Needham & Austin, 2010; Reed et al., 2010), particularly with respect to cannabis use. This may be attributable to the unique legal landscape in California on issues that likely impact nicotine and cannabis product use among sexual minority young adults relative to other areas of the country (e.g., low stigma towards sexual minority individuals, comprehensive tobacco control policy, lenient cannabis climate). Future replication in U.S. settings that differ from California on these dimensions is warranted to better understand the role that contextual factors specific to California may have played in the current study.

4.2. Conclusions

While the appeal of e-cigarettes and cannabis is on the rise among young adults in general, our data suggest that bisexual young adults may be especially at risk. Although gender-stratified results of the interaction analysis suggest that this risk may be compounded among female–relative to male—bisexual young adults, these findings warrant cautious interpretation given that the interactive effect of sexual identity and gender on lifetime product use only reached statistical significance for cigarette use. Nevertheless, future research examining substance use trends among young adult sexual minority populations should further explore the potentially moderating role of gender within this relationship. The prevalence of bisexual self-identification appears to be increasing rapidly relative to other sexual minority identities in the U.S.—especially among younger populations (Copen, Chandra, & Febo-Vazquez, 2016). Thus, the already disproportionate public health burden that bisexual individuals face will likely grow wider yet in the coming years, particularly if concerning trends around bisexual young adults' substance use persist unchecked. The results reported here underscore the urgent need to prioritize this population as among the highest risk subgroup in need of enhanced substance use prevention

efforts across the domains of research, policy, and clinical practice. It is also imperative that future research elucidate why existing substance use screening, prevention, and intervention services continue to fall short for bisexual adolescents and young adults and how such programming can be tailored to address factors that play a unique role in motivating their substance use. To this end, identifying risk or protective factors that may influence the disproportionate nicotine and cannabis use observed in this vulnerable population is warranted.

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Contributors

MML generated the initial idea for the analysis reported in the manuscript and prepared the manuscript first draft. JLB assisted with editing each iterative draft of the manuscript and edited and approved the final draft of the manuscript. FL conducted all data analysis for the manuscript. AS edited and approved the final draft of the manuscript. EAK edited and approved the final manuscript. RM was the principal investigator of the grant which funded this study and edited and approved the final manuscript. RDP assisted with editing each iterative draft of the manuscript and edited and approved the final draft of the manuscript. All authors contributed to and approved of the final version of the manuscript.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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