



State-level marijuana policies and marijuana use and marijuana use disorder among a nationally representative sample of adults in the United States, 2015-2017: Sexual identity and gender matter

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ABSTRACT

Background: Research demonstrates an association between state-level medical marijuana laws (MMLs) and increased marijuana use (MU) and MU disorder (MUD) among adults, but has yet to explore this association among lesbian, gay and bisexual (LGB) individuals, including gender differences.

Methods: We pooled the 2015–2017 National Survey on Drug Use and Health data for adults (n = 126,463) and used gender-stratified adjusted multivariable logistic regression to model the odds of past-year MU, past-year medical MU, daily/near-daily MU, and MUD; we also tested the interaction between MML state residence and sexual identity.

Results: Bisexual women had higher past-year MU (40% versus 10.3%; aOR = 2.9[2.4–3.4]), daily/near-daily MU (9.8% versus 1.5%; aOR = 4.6[3.3–6.2]), and medical MU ((5.5% versus 1.2%) aOR = 5.5[3.8–8.1]) than heterosexual women. Gay/lesbian women also had higher past-year MU (26.1% versus 10.3%; aOR = 2.8[2.2–3.7]), daily/near-daily MU (5.6% versus 1.5%; aOR = 2.9[1.8–4.6]), and medical MU (4.7% versus 1.2%; aOR = 3.0[1.4–6.6]) than heterosexual women. Bisexual women in MML states had higher past-year MU ((44.4% vs. 34.1%); aOR = 1.8[1.5–2.1]) and medical use (7.1% vs. 3.3% (aOR = 2.5[1.5–3.9]) than bisexual women in non-MML states. The odds of any past-year medical MU for bisexual versus heterosexual women was different in MML versus non-MML states (Exponentiated β = 0.53, p = 0.01). Gay men in MML states had higher past year MU (31.2% versus 25.7%; aOR = 1.6[1.1–2.5]) and medical MU (6.4% vs 1.7%; aOR = 5.0[4.2–6.1]) than gay men in non-MML states.

Conclusions: Results suggest that MMLs may differentially impact MU for sexual minority individuals—particularly bisexual women. Findings demonstrate the need for states enacting MMLs to consider potential differential impacts on LGB populations.

1. Introduction

Marijuana is the most frequently used substance in the United States (US) after alcohol and tobacco (Ahrnsbrak et al., 2017). Marijuana prevalence has increased since 2006–2007 (Carliner et al., 2017; Mauro et al., 2018) and in 2017, 15.3% of the US population ages 18 and up reported past-year marijuana use (MU) and 9.9% reported past month use (Ahrnsbrak et al., 2017). Overall prevalence of MU and marijuana use disorder (MUD) are not evenly distributed across individuals, with young adults and males reporting higher prevalence of use than the national average (Carliner et al., 2017; Mauro et al., 2018; Wen et al., 2015). Sexual minorities, including individuals who identify as lesbian,

gay, or bisexual (LGB), also report higher levels of MU and MUD than their heterosexual counterparts (Medley et al., 2016; Schuler et al., 2018). The 2015 National Survey on Drug Use and Health (NSDUH) found that 30.7% of sexual minority adults reported past-year MU compared with 12.9% of heterosexuals; 3.9% reported MUD compared to 1.3% of heterosexuals (Medley et al., 2016). There are also gender differences. Over one-quarter (27.1%) of sexual minority men reported past-year MU compared to one-third (33.2%) of sexual minority women; this is in direct contrast to heterosexuals where men report higher marijuana use than women (Medley et al., 2016). Bisexual women have particularly high rates of MU compared to heterosexual women: research among bisexual women found reports of lifetime use

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ranging from 37%–82.0% and past-year use from 32 to 54%, compared to 41% and 12% of heterosexual adult women, respectively. (Ahrnsbrak et al., 2017; Bostwick et al., 2015; Schauer et al., 2013) Bisexual women were over five times more likely to report past-year marijuana use compared to heterosexual women. (McCabe et al., 2009)

Research demonstrates that LGB individuals may be impacted differently by some state-level policies compared to heterosexual individuals. For example, the state-level policy context influences tobacco use, (Hatzenbuehler et al., 2014) suicidal ideation, (Hatzenbuehler, 2011) and increased sexual risk behavior (Oldenburg et al., 2015) among LGB individuals in ways that may differ from their heterosexual counterparts. This aligns with the minority stress model, which suggests that health disparities based on sexual orientation are due to sexual minorities' exposure to stigma and discrimination. (Feinstein and Dyar, 2017) Experiences with minority stress can differ by gender, with women—particularly bisexual women—at particular risk of negative health outcomes as a result of victimization, internalized homophobia, concealment of their sexual identity, familial rejection, discrimination, and lack of social support. (Feinstein and Dyar, 2017) While research has explored how LGB discrimination policies may impact substance use, less work has explored how substance use policies may impact LGB men and women differently than heterosexuals.

Researchers have begun to explore potentially modifiable factors, such as state-level marijuana policies, that affect MU and related outcomes at the population-level and within subgroups—though as of yet not among sexual minority populations. Medical marijuana laws (MMLs) are an example of a modifiable state-level exposure that has received increased attention. As of December 2018, 33 states passed MMLs, while 10 states and Washington DC had legalized marijuana for recreational purposes. (National Conference of State Legislatures, 2018) Given this pace of change, researchers have increasingly studied the impact of marijuana-specific policies as potential drivers of change on observed MU outcomes. (Martins et al., 2016) MMLs have differential impacts on individuals based on age: adults (26+) living in MML states have higher past month prevalence of marijuana use compared to adults in non-MML states, and also have increased medical and non-medical use following MML enactment. (Martins et al., 2016; Mauro et al., 2017, 2018; Wen et al., 2015) However, the majority of studies found no such relationship among youth. (Sarvet et al., 2018) Differences by gender indicate that past month and past-year daily MU increased between 2004–2013 among both men and women ages 26+ after MML enactment, and that past-year daily MU increased after MML enactment for men ages 18–25, but not women (Mauro et al., 2017). However, these studies found no corresponding increase in MUD. (Mauro et al., 2017) In light of differences in MML effects, it is important to explore whether certain segments of the population—such as LGB individuals who have higher baseline levels of MU than heterosexuals (Medley et al., 2016)—may be disproportionately impacted by MMLs.

Previous research (Bostwick et al., 2015; Hatzenbuehler et al., 2014; Schauer et al., 2013), and the minority stress model (Feinstein and Dyar, 2017; Goldbach et al., 2015; Lea et al., 2014; Lehavot and Simoni, 2011), suggest that substance use outcomes may differ for LGB men and women based on state-level policies. We therefore explored whether differences in MU outcomes may also occur between sexual minority subgroups and by gender depending on residence in an MML state. In this study, we examined whether LGB individuals living in MML states have higher levels of MU/MUD compared to LGB individuals in non-MML states. By using the most recent nationally-representative data of LGB adults in the US, our work builds on the Institute of Medicine (IOM) report highlighting the importance of conducting additional research on LGB populations across the life course, particularly with nationally weighted samples. (Institute of Medicine, 2011) Findings will help determine if MMLs are disproportionately affecting LGB adults in the US, and inform resource allocation as needed.

2. Methods

2.1. Data source and sample

We used the 2015–2017 NSDUH public use files, which the Substance Abuse and Mental Health Services Administration uses to derive annual substance use prevalence estimates. The NSDUH used a nationally representative sample of the non-institutionalized civilian population of the U.S. ages 12 and older in each of the 50 states and Washington DC. Data were collected via face-to-face household interview using computer assisted interviewing and audio computer-assisted self-interviewing (ACASI) to increase the accuracy of responses to potentially sensitive questions. Weighted interview response rates in 2015–2017 ranged from 64.8 to 66.3%. (Substance Abuse and Mental Health Services Administration, 2018) Individuals received \$30 for participating. Methodological descriptions, including reliability and validity of the NSDUH (Harrison et al., 2007) can be found elsewhere (SAMHSA, 2015).

2.1.1. Study sample

We pooled 170,319 observations across the three survey years, adding a year indicator. Individuals ages 12–17 ($n = 41,579$) were not asked the sexual orientation questions and were therefore excluded, as were adults whose self-reported sexual identity was missing ($n = 61$) or reported as “unsure” or “refuse to answer” ($n = 2216$). The final analytic sample included 126,463 survey participants ages 18 and older.

2.2. Measures

2.2.1. Primary exposure

Sexual Identity: Sexual identity was assessed by asking, “Which of the following do you consider yourself to be?” Responses included “Heterosexual, that is straight”, “Lesbian or gay”, or “Bisexual.”

2.2.2. Primary outcomes measures

Past-year marijuana use: Participants were asked if they had ever used marijuana or hashish and if so, how recently. Past-year marijuana use included any use in the past 12 months.

Daily near-daily marijuana use, past-year: daily/near-daily marijuana use included responses of at least 300 days of marijuana use in the past year.

Marijuana use disorder: Past-year marijuana use disorder was operationalized as a binary (yes/no) variable based on meeting DSM-IV criteria for marijuana abuse (1 out of 4 items) and/or dependence (3 out of 6 items). (APA, 2000)

Any past-year medical marijuana: Participants who responded that they had used marijuana were asked if any of their use in the past 12 months was recommended by a doctor or other health care professional (yes/no).

2.2.3. Moderator

Residence in an MML state: The NSDUH coded participants as living in an MML state if the state had a law approving marijuana for medical use before the date of interview, otherwise the participant was coded as living in a non-MML state.

2.2.4. Covariates

Sociodemographic covariates: These included survey year (with year indicator variables), age (18–25; 26–34; 35–49; and 50+), race/ethnicity (non-Hispanic White; non-Hispanic Black; Hispanic; or Other non-Hispanic), gender (male; female), annual household income (< \$20,000; \$20,000–\$49,999; \$50,000–\$74,999; \$75,000 or more), education (some college; high school/GED or less) and urbanicity (large metro; small metro; non-metro).

2.3. Statistical analysis

We first described survey-weighted sample characteristics by sexual identity and gender. Second, we used weighted multivariable logistic regression to examine the association between sexual identity and four separate past-year MU outcomes: any MU, any medical MU, daily/near-daily MU, and MUD; results were also stratified by gender to provide gender-and sexual identity-specific estimates. Models adjusted for sociodemographics. Third, we conducted separate gender-stratified weighted multivariable logistic regression to explore potential differences in MU outcomes by MML state status, and included an interaction term between sexual identity and MML state status to test the moderating effect of MML state status on the association between sexual identity and marijuana outcomes. Statistical analyses were conducted in SAS 9.4 (Cary, NC) and accounted for the NSDUH complex survey design. NSDUH sampling weights accounted for selection probability, non-response, and population distribution. To account for the pooling of three years of NSDUH data, yearly survey weights were divided by three to make estimates nationally representative. All statistical tests were two-sided and p-values < 0.05 were considered statistically significant.

3. Results

3.1. Marijuana use outcomes by sexual identity

3.1.1. Women

Past-year MU was 10.3% among heterosexual women, 26.1% among gay/lesbian women and 40.0% among bisexual women (Fig. 1 and Table 1a). Daily/near-daily use was lower among heterosexual women (1.5%) compared to lesbians (5.6%) and bisexual women (9.8%). Similar patterns emerged for past-year MUD. Any past-year medical MU was reported by 1.2% of heterosexual women, 4.7% of lesbian/gay women and 5.5% of bisexual women.

3.1.2. Men

Compared to heterosexual men (17.0%), past-year use was higher

among bisexual men, (30.2%) and gay men (29.1%). Daily/near-daily MU among men was highest among bisexual men (9.2%) followed by gay (6.8%) and heterosexual men (4.3%). Any past-year medical MU was 2.0% among heterosexual men, 4.6% among gay men and 3.9% among bisexual men.

3.2. Marijuana use outcomes by sexual identity by MML state

We examined whether gender-stratified MU outcomes differed by sexual identity among adults in MML versus non-MML states (Tables 1b and 1c).

3.2.1. Women

Gay/lesbian women in MML states had higher past-year MU (26.1% versus 25.4%) daily/near-daily MU (6.5% versus 4.3%) and medical MU (6.9% versus 1.5%) than gay/lesbian women in non-MML states. Bisexual women in MML states had higher past-year MU (44.4% versus 34.1%), daily/near-daily MU (10.4% versus 8.9%) and medical marijuana use (7.1% versus 3.3%) than bisexual women in non-MML states.

3.2.2. Men

Gay men in MML states had higher past-year MU (31.2% versus 25.7%), daily/near-daily use (6.8% versus 4.3%) and medical MU (6.4% versus 1.7%) compared to gay men in non-MML states. Similarly, bisexual men in MML states reported higher past-year MU (30.9% versus 29.2%), daily/near-daily use (9.2% versus 7.6%) and medical MU (4.6% versus 2.9%).

3.3. Fixed effects of sexual identity

We then examined whether adjusted MU outcomes differed by sexual identity among adults by MML state status, stratified by gender (Table 2).

3.3.1. Women

Compared to heterosexual women, past-year MU was significantly higher among gay/lesbian women (adjusted odds ratio (aOR) 2.8; 95%

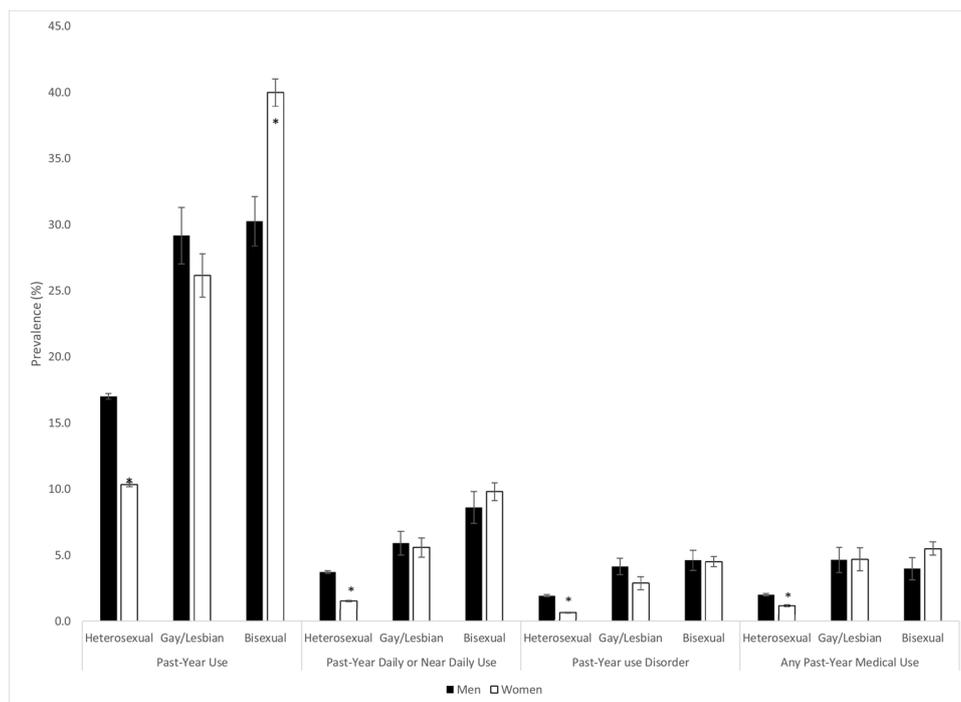


Fig. 1. Prevalence of Past-Year Marijuana Use Outcomes by Sexual Identity and Gender Among US Adults, NSDUH 2015–2017 (N = 126, 463). * denotes a p-value (comparison between men and women) less than 0.05.

Table 1a
Overall Prevalence of Past-Year Marijuana Use Outcomes by Sexual Identity and Gender Among US Adults, NSDUH 2015–2017 (N = 126,463).

	Women (N = 69,048)				Men (N = 59,631)			
	Marijuana Use % (95% CI)	Daily or Near Daily Marijuana Use (≥ 300 days/year) % (95% CI)	Marijuana Use Disorder % (95% CI)	Any Medical Marijuana Use % (95% CI)	Marijuana Use % (95% CI)	Daily or Near Daily Marijuana Use (≥ 300 days/year) % (95% CI)	Marijuana Use Disorder % (95% CI)	Any Medical Marijuana Use % (95% CI)
Heterosexual	10.3% (20.0-10.6)	1.5% (1.4-1.6)	0.6% (0.6-0.7)	1.2% (1.0-1.3)	17.0% (16.6-17.4)	3.7% (3.5-3.9)	1.9% (1.7-2.1)	2.0% (1.8-2.2)
Lesbian/Gay	26.1% (22.9-29.4)	5.6% (4.1-7.0)	2.9% (1.9-3.8)	4.7% (2.9-6.4)	29.1% (24.8-33.4)	5.9% (4.0-7.7)	4.1% (2.9-5.4)	4.6% (2.7-6.5)
Bisexual	40.0% (37.9-42.0)	9.8% (8.4-11.1)	4.9% (3.7-5.3)	5.5% (4.4-6.5)	30.2% (26.5-34.0)	8.6% (6.2-11.0)	4.6% (3.0-6.1)	3.9% (2.2-5.7)

Table 1b
Prevalence of Past-Year Marijuana Use Outcomes by Sexual Identity and Gender Among US Adults Living in MML States, NSDUH 2015–2017 (N = 126,463).

	Women (N = 36,071)				Men (N = 31,728)			
	Marijuana Use % (95% CI)	Daily or Near Daily Marijuana Use (≥ 300 days/year) % (95% CI)	Marijuana Use Disorder % (95% CI)	Any Medical Marijuana Use % (95% CI)	Marijuana Use % (95% CI)	Daily or Near Daily Marijuana Use (≥ 300 days/year) % (95% CI)	Marijuana Use Disorder % (95% CI)	Any Medical Marijuana Use % (95% CI)
Heterosexual	12.0% (11.5-12.4)	1.9% (1.7-2.1)	0.8% (0.7-0.9)	1.8% (1.6-2.1)	19.2% (18.6-19.9)	4.3% (4.0-4.7)	2.1% (1.9-2.4)	3.1% (2.8-3.4)
Lesbian/Gay	26.6% (22.6-30.8)	6.5% (4.3-8.6)	2.7% (1.5-3.9)	6.9% (4.0-9.8)	31.2% (25.5-36.9)	6.8% (4.4-9.2)	4.6% (2.9-6.2)	6.4% (3.5-9.3)
Bisexual	44.4% (41.9-46.9)	10.4% (8.6-12.2)	5.0% (3.9-6.1)	7.1% (5.6-8.6)	30.9% (25.9-35.8)	9.2% (6.3-12.1)	5.2% (3.0-7.3)	4.6% (2.2-7.1)

Table 1c
Prevalence of Past-Year Marijuana Use Outcomes by Sexual Identity and Gender Among US Adults Living in non-MML States, NSDUH 2015–2017 (N = 126,463).

	Women (N = 31,577)				Men (N = 27,087)			
	Marijuana Use % (95% CI)	Daily or Near Daily Marijuana Use (≥ 300 days/year) % (95% CI)	Marijuana Use Disorder % (95% CI)	Any Medical Marijuana Use % (95% CI)	Marijuana Use % (95% CI)	Daily or Near Daily Marijuana Use (≥ 300 days/year) % (95% CI)	Marijuana Use Disorder % (95% CI)	Any Medical Marijuana Use % (95% CI)
Heterosexual	8.5% (8.1-8.9)	1.1% (1.0-1.2)	0.5% (0.4-0.6)	0.4% (0.3-0.5)	14.4% (13.8-15.0)	3.0% (2.7-3.2)	1.6% (1.5-1.8)	0.7% (0.6-0.8)
Lesbian/Gay	25.4% (20.0-30.8)	4.3% (2.2-6.4)	3.1% (1.5-4.7)	1.5% (0.4-2.7)	25.7% (19.6-31.8)	4.3% (1.6-7.0)	3.4% (1.6-5.2)	1.7% (0.4-2.9)
Bisexual	34.1% (31.2-36.9)	8.9% (6.7-11.1)	3.8% (2.5-5.2)	3.3% (2.0-4.6)	29.2% (24.1-34.2)	7.6% (3.8-11.4)	3.7% (1.6-5.7)	2.9% (0.6-5.1)

Table 2
Logistic Regression Modeling of Past-Year Marijuana Use Outcomes by Sexual Identity and Gender Among US Adults, NSDUH 2015–2017 (N = 126,463).

	Past-Year Marijuana Use aOR (95% CI) ^b		Daily or Near Daily Marijuana Use (≥ 300 days/year) aOR (95% CI) ^b		Past-Year Marijuana Use Disorder aOR (95% CI) ^b		Any Past-Year Medical Marijuana Use aOR (95% CI) ^b	
	Women	Men	Women	Men	Women	Men	Women	Men
	Heterosexual	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Lesbian/Gay ^a	2.8 (2.2-3.7) [*]	1.7 (1.2-2.4) [*]	2.9 (1.8-4.6) [*]	1.1 (0.6-2.2)	3.9 (2.3-6.9) [*]	1.6 (0.9-2.7)	3.0 (1.4-6.6) [*]	2.0 (0.9-4.4)
Bisexual ^a	2.9 (2.4-3.4) [*]	1.8 (1.3-2.4) [*]	4.6 (3.3-6.2)	1.9 (1.1-3.2)	3.2 (2.1-4.8) [*]	1.5 (0.8-2.6)	5.5 (3.8-8.1) [*]	3.2 (1.4-7.4) [*]
Heterosexual (MML vs Non-MML)	1.6 (1.5-1.7) [*]	1.6 (1.4-1.7) [*]	1.7 (1.6-2.3) [*]	1.6 (1.4-1.9)	1.6 (1.3-1.9) [*]	1.5 (1.3-1.7) [*]	4.6 (3.6-5.8) [*]	5.0 (4.2-6.1) [*]
Lesbian/Gay (MML vs Non-MML)	1.3 (0.9-1.8)	1.6 (1.1-2.5)	1.9 (1.0-3.6)	2.1 (0.9-4.5)	1.1 (0.5-2.2)	1.8 (0.9-3.5)	5.3 (2.3-12.3) [*]	5.0 (2.0-12.4) [†]
Bisexual (MML vs Non-MML)	1.8 (1.5-2.1) [*]	1.2 (0.9-1.7)	1.4 (0.9-1.9)	1.4 (0.7-2.6)	1.5 (0.9-2.4)	1.6 (0.8-3.4)	2.5 (1.5-3.9) ^{†*}	1.9 (0.7-5.0)

^a Reference: Heterosexual.

^b Models adjust for survey year, age, race/ethnicity, annual household income, and urbanicity.

[†] Difference between sexual minority and heterosexual is statistically significantly different.

* p < 0.01.

Confidence Interval (CI) 2.2–3.7) and bisexual women (aOR 2.9; 95% CI 2.4–3.4). Compared to heterosexual women, daily/near-daily use was significantly higher among gay/lesbian women (aOR = 2.9; 95% CI 1.8–4.6) and bisexual women (aOR = 4.6; 95% CI 3.3–6.2). Compared to heterosexual women, gay/lesbian women reported significantly higher odds of MUD (aOR = 3.9; 95% CI 2.3–6.9) and past-year medical MU (aOR = 3.0; 95% CI 1.4–6.6) as did bisexual women (aOR = 3.2; 95% CI 2.1–4.8 and aOR = 5.5; 95% CI 3.8–8.1, respectively).

3.3.1.1. Differences in the effects of sexual identity by state MML status. Bisexual women in MML states had higher odds of past-year MU (aOR = 1.8; 95% CI = 1.5–2.1) and medical MU (aOR = 2.5; 95% CI 1.5–3.9) than bisexual women in non-MML states. Gay/lesbian women in MML states had higher odds of medical MU (aOR = 5.3; 95% CI 2.3–12.3) than gay/lesbian women in non-MML states.

The odds of any past-year medical MU comparing bisexual to heterosexual women was lower in MML states than in non-MML states (exponentiated $\beta = 0.5$, $p = 0.008$). This was not significant for gay/lesbian women.

3.3.2. Men

Gay men had significantly higher past year MU (aOR = 1.7; 95% CI 1.2–2.4) than heterosexual men, as did bisexual men (aOR = 1.8; 95% CI 1.3–2.4) who also had higher daily (aOR = 1.9; 95% CI 1.1–3.2) and medical MU (aOR = 3.2; 95% CI 1.4–7.4).

Gay men in MML-states had higher past-year use (aOR = 1.6; 95% CI 1.1–2.5) and medical MU (aOR = 5.0; 95% CI 2.0–12.4) than gay men in non-MML states. There were no significant differences in daily/near-daily MU or MUD by MML status for gay men. There was no evidence of effect modification by MML and sexual minority status among men.

4. Discussion

This study examined the relationship between a state's MML status and MU outcomes for LGB men and women using the most up-to-date nationally-representative US data. Specifically, we assessed whether LGB individuals in MML states had higher past-year MU, daily/near-daily MU, MUD and past-year medical MU than those in non-MML states. Findings suggest that patterns of MU among LGB individuals differ from heterosexuals, and that the association between state MML status and MU outcomes differs by LGB and gender. Study findings regarding the relationship between MML and MU outcomes among heterosexuals reaffirm the patterns described by previous studies among the US population as a whole.

When we examined the relationship between state MML status and MU outcomes we found that gay/lesbian women in MML states had higher daily/near-daily MU than those in non-MML states while bisexual women in MML states had higher past-year use; both lesbian/gay and bisexual women in MML states had higher medical MU than those in non-MML states. The difference in odds of any past-year medical MU between bisexual women and heterosexual women and was lower in MML states than in non-MML states. Gay men had higher past-year use than heterosexual men, as did bisexual men, who also had higher medical MU. The only differences for sexual minority men by MML status were past-year MU and medical MU. These elevated rates of past year MU and MUD among sexual minorities is consistent with previous studies (Medley et al., 2016; Schuler et al., 2018). We further extended these findings to estimate daily/near-daily MU prevalence, which was seven times higher among bisexual women than heterosexual women and 2.3 times as high for bisexual men. The mechanisms through which living in a state with MMLs could increase recreational marijuana use include perceptions of increased access (Martins et al., 2016), and lower perceived risk of the impacts of MU (Mauro et al., 2019b, 2017; Pacek et al., 2015). Living in a state with MML could increase medical

marijuana use by receiving recommendations through providers.

Observed differences may be partially driven by social-structural factors impacting the daily lives of sexual minority individuals. The minority stress model outlines how experiences of sexuality-related discrimination and stigma (e.g., expectations of rejection, identity concealment, internalized homophobia, and related coping) may increase risks for poor mental health and substance use among sexual minorities (Meyer, 2013). For example, MU has been significantly associated with internalized homophobia among LGB adolescents (Goldbach et al., 2015). As LGB individuals are more likely than heterosexuals to experience depression, psychological distress and suicidal ideation (Cochran et al., 2003; Lewis, 2009) MU may be a coping mechanism to deal with stigma and related stress.

Consistent with findings for other substance use, our findings call for additional support and programs tailored for sexual minority women, particularly bisexuals (Medley et al., 2016; Schuler et al., 2018). Bisexual women in MML states were more likely to report past-year MU than those in non-MML states: there was an absolute prevalence difference of 10% in past-year MU between bisexual women in MML versus non-MML states (44.4% versus 34.1%), or a relative increase of 30%. In contrast, differences in past-year use among gay/lesbian women by state MML status were minimal (26.6% versus 25.4%).

In addition, the difference in odds of past-year medical MU between bisexual women and heterosexual women was lower in MML states than in non-MML states. Bisexual women in non-MML states had higher baseline levels of any medical MU compared to heterosexual women, and there was therefore less of a difference between use in MML and non-MML states; this suggests that the policy effects of MML are different for bisexual women compared to heterosexual women. While beyond the scope of this analysis, this may be a result of the high levels of stigma faced by bisexual women, which could result in self-medication with medical marijuana even in states without MMLs; if LGB adults are in part using marijuana to alleviate sexual minority stress, then use might remain higher than among heterosexuals regardless of the legal status of marijuana. In addition, there may also be some underlying physical or psychiatric co-morbidities resulting from bisexual women's increased stress that we are not capturing but that influence medical MU. This relationship may also stem from adults' perceptions of increased access to marijuana in MML states (Martins et al., 2016), or from the fact that bisexual women in non-MML states may have different patterns of other substance use.

Bisexual women may face unique stressors and experience increased levels of minority stress compared to other sexual minority individuals (Lea et al., 2014; Lehavot and Simoni, 2011) specifically due to chronic stress related to bisexual stigma and discrimination. Bisexual women may also face negative attitudes toward bisexuality, as well as victimization and micro-aggressions, and challenges around concealment and disclosure (Feinstein and Dyar, 2017). Bisexual individuals may also be doubly marginalized by both the heterosexual community and their sexual minority peers (Bostwick and Hequembourg, 2014; Feinstein and Dyar, 2017) which may limit community-driven support that could mitigate sexuality-related stigma. Facing homophobia and biphobia may lead to a range of coping strategies including substance use.

Our results also support existing literature by demonstrating that bisexual women have higher MUD compared to heterosexual women. This is part of a larger health burden, as bisexual women are twice as likely to have co-occurring mental health and substance use disorders, with one-quarter reporting an unmet treatment need (Lipsky et al., 2012). Concurrently, bisexual women are less likely to have health insurance compared to their heterosexual counterparts, which can impact service utilization and overall well-being (Dillely et al., 2010). In contrast, many gay and bisexual men are targeted by HIV-related programming—which often includes a substance use component—whereas sexual minority women are at lower risk for HIV and therefore often not included in such research. This may limit sexual minority women's

contact with service providers.

Gender differences in our findings indicate fewer differences by MML status among men: past-year MU and any past-year medical MU was higher for gay men in MML versus non-MML states. This suggests that MMLs may differentially influence MU outcomes depending on individuals' gender and substance use patterns, perhaps through pathways such as knowledge or perceived access (Mauro et al., 2019a,b). This finding may also be due to the sample size of gay men; some of the absolute differences in prevalence were not that different than for gay/lesbian women or bisexual women, but we may lack the power to capture them among men. While the NSDUH captured a nationally representative sample of U.S. adults, it did not over-sample sexual minorities, which may limit the precision of our inferences about the relationship between MML state status and marijuana use among gay/bisexual men.

4.1. Strengths and limitations

This study has numerous strengths, including being the first to assess the relationship between state MML status and MU outcomes among LGB individuals. Analyses used a nationally representative sample, which allowed for the generalization of findings to the US non-institutionalized population. We also pooled three years of data to increase our ability to detect differences by LGB and MML. We controlled for individual-level factors such as sociodemographic variables, and urbanicity, which can influence MU outcomes.

Limitations are noted. While the sample was quite robust (~120,000) the number of sexual minority individuals—particularly when broken down by sexual identity and gender—was still relatively small. This may have limited our ability to see trends among the smaller sexual identity subgroups, such as gay and lesbian adults. This is an exploratory study and we therefore did not adjust for multiple comparisons; future studies would need to confirm these findings. The NSDUH did not capture people who were homeless, institutionalized, or in correctional facilities, and such individuals may have different MU patterns. The NSDUH used self-report to assess MU, which could have led to under-reporting among all populations, even when using ACASI. Due to the repeated cross-sectional data design, we are unable to infer causality associated with MML enactment. While we had information on whether individuals resided in an MML state, we did not know the specific state of residence, so we were unable to control for other structural and state-level factors. In addition, we could not control for whether a state had legalized recreational marijuana, which could impact overall marijuana use. The NSDUH does not ask the sexual orientation question of individuals 12–17 so we only have data on adults.

Future research should explore these findings using individual-level data that are linked to state-level identifiers so that the model can control for state-specific factors (e.g., homophobia) and other state-level policies that might influence this relationship. (Philbin et al., 2019) Including state-level variables identifiers would also allow us to explore potential pathways that might explain why the relationship between MML and MU outcomes differs by gender and sexuality (e.g., perceived availability and knowledge). Future work could also elucidate whether other definitions of sexual identity (e.g., attraction and/or behavior) are related to MU outcomes. Next steps should also include exploring this relationship with recreational marijuana laws and MU outcomes among LGB individuals to see if the same patterns emerge. Work should examine whether LGB individuals' use of other substances may vary by residence in an MML state, and whether these findings vary by gender and age. Finally, work should explore whether MMLs may increase marijuana use for other sub-groups, not just LGB adults.

4.2. Conclusions

Social policy debates around substance use, and policies that may impact such use, are prominent in national- and state-level discourse.

(Philbin et al., 2019) This study represents an important contribution to the literature on the structural determinants of substance use for LGB individuals, demonstrating that gay/lesbian women and bisexual women living in states with MMLs have higher levels of MU than those in non-MML states; it also showed that the odds of past-year medical MU comparing bisexual to heterosexual women was different in MML states than in non-MML states. As MML and recreational marijuana laws continue to change at the state level, it is increasingly important to understand the relationship between these laws and MU outcomes for LGB individuals. This research demonstrates the need to allocate resources that target sexual minority women, particularly bisexual women. This work also suggests the need to design future surveys in ways that better capture how individuals identify and to whom they are attracted, in addition to capturing behavior. Doing so will allow us to do a better job of addressing specific, unmet needs, particularly for smaller populations (e.g., those identifying as 'don't know/refuse to answer'). This research can also help identify how state-level marijuana policies may differentially impact specific sub-populations, ultimately promoting the development of more health-promoting policies for all.

Contributors

MP and PM conceived of the study idea, EG conducted the primary analysis and drafted parts of the manuscript, MP led the drafting of the manuscript with support from PM. SSM oversaw the project and supported manuscript writing and development. All authors have seen and approved the final manuscript and contributed significantly to the work.

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Declaration of Competing Interest

No conflict declared

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