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Greater risk for frequent marijuana use and problems among young adult marijuana users with a medical marijuana card

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ABSTRACT

Background: This study compared young adults with and without a medical marijuana (MM) recommendation from a provider ("MM card") on their developmental trajectories of frequent marijuana use and marijuana-related problems in young adulthood.

Methods: The analytic sample consists of young adult past month marijuana users ($N = 671$) who were part of a larger, diverse, and predominantly California cohort. Analyses are based on data from seven surveys completed from ages 13–19.

Results: At age 19, 28% of participants reported having an MM card to legally purchase marijuana from an MM dispensary. A multiple group latent growth model indicated that young adults who had an MM card showed steeper increases in frequent marijuana use (i.e., 20–30 days of use in the past month) from ages 13–19 compared to young adults who did not have an MM card. Logistic regression models that matched MM cardholders and non-MM cardholders on individual sociodemographic characteristics found that MM cardholders were more likely to report marijuana negative consequences, selling marijuana/hashish, and driving under the influence of marijuana in the past year. In addition, MM cardholders were more likely to have tried cutting down or quitting in the past 3-months.

Conclusions: Among young adult marijuana users, those with an MM card had a higher risk profile for marijuana use and related problems compared to those without an MM card. Given expanding state legalization of MM, this issue warrants further attention.

1. Introduction

As of 2018, more than half the states in the U.S. have legalized the use of marijuana for medical purposes. Whether passage of medical marijuana (MM) laws has caused an increase in marijuana use among young people has been challenging to discern (D'Amico et al., 2017; Pacula et al., 2013; Pacula and Smart, 2017). Nonetheless, it is clear that both marijuana use and cannabis use disorder (CUD) have increased among young adults since the early 2000s (Caulkins et al., 2015; Grucza et al., 2016; Hasin et al., 2015; Schulenberg et al., 2017). Recent national data indicate that more than half (54%) of U.S. youth have initiated marijuana use by age 21 (Chen et al., 2017), and among past 30-day marijuana users, about one in five young adults (21–22%) meets diagnostic criteria for CUD (Richter et al., 2016). Further, a study of 1573 youth aged 12 to 18 attending a primary care appointment in either California or Pennsylvania found prevalence rates of marijuana use that approached those of alcohol use (past year use: 37% vs. 42%, respectively; past year heavy use: 19% vs. 22%, respectively) (D'Amico et al., 2016a). However, this same study found that CUD was three times more prevalent than alcohol use disorder (14% and 4%, respectively). CUD has been on the rise nationally among 18 to 29-year-olds, as indicated by the National Epidemiologic Survey on Alcohol and Related Conditions from 2001/2002 to 2012/2013 (Hasin et al., 2015). Additionally, public support of MM has risen dramatically (Geiger, 2016), and young peoples' perceptions of the drug's harms have dropped (Berg et al., 2015; Lipari and Jean-Francois, 2016; Miech et al., 2016).

Obtaining an MM recommendation from a provider ("MM card") allows the holder to legally purchase marijuana from an MM dispensary, and (in some states) cultivate marijuana for personal medical use. Little is known about youth who have an MM card in terms of their use of marijuana, as well as whether they may be at higher risk of

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experiencing negative consequences from their use and marijuana-related problem behaviors, such as selling the drug or driving under the influence of it. One study compared marijuana use for young people with and without an MM card, using cross-sectional data from Monitoring the Future (Boyd et al., 2015). Among 1577 12th graders who reported any marijuana use in the past year, very few (3.0%) used marijuana obtained from their own MM card (Boyd et al., 2015). This low rate is not surprising given that parental/guardian consent is required for minors under age 18 to obtain an MM card, and results are based on a national sample, which included youth from states where MM was not legal. Although adolescents with and without an MM card did not differ in terms of lighter marijuana use (i.e., 10 or more occasions in the past year), adolescents who used marijuana medically were three times more likely to report using marijuana on 40 or more occasions in the past year and four times more likely to report daily marijuana use for at least one month in the past year compared to those who obtained marijuana from a source that was not a legal or medical source.

One possible interpretation of the Boyd et al. (2015) findings is that having an MM card increases the risk of frequent marijuana use (and, possibly, related problems) during the transition to young adulthood. However, such a conclusion is premature based on existing data. Two fundamental questions regarding MM card ownership among young people have yet to be examined. First, do young adults with an MM card show a pattern of frequent use dating back to adolescence compared to young adults using marijuana without an MM card? If so, it raises the possibility that obtaining an MM card may be more a reflection of frequent use than a predictor of frequent use in this age group. Second, among young adults who use marijuana, is MM card possession associated with frequent use (and related problems, such as selling marijuana and driving under the influence of marijuana) after accounting for confounding factors? Potential confounding factors may include commonly reported reasons for seeking an MM card such as physical symptoms (e.g., pain, headaches, sleep problems), anxiety, and depression (Nunberg et al., 2011), or underlying characteristics such as an inclination towards delinquent behavior. Confounding factors may also include demographic characteristics, such as gender and race/ethnicity, which are associated with both marijuana use (Wu et al., 2016) and MM card status (Boyd et al., 2015). As such, it is critical to not only account for confounders but also ensure that, when comparing marijuana use (and related problems) by MM card status, groups have been balanced on important confounders. To this end, propensity score methods can be useful for producing a less biased estimate of the association of marijuana use (and related problems) with MM card status.

The present study addresses these key issues, significantly extending Boyd et al. (2015) in four important respects. First, it focuses on a slightly older age group of young adult marijuana users (mean age 19) who, because they are no longer minors, are able to obtain an MM card on their own (without parental or guardian consent). Second, it builds on their cross-sectional finding that 12th graders who used medically reported more frequent use than those who obtained marijuana from a non-legal/non-medical source by employing seven waves of data (spanning ages 13–19) to examine developmental trajectories of frequent marijuana use for young adults with and without an MM card. Third, it examines not only how MM card status is associated with frequent marijuana use in young adulthood, but also with negative consequences, selling marijuana/hashish, and driving under the influence of marijuana. Fourth, it uses propensity score weighting to produce a less biased estimate of the association between MM card status and these marijuana-related outcomes in young adulthood. In addition, a key strength of this study is the ability to compare young adults who use marijuana with and without an MM card among a racially/ethnically diverse cohort of young adults primarily located in California. California was the first state in the U.S. to legalize MM with the passage of Proposition 215 in 1996, providing a longer time period with which to examine MM card ownership effects on use.

2. Material and methods

2.1. Participants and procedures

Participants were from two cohorts of students in sixth and seventh grade in 2008, who were initially recruited from 16 middle schools from three districts in the southern California area as part of an alcohol and drug use prevention program, CHOICE (D'Amico et al., 2012). All students in the two cohorts who were followed to wave 9 were given a consent form to participate; 6509 students in the two cohorts consented and completed the first survey (age 11–12). Participants completed eight additional waves through 2017 (average age 19), as described elsewhere (D'Amico et al., 2016b, 2018). Briefly, participants completed wave 1 (fall 2008) to wave 5 (spring 2011) during physical education classes. Follow-up rates ranged from 74% to 90%, excluding new youth who could have come in at a subsequent wave. Participants transitioned from middle schools to more than 200 high schools following wave 5 and were subsequently re-contacted and re-consented to complete annual Web-based surveys. At wave 6 (spring 2013 to spring 2014), 61% of the sample participated in the follow-up survey. At wave 7 (1 year later), we retained 80% of the sample, at wave 8 (1 year later; when most students had completed high school), we retained 91% of the sample, and at wave 9 we retained 89% of the sample. If a participant did not complete a wave of data collection, they were still eligible to complete all subsequent waves. Analyses primarily use data from wave 9, which occurred between May 2016 and April 2017, although trajectory models incorporate data on frequent marijuana use from waves 3–9 (note that frequent use was not reported by any respondent prior to wave 3). Of the 2431 participants who completed wave 9, we excluded 1737 who did not report marijuana use within the past 30-days and an additional 23 missing information on whether they had an MM card. This resulted in a final analytic sample of 671 individuals. The study has a Certificate of Confidentiality; all procedures were approved by the institution's review board.

2.2. Demographic covariates

Participants reported age, gender, sexual orientation, and race/ethnicity. Mother's education level was considered a proxy for family socioeconomic status (Korupp et al., 2002). They also reported on their current school enrollment and employment status.

2.3. Mental health, physical health, and delinquency covariates at wave 9

The Patient Health Questionnaire (PHQ-8; Kroenke et al., 2009) assesses how often in the past two weeks respondents experienced eight symptoms of depression, such as "feeling, down, depressed or hopeless" (0 = *not at all* to 3 = *nearly every day*; $\alpha = 0.91$). The Generalized Anxiety Disorder scale (GAD-7; Spitzer et al., 2006) includes seven items of general anxiety experienced in the past two weeks, such as "feeling nervous, anxious, or on edge" (0 = *not at all* to 3 = *nearly every day*; $\alpha = 0.94$). General physical health was assessed with a single item asking: "In general, would you say your health is…", with response options ranging from 1 = *excellent* to 5 = *poor*, such that higher scores indicate poorer health. Four physical ailments/symptoms were assessed by asking participants how bothered they had been in the previous 4-weeks by: stomach pain, headaches, feeling tired or having low energy, and trouble sleeping (Kroenke et al., 2002). Items were rated on a 3-point scale (1 = *not at all bothered*, 1 = *bothered a little*, 3 = *bothered a lot*). Finally, delinquency was assessed with three items asking how often they had been involved in fights, stolen from a store, and damaged something on purpose that did not belong to them in the past year (1 = *not at all* to 6 = *20 or more times*). We derived a variable to indicate the number of different types of delinquent behavior (0–3) they had engaged in during the past year.

2.4. Marijuana use and MM card status

At waves 3–9, participants reported on number of days they used marijuana in the past month (0 = *0 days* to 6 = *20–30 days*). From this information, we derived a dichotomous measure of frequent use, defined as daily or near-daily use (i.e., used 20–30 days in the past month vs. less often). At wave 9, participants who reported lifetime use of marijuana were asked whether they currently had an MM card (yes/no).

2.5. Marijuana-related outcomes

At wave 9, participants indicated the number of times in the past 3-months that they tried to cut down or stop their marijuana use (0 = *never* to 5 = *over 10 times*; D'Amico et al., 2001). They also completed a 9-item measure of negative consequences due to their marijuana use in the past year, rating each from 0 = *never* to 6 = *20 or more times*. Items were drawn from the RAND Adolescent/Young Adult Panel Study (Bogart et al., 2005; Ellickson et al., 2005) and the Marijuana Consequences Questionnaire (Simons et al., 2012) (sample items: missed school, work, or other obligations; got into trouble; did something you later felt sorry for). Separate items for marijuana-related problem behaviors asked how often in the past year they had sold marijuana/hashish and had driven a car, motorcycle or other vehicle after using marijuana (0 = *not at all* to 5 = *20 or more times*). We derived dichotomous indicators of any attempt to cut down or stop their marijuana use in the past 3-months, as well as any negative consequences from marijuana, marijuana/hashish selling, and driving after using marijuana (separate items) in the past year. The decision to dichotomize these variables was informed by both skewed distributions and ease of interpretation (i.e., whether outcome was present or not).

2.6. Statistical analysis

To determine whether there were differences in frequent marijuana use at wave 9 between MM and non-MM cardholders, we estimated an adjusted logistic regression controlling for covariates. As a preliminary and descriptive step, we were interested in exploring whether differences in frequent use between groups at wave 9 could be traced back to early adolescence. To this end, we estimated a multiple group latent growth model (LGM) to compare differences in frequent use trajectories from wave 3 (mean age = 13) to wave 9 (mean age = 19) between youth with and without an MM card at wave 9. Waves 1 and 2 were not included as there was no youth reporting frequent marijuana use in either group (i.e., no variability). LGMs were estimated in Mplus 8.1 (Muthén and Muthén, 2018) using maximum likelihood estimation with robust standard errors. Comparison of growth parameters (i.e., slopes) was evaluated via model constraints and inspection of the Wald test of parameter constraints.

We estimated a series of logistic regressions to compare MM and non-MM cardholders on marijuana-related negative consequences and problem behaviors at wave 9. First, we estimated a series of traditional adjusted logistic regressions controlling for covariates and CHOICE intervention condition. A second set of logistic regressions were estimated, wherein we equated MM card and non-MM cardholders on "influential" covariates. To adjust for differences between MM and non-MM cardholders, we used propensity weighting procedures using Generalized Boosted Models (*gbm*) (Olmos and Govindasamy, 2015). Compared to typical logistic regression techniques, the *gbm* method is a better method for reducing bias (Harder et al., 2010) and, through iterative procedures, identifies the best balance between groups (McCaffrey et al., 2013). We conducted a balance analysis to assess the extent of bias between MM and non-MM cardholders on influential covariates. After weight estimation using propensity scores, we performed a second balance analysis to evaluate the success of bias reduction using the propensity scores as weights in weighted regression. Using propensity scores as weights removed all imbalance, such that were no statistically significant effects for MM card status on any previously identified covariates. Final models controlled for all covariates, including those used in propensity weighting procedures, and CHOICE intervention condition. All analyses were conducted in R (R Core Team, 2014) using the *psych* (Revelle, 2018), *lavaan* (Rosseel, 2012), and, for propensity score procedures, *gbm* (Ridgeway, 2015) packages. Only results from propensity scores weighted logistic regressions are presented.

3. Results

Of the 671 past month marijuana users, 188 (28%) reported having an MM card. As shown in Table 1, those who reported having an MM card were significantly more likely to be male, self-identify as a sexual minority, and not be currently enrolled in school compared to those who reported not having an MM card. In addition, frequent marijuana use was significantly more likely to be reported by those with an MM card (53.2%) compared to those without an MM card (15.7%).

3.1. Latent growth model

Results from the multiple group LGM (Fig. 1) found a significant increase in frequent marijuana use between waves 3–9 for both the group that had an MM card ($p < .05$) and the group that did not have an MM card ($p < .05$) at wave 9. However, when slope growth factors were constrained to be equal, the Wald test indicated that the average increase in the proportion of frequent users among MM cardholders was significantly greater than among non-MM cardholders, $\chi^2(1) = 60.664$, $p < .05$.

3.2. Propensity scores weighted logistic regressions

We conducted a balance analysis to assess the extent of bias between MM and non-MM cardholders on covariates. After examination, significant discrepancies between groups were identified for gender, sexual orientation, student status, near-daily use, PHQ-8, and delinquency, suggesting a need to adjust/correct for this imbalance. After weight estimation using propensity scores, we performed a second balance analysis to evaluate the success of bias reduction using propensity scores as weights in weighted regression. Using propensity scores as weights removed all imbalance, such that were no statistically significant effects for MM card status on any of the previously identified covariates.

As shown in Table 2, after adjusting for differences between MM and non-MM cardholders, those with an MM card had 12% higher odds of trying to cut down or quit in the past 3-months compared to those without an MM card (*AOR* = 1.12, 95% *CI* = 1.01, 1.25, $p = .039$). MM cardholders had 12% higher odds of experiencing marijuana negative consequences (*AOR* = 1.12, 95% *CI* = 1.01, 1.23, $p = .025$) and 20% higher odds of selling marijuana or hashish (*AOR* = 1.20, 95% *CI* = 1.10, 1.31, $p < .001$) in the past year. Finally, MM cardholders were marginally more likely than those without an MM card to have driven a vehicle after using marijuana in the past year (*AOR* = 1.11, 95% *CI* = 1.00, 1.23, $p = .052$). Significant group x frequent use interactions were found for selling marijuana/hashish ($p = .013$) and marijuana negative consequences ($p = .034$), which indicated that youth who did not use frequently and did not have an MM card were less likely to sell marijuana or hashish or experience marijuana negative consequences in the past year compared to the other three groups.

4. Discussion

In our diverse sample of young adults who used marijuana in the past 30 days, nearly 30% reported having their own MM card. This rate is considerably higher than that of the Monitoring the Future sample of

Table 1
Sample Characteristics of Past 30-day Marijuana Users by Medical Marijuana (MM) Card Status (Ns and Weighted Percentages are Reported, Unless Otherwise Noted).

	No MM Card (n = 483)	MM Card (n = 188)	t-test or χ^2 p-value
Age	19.37 (SD = 0.72)	19.40 (SD = 0.77)	0.617
Gender			< .001
Male	208 (43.06%)	118 (62.77%)	
Female	275 (56.94%)	70 (37.23%)	
Sexual orientation			0.003
Straight/heterosexual	414 (86.07%)	142 (76.34%)	
LGBQA	67 (13.93%)	44 (23.66%)	
Race/ethnicity			0.157
Non-Hispanic white (reference)	134 (27.74%)	49 (26.06%)	
African American	12 (2.48%)	8 (4.26%)	
Hispanic	200 (41.41%)	84 (44.68%)	
Asian	88 (18.22%)	22 (11.70%)	
Other	49 (10.14%)	25 (13.30%)	
Mother's education level			0.644
Less than high school	65 (13.74%)	21 (11.35%)	
High school graduate (reference)	66 (13.95%)	24 (12.97%)	
More than high school	342 (72.30%)	140 (75.68%)	
College student status			< .001
Enrolled part- or full-time	411 (85.09%)	127 (67.55%)	
Not enrolled	72 (14.91%)	61 (32.45%)	
Employment status			0.728
Employed part- or full-time	333 (68.94%)	127 (67.55%)	
Not employed	150 (31.06%)	61 (32.45%)	
Days of marijuana use, past 30 days			< .001
Used 20–30 days	76 (15.73%)	100 (53.19%)	
Used less than 20 days	407 (84.27%)	88 (46.81%)	
PHQ-8 (range: 0-24)	5.10 (SD = 4.93)	5.97 (SD = 5.77)	.068
GAD-7 (range: 0-21)	4.58 (SD = 5.10)	5.06 (SD = 5.58)	.302
Physical health (range: 1-5)	2.39 (SD = 0.94)	2.54 (SD = 0.96)	.067
Stomach pain (range: 1-3)	1.34 (SD = 0.56)	1.37 (SD = 0.61)	.595
Headaches (range: 1-3)	1.52 (SD = 0.63)	1.48 (SD = 0.62)	.391
Feeling tired/low energy (range: 1-3)	1.84 (SD = 0.69)	1.76 (SD = 0.70)	.221
Trouble sleeping (range: 1-3)	1.62 (SD = 0.71)	1.66 (SD = 0.74)	.541
Delinquency (possible range: 0-3)	0.37 (SD = 0.69)	0.54 (SD = 0.88)	.033

Note. LGBQA = lesbian, gay, bisexual, questioning, or asexual. Listed ranges reflect possible range of scores.

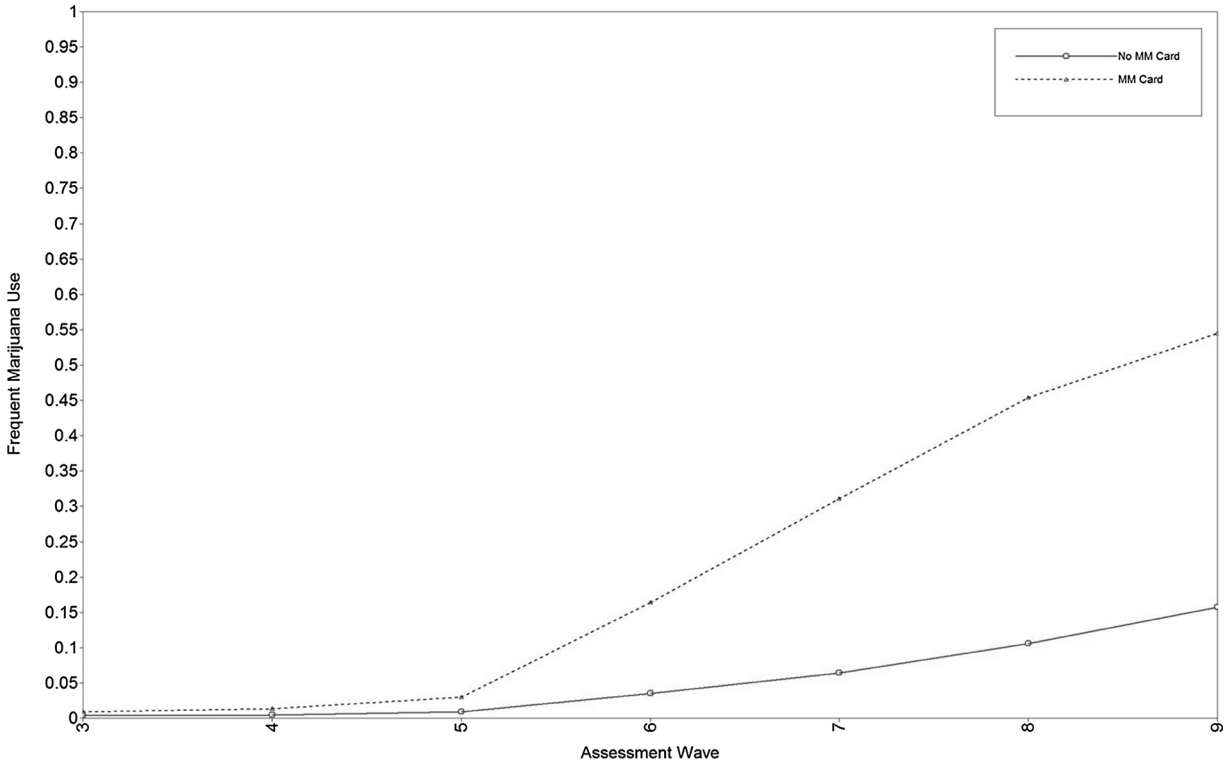

Fig. 1. Comparison of Young Adult (Wave 9) Past Month Marijuana Users With and Without an MM Card on Proportion Who Engaged in Past Month Frequent Marijuana Use From Wave 3 (Mean Age 13) to Wave 9 (Mean Age 19).

Table 2
Propensity Scores Weighted Logistic Regression Comparing Past 30-day Marijuana *Users With and Without an Medical Marijuana Card on Marijuana Quit Attempts, Negative Consequences, and Problem Behaviors.*

	Tried to cut down/quit marijuana, past 3 months (n = 664) % AOR (95% CI)	Consequences from marijuana, past year (n = 663) % AOR (95% CI)	Sold marijuana or hashish, past year (n = 664) % AOR (95% CI)	Drove after using marijuana, past year (n = 664) % AOR (95% CI)
Non-MM card	30.6 1.00	63.8 1.00	11.6 1.00	39.3 1.00
MM card	42.6 1.12 (1.01, 1.25) *	73.3 1.12 (1.01, 1.23) *	30.0 1.20 (1.10, 1.31) ‡	52.9 1.11 (1.00, 1.23) #

Note. MM = medical marijuana. Propensity weighted analyses adjust for all covariates and CHOICE intervention group, as well as equate the Non-MM and MM card groups on gender, sexual orientation, student status, frequent use, PHQ-8, and delinquency. Sample sizes vary due to missing data on the dependent variable of interest. AOR = adjusted odds ratio; CI = confidence interval.

* $p < .05$.

‡ $p < .001$.

12th graders (Boyd et al., 2015) where only 3% of adolescents who reported past year marijuana use also reported using marijuana obtained from their own MM card. The much higher rate of MM cardholders in the present study is likely due to a combination of factors, including an older sample (who did not need parental/guardian consent to obtain an MM card), examination of past month marijuana users rather than past year users, and a focus on California (which legalized the use of marijuana for medical purposes over 20 years ago), as well as the more contemporaneous data collection. Our results suggest that MM cardholders may represent a sizable segment of the population of young adults using marijuana – one that has been understudied and deserves greater attention in research on substance use and its consequences.

We found that MM cardholders were more likely to use marijuana daily or near-daily compared to non-MM cardholders (53% vs. 16%, respectively). Although MM cardholders may engage in more frequent and heavier use due to medical reasons (e.g., to alleviate symptoms of chronic pain, anxiety, or depression), we found that differences in rates of frequent use between MM card and non-MM cardholders remained after controlling for their self-reported physical and mental health status (as well as a number of other factors). Further, extending previous cross-sectional research (Boyd et al., 2015), our results indicate that young adults with an MM card were more likely to also use marijuana frequently during middle school and high school, with a pronounced divergence in trajectories of frequent use occurring at the transition to high school. By young adulthood, MM cardholders were also more likely to report experiencing marijuana negative consequences (especially compared to low frequent users who did not have a card) and trying to cut down or quit their use than those without an MM card. Although we cannot draw causal conclusions, findings raise the possibility that youth with a propensity towards frequent marijuana use are more likely to seek out and obtain an MM card for non-medical reasons soon after they are legally able to do so, and that their continued frequent use during young adulthood increases the likelihood of experiencing negative consequences and a recognition that they need to cut back or quit. Additional longitudinal research is needed to more fully examine this and other possible interpretations, such as whether these youth began legitimately using the drug for medical reasons and obtained an MM card to continue doing so. Legitimate medical use could explain their more frequent use and driving after using marijuana. It should be noted that we did not collect information on whether participants were using marijuana that contained tetrahydrocannabinol (THC) with intoxicating effects or other cannabinoids such as cannabidiol that offer no intoxicating effects.

Findings also indicated a significant difference between those who used marijuana with and without an MM card on drug selling, with 30% of young adults with an MM card reporting that they sold marijuana/hashish in the past year (compared to 12% of those without an MM card). Among young adults with an MM card, those who used marijuana frequently and non-frequently were equally likely to engage in drug selling. This is in contrast to non-MM cardholders, where drug selling was largely limited to those who reported frequent use. We do not have data on whether those with an MM card were selling marijuana that they cultivated at home or purchased from an MM dispensary through having an MM card. This is an important issue worthy of further examination. The use of diverted MM is problematic in its own right, as it has been associated with heavier substance use among young people (Boyd et al., 2015), and poses obvious legal risks for those who sell it and purchase it, especially if they are under 21.

There has also been considerable attention focused on whether driving under the influence of marijuana increases the risk of car accidents. Evidence to date is mixed, and thus more research is needed before drawing definitive conclusions (Asbridge et al., 2012; Compton and Berning, 2015; Elvik, 2013; Li et al., 2012). Nonetheless, a recent nationally representative survey indicated that drivers who use marijuana, particularly those who have driven within an hour of using marijuana, are less likely than other drivers to believe that driving under the influence of marijuana increases the risk of car crashes (Arnold and Tefft, 2016). Consistent with these data, we found high rates of driving under the influence of marijuana in our sample, with a trend association indicating that this was particularly the case for those who had an MM card. As further research investigates the link between driving under the influence of marijuana and car crashes, it will be important to keep in mind that young adults with an MM card may be particularly inclined to engage in this behavior.

Several study limitations should be noted. First, results may not generalize to individuals in other age groups or different regions of the country. Nevertheless, the extent to which California's long history of MM legalization serves as a harbinger for states with newer laws, the implications of our findings that MM cardholders had a higher risk of frequent marijuana use and related problems can inform implementation of interventions to mitigate risks within states with more recent MM legalization. Second, we cannot definitively conclude whether obtaining an MM card contributes to increased use and related problems over time, although our longitudinal analyses highlight that these young adult MM cardholders already had a history of heavier use dating back to adolescence compared to non-MM cardholders. Finally, we do not know whether those without their own MM card obtained marijuana from someone else's card (e.g., diverted MM use), which the Boyd et al. (2015) study of 12th graders found was associated with heavier use compared to obtaining it from a source that was not a legal or medical source.

In sum, young adult marijuana users who had an MM card were more likely to report frequent use and problems from marijuana, including selling marijuana and driving after using marijuana, compared to those without an MM card. There are a number of potentially fruitful directions for future research on this understudied population of MM cardholders. For example, a better understanding is needed of how patterns of marijuana use among young MM cardholders may be related to the age at which they first obtain their MM card and for what medical condition(s). Longitudinal analyses are also needed to

determine the extent to which obtaining an MM card is associated with escalations in other substance use and related problems over time. Given the large number of states that have already legalized MM, and its likely continued expansion in the U.S., results from this study emphasize that a greater focus on young MM cardholders is warranted.

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Contributors

Joan Tucker and Anthony Rodriguez co-led the design of the study and wrote the first draft of the manuscript. Anthony Rodriguez and Rachana Seelam conducted the analyses. Eric Pedersen, Regina Shih, and Elizabeth D'Amico contributed to the design of the study. All authors contributed to and have approved the final manuscript.

Conflict of interest

No conflict declared.

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