

## Research Article

# Medical Marijuana Laws and Maternal Marijuana Use

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Received: October 15, 2018; Accepted: October 23, 2018; Published: October 23, 2018;

## Abstract

**Objective:** Marijuana is the most common illicit drug of abuse in the US among the general population as well as among pregnant women. Numerous states have passed various forms of marijuana laws while societal norms and current trends regarding marijuana use are becoming more relaxed. Evaluation of the potential association between living in a medical marijuana state and maternal marijuana use was lacking in the literature.

**Methods:** This was a secondary analysis of the 2014 National Survey on Drug Use and Health (NSDUH).

**Results:** The study revealed an increase of past month and past year use in medical marijuana states, but the observed increase was not significant. However, an increase of heavy users was observed in medical marijuana states (54% versus 37%).

**Conclusion:** This study will provide policy makers responsible for marijuana policy with useful evidence concerning the unintended consequence of increased maternal marijuana use in areas where medical marijuana is allowed.

## Medical Marijuana Laws and Maternal Marijuana Use

Marijuana is the most common illicit drug of abuse in the United States among the general population as well as among pregnant women [1]. Nearly 4% of pregnant women between 2007 and 2012 used marijuana in the past 30 days according to the National Survey on Drug Use and Health [2]. Studies of prenatal marijuana exposure and neonatal outcomes including low birth weight, head circumference, birth length have not demonstrated consistent negative effects [3–5]. However, long term neurobehavioral studies of prenatal marijuana exposure have revealed a variety of negative consequences of prenatal marijuana exposure presenting in childhood and adolescence such as altered neural functioning, behavioral deficits, emotional deficits, low academic achievement, and increased risk of adolescent substance use initiation [6].

There exists a current trend in the United States of the adoption of various permutations of legislation permitting the use of medical and recreational marijuana [7]. California was the first state to pass a medical marijuana law in 1996 and 10 other states followed their lead over the next 10 years [8]. In 2014, Colorado implemented the most relaxed statewide marijuana policy to date allowing full commercialization and recreational use of marijuana [9]. Over the following 3 years, almost every state in the United States had introduced some version of marijuana law relaxation for consideration [10]. Specifically, during the 2014 NSDUH survey year, 19 states plus the District of Columbia had introduced medical marijuana laws, with three additional states approving medical marijuana during the 2014 survey year.

The potential association between residing in a state with a medical marijuana law and maternal marijuana use has not been reported in the literature to the best of my knowledge. The purpose of this study was twofold. First, using the responses from the 2014 NSDUH, the prevalence of past-month and past-year maternal marijuana use in states that have and do not have medical marijuana laws was conducted controlling for age, household income, race/ethnicity, educational level, and marital status. Second, the association of the level of past-year maternal marijuana use (light use compared to heavy use) in states that allow and do not allow medical marijuana was evaluated.

## Methods

### Study population

The 2014 NSDUH public access data was used for this study. The NSDUH, a nationwide survey of drug use patterns, is carried out periodically by the Substance Abuse and Mental Health Services Administration (SAMHSA) selecting people ages 12 years and older residing in civilian, non-institutional, settings [11]. The NSDUH utilized a complex multidimensional stratification strategy to ensure adequate representation of the national population [11]. The NSDUH provides de-identified data free to the public through internet download for secondary analysis without requiring further IRB approval. This study was limited to those who completed the 2014 NSDUH and were pregnant at the time of their interview. The participants self-reported their pregnancy status with their response to the question, “Are you currently pregnant?” Respondents were included in this study if they provided a response of “Yes.”

## Data analysis

Maternal marijuana use was measured using the response to the question, “How long has it been since you last used marijuana or hashish?” for those that had answered yes to ever using marijuana or hashish. The responses recorded from the original question were recoded to past month use and past year use. Frequency of use was measured with the response to the question, “During the past year, on how many days did you use marijuana or hashish?” This variable was recoded into light use (less than 100 days) and heavy use (100 or more days). The presence of a medical marijuana law of the respondent’s state of primary residence was recorded at the time of the interview. The variable was recorded as either, “In state where marijuana is approved for medical use before interview” or “Not in state where marijuana is approved for medical use by interview date.”

The respondent’s self-reported age was recorded and categorized as 15–17 years old, 18–25 years old, 26–44 years old, and otherwise. Due to the low number of 15–17 years old and otherwise respondents, maternal age was recoded to 14–25 years old and 26–44 years old. The race/ethnicity of the participant was recorded as non-Hispanic White, non-Hispanic Black/African American, non-Hispanic American/Alaskan Native, non-Hispanic Native Hawaiian/Other Pacific Islander, non-Hispanic Asian, non-Hispanic more than one race, and Hispanic. Race/ethnicity was further aggregated to non-Hispanic White, non-Hispanic other, and Hispanic. The education level of the participant was recorded as less than high school, High school graduate, some college, and college graduate. The income of the household that the participant resides in was recorded as less than \$20,000, \$20,000 - 49,999, \$50,000 - 74,999, and \$75,000 or more. The marital status of the respondent was recorded as married, widowed, divorced or separated, and never been married. Due to the low number of widowed and divorced or separated respondents, the marital status category was aggregated to married and unmarried.

Differences in the proportion of pregnant women that self-reported past month or past year marijuana use living in states with medical marijuana laws compared to those residing in states that do not allow medical marijuana was assessed using  $\chi^2$  analysis. Multiple logistic regressions were used to examine relationships between the proportion of pregnant women that self-reported past month or past year marijuana use living in states with and without medical marijuana laws while controlling for age, household income, educational level, race/ethnicity, and marital status. Frequency of use was categorized into light use (< 100 days use in the past year) and heavy use ( $\geq$  100 days use in the past year). Chi-square analysis was used to evaluate differences in the proportion of pregnant women’s self-reported frequency of use in states that allow medical marijuana compared to states that do not allow medical marijuana.

## Results

The 2014 NSDUH surveyed 758 women who indicated that they were pregnant at the time of interview. Among these pregnant women, 306 (40.4%) women lived in states that allowed medical marijuana while 452 (59.6%) did not. The analysis revealed 48 (6.3%) pregnant women that self-reported marijuana use within the past 30

days and 122 (16.1%) pregnant women that self-reported marijuana use during the past year. Selected demographic characteristics of the 758 pregnant women are listed in (Table 1) and overall drug use frequencies percentages are listed in (Table 2).

**Table 1.** Core Demographic Frequencies and Percentages of Pregnant Women Respondents of the 2014 NSDUH (N = 758).

	n	%
<b>Age Group</b>		
15–17	20	2.6
18–25	390	51.5
26–44	345	45.5
Otherwise	3	0.4
<b>Family Income</b>		
Less than \$20,000	210	27.7
\$20,000-\$49,999	244	32.2
\$50,000 - \$74,999	124	16.4
\$75,000 or more	180	23.7
<b>Education Level</b>		
Did not finish high school	117	15.4
High School Graduate	215	28.4
Some College	190	25.1
College Graduate	213	28.1
<b>Race Ethnicity</b>		
Non-Hispanic White	414	54.6
Non-Hispanic Black	108	14.2
Non-Hispanic Native Am/AK	20	2.6
Non-Hispanic HI/Other Pac Island	10	1.3
Non-Hispanic Asian	34	4.5
Multiracial	25	3.3
Hispanic	147	19.4
<b>Marital Status</b>		
Married	391	51.6
Divorced/Separated	43	5.7
Never Married	321	42.3
<b>State Marijuana Law Status</b>		
Medical Marijuana Allowed	306	40.4
Medical Marijuana Not Allowed	452	59.6

There were 26 (5.8%) pregnant women living in states that did not have a medical marijuana law that self-reported marijuana use in the month prior to the interview (Table 3). States where medical marijuana was allowed had 22 (7.2%) pregnant women self-reporting past-month marijuana use ( $\chi^2 = 0.636, p = 0.425$ ). With regard to past year marijuana use, 68 (15%) pregnant women living in states without a medical marijuana law self-reported use and 54 (17.6%) pregnant

women living in states that allowed medical marijuana self-reported use ( $\chi^2 = 0.915, p = 0.339$ ).

**Table 2.** Frequencies and Percentages of Marijuana Use for Pregnant Women Respondents of the 2014 NSDUH (N = 758).

	n	%
<b>Used Marijuana</b>		
Past Month	48	6.3
Past Year	122	16.1
<b>Number of Days Used Past Year</b>		
Did Not Use	636	83.9
1–11 Days	30	4.0
12–49 Days	22	2.9
50–99 Days	16	2.1
100–299	41	5.4
300–365	13	1.7

**Table 3.** Prevalence of Past Month and Past Year Marijuana Use for Pregnant Women Respondents of the 2014 NSDUH (N = 758) in States that Allow Medical Marijuana and States that do not Allow Medical Marijuana.

	Medical Marijuana		p value	$\Phi$
	Allowed (%)	Not Allowed (%)		
Past Month Use	7.2	5.8	0.425	-0.029
Past Year Use	17.6	15.0	0.339	-0.035

Logistic regression was used to evaluate the potential influence of the presence of a medical marijuana law on past-month and past-year self-reported use while controlling for age, household income, race/ethnicity, education, and marital status. The model summary suggested that this evaluation was significant ( $\chi^2(11) = 59.556; p < 0.001$ ). The odds ratios, P-values, and 95% confidence intervals are listed in (Tables 4 (past month) and 5 (past year)). Interaction between terms was investigated but none were observed.

**Table 4.** Past Month use Reported by Pregnant Respondents of the 2014 NSDUH (N = 758).

	$\beta$	SE	Odds Ratio	p	Confidence Intervals
<b>Medical Marijuana</b>					
Not Allowed	ref	ref	ref	ref	ref
Allowed	0.424	0.320	1.52	0.185	0.816–2.859
<b>Age Group</b>					
14–25	1.271	0.484	3.565	0.009	1.379–9.213
26–44	ref	ref	ref	ref	ref
<b>Family Income</b>					
Less than \$20,000	0.129	0.571	1.138	0.821	0.372–3.482
\$20,000–\$49,999	0.359	0.549	1.433	0.513	0.488–4.203
\$50,000–\$74,999	-0.157	0.718	0.855	0.827	0.209–3.490
\$75,000 or more	ref	ref	ref	ref	ref
<b>Education Level</b>					
Did not finish high school	0.619	0.739	1.858	0.402	0.437–7.901
High School Graduate	-0.007	0.736	0.993	0.992	0.235–4.202
Some College	0.597	0.705	1.817	0.397	0.456–7.239
College Graduate	ref	ref	ref	ref	ref
<b>Race Ethnicity</b>					
Non-Hispanic White	ref	ref	ref	ref	ref
Non-Hispanic Other	-0.122	0.359	0.886	0.735	0.438–1.789
Hispanic	-0.885	0.460	0.413	0.054	0.168–1.017
<b>Marital Status</b>					
Married	ref	ref	ref	ref	ref
Not Married	1.918	0.769	6.810	<0.001	2.485–18.661

**Table 5.** Past Year use Reported by Pregnant Respondents of the 2014 NSDUH (N = 758).

	$\beta$	SE	Odds Ratio	<i>p</i>	Confidence Intervals
<b>Medical Marijuana</b>					
Not Allowed	ref	ref	ref	ref	ref
Allowed	0.375	0.215	1.456	0.081	0.955–2.220
<b>Age Group</b>					
14–25	0.782	0.267	2.185	0.003	1.294–3.689
26–44	ref	ref	ref	ref	ref
<b>Family Income</b>					
Less than \$20,000	0.238	0.362	1.269	0.511	0.624–2.580
\$20,000–\$49,999	0.139	0.341	1.149	0.684	0.589–2.243
\$50,000–\$74,999	0.265	0.388	1.304	0.494	0.610–2.790
\$75,000 or more	ref	ref	ref	ref	ref
<b>Education Level</b>					
Did not finish high school	0.005	0.397	1.005	0.989	0.462–2.190
High School Graduate	–0.587	0.388	0.556	0.130	0.260–1.188
Some College	–0.121	0.360	0.886	0.736	0.438–1.792
College Graduate	ref	ref	ref	ref	ref
<b>Race Ethnicity</b>					
Non-Hispanic White	ref	ref	ref	ref	ref
Non-Hispanic Other	–0.229	0.248	0.796	0.357	0.489–1.294
Hispanic	–0.781	0.304	0.458	0.010	0.252–0.831
<b>Marital Status</b>					
Married	ref	ref	ref	ref	ref
Not Married	1.537	0.335	4.650	> 0.001	2.713–7.971

The frequency of self-reported past year use was transformed into light use (< 100 days) and heavy use ( $\geq 100$  days). In states where medical marijuana was not allowed, 36.8% ( $n = 68$ ) pregnant women who reported past year marijuana use were categorized as heavy users. In the medical marijuana states, the proportion of pregnant heavy users increased to 53.7% ( $n = 54$ ;  $\chi^2 = 3.501$ ,  $p = 0.060$ ).

## Discussion

The 2014 NSDUH revealed that 6.8% of women pregnant at the time of interview self-reported past-month marijuana use and 16.1% self-reported past-year marijuana use. Further evaluation with regard to residing in a state with or without a medical marijuana law showed that a higher proportion of pregnant women self-reported past-month marijuana use ( $\chi^2 = 0.636$ ,  $p = 0.425$ ) and past-year marijuana use ( $\chi^2 = 0.915$ ,  $p = 0.339$ ). Although both observations showed increased proportions in the expected direction, the differences were not statistically significant.

Other studies have specifically reviewed adolescent marijuana use using NSDUH data with mixed results. Wall et al studied adolescent

marijuana use between 2002 and 2008 in states where medical marijuana was and was not allowed [12]. On average adolescent marijuana use was higher in medical marijuana states than non-medical marijuana states (8.68% compared to 6.94%). The study was a cross-sectional design and therefore could not infer cause and effect.

Isolation of potential time influences of medical marijuana laws was attempted using a more complex design [13]. An increase in adolescent marijuana use in states with medical marijuana laws observed by Wall et al [12] was confirmed by Harper et al [13]. However, their more complex difference in differences approach suggested that the passage of medical marijuana laws represented no significant affect ( $\beta = -0.53$ ; 95% CI: -1.0, 0.0).

Multiple logistic regressions was used to investigate the differences of past month and past year maternal marijuana use in states that allow and do not allow medical marijuana use while controlling for age, family income, educational level, race/ethnicity, and marital status. These demographic elements did not significantly affect the influence of state medical marijuana laws on self-reported past month maternal marijuana use ( $\beta = 0.424$ ;  $p = 0.185$ ) and past year maternal

marijuana use ( $\beta = 0.375$ ;  $p = 0.081$ ). Additionally, family income level or educational level did not demonstrate statistically significant influence. However, an association between maternal marijuana use and age, marital status, and race/ethnicity was statistically significant which is a similar observation seen in studies of other populations.

Young pregnant mothers (ages of 14–25 years old) self-reported more past month use (OR = 3.565; 95% CI: 1.379, 9.213;  $p = 0.009$ ) and past year use (OR = 2.185; 95% CI: 1.294, 3.689;  $p = 0.003$ ). Unmarried women's odds ratio was 6.81 times higher for marijuana use during the month prior to interview than married women (95% CI: 2.485, 18.661;  $p < 0.001$ ) and 4.650 times higher for marijuana use during the past year use (95% CI: 2.713, 7.971;  $p < 0.001$ ). Being a pregnant Hispanic, however, seemed to provide a degree of protection, where the odds ratio was 0.413 past month use ( $p = 0.054$ ; 95% CI: 0.168, 1.017) and 0.458 for past year marijuana use ( $p = 0.010$ ; 95% CI: 0.252, 0.831) when compared to the reference group, non-Hispanic Whites.

Similar trends by age in the general population were reported by National Epidemiologic Survey on Alcohol and Related Conditions [14]. Among 18–29 year olds, 10.5% reported past-year marijuana use compared to the next highest age group (30–34 years old) only reporting 4.1% in the NESARC Wave I in 2001–2002 [14]. NESARC Wave II (2012–2013) showed past year marijuana use of 18–29 year olds at 21.2% compared to 30–34 year olds at 10.1%. Ko et al [2] showed in their study of the NSDUH (2007–2012) that over half of the pregnant mothers reporting past month marijuana use were between the ages of 18–25 years old (66.7%), which was similar to their findings among non-pregnant females ages 18–25 years old (54.8%). These findings are consistent and showed that young people, whether pregnant or simply part of the general population, were at higher risk to self-report marijuana use.

Marital status has also been a consistent predictor of self-reported marijuana use. The 2012–2013 Wave II of the NESARC showed that unmarried people (21.0%) were much more inclined to report past year marijuana use than widowed/separated people (8.3%) or married individuals (5.5%; Hasin et al, 2015 [14]). The NSDUH (2007–2012) data showed that 70.4% of pregnant women that reported past month marijuana use were never married [2]. This trend was also observed in a French national study which showed that the odds of women that did not cohabit with the child's father were 1.69 times higher (95% CI: 1.01, 2.82;  $p < 0.05$ ) to report marijuana use during pregnancy than pregnant women cohabitating with their partner [15].

Race/ethnicity provided an interesting comparison, in which Hispanics tended to self-report less marijuana use than Non-Hispanics. In the NESARC Wave II in 2012 and 2013, Hasin et al observed in the general population a prevalence of past year marijuana use of 8.4% while non-Hispanic Whites and Blacks reported use at much higher rates (9.4% and 12.7%, respectively; Hasin et al, 2015 [14]). Previous studies using the NSDUH (2007–2012) demonstrated that pregnant Hispanic women were less likely to self-report past year marijuana use (OR = 0.6; 95% CI: 0.4, 0.8) when compared to Non-Hispanic Whites [2].

The final question of this study was to evaluate a potential increase in heavy marijuana use among pregnant women in states that allow

medical marijuana use compared to pregnant women who lived in states that do not allow medical marijuana use. Light marijuana use was defined as using 99 days or less per year while heavy use was defined as using 100 or more days per year. Of the pregnant women that reported past year marijuana use living in a state that does not allow medical marijuana use, 37% self-reported as heavy users. In states that allowed medical marijuana use, 54% were categorized as heavy users. This was a large increase in the direction that was hypothesized and the finding approached statistical significance ( $p = 0.061$ ).

This finding is consistent with a recent report evaluating concentrations of marijuana metabolite (THCA) in newborn meconium before and after legalization of recreational marijuana use in Colorado [16]. Meconium, the first fecal material excreted by the newborn soon after birth, is a complex material that has accumulated in the large intestine of the neonate during the second and third trimesters [17]. Meconium has been considered as the gold standard specimen type to monitor prenatal drug exposure due to its lengthy window of detection, near universal availability, and noninvasive collection procedure [17].

Chasnoff [16] reported data that indicated a significant increase in the prevalence of positive meconium specimens was not observed following the initiation of Colorado's recreational marijuana law in 2012. There was, however, a significant increase in the levels of marijuana metabolite (THCA) found in newborn meconium ( $213 \pm 230$  ng/g compared to  $361 \pm 420$  ng/g;  $p = 0.013$ ). Chasnoff [16] inferred that this was due to an increase in heavy marijuana use among those that chose to use which is a similar conclusion to the study presented here.

Using the NSDUH presents two distinct advantages, the number of respondents and inclusion of the new question about the presence of medical marijuana law at the time of inquiry. The 2014 NSDUH surveyed nearly 60,000 respondents of which 758 were pregnant women. The NSDUH used a sophisticated sampling strategy to ensure an accurate representation of the national demographic. Inclusion of the new questionnaire item noting the presence of state medical marijuana laws at the time of interview allowed for simple categorization of the dependent variable.

The most significant limitation to this study was its reliance on self-report of drug use behavior. The prevalence and extent of marijuana use was expected to be under-reported due to reasons of self-incrimination and stigma. McDonald [18] concluded that individuals in general answer questions in a manner that is more socially acceptable. The survey attempted to mitigate these concerns by conducting the interview in a private area away from others and by the use of a computer assisted protocol. The NSDUH does not include institutionalized, incarcerated, or homeless individuals in their survey. These populations are at high risk for substance use and abuse which may affect the outcome of this study [19]. Lastly, this survey did not capture information regarding the participants residing in a state that adopted a recreational marijuana law. The influence of a state recreational marijuana law may not be equivalent to that of a state medical marijuana law thus affecting the outcome of this study. Future directions of this study include replication with subsequent waves of

NSDUH [20], the inclusion of marijuana questions in the Pregnancy Risk Assessment Monitoring System general core questions, and inclusion of an appropriate biomarker in epidemiological studies of newborns in various geographical areas.

An association exists between *in utero* exposure to marijuana and long-term neurobehavioral deficits and these marijuana induced deficits are 100% preventable. The results of this study confirm previous reports in that marijuana use in jurisdictions that allow medical marijuana, while statistically insignificant, are higher than in jurisdictions that do not allow for medical marijuana. Furthermore, among those that reside in states that allow medical marijuana and that choose to use during pregnancy, use more frequently than their counterparts in states that do not allow medical marijuana. This study also aligns with previous reports stating that younger and unmarried women are at higher risk of maternal marijuana use than other women. These findings along with increasing permissive views of marijuana use among adolescents and an increase in the number of states that allow medical marijuana use demand that policymakers direct prevention efforts to these higher risk group.

The increase of permissive views of marijuana use among adolescents presents a compounded set of public health issues. An association between age of substance use initiation and higher substance dependency later in life exists. Additionally, the adolescent demographic are entering into the reproductive age range. Policymakers in all jurisdictions but especially in those jurisdictions that either allow medical marijuana or are considering the allowance of medical marijuana should focus substance use prevention resources to their adolescent constituents including information concerning the long term neurobehavioral deficits associated with maternal marijuana use.

Policymakers in all states but especially in states that allow medical marijuana or states considering the allowance of medical marijuana should provide additional resources for substance use prevention for young unmarried women. This study was consistent with previous reports showing that these two characteristics are at a statistically significant increased risk over other demographics studied. Additionally, young, unmarried women are more apt to not have adequate healthcare coverage which may present a barrier to prenatal treatment and a conduit for substance use prevention efforts. Access to accurate information regarding the question of negative long term health consequences of prenatal marijuana exposure was disappointing Jarlenski et al. [21]. The findings of Jarlenski and colleagues [21] along with the outcome of this study point to a public health opportunity for jurisdictions considering or adopting relaxed marijuana policies to make sure that quality information concerning prenatal marijuana exposure is readily available especially for young unmarried pregnant mothers-to-be.

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## Citation:

Dr. Joseph Jones (2018) Medical Marijuana Laws and Maternal Marijuana Use. *ARCH Women Health Care* Volume 1(2): 1–6.