Association of Unintentional Pediatric Exposures With Decriminalization of Marijuana in the United States

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Study objective: We compare state trends in unintentional pediatric marijuana exposures, as measured by call volume to US poison centers, by state marijuana legislation status.

Methods: A retrospective review of the American Association of Poison Control Centers National Poison Data System was performed from January 1, 2005, to December 31, 2011. States were classified as nonlegal if they have not passed legislation, transitional if they enacted legislation between 2005 and 2011, and decriminalized if laws passed before 2005. Our hypotheses were that decriminalized and transitional states would experience a significant increase in call volume, with more symptomatic exposures and more health care admissions than nonlegal states.

Results: There were 985 unintentional marijuana exposures reported from 2005 through 2011 in children aged 9 years and younger: 496 in nonlegal states, 93 in transitional states, and 396 in decriminalized states. There was a slight male predominance, and the median age ranged from 1.5 to 2.0 years. Clinical effects varied, with neurologic effects the most frequent. More exposures in decriminalized states required health care evaluation and had moderate to major clinical effects and critical care admissions compared with exposures from nonlegal states. The call rate in nonlegal states to poison centers did not change from 2005 to 2011. The call rate in decriminalized states increased by 30.3% calls per year, and transitional states had a trend toward an increase of 11.5% per year.

Conclusion: Although the number of pediatric exposures to marijuana reported to the National Poison Data System was low, the rate of exposure increased from 2005 to 2011 in states that had passed marijuana legislation. [Ann Emerg Med. 2014;63:1450-1456.]

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INTRODUCTION

Background

Currently, legalization of marijuana is being debated in both public and government forums in the United States. Although still criminalized at the federal level, decriminalization at the state level has received national attention as states continue enacting marijuana legislation for medical and recreational purposes.[1] As of December 2013, 18 states and Washington, DC, have passed legislation allowing medical marijuana.[2] California has the oldest medical marijuana law; proposition 215 passed in 1996. In the recent 2012 elections, Washington and Colorado, states that decriminalized medical marijuana in 1998 and 2000, respectively, decriminalized small amounts of recreational marijuana.

Importance

In 2004, the American Academy of Pediatrics released a policy statement that expressed concerns about adolescent marijuana abuse associated with decriminalization of marijuana.[3] In Colorado, authorities have found evidence of diversion of medical marijuana to adolescents.[4,5] Reports of marijuana exposures in younger children have been limited historically to a few case reports.[6-11] More recently, an emergency department (ED) in Colorado showed an increase in children younger than 12 years and presenting for symptomatic, unintentional marijuana exposures after 2009.[12] The majority of these exposures were from medical marijuana, which was often packaged in the form of a food product. The effect of an increasing number of states decriminalizing medical and recreational marijuana on children is unclear.

Goals of This Investigation

Our objective was to compare the trends in population-adjusted rates of unintentional pediatric (aged 0 to 9 years) marijuana exposures as measured by call volume reported to US poison centers, stratified by marijuana legislation status. Our secondary objective was to compare demographics, exposure site, management site, clinical effects, therapies, medical outcomes, and disposition for these exposures.

Editor's Capsule Summary

What is already known on this topic

Some states have recently decriminalized marijuana, increasing availability.

What question this study addressed

Are there more unintentional marijuana exposures in children in decriminalized states?

What this study adds to our knowledge

In this poison center database review of 985 inadvertent pediatric marijuana exposures, call rates in decriminalized states increased by 30% per year from 2005 to 2011, whereas in nonlegal states they did not change.

How this is relevant to clinical practice

Decriminalization of marijuana is associated with increased reports of unintentional exposures in children; however, even in legalized states, they remain low.

MATERIALS AND METHODS

Study Design and Setting

We performed a retrospective review of the American Association of Poison Control Centers National Poison Data System from January 1, 2005, to December 31, 2011.

Selection of Participants

For this study, the National Poison Data System database was searched for the generic code for marijuana (0083000). Single-substance, unintentional exposures in children aged 9 years and younger were included as cases; the age range was chosen a priori because exposure at that age is less likely to be intentional, and to match census data for population-adjusted rate calculations.

Methods of Measurement

Trained specialists in poison information (eg, nurses, pharmacists) collect standardized data for each call to the National Poison Data System. Cases are generally followed until resolution. Detailed definitions of National Poison Data System data fields and medical outcome are available in the 2011 annual report of the National Poison Data System.[13] In 2011, there were 1,285,850 exposures in children aged 12 years or younger.[13]

Outcome Measures

The following variables were captured: date of exposure, state, age, sex, exposure site, management site, route of exposure, clinical effects, duration of effect, medical outcome (classified as no, minor, moderate, or major effect), and therapies. Clinical effects were included only if they were coded as related to the exposure. A minor effect is defined as a patient's developing some signs or symptoms of the exposure that were minimally bothersome and resolve rapidly. A moderate effect is defined as a patient's exhibiting signs or symptoms as a result of the exposure that are more pronounced, more prolonged, or more systemic than minor symptoms, and usually some form of treatment is indicated. A major effect is defined as a patient's exhibiting signs or symptoms as a result of the exposure that are life threatening or result in significant residual disability or disfigurement. Therapies were recorded if they were performed or recommended by the poison center.

States were considered nonlegal if they had not passed legislation up through 2012 and decriminalized if they passed laws before 2005 (Alaska, California, Colorado, Hawaii, Maine, Nevada, Oregon, Vermont, and Washington). States that enacted legislation between 2005 and 2011 were analyzed as transitional states (Arizona, Michigan, Montana, New Mexico, and Rhode Island). Data from other countries and Puerto Rico were excluded from the analysis. Annual state census counts from 2005 to 2011 for children aged 0 to 9 years were obtained with population estimates through historical data from the US Census Bureau Web site, https://www.census.gov.

Primary Data Analysis

Odds ratios with 95% confidence intervals (CIs) were calculated for nominal variables. General linear mixed modeling was used to determine the association of medical marijuana laws on the number of calls per population aged 0 to 9 years over time. To correct for overdispersion of the data, the negative binomial distribution was used. Missing data were not analyzed in demographics, sites, clinical effects, outcomes, and disposition, but all patients were included in the analysis for rates. All analyses were performed with SAS (version 9.3; SAS Institute, Inc., Cary, NC). Our local institutional review board approved the study, granting a waiver of informed consent.

RESULTS

Characteristics of Study Subjects

There were 985 unintentional marijuana exposures reported between January 1, 2005, and December 31, 2011, in children aged 9 years and younger in the United States: 496 in nonlegal states, 93 in transitional states, and 396 in decriminalized states. Every state had at least 1 call, with California having the highest number of calls (Figure 1). There was a slight male predominance, and the median age ranged from 1.5 to 2.0 years in the 3 groups (Table 1).

Main Results

More patients were evaluated in a health care facility in decriminalized states compared with nonlegal states (OR 1.9;

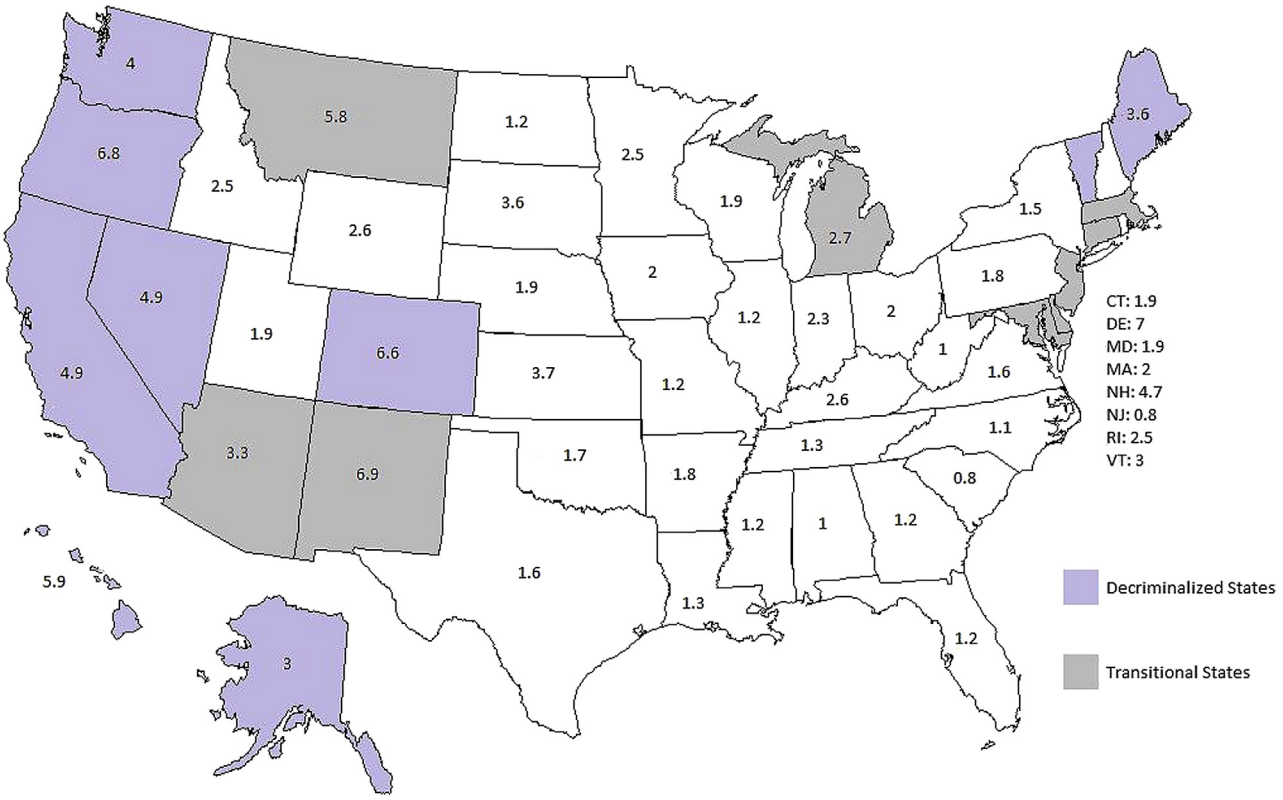

Figure 1. Distribution of unintentional marijuana pediatric exposures reported to poison centers in the United States from 2005 to 2011. Decriminalized states passed laws before 2005. Transitional states enacted legislation between 2005 and 2011. Numbers represent calls per state, per 100,000 (based on 2010 census data for children aged 9 years and younger).

95% CI 1.5 to 2.6) (Table 1). The symptomatology varied, with neurologic effects the most common. The majority of patients exhibited clinical effects lasting fewer than 24 hours (Table 2). Ingestion (n=792; 78%) was the most common route of exposure, although this variable does not distinguish between marijuana intended for smoking versus marijuana in food products.

More patients who were evaluated in decriminalized states had major or moderate effects (OR 2.1; 95% CI 1.4 to 3.1) and admission to critical care units (OR 3.4; 95% CI 1.8 to 6.5) compared with patients in nonlegal states (Table 3). Most patients treated in a health care facility were eventually discharged from the ED. Most patients with exposures did not have documentation of receiving therapeutic interventions. Overall, the most common therapy was intravenous fluids (n=62; 6%). Other therapies included activated charcoal (n=37; 4%), naloxone (n=9; 1%), oxygen (n=7; 0.4%), benzodiazepines (n=7; 0.4%), flumazenil (n=1; 0.1%), atropine (n=1; 0.1%), and vasopressors (n=1; 0.1%). Aggressive interventions were rare. These included intubation (n=4; 0.4%), cardiopulmonary resuscitation (n=2; 0.2%), and gastric lavage (n=1; 0.1%). There were no deaths.

Table 1. Demographics, exposure site and management site of unintentional pediatric exposures (2005 to 2011).

	Nonlegal States (n=496)	Transitional States (n=93)	Decriminalized States (n=396)
Demographics			
Male (%)	252 (51)	51 (55)	199 (50)
Median age (IQR), y (%)	1.5 (0.9, 2.0)	1.7 (0.9, 3.0)	2.0 (1.2, 3.0)
Exposure site*			
Child's residence (%)	397 (80)	70 (75)	347 (88)
Management site*			
Health care facility (%)	298 (60)	67 (72)	295 (74)
Non–health care facility (%)	181 (36)	24 (26)	91 (23)

*Not all patients had exposure site and management site documented.

The call rate in nonlegal states to poison centers did not change from 2005 to 2011 (1.5% calls per year; 95% CI –3.5% to 6.7%). The call rate in decriminalized states increased by 30.3% calls per year (95% CI 22.5% to 38.5%), with a difference between nonlegal and decriminalized state rates of 28.3% (95% CI 19.0% to 38.4%) (Figure 2). Transitional states had a trend toward an increase of 11.5% per year (95% CI –0.4% to 24.7%).

LIMITATIONS

Limitations of our study include that likely not all cases were reported to the National Poison Data System, and cases reported may not be representative of all unintentional pediatric marijuana exposures.

Table 2. Symptoms and duration of symptoms of unintentional pediatric exposures (2005 to 2011).

Symptoms*	Nonlegal States (n=496)	Transitional States (n=93)	Decriminalized States (n=396)
Nervous system			
Drowsiness/lethargy (%)	97 (20)	28 (30)	147 (37)
Ataxia (%)	29 (6)	3 (3)	14 (4)
Agitated/irritable (%)	16 (3)	2 (2)	14 (4)
Confused (%)	7 (1)	3 (3)	17 (4)
Other (%)†	10 (2)	7 (8)	19 (5)
Total	159 (32)	43 (46)	211 (53)
Gastrointestinal system			
Nausea/vomiting (%)	9 (2)	2 (2)	19 (5)
Cardiovascular and respiratory systems			
Respiratory depression, bradycardia, hypotension (%)	3 (<1)	2 (2)	5 (1)
Duration of symptoms			
≤2 h (%)	9 (2)	4 (4)	12 (3)
>2 h, ≤8 h (%)	55 (11)	12 (13)	63 (16)
>8 h, ≤24 h (%)	58 (12)	16 (17)	63 (16)
>24 h, ≤3 days (%)	5 (1)	3 (3)	16 (4)
>3 days, ≤1 wk (%)	1 (<1)	1 (1)	1 (<1)

*Not all patients had symptoms, type of symptom, or duration of symptoms documented. Some patients had more than 1 symptom.
†"Other" includes tremor, coma, hallucinations, nystagmus, muscle weakness, slurred speech, and seizures.

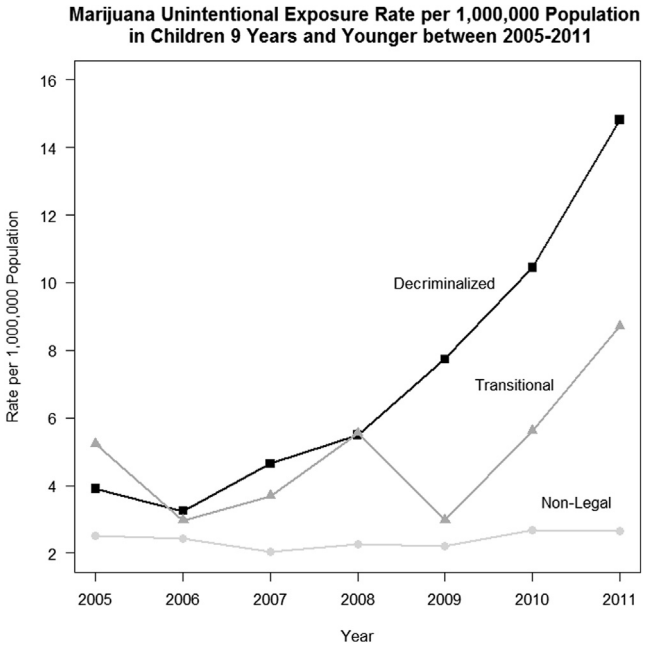

Figure 2. Comparison of unintentional marijuana exposure rates between nonlegal, transitional, and decriminalized states.

Calls made to the National Poison Data System may have reporting bias because exposures calls may have more severe effects.

Caregivers in states where marijuana is decriminalized may be more likely to call poison centers or present to health care facilities for help than in nonlegal states. Information provided to the National Poison Data System depends on the history and symptoms from either the lay caller or health care provider. We were also unable to account for unmeasured state-level confounding because of low case counts.

Although the information collected was standardized, the information documented can be variable, and the accuracy of coding may vary among poison centers. Miscoding of exposures may have occurred, either falsely increasing or decreasing the number of children identified with a marijuana exposure. Confirmatory testing was not performed on all exposures, so it is possible that some cases may not have been true exposures.

Substance coding during the years studied did not distinguish between marijuana intended for smoking versus marijuana in food products. In 2013, this National Poison Data System limitation was corrected with new coding options.

Finally, by combining cases by states with and without legalization, within-state variability is not taken into account, and therefore the model may be suboptimal.

Table 3. Medical outcomes and patient disposition of unintentional pediatric exposures (2005 to 2011).

	Nonlegal States (n=496)	Transitional States (n=93)	Decriminalized States (n=396)
Medical outcomes if documented*			
Major or moderate effect	44 (9)	9 (10)	67 (17)
Minor or no effect	204 (41)	43 (46)	143 (36)
Disposition of patients evaluated in a health care facility*	**(n=298)**	**(n=67)**	**(n=295)**
Admitted to critical care unit	13 (4)	10 (15)	33 (11)
Admitted to non–critical care	46 (15)	11 (16)	42 (14)
Treated/evaluated and released	150 (50)	23 (34)	117 (40)

*Not all patients had medical outcomes or disposition documented. Data are presented as No. (%).

DISCUSSION

Unintentional pediatric marijuana exposures as measured by calls to the National Poison Data System increased from 2005 to 2011 in states that passed legislation decriminalizing marijuana before 2005. The trend toward an increase observed in transitional states suggests a lag between passage of marijuana legislation and local proliferation of the marijuana industry. Although there was no long-term morbidity or mortality, a greater proportion of patients in decriminalized states had moderate to major clinical effects and critical care admissions, which may be due to unfamiliarity with the exposure, limited resources, or greater potency of the marijuana. As more states pass legislation to decriminalize medical and recreational marijuana, we expect the rate of marijuana exposures in young children to continue to increase.

There are several possible explanations for the increase in reported marijuana exposure rates in young children: increased

use by family members, increased likelihood of ingestion, or increased potency of the ingestion. The Substance Abuse and Mental Health Services Administration, an annual nationwide survey of 67,500 Americans aged 12 years and older, reported only a slight increase in the proportion of individuals using marijuana, from 6.2% in 2002 to 6.9% in 2010.[14] However, several authors have found higher marijuana use in states with medical marijuana legislation. Using the National Survey on Drug Use and Health, Wall et al[15] found that adolescents (aged 12 to 17 years) in states with medical marijuana legislation had higher marijuana use in the past month (8.68%; 95% CI 7.95% to 9.42%) compared with those in states without legislation (6.94%; 95% CI 6.6% to 7.28%) during the period 2002 to 2008. Harper et al[16] came to similar conclusions in their analysis of National Survey on Drug Use and Health data of higher prevalence of past-month marijuana use by adolescents in states with medical marijuana laws compared with those without laws (difference 1.74%; 95% CI 1.4% to 2.4%) and a higher prevalence of past-month marijuana use by adolescents in states passing laws since 2004 compared with that in states that never passed a law (difference 1.65%; 95% CI 1.0% to 2.3%) during the same period of 2002 to 2008. Cerda et al[17] reported that adults (aged >18 years) in states with medical marijuana laws had higher marijuana use in the past year (7.13%; 95% CI 6.02% to 8.24%) compared with those in states without laws (3.57%; 95% CI 3.1% to 4.03%) according to the National Epidemiologic Survey on Alcohol and Related Conditions from 2004 to 2005. These studies suggest that differences in the prevalence of marijuana use in states with medical marijuana legislation compared with those without range from 1.5% to 3.5%. This increase in marijuana use in states with medical marijuana legislation may be contributing to the increase in exposure rates. However, we believe this small increase in use is not the only factor responsible for the significant increase in exposure rates in children.

In 2011, *USA Today* reported that the marijuana industry had $1.5 billion in sales, which is expected to increase to $3.3 billion by 2015.[18] As part of this growth, available forms of marijuana expanded to include edible products (eg, bear-shaped soft candies, cookies, hard candies and chocolates, popsicles, beverages), concentrated tinctures, and electronic cigarettes.[19] Besides Food and Drug Administration–regulated films and sublingual tablets containing fentanyl or buprenorphine hydrochloride/naloxone hydrochloride, as well as nicotine- and aspirin-containing gum, no other medications, drugs, or controlled substances are available as food or beverages. These edible products are often indistinguishable from non–marijuana-containing food products, are highly attractive and palatable to children, and can contain very high amounts of tetrahydrocannabinol (100 to 500 mg). A recently published case series showed that the majority of unintentional marijuana exposures in young children were from medical marijuana, which was often packaged in the form of a food product.[12] Historically, acute unintentional pediatric exposures were expected to be of low consequence with minimal symptoms because of the poor palatability of the marijuana plant. In this study, because most exposures occurred at home, were the result of an ingestion, and were associated with more severe clinical effects in decriminalized states, we believe that high-dose edible products and tinctures may have played a significant role in the increased rate of reported exposure because they increase the likelihood of ingestion, given their palatability, and cause more severe symptoms after ingestion, given their higher concentrations of tetrahydrocannabinol.

Public health preventive interventions have been successful in the past at reducing unintentional pediatric ingestions. The Poison Prevention Packaging Act of 1970 requires child-resistant packaging for toxic household products and medications, including most oral prescription drugs and all oral controlled substances. The act resulted in a remarkable decline in reported deaths from ingestions by children of these products.[20-22] Given the previous success of child-resistant packaging, we believe the marijuana industry should consider Poison Prevention Packaging Act standards to minimize the potential harmful effect on children.

Although medical marijuana was decriminalized in Colorado in 2000, the medical marijuana industry there did not expand and prosper until 2009, when the Department of Justice decided not to pursue medical marijuana users who conformed to state laws. In the original law decriminalizing medical marijuana, there were no strict provisions for child-resistant packaging, warning labels, or consumer or health care provider education. After 2009, there was an increase in symptomatic, unintentional pediatric exposures in a children's hospital in Colorado.[12] After hearing testimony about the risks to small children, Colorado lawmakers included a requirement for child-resistant packaging for recreational marijuana in 2013. Pediatricians, toxicologists, and emergency physicians need to be willing to advocate the safety of children to state lawmakers as this industry expands across the United States.

In summary, although the number of pediatric exposures to marijuana reported to the National Poison Data System was low, the rate of exposure increased significantly from 2005 to 2011 in states that had passed marijuana legislation. Most exposures were evaluated in health care facilities, resulting in health care system costs. As more states pass marijuana legislation and access to the drug is eased, the availability of high-concentration edible products may lead to an increase in symptomatic pediatric exposures. Ongoing surveillance is crucial in assessing the marijuana industry's effect on children and evaluating preventive efforts as it continues to expand. Decreasing the likelihood of ingestion offers the best strategy to minimize these childhood exposures because the increasing use and availability after decriminalization will be less amenable to public health interventions. We believe state lawmakers should consider requirements, such as child-resistant packaging, warning labels, and public education, when drafting marijuana legislation to minimize the effect on children.

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