

Selected Topics: Toxicology

UNINTENTIONAL PEDIATRIC MARIJUANA EXPOSURES PRIOR TO AND AFTER LEGALIZATION AND COMMERCIAL AVAILABILITY OF RECREATIONAL MARIJUANA IN WASHINGTON STATE

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Abstract—Background: Washington State was one of the first states to legalize recreational marijuana. Increased availability of marijuana may result in more unintentional pediatric exposure, which often presents as altered mental status with unknown cause. **Objectives:** To quantify unintentional pediatric marijuana exposures reported to the Washington Poison Center (WAPC) prior to and after legalization and commercial availability of recreational marijuana. **Methods:** Data were obtained from the WAPC database, *toxiCALL*®. Patients ≤ 9 years old with a reported marijuana exposure between July 2010 and July 2016 were included in the analysis. Patient and exposure characteristics were summarized and median exposure frequencies were calculated for the periods prior to and after legalization. **Results:** There were 161 cases meeting the inclusion criteria that occurred between July 2010 and July 2016. Of these, 130 (81%) occurred in the 2.5-year period after legalization of recreational marijuana in January 2013. The median age of exposed children was 2 years (range 0–9 years). Eighty-one percent of the exposures occurred in the child's own home. The number of exposures per month increased after recreational marijuana was legalized in November 2012, and increased further once recreational marijuana shops were legally allowed to open in July 2014. **Conclusion:** Reported unintentional pediatric marijuana exposure has increased in the state of Washington since recreational marijuana was legalized. As marijuana

becomes more available, clinicians should be aware of the risk of unintentional pediatric marijuana exposure, and this should inform lawmakers regarding regulations around childhood exposure to marijuana. © 2019 Elsevier Inc. All rights reserved.

Keywords—marijuana; poisoning; pediatrics; intoxication; THC

INTRODUCTION

Marijuana ingestion is an increasingly common cause of altered mental status in children, perhaps due to a wider availability of edible marijuana products that may be appealing to children, such as gummy or candy products, in the setting of increased legalization (1,2). Washington was one of the first states to legalize recreational marijuana in 2012, and it became commercially available about 18 months later in July 2014 (3). Medical marijuana, dispensed to those with prescriptions for specific indications, has been legal in Washington State since 1998 (4). Although studies in other states have demonstrated an increase in the number of pediatric marijuana exposures since legalization, the number of pediatric unintentional exposures to

marijuana has not been quantified since the legalization of medical and recreational marijuana in Washington State (5,6). In Colorado, medical marijuana regulation was in place prior to recreational marijuana regulation, in contrast to Washington, where stringent medical marijuana regulation did not go into effect until after recreational marijuana was legalized, which was highly regulated (7).

Washington State regulates products containing tetrahydrocannabinol (THC), or the active ingredient in marijuana. Prior to retail, THC-containing products need to be approved (8). Currently, recreational THC products are available to adults aged 21 years and older for purchase in up to 1 ounce of useable marijuana, 16 ounces of marijuana-infused edibles in solid form, 72 ounces in liquid form, and 7 grams of marijuana concentrates (8). Recreational marijuana products that are deemed appealing to children cannot be sold, and it is a felony to allow marijuana access to minors < 18 years of age, punishable with up to 10 years in prison and up to a \$10,000 fine (8). As of May 2018, approximately 9% of marijuana distribution violations were related to providing a minor with marijuana (9). From July–December 2014, about 600 recreational marijuana shops were issued licenses to open in Washington State, compared with about 1200 in 2016 (Figure 1). Medical marijuana retail locations were unregulated up through July 2016 (8).

Despite the legalization of recreational marijuana in Washington State, rates of self-reported teen marijuana use remained stable as of May 2018 (10). Use of marijuana in pediatric nonadolescent patients in Washington State has not yet been studied. Using Washington Poison Center (WAPC) data, this study aimed to quantify reported unintentional pediatric marijuana exposures prior to and after the legalization of recreational marijuana in Washington and to describe the characteristics of all exposed patients including age, gender, symptoms, and if any additional medical evaluation was pursued.

METHODS

Study Design

This retrospective study evaluated pediatric marijuana exposures reported to the WAPC in the 2 years prior to and after the law to legalize recreational marijuana in Washington was passed in 2012, and 2 years after the law was implemented on July 8, 2014 (11). This study was reviewed and approved by the Institutional Review Board at the study institution.

Study Setting

The WAPC is Washington's only poison control center and serves a population of approximately 7.3 million peo-

ple, with over 55,000 calls per year related to exposures in humans (12).

Patient Population

Patients aged 9 years old or younger who had been exposed to marijuana from January 1, 2010 to July 31, 2016 were retrospectively identified through a data query in *toxiCALL*® (Computer Automation Systems, Inc., Aurora, CO), the electronic record-keeping system used by the WAPC. Nine years was chosen as the upper age limit, as other pediatric marijuana exposure studies have used a similar age, given developmental capabilities (2). The American Association of Poison Control Centers has since added additional search terms for marijuana, but at the time, search terms included the following:

Start Date: [] Between #7/1/12 00:00:00 am# And #8/1/16#

Call Type: [] = |Exposure ~250~|

Age Units: ([Age ~854~] <= 9 And [] = |Years ~17~|) Or [] = |Days ~19~| or [] = |Months ~18~| Or [] = |<=5 yrs ~21~|

Ingestion: [] <> 0

Sub Generic Code: [] = '|Marijuana (0083000) ~0083000~|'

Variables

toxiCALL data are entered in real time as staff are receiving calls. There are multiple dropdown fields where staff select specific/defined parameters related to the call (e.g., call type, call reason, exposure location, management site) or "fill in" fields such as phone number, address, age, or time of exposure. There is also a free text field to describe substances in addition to a substance generic code, as well as a free text notes field. Effects of exposures were classified as minor, moderate, and major as defined by the National Poison Data System (Table 1) (13). Data were extracted by using the criteria of pediatric marijuana exposures of subjects ≤ 9 years old between January 1, 2010 and August 1, 2016. The search criteria were entered into *toxiCALL* and run against the WAPC archived database. The results of the WAPC data query were exported by case numbers to an Excel spreadsheet (Microsoft Corporation, Redmond, WA) so that a member of the WAPC could extract data from the free notes without protected health information. Remaining protected health information were redacted by a study team member and a member of the WAPC. For each exposure, the data query included information about patient characteristics, type of exposure, patient management, and clinical effects.

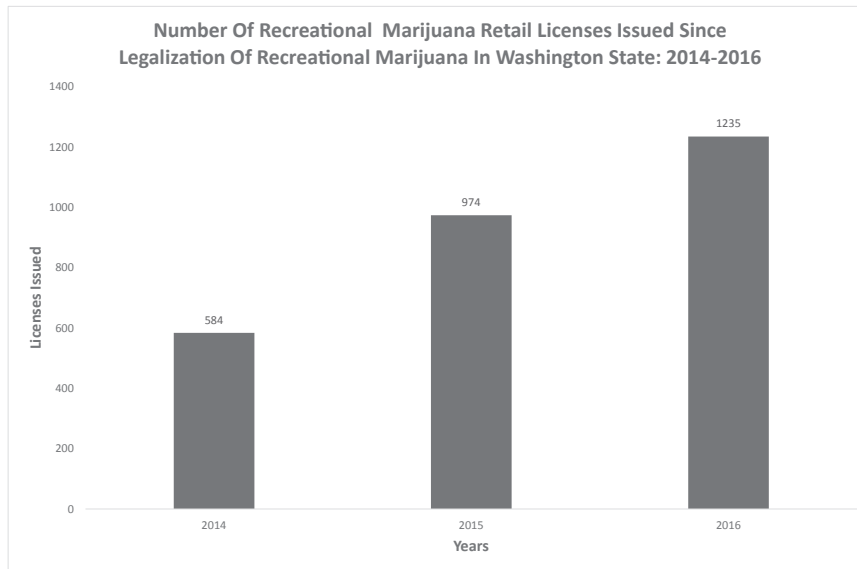


Figure 1. Number of recreational marijuana retail licenses issued since legalization of recreational marijuana in Washington State: 2014–2016. Data from Washington State Liquor and Cannabis Board public records request.

Statistical Analysis

Patient and exposure characteristics were summarized using descriptive statistics (counts and percentages for categorical variables, median and range for patient age). To evaluate whether exposures increased after legalization, we constructed plotted monthly exposure counts with means and median counts for the periods prior to legalization, from legalization to the opening of the first recreational marijuana stores, and after recreational marijuana became commercially available. Demographic data and outcome measures were assessed for group-to-group differences. All statistical analyses were performed using Stata version 14 (StataCorp, College Station, TX).

Measurements/Outcomes

The primary outcome for this study was evaluating WAPC call volumes and demographics related to pediatric marijuana exposures in patients ≤ 9 years old over the specified time period of January 1, 2010 through July 31, 2016 using WAPC data through toxiCALL. In toxiCALL, cases are coded as not followed (generally because

toxicity is not suspected) or followed with a known outcome. Followed cases have subsequent calls recorded to assess patient outcome. All such cases with known outcome must have a recorded duration of clinical effects, coded as ≤ 2 h, > 2 h to ≤ 8 h, > 8 h to ≤ 24 h, > 24 h to ≤ 3 days, > 3 days to ≤ 1 week, ≥ 1 week to ≤ 1 month, ≥ 1 month, anticipated permanent, or unknown. Clinical effects ranged from ≤ 2 h to ≤ 3 days, although 52% of the affected patients' lengths of clinical effects were listed as unknown.

RESULTS

There were 161 patient encounters with concern for unintentional marijuana exposure recorded between January 2010 and July 2016. The number of cases per month increased after recreational marijuana was legalized in November 2012, and increased again once recreational marijuana shops opened in July 2014 (Figure 2). Using Poisson regression modeling with monthly counts as the outcome and time period as the predictor supports this increase, with a p value < 0.01 for the overall test for significance of time period (Figure 3). Comparing

Table 1. Minor, Moderate, Severe Symptoms as Defined by toxiCALL® via the Washington Poison Center

Effect	Definition	Symptoms
Minor	Some symptoms that were minimally bothersome	Quick resolution, often involve skin or mucous membranes
Moderate	More pronounced, prolonged, or more systemic symptoms than minor symptoms as a result of the exposure	Not life-threatening and return to a pre-exposure state of well-being with no residual disability or disfigurement
Severe	Exposure-related symptoms that were life-threatening/ resulted in significant residual disability or disfigurement	Life-threatening, persistent disability/disfigurement

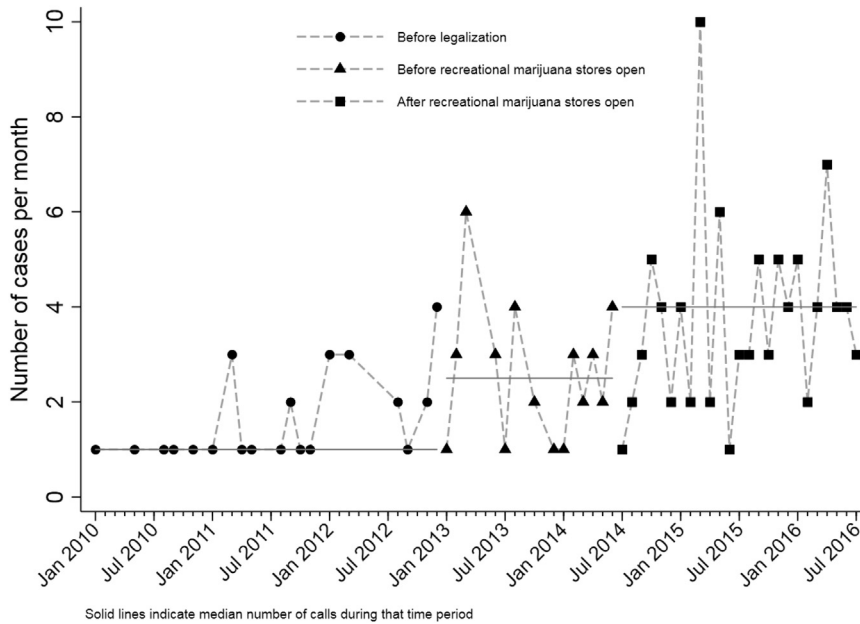


Figure 2. Pediatric marijuana exposures reported to the Washington Poison Center prior to and after legalization and retail availability of recreational marijuana.

the call rate after stores opened with the rate prior to legalization, we estimate that the rate increased 2.3 times (95% confidence interval for the rate ratio: 1.5–3.5; $p < 0.01$) (Figure 3). Of the 161 reported exposures, 52% of calls were male and the median age of exposed patients was 2 years (range 0–9 years). Eighty-one percent of the exposures occurred in the patient’s home. Thirty-nine percent of patients experienced a minor effect from the exposure, with the majority of these calls managed at home over the phone by a WAPC poison specialist.

Thirty-six percent of patients were seen at an outpatient health care facility or emergency department (ED) and were discharged, 3% were admitted to a critical care unit, and 14% admitted to a non-critical care unit. Twenty-four percent of patients were treated with observation only, although this value is unknown in 73% of patients. Although the number of THC-related physician visits and hospitalizations did not increase over that time, 12% of patients had a moderate effect and 1% had a major effect from THC exposure (Table 2).

DISCUSSION

After legalization of recreational marijuana in Washington State, the number of calls to the regional poison center related to unintentional marijuana exposure in children 0–9 years old increased. This reflects what was demonstrated in Colorado after marijuana legalization, where there was an increase in ED visits for unintentional marijuana ingestion after modification of drug-enforcement

laws for marijuana and where there was an increase in regional poison center calls related to pediatric marijuana exposure (2,6). In our study, the increase in WAPC calls is most notable in two spikes: after recreational marijuana was legalized in November 2012 and again after the first recreational marijuana shops opened in July 2014. The etiology of these call spikes to the WAPC is unclear, however, it could point to a de-stigmatization of marijuana, particularly given media coverage in Washington State. Although the number of marijuana retail licenses issued increased from 2014–2016, there does not seem to be a correlation with pediatric exposures to marijuana (Figures 1 and 2).

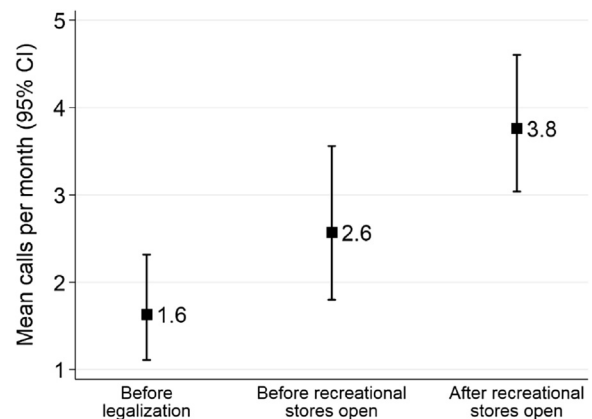


Figure 3. Mean monthly calls of pediatric marijuana exposures reported to the Washington Poison Center prior to and after legalization and retail availability of recreational marijuana. CI = confidence interval.

Table 2. Demographics

Demographic	n (%)
Year	
2010	5 (3)
2011	11 (7)
2012	15 (9)
2013	21 (13)
2014	32 (20)
2015	48 (30)
*2016	29 (18)
Patient gender	
Male	83 (52)
Female	76 (47)
Unknown	2 (1)
Age in years, median (range)	2 (0–9)
Multiple patients exposed	25 (16)
Caller relationship to patient	
Parent	65 (40)
Grandparent or other relative	9 (6)
Health care provider	73 (45)
Other	14 (9)
Exposure site	
Own residence	130 (81)
Other residence	22 (14)
Public area	4 (2)
Other	1 (1)
Unknown	4 (2)
Where the case was managed	
Managed on site (non-health care facility)	62 (39)
Patient already in (en route to) HCF when PCC called	72 (45)
Patient was referred by PCC to a HCF	26 (16)
	1 (1)
Highest level of care provided by the health care facility	
Treated/evaluated and released	58 (36)
Admitted to critical care unit	5 (3)
Admitted to noncritical care unit	22 (14)
Patient lost to follow-up/left AMA	8 (5)
Patient refused referral/did not arrive at HCF	5 (3)
Unknown	63 (39)
What therapy was known to be provided	
No therapy provided	3 (2)
Observation only	39 (24)
Patient refused any help	1 (1)
Unknown if therapy provided	118 (73)
Severity of clinical effects	
No effect	18 (11)
Minor effect	62 (39)
Moderate effect	20 (12)
Major effect	1 (1)
Not followed, minimal clinical effects possible (no more than minor effect possible)	39 (24)
Unable to follow, judged as a potentially toxic exposure	14 (9)
Unrelated effect, the exposure was probably not responsible for the effect(s)	5 (3)
Confirmed nonexposure	2 (1)
Reported length of clinical effects	
≤2 h	10 (6)
≤8 h	36 (22)
≤24 h	24 (15)
≤3 days	8 (5)
Unknown	83 (52)

HCF = health care facility; PCC = poison control center; AMA = against medical advice; dashed arrow = 2012 when recreational marijuana was legalized; solid arrow = 2014 when recreational marijuana retail shops opened.

* Through August 1, 2016.

Generally, symptoms of THC exposure include dizziness, injected conjunctiva, nausea, vomiting, increased appetite/thirst, tachycardia, impaired memory, ataxia, dilated and slow pupils, euphoria, disorientation, stupor, or coma (14). Edible THC products may be more attractive to children, and potency can vary (15). Medical cannabinoid edible labeling does not always correlate with actual THC concentrations, so quantification of THC and subsequent effects can be difficult to assess (16). In addition, ingested THC can produce the same effects at a lower concentration and a delayed and prolonged effect compared with inhaled THC (14,15,17). Pediatric THC exposures can present as altered mental status, especially in unknown THC exposures; this may lead to an extensive health care work-up with laboratory tests, imaging, or invasive tests such as lumbar puncture (1). It is useful to consider early urine drug testing in a patient's presentation, as this can guide management.

The increase in WAPC calls after recreational marijuana legalization in Washington State suggests that pediatric exposures to THC-containing products have increased. In addition to increased local awareness of marijuana availability, general social stigma surrounding marijuana products may have decreased as well, as THC-related calls to the WAPC increased after the recreational marijuana law was passed but before it was implemented, that is, prior to recreational marijuana being readily commercially available. Given these findings, it is important to be aware of local regulations around marijuana and to ask families about both recreational and medical marijuana (including edible forms) as a potential contributor to altered mental status.

Regulations on Recreational Marijuana

Recreational marijuana is heavily regulated in states where it has been legalized. Under the Title 16 CFR 1700 of the Poison Prevention Packaging Act, marijuana-infused products must be packaged in child-resistant packaging (18,19). Additionally, marijuana-infused products may not be packaged to make them especially appealing to children, and labels must be submitted to the Liquor and Cannabis Board for approval (18). Each serving must be individually packaged in childproof packaging and the distribution of marijuana must be homogenous throughout the edible (18). The WAPC developed a "Not For Kids" logo, which is now mandated on all marijuana edible products, and displays the poison center number (20). Once marijuana products are purchased for personal use, the Washington State Liquor and Cannabis Board recommends storing the marijuana products in a child-resistant container in a locked cabinet and in the original packaging that is clearly labeled as containing marijuana (21). Child-resistant

packaging and warning stickers might not deter children completely, and despite this legislation, pediatric marijuana exposure-related calls to the WAPC have increased since recreational legalization (22). Thus, clinicians should continue to be aware of the risk of unintentional THC exposure in pediatric patients.

Limitations

Limitations of this study include its retrospective design and that it includes only cases called into the WAPC. Data are limited by level of completeness of charts in the poison center call record. In addition, outcomes of individual patients may not be complete given that solely WAPC records were evaluated, as opposed to cross-referencing WAPC records with various hospitals' records. A limitation is that confirmatory urine testing for THC was not routinely obtained for subjects, so there is a possibility of false-positive THC test results. In addition, it is important to note that reporting of exposures to the WAPC is voluntary and not mandated by law. As such, WAPC data describe the number of calls received by the WAPC and may under-represent the true occurrence of any exposure to any one substance. There are standard known limitations of Poison Center data, which include insufficient, incomplete, or inaccurate data, such as unproven ingestions, which could introduce bias into data (23). In addition, caretakers may be reluctant to call the WAPC about marijuana exposure in their children. On the other hand, legalization may have made people more apt to report exposures, perhaps accounting for some of the observed increases in cases.

CONCLUSION

Reported cases of unintentional pediatric marijuana exposure have increased in Washington State since the legalization and commercial availability of recreational marijuana, as measured by calls to the regional poison center. The authors hope that these findings not only inform clinicians, but also lawmakers. As marijuana becomes more available through commercial, legal means, clinicians should be aware of the risk of unintentional pediatric marijuana exposure, particularly in households where there are recreational or medical marijuana users. Marijuana accessibility should be routinely discussed at medical visits, and families should be counseled to keep marijuana products out of reach from children.

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ARTICLE SUMMARY

1. Why is this topic important?

This is relevant for emergency physicians who evaluate pediatric patients with altered mental status, as knowledge of local marijuana laws and commercial availability of marijuana can affect pediatric exposures.

2. What does this study attempt to show?

To quantify unintentional pediatric marijuana exposures reported to the Washington Poison Center prior to and after legalization and commercial availability of recreational marijuana.

3. What are the key findings?

Reported cases of unintentional pediatric marijuana exposure have increased in Washington State since the legalization and commercial availability of recreational marijuana, as measured by calls to the regional poison center.

4. How is patient care impacted?

Clinicians should maintain a high level of suspicion for marijuana exposure in pediatric patients, particularly in states where marijuana is readily commercially available.