

Recreational cannabis legalization and pediatric exposures in Massachusetts, United States

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ABSTRACT

Introduction In Massachusetts, US, medical cannabis legalisation was associated with increased paediatric cannabis exposure cases, including emergency department (ED) visits and hospitalizations. The impact of recreational cannabis legalisation (RCL) on paediatric exposures in Massachusetts has yet to be studied.

Methods To compare the incidences before and after RCL in Massachusetts, US, we queried the data on paediatric cannabis exposure cases in 2016–2021 from the Centre for Healthcare and Analysis and Injury Surveillance Programme at the Massachusetts Department of Public Health. The pre-and post-legalisation phases comprised the periods between 2016–2018 and 2019–2021, respectively. Cannabis-related exposure cases included ED visits and hospitalizations among children and young adolescents of 0–19 years old.

Results During the 6-year period (2016–2021), 2357 ED visits and 538 hospitalizations related to cannabis exposure among children and teenagers (0–19 years) were reported in Massachusetts. The incidence of ED visits for all age groups increased from 18.5 per 100 000 population before RCL to 31.0 per 100 000 population (incidence rate ratio (IRR), 1.6; 95% CI, 1.5 to 1.8). Children in the age groups of 0–5 and 6–12 years experienced the highest increase in cannabis-related ED visits. Additionally, the incidence of hospitalisation due to cannabis intoxication substantially increased following RCL (IRR, 2.2; 95% CI, 1.8 to 2.7), a 126% increase.

Conclusions Cannabis-related ED visits and hospitalizations among children and teenagers increased after recreational cannabis became legal in Massachusetts, US. Further efforts are warranted to prevent the unintentional impact of RCL, especially considering substantial increases in cannabis exposure cases among young children.

INTRODUCTION

Cannabis (marijuana) continues to become legal in an increasing number of US states for both medical and recreational purposes. In several states where medical cannabis became decriminalised, a subsequent increase in the number of emergency department (ED) visits related to paediatric cannabis exposure was reported.^{1,2} The state of Massachusetts passed a law legalising medical cannabis in 2012, and the first dispensaries opened in 2015. A recent study showed a significantly increased incidence of cannabis exposure among children and teenagers aged 0–19 following medical cannabis legalisation in Massachusetts.³ Growing evidence

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Paediatric cannabis exposure cases increased in Massachusetts, US, after medical cannabis was legalised in 2012. The recreational use of cannabis products was approved in 2016, and its impact on paediatric cannabis exposures remains unknown.

WHAT THIS STUDY ADDS

⇒ This study provides additional evidence that the legalisation of recreational cannabis in Massachusetts was associated with the increased incidences of paediatric cannabis emergency department visits and hospitalizations, especially among very young children.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Given the increasing number of states and countries legalising cannabis for adult use, continued efforts are needed to effectively decrease cannabis exposures among the paediatric population.

based on the studies evaluating paediatric exposures to cannabis in Colorado (US) and in several provinces in Canada suggests that the legalisation of recreational cannabis further contributes to this increasing trend.^{4–7} In this study, we aimed to compare the incidence of paediatric ED visits and hospitalizations among children and young adolescents of 0–19 years old due to cannabis exposure before and after recreational cannabis legalisation (RCL) in Massachusetts.

METHODS

Study sample

This was a repeated cross-sectional study using data from the Massachusetts Centre for Healthcare and Analysis (CHIA) and the Injury Surveillance Programme at the Massachusetts Department of Public Health, US. These databases capture ED visits and hospitalizations across all acute care hospitals in Massachusetts. Of the 61 acute care hospitals in the state, 57 operate EDs with at least one campus, resulting in a total of 71 ED locations spread across the state.⁸ While acute care hospitals are stratified into five types (academic medical centres, teaching hospitals, community hospitals, etc.), any ED affiliated with those acute care hospitals can provide initial paediatric acute care. Given that these datasets contain de-identified information, no informed



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Table 1 ED Visits and Hospitalizations Related to Cannabis Exposure Before (2016–2018) and After (2019–2021) the Recreational Cannabis Legalisation (RCL) and Implementation in Massachusetts, US

Variable	Number of ED visits (Incidence per 100,000)		
	Before RCL and implementation, FFY 2016–2018	After RCL and implementation, FFY 2019–2021	After vs before RCL and implementation, IRR (95% CI)
Age group, all (0–19 y)	892 (18.5)	1465 (31.0)	1.6 (1.5 to 1.8)
0–5	28 (2.1)	127 (9.8)	4.5 (3.0 to 6.8)
6–12	14 (0.9)	101 (6.4)	7.2 (4.1 to 12.6)
13–19	850 (45.2)	1237 (67.0)	1.5 (1.3 to 1.6)
Sex			
Female	382 (16.1)	680 (29.3)	1.8 (1.6 to 2.0)
Male	570 (20.9)	785 (32.7)	1.4 (1.2 to 1.5)
Race/Ethnicity			
Asian, non-Hispanic/non-Latinx	24 (7.0)	45 (12.8)	1.9 (1.1 to 3.1)
Black, non-Hispanic/non-Latinx	143 (35.0)	272 (70.0)	1.9 (1.6 to 2.3)
White, non-Hispanic/non-Latinx	509 (17.0)	744 (27.0)	1.5 (1.3 to 1.6)
Hispanic/Latinx	158 (18.6)	264 (29.8)	1.7 (1.4 to 2.0)
	Number of Hospitalizations (Incidence per 100,000)		
All, 0–19	167 (3.5)	371 (7.9)	2.2 (1.9 to 2.7)

ED, emergency department; IRR, incidence rate ratio; RCL, recreational cannabis legalization.

consent was required. All ED visits and hospitalizations involving patients between 0–19 years of age with a diagnosis of cannabis intoxication or poisoning (online supplemental file 1) were investigated between 2016 and 2021. This study was conducted according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines and was deemed exempt from review by the Institutional Review Board due to the use of de-identified data.

Study periods

The recreational use of cannabis in Massachusetts was legalised through a ballot measure passed on November 8, 2016. The first adult-use dispensaries selling legal, recreational cannabis in Massachusetts opened in November 2018, marking the point when cannabis products for non-medical use became available for purchase. Therefore, even though recreational cannabis was legally approved in 2016, that is, when the “policy intervention” happened, given this 2-year policy implementation lag, the year

2018 practically became the time point dividing the pre- and post-policy implementation (RCL) periods.

To evaluate the impact of RCL on paediatric ED visits and hospitalizations due to cannabis exposure among children and young adolescents, two periods, including 3 years before (2016–2018) and after the policy implementation (2019–2021), were utilised. It should be noted that the CHIA collects data on cannabis-related ED visits and hospitalizations based on the federal fiscal year (FFY) running from October 1st to September 30th of the following year. Therefore, the FFY 2016 represented the data captured over the period from October 1st, 2015, to September 30, 2016. Similarly, the FFY 2021 represented the data captured over the period from October 1st, 2020, to September 30th, 2021.

Measures

The primary outcomes included an ED visit and hospitalisation associated with cannabis intoxication or poisoning. ED

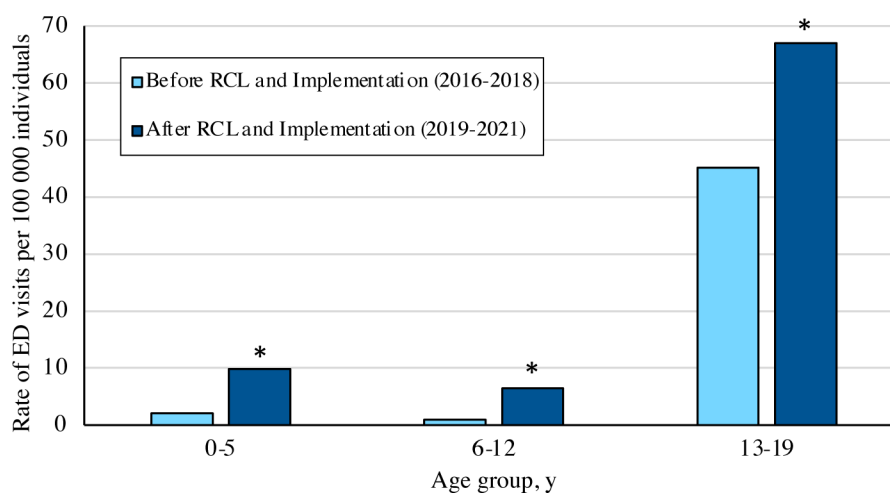


Figure 1 Rate of Emergency Department (ED) Visits Due to Cannabis Exposure Before and After Recreational Cannabis Legalisation and Implementation in Massachusetts, US, stratified by age groups: 2016–2021. *Indicates statistically significant IRRs.

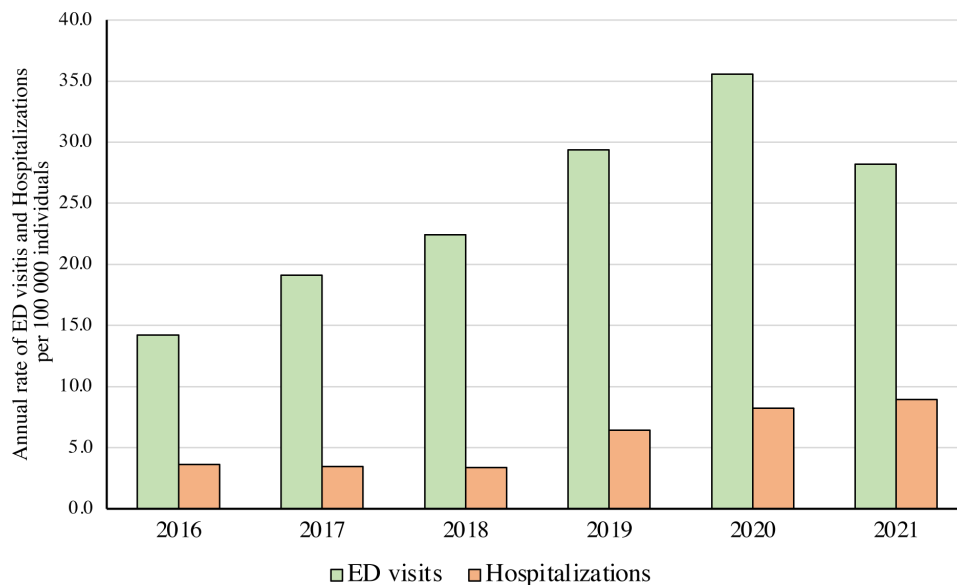


Figure 2 Rate of Emergency Department (ED) Visits and Hospitalizations Due to Cannabis Exposures Among Children in Massachusetts, US from 2016 to 2021.

visits were evaluated using the following International Classification of Diseases, Tenth Revision, Procedure Coding System (ICD-10-PCS) codes listed in diagnostic fields (primary and associated).

Statistical analysis

Rates of ED visits and hospitalizations related to cannabis exposure were compared across the study time periods (pre- and post-policy implementation). Annual rates were calculated per 100 000 persons using age-based population estimates from the University of Massachusetts Donahue Institute (UMDI) in partnership with the Massachusetts Department of Public Health, Bureau of Environmental Health. Incidence rate ratios (IRRs) were computed and compared between pre- and post-policy implementation time periods with 95% confidence intervals (CI) using a Poisson distribution. Generalised linear modelling was utilised as a sensitivity analysis to calculate IRRs while adjusting for the increasing trend in annual rates of ED visits and hospitalizations from FFY 2016 to 2021. All statistical analyses were performed with 2-sided tests, and p-values below 0.05 were considered statistically significant. Data analysis was performed in 2023 using Stata version 17.0 (StataCorp).

Table 2 Cannabis Exposures Among Children in Massachusetts, US, from 2016 to 2021

	Before RCL and implementation, FFY 2016–2018	After RCL and implementation, FFY 2019–2021	P value
Cannabis ED exposure visits per 100 000 individuals			
IRR (95% CI)			
Unadjusted	1 (Reference)	1.7 (1.2–2.3)	0.002
Adjusted for yearly time trend	1 (Reference)	2.0 (1.04–3.75)	0.035
Cannabis-related hospitalisation per 1 000 000 individuals			
IRR (95% CI)			
Unadjusted	1 (Reference)	2.3 (1.8–2.8)	<0.001
Adjusted for yearly time trend	1 (Reference)	2.5 (1.7–3.6)	<0.001

RESULTS

During the 6-year study period, a total of 2357 ED visits and 538 hospitalizations associated with cannabis exposure among children and young adolescents (0–19 years) were reported in MA. Most cannabis-related ED visits included males (1295 [54.9%]), with the 13–19 age group representing the largest proportion (2087 visits [88.5%]). There were zero cannabis intoxication or poisoning-associated deaths reported between FFY 2016–2021.

There were 892 and 1465 cannabis-related ED visits for ages 0–19 reported during the FFY 2016–2018 vs 2019–2021 periods, respectively. The incidence of ED visits for all age groups before and after the policy implementation was 18.5 per 100 000 population and 31.0 per 100 000 population, respectively (IRR, 1.6; 95% CI, 1.5 to 1.8) (table 1). The increase in cannabis-related ED visits was documented across all racial and ethnic groups. The incidence of cannabis-related hospitalizations similarly rose in the post-policy implementation period from 3.5 per 100 000 population to 7.9 per 100 000 population, with a 126% increase for all age groups (IRR, 2.2; 95% CI, 1.9 to 2.7).

When stratified by age, the most significant increase in ED visits related to cannabis exposure was observed among children aged 6–12 years. The incidence rate for this age group in the post-policy implementation period was more than seven times higher than in the pre-legalisation period of recreational cannabis (IRR, 7.2; 95% CI, 4.1 to 12.6) (figure 1). The incidence rate in the youngest group of patients (0–5 years) increased by more than four times following the policy implementation (IRR, 4.5; 95% CI, 3.0 to 6.8).

Sensitivity analysis

The annual rates of ED visits due to cannabis exposure among children and young adolescents increased from 14.2 per 100 000 population in FFY 2016 to the peak of 35.6 per 100 000 population in FFY 2020, with a slight decrease to 28.2 per 100 000 population in FFY 2021 (figure 2). After adjusting for an overall increasing time trend throughout the study period, the period after the recreational cannabis policy implementation (2019–2021) was still associated with an increase in ED visits due to cannabis exposure (IRR, 2.0; 95% CI, 1.04 to 3.75, $p=0.035$).

(table 2). Similarly, when accounting for the pre-post policy implementation trends, the rates of cannabis-related hospitalizations after the recreational cannabis policy implementation (2019–2021) were significantly higher (IRR, 2.5; 95% CI, 1.7 to 3.6, $p < 0.001$).

DISCUSSION

Our study demonstrates increases in the incidences of ED visits and hospitalizations among children and young adolescents due to cannabis exposures following the recreational cannabis policy implementation (2019–2021) in Massachusetts, US. Our findings further contribute to the growing body of evidence linking the availability of recreational cannabis products and increased paediatric cannabis exposures.

The previous study reported an increase in paediatric cannabis exposure cases in Massachusetts following medical cannabis legalisation (2013–2016).³ In contrast to the previous work showing that medical cannabis legalisation primarily impacted teenagers aged 15 to 19 years, the legalisation and implementation of recreational cannabis were associated with increases in cannabis exposure cases across all age groups. Moreover, considering the highest rates of increase observed in the age groups of 0–5 and 6–12 years, young children remain particularly vulnerable to cannabis exposure. These findings suggest that commercially available cannabis products, while not intended for use by children, are being unintentionally consumed by the youngest children. While our study lacks data on the types and appearance of cannabis products, the resemblance of manufactured edible products to commercially available candy has been previously highlighted as a public health concern.^{9 10}

Our analysis also extends the existing evidence from other US states and Canada, indicating the increased burden associated with cannabis exposure among children after recreational cannabis legalisation and implementation.^{5 11 12} The trends of unintentional paediatric cannabis exposures persist despite strict regulations, including child-resistant packaging, warning labels, and attempts at minimising the appealing resemblance to commercially available products.^{13 14}

Limitations

Our study limitations include a lack of data on specific cannabis product types. Therefore, it is possible that cannabis exposure due to other sources (eg, illicit products) may contribute to the reported increase in ED visits. Additionally, when stratified by age groups, the annual rates of ED visits/hospitalizations were lacking due to the state's requirement to suppress data if the number of encounters was < 11 . The current study is also limited by the lack of data on whether cannabis exposure among children was unintentional or intentional. However, it may be reasonable to assume that most young children, primarily those aged 0–5 years, experienced unintentional cannabis exposure.

CONCLUSIONS

In Massachusetts, US, recreational cannabis legalisation and implementation resulted in an increased number of ED visits and hospitalizations among children and young adolescents. Considering the increasing number of states and countries legalising recreational cannabis, further effective preventive strategies and regulatory measures are needed to limit the growing impact of

cannabis exposure on the paediatric population and mitigate the unintended consequences of commercial cannabis.

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– SUPPLEMENTAL MATERIAL –

Recreational Cannabis Legalization and Pediatric Exposures in Massachusetts, United States

Case Definition

Emergency Department (ED) visits were evaluated using the following International Classification of Diseases, Tenth Revision, Procedure Coding System (ICD-10-PCS) codes listed in diagnostic fields (primary and associated). The data is limited to cannabis intoxication and unintentional/undetermined cannabis poisoning.

- F12.12 cannabis abuse with intoxication
- F12.22 cannabis dependence with intoxication
- F12.92 cannabis use, unspecified with intoxication
- T40.7X poisoning by cannabis (unintentional) prior to 2021
- T40.7X4 poisoning by cannabis (undetermined) prior to 2021
- T40.711 poisoning by cannabis, accidental (unintentional) new code
- T40.714 poisoning by cannabis, undetermined
- T40.721 poisoning by synthetic cannabinoids, accidental (unintentional) new code
- T40.724 poisoning by synthetic cannabinoids, undetermined new code

Selection Criteria and Representativeness of Study Participants

All ED visits and Hospitalizations among children and adolescents (Massachusetts residents only) aged 0-19 were included. Hospitalizations included hospital stays and observation stays combined. To minimize double counts, hospitalization excluded cases transferred to another acute care hospital. The Massachusetts Center for Health Information and Analysis (CHIA) database captures all acute care ED visits and hospitalizations across Massachusetts, and all patients were included regardless of insurance status. Given the use of the population-level data for this study, the findings may be generalizable to other states and countries with similar approaches to medical and recreational cannabis legalization.