Presentation of pediatric cannabis ingestion in the emergency department

Cannabis toxicity should be considered in any child who presents with altered mental status, irritability, or ataxia, as well as nonspecific presentations.

Adam P. Sage, MD, MSc, Mohamed Alahmadi, MD, FRCPC, Vikram Sabhaney, MD, FRCPC, Jessica Moe, MD, FRCPC, MSc, MA

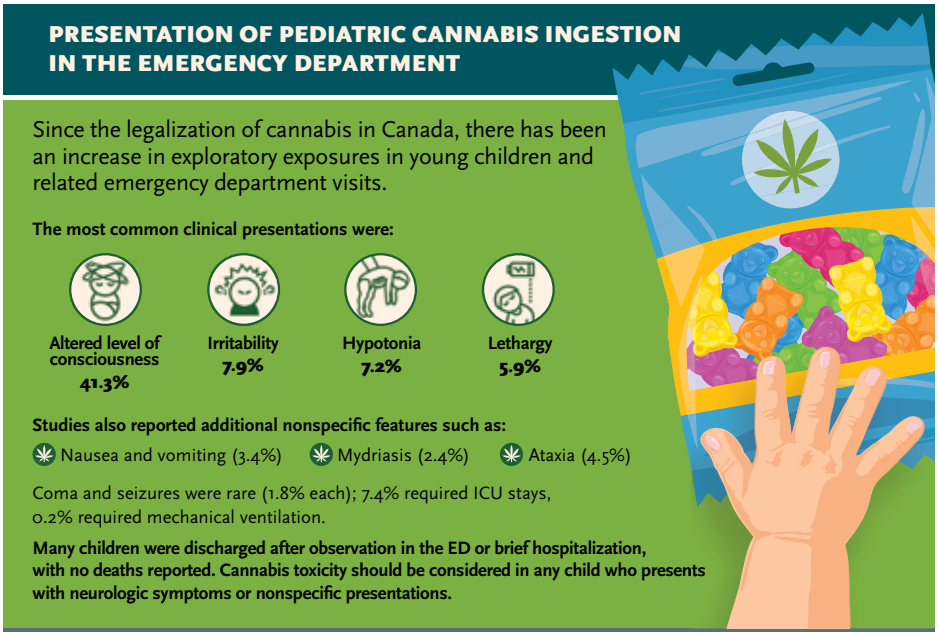
ABSTRACT

Background: Since the legalization of cannabis in Canada, there has been an increase in exploratory exposures in young children and related emergency department visits.

Methods: We synthesized published peer-reviewed studies on clinical presentations, management, and outcomes in children with unintentional exposure to cannabis. We reviewed the Medline and Embase databases for articles that discussed unintentional exposures to cannabis in children (≤ 18 years of age).

Results: We identified 429 articles, of which 46 met our inclusion criteria. Most patients (88.0%) ingested edible cannabis products, which included gummies, candies, chocolates, or baked products. The most common presentations included altered level of consciousness (41.3%), irritability (7.9%), hypotonia (7.2%), and lethargy (5.9%); however, additional nonspecific features such as nausea and vomiting (3.3%), mydriasis (2.4%), and ataxia (4.5%) were also reported. Serious presentations such as coma and seizure were infrequently reported (1.8% each), and some patients required mechanical ventilation (0.2%) or ICU stays (7.4%). Many children were ultimately discharged after observation in the emergency department or following brief hospitalization, and no deaths were reported. Urine toxicology screen was the most common method of confirming unintentional cannabis exposure (61.1%).

Conclusions: Cannabis toxicity should be considered in any child who presents with neurologic symptoms or nonspecific presentations. Prompt recognition may limit unnecessary extensive or invasive testing.



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Dr Sage is a pediatric resident physician at the University of British Columbia. Dr Alahmadi recently completed a pediatric emergency medicine fellowship at UBC and is now an attending physician at Prince Mohammed Bin Abdulaziz Hospital in Madinah, Saudi Arabia. Dr Sabhaney is an attending emergency medicine physician at BC Children's Hospital, research director of pediatric emergency medicine at BC Children's, and a clinical assistant professor at UBC. Dr Moe is an attending emergency medicine physician at Vancouver General Hospital and BC Children's, scientific director of the Emergency Opioid Innovation Program at Emergency Care BC, an assistant professor with the Department of Emergency Medicine at UBC, and a clinician scientist with the BC Centre for Disease Control.

Corresponding author: Dr Adam P. Sage, adam.sage@phsa.ca.

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Background

The Cannabis Act, introduced for the purpose of deterring illicit activities and reducing the burden on the criminal justice system and the associated marginalization of specific groups, came into effect in Canada in October 2018 in a two-phase process.[1] One year after initial legalization of cannabis, access to cannabis products was extended from dried flowers, seeds, and oils to include edible cannabis products such as gummies and chocolates.[2]

Since the introduction of the Cannabis Act, there has been an increase in presentations to care—both ED visits and hospitalizations—due to unintentional cannabis exposure among children.[3,4] In Ontario, an increase from 0.8 to 9.6 cannabis-poisoning-related ED visits per 100 000 ED visits occurred between 2015 and 2019; a further increase to 18.1 cannabis-poisoning-related ED visits per 100 000 ED visits occurred in 2021, corresponding to a higher proportion of presentations related to the legalization and ingestion of edible cannabis products.[3] The higher burden of unintentional cannabis exposure since legalization is due in part to exploratory ingestions by children of often sweet-tasting and attractive-looking edible products.[5]

The psychoactive component of cannabis—tetrahydrocannabinol (THC)—is primarily responsible for CNS toxicity in pediatric exposures. THC is a lipophilic molecule that exerts its effects differently in children than in adults. Due to decreased adiposity and more localized arrangement of specific cannabinoid receptors in the brainstem, children experience more potent CNS effects compared with adults.[6,7] Further, because the onset of symptoms is often delayed up to 2 hours from the time of ingestion of edible cannabis products, children can continue to consume those products, leading to accumulation of high and very dangerous amounts of THC in the bloodstream.[8,9] Children with exposure to THC often present to care with nonspecific CNS symptoms, including altered level of consciousness, gait abnormalities, and seizures, as well as vital sign changes of tachycardia or respiratory depression.[10]

These features make unintentional cannabis exposure difficult to diagnose and subsequently to manage, which often results in increased hospital length of stay for observation.[11] Due to the increasing incidence of unintentional cannabis exposure, clinicians must be comfortable recognizing and treating cannabis intoxication in children. We reviewed the current published literature on unintentional exposure to cannabis in children and youth with the aim of providing a clinical resource for health care providers. To that end, we describe presenting signs and symptoms, management, and outcomes in pediatric patients with unintentional cannabis exposure.

Due to the increasing incidence of unintentional cannabis exposure, clinicians must be comfortable recognizing and treating cannabis intoxication in children.

Methods

Eligibility criteria

We included published peer-reviewed studies of children (≤ 18 years of age) with confirmed unintentional ingestion of cannabis. We required studies to describe the route of cannabis exposure, clinical signs and symptoms, investigations and medical interventions performed, and/or outcomes and disposition. We excluded narrative reviews and articles written in a language other than English.

Information sources and search strategy

We reviewed published articles in both the Medical Literature Analysis and Retrieval System Online (Medline; Ovid) and Embase (Ovid) databases, from their inception (Medline: 1946; Embase: 1974) to the date of our search (26 July 2022). We used Medical Subject Headings (MeSH), keywords, and author-assigned terms to identify articles that discussed unintentional cannabis ingestion in pediatric patients **[Tables S1 and S2]**. (All supplementary files are available at bcmj.org.)

Study selection and data extraction

We first screened article titles to remove duplicates, those not written in English, and those that did not discuss the effects of cannabis ingestion in humans. We then obtained the articles we identified for review from the University of British Columbia Library. We removed articles that were not available in the library's database; referred to an adult-only population or the intentional ingestion of cannabis; did not describe clinical presentation, treatment, or outcome; or were narrative reviews **[Figure S1]**. We then reviewed the full text of eligible articles and summarized it in relation to our study aim. **Table S3** presents a summary of these articles.

We present results as percentages of patients who were reported to be within a particular clinical category (e.g., symptom category) **[Table 1]**.

Results

Search results and population demographics

Our search strategy yielded 429 articles. On initial review of titles and abstracts, we removed 97 duplicate articles and another 245 articles based on our exclusion criteria. We reviewed the full text of 87 articles and included 46 of them in our final review, 16 of which were abstracts in press **[Figure S1, Table S3]**. The included articles were published between 1983 and 2022, six prior to 2012. Most articles were published in the United States (n = 22), followed by Canada (n = 7) and France (n = 7); a small number were published in Italy (n = 3), Ireland (n = 2), Algeria (n = 1), Australia (n = 1), Portugal (n = 1), Scotland (n = 1), and the United Kingdom (n = 1). The studies included retrospective cohort studies (n = 17), case

TABLE 1. Number and proportion of patients in included articles, with respect to specific variables discussed.

Variable	No. patients per variable (%)	Total no. patients in study	No. articles
Exposure route			
Edible products	15 979 (88.0)	18 179	27
Unknown	1 160 (6.4)	18 162	27
Inhalation	912 (5.9)	15 581	11
Signs and symptoms			
Altered mental status	2 127 (41.3)	5 145	32
Irritability	346 (7.9)	4 391	11
Lethargy	238 (5.9)	4 049	19
Nausea/vomiting	257 (3.3)	7 806	10
Coma	268 (1.8)	14 972	13
Seizure	212 (1.8)	12 040	19
Respiratory depression	258 (1.7)	15 012	16
Physical examination findings			
Hypotonia	353 (7.2)	4 902	15
Conjunctival injection	50 (4.9)	1 018	8
Ataxia	359 (4.5)	7 928	16
Tachycardia	362 (4.5)	8 111	18
Mydriasis	161 (2.4)	6 626	13
Hypotension	142 (1.2)	12 053	14
Bradycardia	99 (0.8)	11 792	7
Investigations			
Basic bloodwork	240 (71.6)	335	23
Urine drug screen	1 449 (61.1)	2 373	33
Chest X-ray	9 (36.0)	25	18
ECG	74 (26.8)	276	14
CT scan of head	88 (23.6)	373	15
Serum drug screen	270 (20.9)	1 291	23
Abdominal ultrasound	40 (14.7)	273	13
EEG	29 (10.5)	276	14
Lumbar puncture	50 (7.3)	685	15
Clinical trajectory			
Admission to ward	7 842 (43.5)	18 045	28
Observation < 12 h in ED	1 450 (29.9)	4 856	18
Admission to ICU	1 346 (7.4)	18 172	23
Management			
IV fluids	1 863 (11.4)	16 326	25
Supplemental oxygen	261 (1.9)	13 929	22
Medications (flumazenil or benzodiazepines)	194 (1.2)	16 045	23
Gastric decontamination (activated charcoal or gastric lavage)	323 (1.9)	16 989	23
Mechanical ventilation	30 (0.2)	17 719	30

reports (n = 15), case series (n = 11), a systematic review (n = 1), an observational study (n = 1), and a prospective cohort study (n = 1) **[Table S3]**. The articles summarized clinical presentations, treatments, and/or outcomes for a total of 21 885 patients. Patients' ages ranged from 2 months to 17 years; 44.9% were born female, 48.3% were born male, and 6.8% did not have their sex documented **[Table S3]**.

Exposure

Note: The studies we referenced in each clinical category discussed are referred to by roman numeral in the following text and are available at bcmj.org.

Of the 46 studies reviewed, 35 (n = 18 192 patients)[i] included a description of the route of exposure **[Table 1]**. Most patients (88.0%) ingested edible cannabis products,[ii] which included gummies, candies, chocolates, or baked products. Only 5.9% of patients experienced unintentional inhalational exposure,[iii] and 6.4% had confirmed exposure via an unknown route.[iv]

Clinical presentation

Most articles described symptoms associated with cannabis exposure in children (40 articles, n = 20 724 patients)[v] **[Table 1]**. The most common clinical presentations involved CNS symptoms: altered mental status (41.3% of patients),[vi] followed by irritability (7.9%)[vii] and lethargy (5.9%).[viii] Presentations that required critical intervention were less frequently reported: coma (1.8%),[ix] seizure (1.8%),[x] and respiratory depression (1.7%).[xi] With respect to non-CNS-related presentations, the studies described mainly gastrointestinal symptoms, specifically nausea and vomiting (3.3%).[xii] The articles infrequently discussed other symptoms noted at initial presentation, including blurred vision, headache, and decreased appetite. We did not summarize the frequency of these symptoms because of the limited number of patients involved.

Physical examination findings

Physical examination findings were described less frequently (32 articles, n = 20 097

patients) **[Table 1]**. The most common findings on examination were hypotonia (7.2%),[xiii] conjunctival injection (4.9%),[xiv] and ataxia (4.5%).[xv] Mydriasis was also present in 2.4% of children exposed to cannabis.[xvi] Vital sign abnormalities included tachycardia (4.5%),[xvii] hypotension (1.2%),[xviii] and bradycardia (0.8%).[xix]

Investigations, management, and clinical outcomes

Overall, investigations were more often related to the clinical scenario than to cannabis ingestion. Many articles either described patients who did not receive investigations or focused on clinical trajectory with no discussion of investigations. Of the 46 studies reviewed, 34[xx] included some description of investigations. These studies included 4916 patients, 22.5% of the total 21 885 patients described in the articles included in this review.

Urine toxicology screen was the most common method of confirming unintentional cannabis exposure (61.1%)[xxi] **[Table 1]**. A smaller proportion of patients underwent serum drug screening (20.9%), although the specific substances tested were rarely discussed.[xxii] Basic laboratory analyses (complete blood count, electrolytes, liver panel, C-reactive protein, and/or blood cultures) were performed in 71.6% of patients.[xxiii] The use of diagnostic imaging was infrequently reported. Chest X-rays (36.0%),[xxiv] abdominal ultrasounds (14.7%),[xxv] and CT scans of the head (23.6%)[xxvi] were performed in some patients. Lumbar punctures were performed on 7.3% of patients.[xxvii] Ancillary investigations included ECG (26.8%)[xxviii] and EEG (10.5%).[xxix]

In the 38 articles that described disposition for patients with unintentional cannabis exposure (n = 18 445 patients),[xxx] most patients were monitored either in the ED (29.9%)[xxxi] or on the ward (43.5%).[xxxii] A smaller proportion of patients (7.4%)[xxxiii] required admission to the ICU, most often for intensive monitoring.

Management specific to THC was not typically required; when reported (32 articles; 20 625 patients),[xxxiv] it was largely supportive. Intravenous fluids were administered in 11.4% of patients,[xxxv] and supplemental oxygen was used in 1.9% of patients.[xxxvi] Gastric decontamination with activated charcoal was used in 1.9% of patients,[xxxvii] and two single-patient case reports published prior to legalization reported the use of gastric lavage.[xxxviii] Medications were very rarely used and were targeted to the clinical scenario; benzodiazepines were used in cases of seizure (1.2%).[xxxix] The benzodiazepine antagonist flumazenil was reported to treat a single case of altered level of consciousness with no clear exposure history.[xl] Finally, 0.2% of patients required mechanical ventilation[xli] because of poor respiratory effort or severely altered level of consciousness.

Most pediatric cannabis toxicity presentations are related to accidental ingestion of edible cannabis products. Preventive strategies should be aimed at reducing the availability of these products to young children.

In all the articles reviewed, there were no cases of death resulting from unintentional cannabis ingestion. The articles focused on patients' presentation and course in hospital; there was limited discussion of long-term follow-up and outcomes.

Discussion

Our review included 46 articles that described nearly 22 000 pediatric patients who presented to care in the setting of unintentional exposure to cannabis. These children were exposed to cannabis primarily through accidental ingestion of edible cannabis products. The most common presenting symptoms and signs associated with exposure were altered mental status, irritability, lethargy, and hypotonia. A small subset of patients had more serious presentations, with seizure, coma, or respiratory involvement. Most patients were discharged after observation, either in the ED or in hospital. A relatively small proportion of patients required admission to the ICU, which was often out of a need for intensive monitoring due to seizure or a substantially altered level of consciousness. Management of cannabis exposure was largely supportive, with intravenous fluids or supplemental oxygen. Many patients had exposure confirmed through urine toxicology screen. Further investigations were performed sparingly, in less than 5000 patients. Despite this, some patients underwent invasive investigations, such as lumbar puncture or exposure to ionizing radiation from neuroimaging. Reassuringly, no cases resulted in death.

Due to the widespread legalization of cannabis in Canada and other countries, it is important for clinicians to feel comfortable recognizing and managing accidental cannabis intoxication in the pediatric population. Most pediatric cannabis toxicity presentations are related to accidental ingestion of edible cannabis products. Unsurprisingly, the literature indicates a temporal association between the introduction of edible cannabis products in Canada and increased numbers of pediatric ED visits for cannabis exposure.[6] Thus, preventive strategies should be aimed at reducing the availability of these products to young children, as highlighted by the Canadian Paediatric Society. This includes implementing strict labeling standards and package warnings, especially in relation to visually attractive forms of edible cannabis like candies and chocolate; creating promotional limitations, especially with respect to social media; and restricting access to cannabis near locations frequented by children.[12]

An added challenge for physicians in managing unintentional cannabis exposure in children who present to the ED is the consideration of child maltreatment or neglect. Canadian data on rates of unintentional cannabis exposure are limited. Globally, the literature suggests there are

high rates of referral to social services or child protection services for further assessment of neglect or maltreatment.[13] While some argue for widespread involvement of child protection services, others highlight the potential harm to families and exacerbation of sociocultural inequities inherent in current reporting structures. Recently, Raz and colleagues presented guidelines for practitioners on reporting to child protection services in cases of unintentional cannabis exposure, asking "1. Was this [truly] unintentional? 2. Did parents or guardians take steps to prevent ingestion, even if inadequate? 3. If the ingested substance was not THC, would this event be reportable? 4. What other factors contributed to this outcome?"[14] Taken together, the decision to report to child protection services should be based on the context of each case, in tandem with local reporting guidelines. For further guidance, the Government of British Columbia developed *The B.C. Handbook for Action on Child Abuse and Neglect*.[15]

Consistent with the pathophysiology of THC exposure in children, most patients presented with CNS findings. However, in our review, signs and symptoms of cannabis exposure were nonspecific; thus, it is important that clinicians maintain a high index of suspicion for cannabis exposure in children with nonspecific presentations. Urine toxicology can be used to confirm the diagnosis of THC exposure in children, because it has high sensitivity and specificity (both near 92%) for acute edible cannabis ingestions and a low proportion of false positives from secondhand cannabis smoke.[16,17] Given the varied presentations in unintentional cannabis ingestion, clinicians should inquire about access to substances when taking histories and consider including urine toxicology as part of the initial workup for children who present with altered mental status, irritability, and/or lethargy, particularly if there is an unknown or unclear history of ingestion. The investigations and therapies described in our review were largely case specific, indicating a lack of clear consensus in the literature. In cases of unintentional cannabis intoxication, the cornerstones of management are appropriate monitoring and supportive measures such as intravenous fluids and oxygen, as indicated.

Key findings and recommendations regarding cannabis exposure in children are summarized in the **Box.**

BOX. Unintentional cannabis exposure in children: Key findings and recommendations.

Clinical problem

- Increased access to and attractive marketing and formulations of cannabis products have resulted in increased unintentional cannabis exposure among children and associated visits to the ED.
- Symptoms and signs commonly associated with cannabis exposure are nonspecific.
- There is no exact dose–response relationship for cannabis, but oral bioavailability of tetrahydrocannabinol (THC) is higher in children than in adults.

Common presentation

- Symptoms: altered mental status, irritability, and lethargy.
- Signs: hypotonia, conjunctival injection, ataxia, and tachycardia.

Diagnosis and management

- In the absence of a clear exposure history, a high index of suspicion should be maintained in children with altered mentation. This may prompt recognition of cannabis exposure and limit excessive diagnostic testing.
- Urine toxicology is the method of choice for confirming cannabis exposure: it is sensitive, specific, and accessible.
- Blood investigations are nonspecific for cannabis exposure but may be helpful to exclude co-ingestions.
- Most children require supportive care and monitoring for respiratory compromise, seizure, or severe obtundation.
- Most children can be discharged after observation in the ED if they demonstrate improvement in symptoms; however, some may require admission to hospital.

Other considerations

- Consideration should be given to contacting child protection services on a case-by-case basis.
- Parents and guardians should be counseled on the safe handling and storage of cannabis.
- Legislation on access to and packaging of cannabis is required to prevent harms associated with exposure.

Study limitations

Our review was limited by the quality of the studies included, which retrospectively described clinical presentations, interventions, and short-term sequelae of unintentional cannabis exposure. Given their retrospective and short-term nature, most studies lacked comparisons to other causes of altered consciousness and did not describe long-term outcomes. To ensure a comprehensive review of the literature, we included case series, case reports, and abstracts in press. This introduced a potential bias toward the most symptomatic or severe presentations being included as case reports, which would overestimate the frequency of the symptoms and signs of unintentional cannabis exposure. Further, given the limited availability of published literature, our review included articles from

worldwide populations, some of which may not be immediately generalizable to the specific context of Canadian EDs. A review of presentations of cannabis poisonings in the BC Children's Hospital ED prior to legalization indicated that only 1.1% of poisonings treated at BC Children's from 2016 to 2018 were related to unintentional cannabis exposure; this highlights the need for ongoing surveillance in BC EDs.[18]

Conclusions

Unintentional exposure to cannabis is an increasingly prevalent clinical entity. Due to the nonspecific nature of historical and physical examination findings of unintentional cannabis exposure in children, cannabis toxicity should be considered in any child who presents with neurologic symptoms such as altered mental status, irritability, or ataxia, as well as nonspecific presentations. Prompt recognition may limit unnecessary extensive or invasive testing. Despite the rarity of serious complications, including respiratory depression and seizures, future studies should seek to better identify risk factors for children to develop these complications. Beyond recognition of cannabis intoxication, clinicians and policymakers should address prevention through advocacy, counseling, and guideline-supported interventions to limit unintentional pediatric cannabis exposures to prevent harms. ■

Competing interests

None declared.

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