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Original quantitative research

Setting the baseline: a description of cannabis poisonings at a Canadian pediatric hospital prior to the legalization of recreational cannabis

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Abstract

Introduction: This study describes the events and circumstances preceding children aged 16 years or younger being treated for cannabis poisoning in the emergency department (ED) of a Canadian pediatric hospital.

Methods: We extracted cannabis poisonings treated in the ED at British Columbia Children's Hospital (BCCH) between 1 January, 2016, and 31 December, 2018, from the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) database. The poisonings were distinguished by the inadvertent or intentional ingestion of cannabis. We reviewed the hospital's electronic health information system and the patients' health records to obtain additional information on the context, including spatial and temporal characteristics.

Results: Of the 911 poisonings treated at BCCH, 114 were related to intentional cannabis use (12.5%). Fewer than 10 poisonings resulted from inadvertent ingestion by children, and the median age for these was 3 years. All inadvertent ingestions occurred at home and involved cannabis belonging to the patient's family. The vast majority of poisonings resulted from the intentional use of cannabis only (28.9%) or cannabis use with other psychoactive substances (co-ingestions; 71.1%). The median patient age was 15 years. Most patients reported consuming cannabis through inhalation and with peers. Cannabis and co-ingestion poisonings were more often reported on weekdays than weekends. The consumption of cannabis leading to poisoning more often occurred in private residences. Patients with cannabis poisoning more often sought medical treatment themselves or were helped by their family.

Conclusion: The characteristics of cannabis poisonings among children are described for the three-year period prior to recreational cannabis legalization in Canada in order to set a baseline for future comparisons. Implications for improving injury prevention initiatives and policies are discussed.

Keywords: *cannabis, marijuana, substance use, poisoning, child, youth, injury prevention*

Highlights

- Few pediatric poisonings involved the inadvertent ingestion of cannabis; in these cases, patients consumed cannabis found in their home.
- The vast majority of pediatric cannabis poisonings resulted from intentional use. Of these, more poisonings resulted from cannabis co-ingestions with alcohol as compared to cannabis use only.
- Cannabis was most often intentionally consumed in the company of peers and in private residences.
- Cannabis-only and cannabis co-ingestion poisonings were more often reported on weekdays than on weekends.
- A higher proportion of patients with cannabis poisoning sought medical treatment themselves or were helped by family members, rather than being helped by a bystander.

Introduction

Cannabis is one of the most commonly reported illicit psychoactive substances consumed by Canadian children, aside from alcohol.[1,2] Despite laws and regulations restricting cannabis access to adults over 18 years of age, an estimated one-fifth of students in Grades 7 to 12 across Canada reported past cannabis use in a 2015 survey.[3] The average age of first cannabis use was reported to be around 14 years and most students reported high confidence in their ability to access cannabis.[3,4]

Cannabis can elicit feelings of euphoria when consumed in moderation,[5] but to an inexperienced user, the effects can produce negative outcomes. Children are especially vulnerable to cannabis poisoning due to their metabolism and lower body weight.[6,7] Other contributing factors

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to cannabis poisoning include inexperience with using psychoactive substances;[8] substances obtained from unlicensed sources;[9] co-ingestion with stimulants, opioids, or psychedelics;[10,11] and lack of insight into harm reduction behaviours.[12] Common signs of cannabis poisoning include vomiting, dizziness, slurred speech and a decreased level of consciousness.[13-15] Oftentimes, these symptoms can be resolved in the emergency department (ED) and pose little or no long-term harm.[13]

According to the Canadian Institute for Health Information, approximately 40% of the 23 580 Canadians aged 10 to 24 years who were hospitalized in 2017-2018 for harms caused by substance use have been admitted due to cannabis use. This is equivalent to 25 youth hospitalized each day due to cannabis use.[16] Individuals poisoned by cannabis can be categorized into two groups: inadvertent ingestions and intentional use. Inadvertent ingestions often involve younger children unintentionally exposed to cannabis in the home.[17-19] In comparison, those with intentional cannabis use leading to poisoning tend to be older than their inadvertent counterparts, and are often male.[20] Research into the health impacts of cannabis poisonings continues to be conducted primarily on adult populations. Comparatively less is known about harms to children from exposure to cannabis, and when studied, it is often in the context of inadvertent ingestion.[21-23] Cannabis-related harms in children and youth who intentionally consume cannabis are substantially harder to capture due to the illegal nature of underage use.[24] Therefore, there is limited research into intentional cannabis use leading to poisoning among children, and it is currently unclear how, where, when and with which substance children who intentionally use cannabis are most likely to experience poisonings.

With the October 2018 legalization of recreational cannabis use in Canada impending,[24] the purpose of this study was to examine the circumstances of cannabis poisonings in children aged 16 years or younger resulting in treatment in the ED, in order to establish the baseline dataset for future comparisons. This data included spatial and temporal characteristics of cannabis use leading to poisoning, and the persons responsible for helping poisoned patients seek medical care. The sample consisted of children that were treated in the ED of a pediatric hospital in British Columbia (BC) between 1 January, 2016, and 31 December, 2018. Ethics approval was obtained from the University of British Columbia (UBC), Children's & Women's Health Centre of British Columbia (CW), Research Ethics Board; certificate number H18-03680.

Methods

Data collection and extraction

We accessed data regarding cannabis poisoning–related ED visits at British Columbia Children's Hospital (BCCH) using the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) database. CHIRPP is an ED surveillance system that collects information on all injuries, including poisoning, by means of forms administered by the ED registration clerk to the patient or caregiver. If a patient or caregiver is unable to complete the CHIRPP form, the CHIRPP coordinator uses the information from the hospital's electronic health information system and the patient's health record to complete the form. Subsequently, the coordinator reviews all ED visits daily or near daily to ensure all injuries have been captured comprehensively and accurately.

Once the data were entered into the CHIRPP database, we selected poisoning cases fulfilling the following requirements: patients aged 16 years or younger; injuries with codes "50NI: poisoning or toxic effect" and "900BP: body part not required"; ED visits occurring at BCCH between 1 January, 2016, and 31 December, 2018; and injury event descriptions in which a string search found one or more of the following words: "cannabis," "hash," "CBD," "marijuana," "weed," "THC," "bong," or "edible." To ensure that all cannabis poisonings were captured, we conducted a final review of the injury event descriptions attached to poisonings for those not already captured. Age, sex, description of the poisoning event, time and place of poisoning, substances consumed and patient disposition were collected from the CHIRPP database. The following variables were obtained from the patients' health records and the hospital's electronic health information system: whether the poisoning was due to inadvertent ingestion or intentional use; the location where the substance or substances were consumed; whether the substance or substances were consumed in the presence of another person (peer substance use); whether alcohol, illicit drugs (including fentanyl and its derivatives, heroin, cocaine, methamphetamine, MDMA, psilocybin, LSD/acid) or medication (including prescription or over-the-counter drugs used for other than their intended medicinal purposes) were consumed with cannabis; the primary individual who sought medical care for the patient (treatment-seeking individual); and the mode of arrival at the hospital. The method of cannabis use was characterized as "inhaled" or "orally ingested."

Interrater reliability

We calculated interrater agreement as described by the Cohen kappa statistic for peer substance use and treatment-seeking individual, as this information was not explicit for every poisoning. For peer substance use, two coders were assigned to code "yes" for those who had consumed cannabis with one or more individuals prior to their poisoning, or "no" for those who consumed the substance while alone. For treatment-seeking individual, the coders were instructed to code for "bystander," "patient" or "family or friend." A bystander is defined as an individual who did not participate in the substance use with the patient, and was not a friend or family member of the patient. Family is defined as all individuals within the patient's nuclear and extended family. One-quarter of the poisoning cases containing the coded variables were randomly selected for comparison. The interrater reliability for peer substance use was $\kappa = 0.796$ (SE = .090, $p < .001$) and treatment-seeking individual was $\kappa = 0.755$ (SE = .088, $p < .001$).

Data analyses

Data analyses were conducted using IBM SPSS Statistics Version 25.0 (IBM Corp, Armonk, NY, USA) and RStudio Version 1.2.1335 (R Development Core Team, Vienna, Austria). We analyzed data separately for cases of inadvertent ingestion and intentional use. Poisonings resulting from inadvertent ingestion of cannabis were aggregated due to low counts. Those resulting from intentional use were analyzed separately for cannabis-only cases and cannabis co-ingestion cases. Cannabis co-ingestions included patients who consumed cannabis with alcohol, illicit drugs and/or medication. We calculated descriptive statistics and χ^2 tests using SPSS and

conducted the post-hoc analyses with false discovery rate corrections in RStudio using the R Companion package (Mangiafico S, R Companion, version 2.3.21);[25] results were interpreted to be significant if $p < .05$.

Results

Between 1 January, 2016, and 31 December, 2018, there were 114 ED visits due to poisoning by intentional cannabis use, representing 12.5% of all 911 poisoning-related ED visits at BCCH.

Fewer than 10 patients captured reported inadvertent cannabis ingestion.

Inadvertent cannabis ingestion leading to poisoning

Although few patients were treated for poisoning resulting from the inadvertent ingestion of cannabis, they shared common circumstances and events that led up to their presentation at the BCCH ED. This sample consisted predominantly of male patients ranging from 1 to 11 years of age. The median age was 3 years (interquartile range [IQR] = 1–7.5 years). Most inadvertent ingestions occurred on a weekend (i.e. Saturday or Sunday) while the patient was at home. Products inadvertently ingested by the patient included edibles, topicals and undiscarded cannabis cigarettes. All products mentioned belonged to the parents or siblings of the patient. Patients were brought to BCCH either by their parents or with Emergency Health Services (EHS). Most poisoning symptoms were resolved in the ED and the patients subsequently discharged.

Demographics of intentional cannabis use leading to poisoning

Of the 114 patients with reported intentional use, 28.9% had consumed cannabis only and 71.1% reported co-ingesting cannabis with alcohol, illicit drugs and/or medication (Table 1). The median age of patients was 15 years (IQR: 14–15 years for cannabis-only, 14–16 years for co-ingestions), with ages ranging from 12 to 16 years. Patients' sex did not vary significantly between the two groups ($p = .293$), with cannabis-only use fairly even between males and females, and co-ingestions slightly higher among males than females. The majority of poisonings were described as unintentional as compared to purposeful self-harm, and most patients were discharged directly from the ED.

Temporal distribution of intentional cannabis use leading to poisoning

Over short time periods, poisoning-related ED visits aggregated at certain times in the day ($p = .003$) and days of the week ($p = .014$) (Table 2). Post-hoc analyses indicated that cannabis and co-ingestion poisonings were equally common in the evening and in the morning ($p = .535$), but more cannabis poisonings were reported in the afternoon than the morning ($p = .013$), while more co-ingestion poisonings were reported in the evening than the afternoon ($p = .013$) (data not shown). Both cannabis-only and co-ingestion poisonings were more prevalent on weekdays than weekends (90.9% and 69.1%, respectively).

Characteristics of intentional cannabis ingestion leading to poisoning

Common characteristics of intentional cannabis use leading to poisoning are presented in Table 3. Most cannabis-only and co-ingestion patients reported using inhalation methods achieved either through a blunt, bong, joint, pipe or vaporizer to consume cannabis. Fewer than 15 patients reported using edibles, which included the ingestion of brownies, cookies, chocolate or gummies, and fewer than ten patients reported using multiple consumption methods. Alcohol was the predominant substance used (59.3%) among those who reported co-ingesting other substances along with cannabis, followed by alcohol with illicit drugs (12.3%), and illicit drugs (11.1%) (data not shown). Fewer than five patients reported consuming cannabis with medication, or cannabis with illicit drugs and medication. Regardless of how cannabis was consumed, over half of cannabis-only and co-ingestion poisoning patients reported consuming the substances in the company of peers (54.5% and 60.5%, respectively).

Although one-third of cannabis-only use and one-quarter of co-ingestions occurred in residential spaces such as the patient's home, over one-third of cannabis-only poisoning patients and over half of the patients with co-ingestion poisonings did not provide information on where they consumed the substances. Similar to the location of cannabis consumption, cannabis poisoning events often occurred in residential spaces (39.4% for cannabis-only, 38.3% for co-ingestions), and in public spaces among co-ingestion patients (38.3%), while five cannabis patients reported being poisoned in public spaces.

Almost half of all cannabis-only poisonings were reported by the patient's family or friends (45.4%), while co-ingestion poisonings were most often reported by bystanders (39.5%) and family or friends (34.5%). EHS, including ground and air ambulance, was the most common mode of transport to the ED across all poisonings (69.7% for cannabis-only, 88.9% for co-ingestions).

Discussion

This study describes the events and circumstances preceding treatment for cannabis poisoning of children aged 16 years or younger in the ED of a Canadian pediatric hospital. Further, it establishes the baseline data on pediatric cannabis poisoning seen in the ED from both inadvertent cannabis ingestion and intentional cannabis use, prior to the legalization of recreational cannabis use in Canada. Despite the small sample, the inclusion of those poisoned by inadvertently ingesting cannabis is crucial in capturing the complete range of cannabis poisonings treated at the ED. Consistent with past research, this study found that all cannabis products inadvertently ingested by children, including edibles and inhalation materials, belonged to the patient's family and occurred predominantly on the weekends at the patient's home.[17,18] It is well known that edibles are a particularly dangerous form of cannabis for children, due to their enticing appearance as candy and treats;[23] however, this study highlights the importance of proper storage of all cannabis products securely out of the reach of young children. The continued surveillance of inadvertent cannabis ingestions in children will be especially important for informing health promotion initiatives, policy, and prevention efforts following the October 2019 legalization of cannabis edibles, topicals and extracts in Canada.[26]

Aside from inadvertent ingestions, this study also examined patients treated for pediatric poisoning in the ED following intentional cannabis use—cannabis-only or co-ingestion with other substances. The poisonings were commonly reported on weekdays and involved the inhalation of cannabis. Also, a higher proportion of

TABLE 1
Demographics of patients seen at the emergency department of British Columbia Children's Hospital for poisonings due to the intentional ingestion of cannabis or co-ingestions, CHIRPP, January 2016 to December 2018

Descriptives	Substance used				χ^2	df	*p*-value
	Cannabis		Co-ingestion				
	n	%	n	%			
	33	28.9	81	71.1			
Median age in years (IQR)	15 (14–15)		15 (14–16)				
Sex							
Male	16	48.5	48	59.3	1.11	1	.293
Female	17	51.5	33	40.7			
Intent of poisoning							
Unintentional	45	97.8	59	86.8	—	—	—
Intentional self-harm	*	*	6	8.8			
Other intents	*	*	*	*			
Patient disposition							
No treatment (advice only, diagnostic testing, referred to GP)	7	21.2	19	23.5	—	—	—
Treated, follow-up may or may not be required	7	21.2	27	33.3			
Observation, follow-up may or may not be required	16	48.5	26	32.1			
Admittance into hospital for treatment	*	*	8	9.9			
Other treatments	*	*	*	*			

Abbreviations: CHIRPP, Canadian Hospitals Injury Reporting and Prevention Program; df, degrees of freedom; GP, general practitioner; IQR, interquartile range.

Notes: Dashes indicate the absence of a χ^2 test, due to the violation of one or more assumptions of the test. Asterisks (*) indicate absolute frequencies of fewer than five. "Other intents" are unspecified assault or event of undetermined intent. "Other treatments" are admitted primarily for reason other than injury treatment, left without being seen by physician, referred to other hospital or specialist clinic for injury treatment.

patients reported consuming the substances with peers and in residential spaces. Together with the finding that most poisonings were unintentional in nature and required minimal treatment in the ED, these trends may be indicative of the lack of awareness of harm reduction methods concerning cannabis use. Prior research has shown that Canadian children and youth who use cannabis are more likely to downplay the harms of its use compared to those who don't use cannabis.[3,4] When this lack of awareness is combined with the risks inherent in purchasing cannabis of varying quality from illicit markets, the chances that people will experience adverse effects may be dramatically increased.[27] With the legalization of recreational cannabis, it has become more important than ever to educate children about the risks of cannabis and harm reduction behaviours.

While patients' lack of understanding of their own tolerance for cannabis might have been the cause of some of the pediatric poisonings, it should be noted that there were twice as many co-ingestion poisonings treated at the ED as cannabis-only poisonings. Alcohol was identified as the predominant substance in co-ingestion cannabis poisonings. Numerous studies have reported on the practice of mixing cannabis with alcohol among student populations to accelerate and prolong the euphoric experience.[28,29] In vivo studies have confirmed the impact of alcohol on increasing blood THC levels.[30] Our study extended these findings by comparing the proportion of cannabis-only poisonings seen in the ED with co-ingestion poisonings. This information provides a basis for discussion of how government policies can work towards discouraging polydrug use involving cannabis among children.

Other key topics we examined were the individual seeking medical treatment for the poisoning patient, and the location of the patient when the poisoning event was recognized. This framework has been used extensively to study the overdose response in the opioid crisis,[31-33] resulting in valuable data for emergency responders on when and where overdoses are most likely to occur. In our study, a higher proportion of cannabis-only poisoning patients presenting at the BCCH ED sought medical treatment for themselves or received help from family or friends, as compared to receiving help from a bystander. This is consistent with the finding that cannabis-only use and subsequent poisoning often occurred within private, residential homes rather than in public spaces. In contrast, patients with co-ingestion poisonings were often helped to hospital by bystanders. These poisonings often occur in public spaces, and therefore co-ingestion patients may be more likely to be noticed by bystanders than if the poisonings occur in secluded locations such as private homes. Further studies are needed to understand the individual factors and decisions that contribute to whether a bystander, family member or friend acts to intervene during a cannabis poisoning event. Our findings suggest that it may be helpful to educate the public about responding to cannabis poisonings in children so that bystanders are more likely to offer assistance when required.

TABLE 2
Temporal distribution of cannabis and co-ingestion poisonings due to intentional ingestions seen at the emergency department of British Columbia Children's Hospital, CHIRPP, January 2016 to December 2018

Descriptives	Substance used				χ^2	df	*p*-value
	Cannabis		Co-ingestion				
	n	%	n	%			
	33	28.9	81	71.1			
Time							
Morning	*	*	19	23.5	**11.86**	**2**	**.003**
Afternoon	15	45.5	13	16.0			
Evening	14	42.4	47	58.0			
Unknown	*	*	*	*			
Time in the week							
Weekday	30	90.9	56	69.1	**6.00**	**1**	**.014**
Weekend	*	9.1	25	30.9			
Season							
Spring	5	15.2	23	28.4	7.76	3	.051
Summer	10	30.3	18	22.2			
Autumn	8	24.2	30	37.0			
Winter	10	30.3	10	12.3			
Year							
2016	8	24.2	27	33.3	1.20	2	.549
2017	10	30.3	25	30.9			
2018	15	45.5	29	35.8			

Abbreviations: CHIRPP, Canadian Hospitals Injury Reporting and Prevention Program; df, degrees of freedom.

Notes: Dashes indicate the absence of a χ^2 test, due to the violation of one or more assumptions of the test. Bolded values indicate significant findings at the $p < .05$ level. Asterisks (*) indicate absolute frequencies of fewer than five. Time: morning = 12:00 a.m.– 11:59 a.m; afternoon = 12:00 p.m.–5:59 p.m; evening = 6:00 p.m.–11:59 p.m. Weekdays are Monday, Tuesday, Wednesday, Thursday, and Friday. Weekends are Saturday and Sunday. Season: spring = March to May; summer = June to August; autumn = September to November; winter = December to February.

Strengths and limitations

To date, only a handful of papers have documented the injury landscape of Canadian children poisoned from the inadvertent consumption or intentional use of cannabis, and few studies have attempted to conduct a review of patients' medical records in order to understand the narrative taking place before and after the poisoning event. By utilizing multiple data sources such as CHIRPP, the hospital's electronic health information system and patients' health records, this study was able to describe a population frequently overlooked in the literature and provide context on the circumstances of cannabis poisoning among Canadian children prior to the legalization of recreational cannabis use. The next step will be to continue surveillance of these pediatric cannabis poisonings in order to understand how legalization influences cannabis poisonings in children resulting in ED visits.

The major limitation of this study stems from the reliance on self-reported data by the patients, caregivers, EHS and ED staff regarding the circumstances of the poisoning events. Missing data were most common for the location of consumption, the location of poisoning and the treatment-seeking individual.

Socioeconomic variables, such as ethnicity, education level and household income, and details on cannabis use (including source and strain of cannabis and frequency of use) were also unavailable. Our sample also represents a small proportion of Canadian children who were treated at one hospital in BC; results may not be representative of youth aged 17 years or older, children declared deceased at the scene of the poisoning, populations in rural areas or those residing in other Canadian provinces and territories.

Conclusion

The vast majority of cannabis poisonings seen in the ED were among patients aged 12 to 16 years who intentionally used cannabis in combination with other psychoactive substances. This study sets a baseline for pediatric cannabis poisonings in the ED, and highlights the need for post-legalization surveillance in order to inform future prevention efforts.

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TABLE 3
Characteristics of cannabis and co-ingestion poisonings from intentional ingestions, patients' health records, British Columbia Children's Hospital's electronic health information system, January 2016 to December 2018

Characteristics	Substance used				χ^2	df	*p*-value
	Cannabis		Co-ingestions				
	n	%	n	%			
	33	28.9	81	71.1			
Method of cannabis use							
Inhalation	23	69.7	65	80.2	—	—	—
Ingestion	10	30.3	*	*			
Multiple	*	*	*	*			
Unknown	*	*	12	14.8			
Peer substance use							
No	11	33.3	13	16.0	2.93	1	.087
Yes	18	54.5	49	60.5			
Unknown	*	*	19	23.5			
Location of consumption							
Residential spaces	11	33.3	20	24.7	3.29	2	.193
Other private spaces	6	18.2	*	*			
Public spaces	*	*	12	14.8			
Unknown	12	36.4	45	55.6			
Location of poisoning							
Residential spaces	13	39.4	31	38.3	**9.91**	**2**	**.007**
Other private spaces	9	15.2	7	8.6			
Public spaces	5	15.2	31	38.3			
Unknown	6	18.2	12	14.8			
Treatment-seeking individual							
Bystander	*	*	32	39.5	**9.14**	**2**	**.010**
Patient	8	24.2	9	11.1			
Family or friends	15	45.4	28	34.5			
Unknown	6	18.2	9	14.8			
Mode of ED arrival							
EHS	23	69.7	72	88.9	—	—	—
Family	7	21.2	5	6.2			
Other(s)	*	*	*	*			
Unknown	*	*	*	*			

Abbreviations: ED, emergency department; EHS, emergency health services.

Notes: Dashes indicate the absence of a χ^2 test due to the violation of one or more assumptions of the test. Bolded values indicate significant findings at the $p < .05$ level. Asterisks (*) indicate absolute frequencies of fewer than five. "Inhalation methods" refers to the consumption of cannabis either through a blunt, bong, joint, pipe or vaporizer. "Ingestion methods" involve the ingestion of brownies, cookies, chocolate, or gummies. "Other private spaces" include concerts and festivals, commercial and retail spaces, educational institutions, police stations and major transit stations. "Public spaces" include parks, beaches, roads, streets, libraries and community centres. "Other modes of ED arrival" are self-admittance, with social worker and with friends.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Authors' contributions and statement

AZ and SB conceptualized the plan and objectives for this study. AZ and PC led the data collection. PC conducted the analyses and interpretation of the results, and drafted the manuscript. FR provided assistance with the analysis and interpretation of the manuscript. KT provided support with the ethics application. PC, FR, KT and SB contributed to the review and revision of the manuscript. All authors read and approved the final manuscript.

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