

Edible Cannabis Exposures Among Children: 2017–2019

Jennifer M. Whitehill, PhD,^a Julia A. Dilley, PhD, MES,^b Ashley Brooks-Russell, PhD, MPH,^c Lucia Terpak, MA,^c Janessa M. Graves, PhD, MPH^d

With legal commercialization of cannabis in a growing number of US states, increasing numbers of children have experienced unintentional cannabis exposure resulting in calls to poison control centers, health care visits,¹ and hospitalizations.^{2,3} Edible cannabis products, which can have a high concentration of δ -9-tetrahydrocannabinol and may resemble foods that appeal to youth, have been implicated in many such exposures.^{4,5} In addition, edible products are often sold with multiple doses per package, meaning ingestion of large quantities is possible before effects are realized. Use of edible cannabis products has increased over time,^{6,7} but we lack national estimates of edible-involved pediatric cannabis exposures.

METHODS

We obtained data on cannabis-involved human exposure calls for children aged 0 to 9 years reported to US poison centers from January 1, 2017, to December 31, 2019. Data were extracted from the National Poison Data System (NPDS) in March 2020. The NPDS records the type of product involved in an incident using standardized codes, with generic codes for products that have no reported manufacturer.⁸ Data were composed of all closed incidents involving a cannabis generic code, including the code for edible products (added to NPDS November 16, 2016). Cannabidiol-only and synthetic cannabinoid exposures were excluded.

We compared edible exposures to all other types of cannabis exposures (eg, dried plant, concentrated extracts) and examined differences by age, sex, intentionality, caller location, and medical outcomes as defined by NPDS.⁸ We evaluated changes in exposure counts per quarter using linear regression and testing for differences in trend between edible and nonedible exposures. For 2019, we compared cases in states with legal adult cannabis use to cases in states without, including states with medical cannabis. Comparisons were assessed by using χ^2 tests. Stata 16 software (Stata Corp, College Station, TX) was used and $\alpha = .05$. The Washington State University Institutional Review Board determined this study was exempt from review.

RESULTS

There were 4172 cannabis exposure cases among children aged 0 to 9 years during the study period, of which 45.7% ($n = 1906$) were associated with edible cannabis products (Table 1). From 2017 to 2019, cannabis product exposures increased overall (slope coefficient [β] for quarter 31.6 [95% confidence interval [CI]: 26.0–37.3]), as did the proportion of cannabis cases that were associated with edible products (Fig 1). The increase in edible-related exposures per quarter ($\beta = 26.0$; 95% CI: 23.6–28.3) was greater than the increase in nonedible cannabis exposures ($\beta = 5.7$; 95% CI: 1.4–9.9), confirmed by a significant interaction term in a combined model (interaction



This article has an accompanying video summary.

^aDepartment of Health Promotion and Policy, School of Public Health and Health Sciences, University of Massachusetts Amherst, Amherst, Massachusetts; ^bProgram Design and Evaluation Services, Multnomah County Health Department and Oregon Public Health Division, Portland, Oregon; ^cDepartment of Community and Behavioral Health, Colorado School of Public Health, University of Colorado Anschutz Medical Campus, Aurora, Colorado; and ^dCollege of Nursing, Washington State University, Spokane, Washington

Dr Whitehill conceptualized and designed the study, drafted the initial manuscript, and reviewed and revised the manuscript; Dr Dilley conducted the analyses and reviewed and revised the manuscript; Dr Brooks-Russell conceptualized and designed the study and critically reviewed and revised the manuscript; Ms Terpak contributed to data analysis and critically reviewed and revised the manuscript; Dr Graves conceptualized and designed the study, obtained funding, and critically reviewed and revised the manuscript; and all authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

DOI: <https://doi.org/10.1542/peds.2020-019893>

Accepted for publication Jan 5, 2021

Address correspondence to Jennifer M. Whitehill, PhD, Department of Health Promotion and Policy, School of Public Health and Health Sciences, University of Massachusetts Amherst, 715 N Pleasant St, Room 338, Amherst, MA 01003. E-mail: jmw@umass.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

Copyright © 2021 by the American Academy of Pediatrics

To cite: Whitehill JM, Dilley JA, Brooks-Russell A, et al. Edible Cannabis Exposures Among Children: 2017–2019. *Pediatrics*. 2021;147(4):e2020019893

TABLE 1 Cannabis-Related Exposures Reported to US Poison Centers for Patients Aged 0 to 9 years, 2017–2019

	Edible Product– Involved Cases		Other Cannabis- Involved Cases		<i>P</i> From χ^2 ^a	All Cannabis- Involved Cases	
	<i>n</i> = 1906		<i>n</i> = 2266			<i>n</i> = 4172	
	<i>n</i>	%	<i>n</i>	%		<i>n</i>	%
Year					<.001		
2017	223	11.7	664	29.3		887	21.3
2018	615	32.3	707	31.2		1322	31.7
2019	1068	56.0	895	39.5		1963	47.1
Sex					.006		
Female	911	47.8	1027	45.3		1938	46.5
Male	961	50.4	1219	53.8		2180	52.3
Unknown	34	1.8	20	0.9		54	1.3
Age, y					<.001		
0–2	512	26.9	794	35.0		1306	31.3
3–5	944	49.5	853	37.6		1797	43.1
6–9	450	23.6	619	27.3		1069	25.6
Coingestants					<.001		
Only cannabis	1873	98.3	2082	91.9		3955	94.8
Other substances involved	33	1.7	184	8.1		217	5.2
Route of exposure					<.001		
Inhalation	2	0.1	136	6.0		138	3.3
Ingestion	1674	87.8	1330	58.7		3004	72.0
Other	33	1.7	43	1.9		76	1.8
Unknown	197	10.3	757	33.4		954	22.9
Intent of exposure					<.001		
Intentional	11	0.6	28	1.2		39	0.9
Unintentional	1837	96.4	2111	93.2		3948	94.6
Other	27	1.4	50	2.2		77	1.9
Unknown	31	1.6	77	3.4		108	2.6
Medical outcome (excludes cases with any with coingestants, <i>n</i> = 217) ^b					<.001		
Death	0	0	0	0		0	0
Major effect	28	1.5	29	1.4		57	1.4
Moderate effect	298	15.9	310	14.9		608	15.4
Minor effect	634	33.9	555	26.7		1189	30.1
No effect	295	15.8	394	18.9		689	17.4
Unable to follow, judged potentially toxic	365	19.5	372	17.9		737	18.6
Not followed, minimal or unrelated effects	253	13.5	422	20.3		675	17.1
Caller location					.207		
Health care facility	859	45.1	1019	45.0		1878	45.0
Residence (own, other)	890	46.7	1075	47.4		1965	47.1
Other	137	7.2	161	7.1		298	7.1
Unknown	20	1.1	11	0.5		31	0.7
State policy status (2019 only) ^c					<.001		
Legal adult use in 2019 (estimated total population <10 y = 10 895 136)	608	57.5	367	41.3		975	50.1
Not legal adult use in 2019 (estimated total population <10 y = 28 200 136)	450	42.5	522	58.7		972	49.9

^a Missing values were excluded from χ^2 .

^b Minor outcomes involved some signs or symptoms, but they were minimally bothersome and generally resolved rapidly. Moderate outcomes involved more pronounced, more prolonged, or more systemic symptoms. Major outcomes involve signs or symptoms that were life-threatening or resulted in significant residual disability or disfigurement.⁸

^c States with legal adult use in 2019 included Alaska, California, Colorado, Illinois, Massachusetts, Maine, Michigan, Nevada, Oregon, Vermont, Washington state, and Washington, District of Columbia. A total of 42 exposures were excluded because the state was unknown (*n* = 19) or refused to give (*n* = 8) or exposure occurred outside of US states and the District of Columbia (Puerto Rico [*n* = 6], US Virgin Islands [*n* = 1], other US territory [*n* = 4], Mexico [*n* = 2], other foreign country [*n* = 2]). Total 2019 populations <10 y are from the US Census Bureau, table S0101.

term coefficient 20.3; 95% CI: 15.8–24.8; *P* < .001).

Children aged 3 to 5 years experienced the highest proportion of

all exposures (43.1%). Most cases were exposed by ingestion (72.0%). A small proportion experienced major (1.4%) or moderate (15.4%) medical outcomes. In 2019, areas with legal

adult cannabis use reported greater pediatric cannabis exposures compared with states without this policy: 975 exposures (8.9 per 100 000 population) versus 972

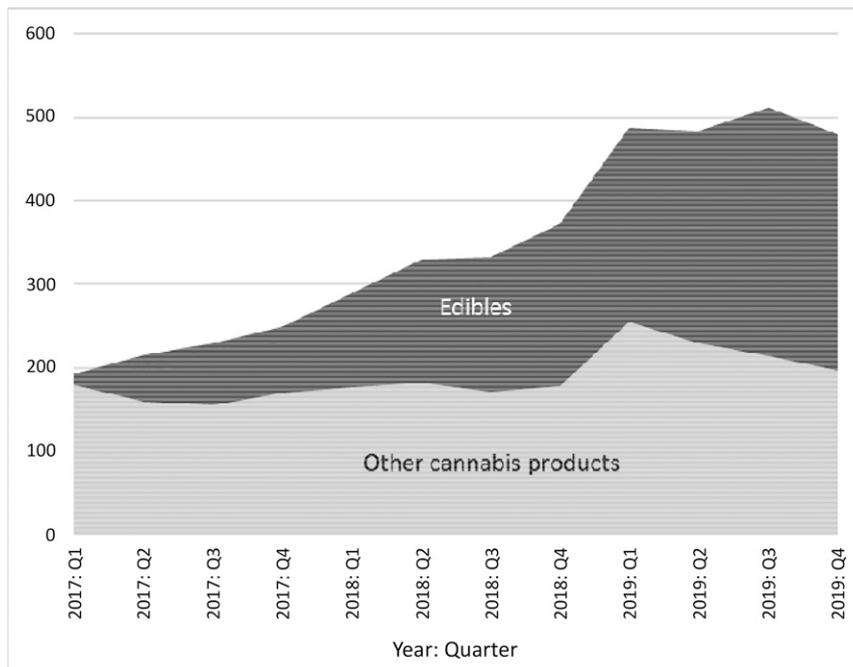


FIGURE 1

Cannabis product exposure among US children aged 0 to 9 years (quarterly counts for 2017–2019). All cannabis generic codes were obtained from the NPDS. Exposures were deduplicated (ie, if >1 cannabis type was involved [$n = 6$]), and those with final medical outcomes of “confirmed non-exposure” ($n = 38$) or “unrelated effect, the exposure was probably not responsible for the effect(s)” ($n = 34$) were excluded. The “edibles” category includes only the NPDS code for edibles 0310121. The “other cannabis products” included concentrates 0310124 ($n = 424$), dried plant 0083000 ($n = 1479$), capsule or pill 0310122 ($n = 23$), unknown preparation 0310126 ($n = 177$), pharmaceutical 0200618 ($n = 64$), topical 0310125 ($n = 13$), undried plant 0310123 ($n = 11$), vaporizer liquid or unknown if flavored 0310096 ($n = 46$), vaporizer liquid with flavoring 0310034 ($n = 5$), vaporizer liquor without flavoring 0310033 ($n = 2$), marijuana liquid flavor unknown 0310097 ($n = 15$), marijuana liquid with flavor 0310036 ($n = 6$), and marijuana liquid without flavor 0310035 ($n = 3$). Q1, quarter 1; Q2, quarter 2; Q3, quarter 3; Q4, quarter 4.

exposures (3.4 per 100 000 population). The proportion of calls due to edible cannabis product exposures was greater in legal states than in states without this policy: 62% vs 46% ($P < .001$).

DISCUSSION

Poison center calls associated with pediatric exposure to cannabis

increased in the United States from 2017 to 2019; the increase appears to be largely composed of unintentional exposures to edible cannabis products. Pediatric exposures were more frequent, and more often involved edible products, in states with legal adult cannabis use.

A limitation of these data is that they rely on self-reports, potentially

leading to underestimation of cases. Data were extracted from the NPDS before the annual “locking” of the database,⁸ so the 2019 data may be subject to minor changes.

The trend we observed could be expected to continue or increase. Cannabis consumers may shift from combustible to edible products because of the epidemic of e-cigarette- and vaping product-associated lung injury in late 2019. In addition, as many states close or restrict access to school and child care centers to mitigate the coronavirus disease pandemic, increases in unintentional ingestions of potentially harmful substances at home are of growing concern. State governments, particularly those with legal adult use, should consider issuing additional warnings about safe storage of cannabis. Regulators should ensure that packaging policies require child-resistant plain and opaque containers and that products, particularly edible products, do not appeal to children.

ACKNOWLEDGMENT

We thank Nathaniel Pham of the American Association of Poison Control Centers for assistance with data retrieval.

ABBREVIATIONS

CI: confidence interval
NPDS: National Poison Data System

FINANCIAL DISCLOSURE: The American Association of Poison Control Centers (AAPCC) (<http://www.aapcc.org/>) maintains the national database of information logged by the country's poison centers (National Poison Data System). Case records in this database are from self-reported calls: they reflect only information provided when the public or health care professionals report an actual or potential exposure to a substance (eg, an ingestion, inhalation, or topical exposure, etc) or request information and/or educational materials. Exposures do not necessarily represent poisoning or overdose. The AAPCC is not able to completely verify the accuracy of every report made to member centers. Additional exposures may go unreported to poison centers, and data referenced from the AAPCC should not be construed to represent the complete incidence of national exposures to any substance(s).

FUNDING: Supported in part by funds provided for medical and biological research by the State of Washington Initiative Measure No. 171. The funder/sponsor did not participate in the work.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Thomas AA, Mazor S. Unintentional marijuana exposure presenting as altered mental status in the pediatric emergency department: a case series. *J Emerg Med.* 2017;53(6): e119–e123
2. Wang GS, Le Lait MC, Deakne SJ, Bronstein AC, Bajaj L, Roosevelt G. Unintentional pediatric exposures to marijuana in Colorado, 2009-2015. *JAMA Pediatr.* 2016;170(9):e160971
3. Richards JR, Smith NE, Moulin AK. Unintentional cannabis ingestion in children: a systematic review. *J Pediatr.* 2017;190:142–152
4. Whitehill JM, Harrington C, Lang CJ, Chary M, Bhutta WA, Burns MM. Incidence of pediatric cannabis exposure among children and teenagers aged 0 to 19 years before and after medical marijuana legalization in Massachusetts. *JAMA Netw Open.* 2019;2(8):e199456
5. Cao D, Srisuma S, Bronstein AC, Hoyte CO. Characterization of edible marijuana product exposures reported to United States poison centers. *Clin Toxicol (Phila).* 2016;54(9):840–846
6. Reboussin BA, Wagoner KG, Sutfin EL, et al. Trends in marijuana edible consumption and perceptions of harm in a cohort of young adults. *Drug Alcohol Depend.* 2019;205:107660
7. Monte AA, Shelton SK, Mills E, et al. Acute illness associated with cannabis use, by route of exposure: an observational study. *Ann Intern Med.* 2019;170(8):531–537
8. Gummin DD, Mowry JB, Spyker DA, et al. 2018 annual report of the American association of poison control centers' National Poison Data System (NPDS): 36th annual report. *Clin Toxicol (Phila).* 2019;57(12): 1220–1413

Edible Cannabis Exposures Among Children: 2017–2019

Jennifer M. Whitehill, Julia A. Dilley, Ashley Brooks-Russell, Lucia Terpak and
Janessa M. Graves

Pediatrics 2021;147;

DOI: 10.1542/peds.2020-019893 originally published online March 22, 2021;

Updated Information & Services

including high resolution figures, can be found at:
<http://pediatrics.aappublications.org/content/147/4/e2020019893>

References

This article cites 8 articles, 0 of which you can access for free at:
<http://pediatrics.aappublications.org/content/147/4/e2020019893#BL>

Subspecialty Collections

This article, along with others on similar topics, appears in the following collection(s):
Injury, Violence & Poison Prevention
http://www.aappublications.org/cgi/collection/injury_violence_-_poison_prevention_sub
Substance Use
http://www.aappublications.org/cgi/collection/substance_abuse_sub
Public Health
http://www.aappublications.org/cgi/collection/public_health_sub

Permissions & Licensing

Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at:
<http://www.aappublications.org/site/misc/Permissions.xhtml>

Reprints

Information about ordering reprints can be found online:
<http://www.aappublications.org/site/misc/reprints.xhtml>

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®



PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Edible Cannabis Exposures Among Children: 2017–2019

Jennifer M. Whitehill, Julia A. Dilley, Ashley Brooks-Russell, Lucia Terpak and
Janessa M. Graves

Pediatrics 2021;147;

DOI: 10.1542/peds.2020-019893 originally published online March 22, 2021;

The online version of this article, along with updated information and services, is
located on the World Wide Web at:

<http://pediatrics.aappublications.org/content/147/4/e2020019893>

Pediatrics is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. Pediatrics is owned, published, and trademarked by the American Academy of Pediatrics, 345 Park Avenue, Itasca, Illinois, 60143. Copyright © 2021 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 1073-0397.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®

