

ORIGINAL RESEARCH

Awareness and Use of Delta-8-THC Cannabis Products in the United States: Findings from National Surveys in 2021 and 2022

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Abstract

Introduction: While recreational marijuana remains illegal under federal law in the United States, “hemp-derived” products that contain less than $\leq 0.3\%$ Delta-9-tetrahydrocannabinol (THC) were legalized in 2018. New classes of intoxicating products have proliferated, such as Delta-8 products, with few regulatory restrictions. The current study sought to assess awareness and prevalence of use of Delta-8-THC products in the United States.

Materials and Methods: Data are from 69,564 U.S. 16–65-year-old respondents to the 2021–2022 International Cannabis Policy Study (ICPS). Participants were asked about awareness, ever use, and past-month use of specific THC isomers. Logistic regression models examined correlates in the awareness and use of Delta-8-THC, including state cannabis laws.

Results: In 2021, 14.5% of respondents reported ‘hearing’ about Delta-8 products, which increased to 21.8% in 2022 (AOR = 1.76, 95% CI = 1.59–1.95, $p < 0.001$). Ever use of Delta-8 was higher in states where ‘conventional’ Delta-9 cannabis was illegal (11.2%), compared with states where medical cannabis (8.5% vs. 11.2%, AOR = 0.68, 95% CI = 0.58–0.79, $p < 0.001$) and adult-use recreational cannabis is legal (6.5% vs. 11.2%, AOR = 0.44, 95% CI = 0.36–0.55, $p < 0.001$).

Discussion: The cannabinoid market is rapidly diversifying with increased use of hemp-derived cannabinoid products, particularly in states where Delta-9-THC cannabis remains illegal.

Conclusions: There is an urgent need for enhanced monitoring of the diversifying cannabinoid market. Education is warranted to inform consumers about the type and potential health risks of novel hemp-derived products.

Keywords: Cannabis; Public Health; Policy Surveillance; Delta-8-tetrahydrocannabinol

Introduction

Both hemp and marijuana come from the *Cannabis sativa* L plant¹ – a complex plant with more than 100 cannabinoids. While recreational (adult-use) marijuana remains federally illegal in the United States under the Controlled Substances Act (21 U.S.C. § 802 [16]), hemp was legalized in the U.S. through the 2018 Agriculture and Nutrition Improvement Act with a broad definition that legalized “any part of that plant, including the seeds thereof and all derivatives, extracts,

cannabinoids, isomers, acids, salts, and salts of isomers, whether growing or not, with a Delta-9-THC concentration of not more than 0.3% on a dry weight basis.”² Delta-9-THC is the most recognized cannabinoid but not the only intoxicating form.

This broad definition of hemp in the 2018 Farm Bill created a growing marketplace of psychotropic hemp-derived cannabinoids.^{3,4} These products include Delta-8 or Delta-10-THC, which are THC isomers with identical molecular formulas but different atomic arrangements.

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The study was reviewed by and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#31330).

The raw survey data file supporting the findings of this study is available from the corresponding author upon request.

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Because Delta-8-THC exists in only very small quantities in the plant,⁵ most of the Delta-8 on the marketplace in the United States is obtained from chemical synthesis,⁶ which yields unknown byproducts not studied for human safety. World Health Organization (WHO) reports Delta-8-THC is about 50%–75% as potent as Delta-9-THC⁵; however, the typical level of Delta-8-THC in commercial products remains largely unknown. Other THC isomers (Delta-10, Delta-7, etc.) are psychoactive, but to a lesser degree.⁵

The increase in unregulated hemp-derived cannabinoids poses public health risks. Delta-8 and other hemp-derived cannabinoid products have been packaged like commercial candies appealing to children^{7–10} and sold online with limited age restrictions. As of August 2024, the U.S. Food and Drug Administration (FDA) and the Federal Trade Commission (FTC) had issued warning letters to 11 companies for selling illegal copycat food products containing Delta-8-THC online.⁹ No federal packaging warns consumers that hemp-derived cannabinoids like Delta-8 and Delta-10 can be intoxicating. Adults may assume hemp-labeled products are nonintoxicating, increasing the risk of overconsumption and adverse reactions.^{11–14} Between January 2021 and December 2023, the FDA received over 300 adverse event reports (e.g., hallucinations, vomiting, anxiety, and dizziness) in children and adults who consumed Delta-8 products.¹² America's Poison Centers reported 2,362 exposure cases to Delta-8 products between January 2021 and February 2022, with 59% of cases involving adults, and 40% of cases involving an unintentional exposure.¹²

Regulation could mitigate public health risks, but federal policy to date has left hemp regulation to states. A growing number of states have enacted regulations for cannabinoid hemp products like Delta-8-THC.^{15,16} Many of these state regulations were or are currently on hold due to industry litigation.¹⁷ Furthermore, states have struggled to regulate e-commerce and interstate commerce.

Despite health risks, a large survey of Delta-8 consumers recruited through a hemp-derived Delta-8-THC and CBD product manufacturer found self-perceived benefits of Delta-8-THC, fewer side effects than Delta-9-THC, and substitution of Delta-8-THC products for Delta-9-THC and pharmaceutical drugs.¹⁸ A 2022 survey found that Delta-8-THC use was more prevalent in states without recreational marijuana laws,

suggesting that Delta-8-THC may be used as a legal alternative to illicit cannabis.¹⁹

While national youth surveillance systems like Monitoring the Future have added questions to assess the prevalence of Delta-8-THC use,²⁰ national estimates remain scarce. Tracking Delta-8-THC use among adults is important as its marketplace and scientific understanding of its risks and potential benefits evolve. Online surveys have been conducted with cannabis¹⁹ and Delta-8 consumers.^{18,21} Among 4,348 U.S. adult past 30-day cannabis users, 17% reported past 30-day Delta-8-THC use.¹⁹ Among 521 Delta-8-THC consumers, more than half reported substitution of Delta-8-THC for Delta-9-THC (57%) and for pharmaceutical drugs (59%).^{18,21} However, these studies with Delta-8 consumers—recruited through a manufacturer's distribution channels and social media advertisements—may be subject to selection bias.^{18,21} More recently, a population-based survey conducted in 2023 among U.S. adults estimated that 41% of U.S. adults had heard of Delta-8-THC and 12% reported past-year use.²² Another national survey conducted in 2023 found that 8% of U.S. adults reported lifetime Delta-8-THC use.²³ Both national surveys found higher prevalence of use in states where Delta-9 cannabis remained illegal. The current study sought to assess awareness and use of Delta-8-THC and other THC isomers (Delta-9, Delta-10) among older teens and adults in the United States.

Methods

This study used data from the United States arm of the International Cannabis Policy Study (ICPS), annual repeat cross-sectional national surveys conducted since 2018.²⁴ Respondents aged 16–65 self-completed web-based surveys in 2021, and 2022. A non-probability sample of respondents was recruited through the Nielsen Consumer Insights Global Panel and their partners' panels. For ICPS surveys, Nielsen draws stratified random samples from online panels using age and state-based quotas. Participants younger than 18 were recruited through their parents.

Respondents received remuneration in accordance with their panel's usual incentive structure. Median survey time was 22 minutes in 2021, and 23 minutes in 2022. The cooperation rate, which was calculated based on AAPOR Cooperation Rate #2 as the percentage of respondents who completed the survey of eligible respondents who accessed the survey link, was 61% in

2021, and 61% in 2022.²⁵ Technical reports with additional methodological description are publicly accessible at: www.cannabisproject.ca/methods/.

Measures

Because both hemp and marijuana come from the *Cannabis sativa* L plant, for the purposes of this study, the terms marijuana and hemp are used over cannabis to ensure clarity. The full ICPS surveys and verbatim wording for the measures described below are publicly available at www.cannabisproject.ca/methods/.

Awareness and use of Delta-8-THC products. All respondents were asked, “THC is responsible for the “high” in marijuana. Have you heard of products that contain the following. . .?” Respondents had the option to ‘select all that apply’ for the following products: Delta-4-THC, Delta-8-THC, Delta-9-THC, and Delta-10-THC. In an effort to account for potential over-reporting of Delta-8-THC due to a lack of familiarity with THC types and numbers among consumers,^{26,27} this list included a THC isomer that is not commercially available in the U.S. (Delta-4), as well as Delta-9-THC, the primary psychoactive cannabinoid in ‘conventional’ cannabis products, which is available in the hemp marketplace as well as in jurisdictions that have legalized medical and legal adult-use or recreational cannabis.

Participants who indicated awareness for Delta-8 were asked, “Have you ever used a Delta-8-THC product?” (No/Yes—within the past 30 days/Yes—more than 30 days ago). Participants who reported using Delta-8 product either within or more than 30 days ago (i.e., ‘ever use’), were asked, “What type of Delta-8-THC product have you used?” with the option to ‘select all that apply’ for the list of the 9 product forms shown in Table 2.

State-level cannabis laws. Respondents were classified into three categories based on the policy status of ‘conventional’ Delta-9 cannabis in their state of residence at the time of data collection (see Supplementary Table S1). State policies were categorized based on information from state regulatory agencies: ‘illegal’ (states in which use and possession of both medical and recreational Delta-9 cannabis is generally prohibited); ‘medical’ (states that had legalized the use and sale of medical Delta-9 cannabis) and ‘legal adult-use’ (states that legalized use and sale of adult-use Delta-9 cannabis for medical and non-medical/recreational purposes). State policies on Delta-8-THC and other hemp-derived THC

isomers were not included in this study due to rapid changes and inconsistent enforcement during data collection. Litigation has hindered the enforcement of Delta-8-THC regulations in some states. Furthermore, regardless of the state policy or implementation, online sales of Delta-8 products were available across nearly all states during data collection.

Sociodemographics. Respondents provided sociodemographic information, including sex at birth, age, highest education level, race, perceived income adequacy, and state of residence. Respondents were classified into 1 of 4 age groups: 16–20, 21–35, 36–50, or 51–65 years. Race was assessed with U.S.-specific measures drawn from the census or benchmark health surveys. Income adequacy, a measure that is associated with objective measures of income and health status,²⁸ was assessed by asking respondents “Thinking about your family’s income, how difficult or easy is it to make ends meet?” (on a 5-point Likert scale ranging from ‘Very difficult’ to ‘Very easy’).

Marijuana use status. The ICPS asked respondents about past 30-day use of marijuana (also known as cannabis, pot, weed, hash, kush), including use of dried herb, edibles, oils (e.g., vaped or taken orally), hash or kief, concentrates (wax, shatter, budder, etc.), marijuana drinks (tea, cola, etc.), tinctures, lotions, or other marijuana products. Respondents reported all forms and types of preparations. Respondents were classified into those that reported using any marijuana in the past 30 days versus those with no use in the past 30 days.

Analysis

Overall, 70,501 respondents completed the 2021 and 2022 U.S. ICPS surveys. A total of 943 respondents were excluded due to missing data (i.e., refusals) for awareness or use of Delta-8-THC products. An additional 474 respondents were excluded from regression modeling due to missing data on education level, and 20 respondents who had also participated in the 2021 survey were excluded from the 2022 data, resulting in a final analytical sample size of 69,064.

Analysis used poststratification survey weights. Estimates were weighted similar to known population targets based on age-by-sex-by-state, education-by-state, region-by-race, and age-by-smoking status groups where region refers to the nine U.S. Census Divisions. Regarding the states, for ICPS 2021, respondents were weighted separately by adult-use legal status of cannabis

in their state of residence, and for ICPS 2022, the states with small samples were grouped. A raking algorithm was applied to the analytic sample to compute weights that were calibrated to these groupings. All analyses used weights rescaled to the study sample size.

Descriptive statistics were used to characterize the sample profile and primary outcomes. Separate logistic regression models were fitted to examine differences in awareness of Delta-4, Delta-8, Delta-9, and Delta-10 products. In all models, indicator variables were included for survey year (2021 vs. 2022) and state-level cannabis laws (illegal, medical, or adult-use), adjusting for sex, age, education, race, income adequacy, alcohol, tobacco cigarettes, e-cigarettes, and cannabis use. An additional logistic regression model was run to examine differences in “ever use” of Delta-8 products, with the same covariates. All logistic regression models were adjusted for the correlation between respondents within states. Adjusted ORs (AORs), 95% CIs, and *p*-values are reported. Analyses were conducted using SAS (SAS 9.4, SAS Institute Inc., Cary, NC, USA).

Results

Table 1 shows the profile of respondents in the analytical sample. Most respondents had a college or university degree, identified as non-Hispanic white, consistent with national demographic profile.

Awareness of Delta-8-THC products

‘Hearing’ about Delta-8 products increased from 14.5% in 2021 to 21.8% in 2022 (AOR = 1.76, 95% CI = 1.59–1.95, *p* < 0.001). As Table 2 shows, awareness of Delta-4, Delta-9, and Delta-10-THC products was lower than Delta-8. While awareness for all products increased between 2021 and 2022, increases were more modest for other THC products compared to Delta-8, including for Delta-4 – a synthetic cannabinoid not available on the marketplace in the U.S. (11.6% vs. 9.5%, AOR = 1.28, 95% CI = 1.16–1.41, *p* < 0.001), Delta-9 (13.5% vs. 10.1%, AOR = 1.45, 95% CI = 1.33–1.58, *p* < 0.001), and Delta-10 (9.4% vs. 6.3%, AOR = 1.60, 95% CI = 1.44–1.78, *p* < 0.001).

Awareness of Delta-8-THC products differed by state adult-use Delta-9 cannabis legislation. As shown in Table 3, compared to states where Delta-9 cannabis was illegal, Delta-8 awareness was lower in states with legal medical Delta-9 cannabis (19.1% vs. 24.3%, AOR = 0.69, 95% CI = 0.58–0.81, *p* < 0.001) and in states with legal adult-use Delta-9 cannabis (15.2% vs. 24.3%, AOR = 0.48, 95% CI = 0.39–0.59, *p* < 0.001). In

Table 1. Sample Characteristics Table

Characteristic	2021	2022	All
	N = 29,458 ^a	N = 40,106 ^b	N = 69,564
Sex at birth			
Female	50.3% (14,826)	49.9% (19,997)	50.1% (34,822)
Male	49.7% (14,632)	50.1% (20,109)	49.9% (34,742)
Age (in years)			
16–20	11.5% (3,375)	13.4% (5,384)	12.6% (8,759)
21–35	29.9% (8,800)	27.7% (11,093)	28.6% (19,893)
36–50	28.6% (8,412)	28.8% (11,537)	28.7% (19,950)
51–65	30.1% (8,871)	30.1% (12,092)	30.1% (20,962)
Highest education level			
<high school	10.4% (3,063)	13.3% (5,342)	12.1% (8,405)
High school diploma or equivalent	22.5% (6,626)	20.7% (8,311)	21.5% (14,937)
Some college	36.5% (10,748)	34.0% (13,628)	35.0% (24,376)
Bachelor's degree or higher	29.9% (8,794)	31.4% (12,573)	30.7% (21,367)
Don't know or refuse to answer	0.8% (227)	0.6% (252)	0.7% (479)
Race			
Non-Hispanic White	65.8% (19,375)	66.2% (26,542)	66.0% (45,916)
Hispanic White	10.0% (2,937)	9.3% (3,742)	9.6% (6,680)
American Indian/Alaska Native	1.1% (321)	1.1% (460)	1.1% (781)
Asian	3.8% (1,120)	3.6% (1,444)	3.7% (2,564)
Black or African American	13.8% (4,061)	13.9% (5,586)	13.9% (9,648)
Native Hawaiian/Pacific Islander	0.4% (116)	0.4% (171)	0.4% (287)
Other/Multiracial	3.7% (1,078)	3.7% (1,488)	3.7% (2,566)
Unreported	1.5% (450)	1.7% (673)	1.6% (1,123)
Income adequacy			
Very difficult	10.3% (3,032)	11.1% (4,461)	10.8% (7,493)
Difficult	18.7% (5,506)	21.9% (8,765)	20.5% (14,272)
Neither easy nor difficult	32.8% (9,664)	32% (12,847)	32.4% (22,511)
Easy	20.6% (6,083)	19.9% (7,981)	20.2% (14,064)
Very easy	13.5% (3,966)	11.7% (4,695)	12.4% (8,661)
Don't know	2.8% (827)	2.3% (919)	2.5% (1,746)
Refuse to answer	1.3% (380)	1.1% (439)	1.2% (819)
State-level Delta-9 cannabis laws			
Illegal	27.2% (8,001)	26.7% (10,696)	26.9% (18,697)
Medical	28.3% (8,346)	28.6% (11,468)	28.5% (19,814)
Legal adult-use	44.5% (13,112)	44.7% (17,942)	44.6% (31,054)
Past 30-day alcohol use			
Yes	33.3% (9,810)	34.4% (13,785)	33.9% (23,595)
No	66.3% (19,542)	65.2% (26,150)	65.7% (45,692)
Don't know	0.3% (89)	0.3% (122)	0.3% (211)
Refuse to answer	0.1% (17)	0.1% (49)	0.1% (66)
Past 30-day tobacco cigarette use			
Yes	17.6% (5,187)	16.8% (6,734)	17.1% (11,921)
No	81.9% (24,129)	82.7% (33,154)	82.3% (57,283)
Don't know	0.4% (126)	0.4% (178)	0.4% (304)
Refuse to answer	0.1% (16)	0.1% (40)	0.1% (56)
Past 30-day e-cigarette use			
Yes	8.5% (2,498)	8.9% (3,559)	8.7% (6,057)
No	91.2% (26,860)	90.8% (36,415)	91.0% (63,275)
Don't know	0.3% (87)	0.3% (106)	0.3% (192)
Refuse to answer	0.0% (13)	0.1% (27)	0.1% (40)
Past 30-day cannabis use			
Yes	25.5% (7,498)	24.9% (9,992)	25.1% (17,490)
No	74.5% (21,960)	75.1% (30,114)	74.9% (52,074)

^a366 respondents were removed from ICPS 2021 because they were aware of the Delta-8-THC products but missed the follow-up question on whether they had ever used a Delta-8 product, and 257 were removed because they refused to answer whether they have heard of the products that contain Delta-8.

^b294 respondents were removed from ICPS 2022 because they refused to answer whether they have heard of the products that contain Delta-8, 20 respondents were excluded from the 2022 data because they had also participated in the 2021 survey, avoiding duplicate observations across years.

Table 2. Weighted Prevalence of Delta-8-THC Knowledge, Use, and Type of Product Used, Overall and by State-Level Cannabis Laws, 2021–2022

Measure	2021				2022			
	Total	Illegal	Medical	Legal	Total	Illegal	Medical	Legal
Among all respondents (n = 69,564)	(N = 29,458)	(N = 8,001)	(N = 8,345)	(N = 13,112)	(N = 40,106)	(N = 10,696)	(N = 11,468)	(N = 17,942)
Ever heard of products that contain (% Yes)								
Delta-8-THC	14.5% (4,267)	17.5% (1,402)	14.0% (1,167)	13.0% (1,698)	21.8% (8,751)	29.3% (3,132)	22.9% (2,625)	16.7% (2,993)
Delta-4-THC	9.5% (2,805)	9.2% (733)	8.9% (740)	10.2% (1,332)	11.6% (4,644)	13.5% (1,443)	10.8% (1,236)	11.0% (1,965)
Delta-9-THC	10.1% (2,986)	11.6% (930)	9.9% (824)	9.4% (1,232)	13.5% (5,427)	15.6% (1,669)	14.9% (1,704)	11.4% (2,054)
Delta-10-THC	6.3% (1,849)	7.6% (605)	6.4% (531)	5.4% (713)	9.4% (3,767)	11.8% (1,261)	10.1% (1,159)	7.5% (1,347)
No	73.8% (21,743)	70.4% (5,633)	75.3% (6,283)	75.0% (9,828)	67.4% (27,042)	60.2% (6,441)	66.6% (7,638)	72.3% (12,963)
Ever used a Delta-8-THC product? ^a	(N = 29,453)	(N = 8,001)	(N = 8,345)	(N = 13,107)	(N = 40,085)	(N = 10,692)	(N = 11,459)	(N = 17,934)
Yes—within the past 30 days	3.9% (1,139)	4.6% (368)	4.1% (340)	3.3% (430)	4.8% (1,924)	6.2% (664)	5.1% (580)	3.8% (680)
Yes—more than 30 days ago	2.8% (838)	4.1% (325)	2.3% (194)	2.4% (319)	4.7% (1,884)	6.8% (725)	5.0% (576)	3.3% (583)
No or don't know	93.3% (27,476)	91.3% (7,308)	93.6% (7,811)	94.2% (12,358)	90.5% (36,277)	87.0% (9,303)	89.9% (10,303)	93.0% (16,671)
Among respondents who reported ever using Delta-8-THC (n = 5,774)								
Which type of Delta-8-THC product have you used? ^b	(N = 1,973)	(N = 693)	(N = 531)	(N = 749)	(N = 3,801)	(N = 1,387)	(N = 1,155)	(N = 1,259)
Dried herb	39.9% (788)	37.1% (257)	38.9% (207)	43.3% (324)	34.8% (1,322)	33.8% (469)	33.7% (389)	36.9% (465)
Vaping cannabis oils/liquids	36.2% (715)	36.7% (254)	35.6% (189)	36.3% (272)	37.3% (1,417)	37.1% (515)	39.2% (453)	35.7% (450)
Edibles/foods	32.3% (637)	38.4% (266)	33.1% (176)	26.0% (195)	37.4% (1,422)	40.1% (556)	37.1% (428)	34.8% (438)
Oral cannabis oils/ liquids	28.9% (569)	26.5% (184)	26.2% (139)	32.9% (246)	19.8% (754)	16.9% (234)	17.5% (202)	25.3% (318)
Drinks	17.9% (353)	15.0% (104)	15.0% (80)	22.6% (169)	11.8% (449)	9.8% (136)	9.6% (111)	16.0% (201)
Concentrates	12.6% (249)	10.7% (74)	10.0% (53)	16.2% (122)	8.6% (327)	7.3% (101)	6.8% (78)	11.8% (148)
Tinctures	9.0% (178)	7.3% (51)	8.3% (44)	11.1% (83)	5.8% (220)	4.1% (57)	5.8% (67)	7.6% (96)
Hash/kief	7.6% (150)	6.7% (47)	5.6% (30)	9.8% (73)	4.7% (178)	4.5% (63)	4.0% (46)	5.5% (69)
Topical ointments	4.8% (95)	4.1% (29)	5.1% (27)	5.2% (39)	3.9% (147)	4.3% (60)	2.7% (31)	4.5% (56)
Other	0.8% (15)	0.9% (7)	0.8% (4)	0.5% (4)	0.8% (30)	0.7% (10)	0.9% (10)	0.8% (10)
Don't know	1.7% (34)	1.7% (12)	2.0% (10)	1.6% (12)	1.5% (56)	1.1% (16)	2.3% (27)	1.0% (13)

^aRefused n = 26 (5 respondents from 2021 and 21 from 2022).

^bRefused n = 11 (4 respondents from 2021 and 7 from 2022); each respondent could select multiple types of products.

Table 3. Logistic Regression of Correlates of Awareness of Delta-8-THC, 2021–2022 (N = 69,085)^a

Covariate	Weighted % (weighted n)	AOR (95% CI)	P level
Survey wave			
2021	14.5% (4,252)	Ref	
2022	21.8% (8,718)	1.76 (1.59, 1.95)	<0.0001
State-level Delta-9 cannabis laws			
Illegal	24.3% (4,523)	Ref	
Medical	19.1% (3,772)	0.69 (0.58, 0.81)	<0.0001
Legal adult-use	15.2% (4,675)	0.48 (0.39, 0.59)	<0.0001
Sex at birth			
Male	21.0% (7,254)	1.30 (1.14, 1.48)	0.0002
Female	16.5% (5,716)	Ref	
Age (in years)			
16–20	19.9% (1,720)	3.23 (2.84, 3.66)	<0.0001
21–35	26.5% (5,214)	3.24 (2.98, 3.51)	<0.0001
36–50	20.4% (4,057)	2.24 (2.02, 2.48)	<0.0001
51–65	9.5% (1,979)	Ref	
Highest education level			
<high school	18.0% (1,517)	0.59 (0.46, 0.74)	<0.0001
High school diploma or equivalent	18.5% (2,768)	0.79 (0.72, 0.87)	<0.0001
Some college	18.5% (4,500)	0.91 (0.79, 1.05)	0.1809
Bachelor's degree or higher	19.6% (4,186)	Ref	
Race			
Non-Hispanic White	19.1% (8,729)	Ref	
Hispanic White	19.4% (1,291)	0.87 (0.75, 0.99)	0.0384
American Indian/Alaska Native	19.8% (150)	0.93 (0.66, 1.32)	0.6825
Asian	11.2% (285)	0.61 (0.49, 0.75)	<0.0001
Black or African American	19.1% (1,837)	0.82 (0.74, 0.92)	0.0013
Native Hawaiian/Pacific Islander	17.1% (49)	0.87 (0.51, 1.48)	0.5896
Other/Multiracial	20.2% (515)	0.94 (0.82, 1.06)	0.3037
Unreported	12.3% (114)	0.68 (0.56, 0.83)	0.0003
Income adequacy			
Very difficult	19.5% (1,455)	Ref	
Difficult	19.6% (2,796)	0.98 (0.88, 1.08)	0.6175
Neither easy nor difficult	17.4% (3,897)	0.89 (0.80, 1.00)	0.0485
Easy	19.6% (2,748)	1.00 (0.87, 1.14)	0.9339
Very easy	20.6% (1,781)	1.01 (0.89, 1.15)	0.8406
Don't know	13.9% (220)	0.65 (0.51, 0.84)	0.0015
Refuse to answer	10.5% (74)	0.53 (0.41, 0.70)	<0.0001
Past 30-day alcohol use			
No/Don't know/Refuse to answer	17.8% (8,122)	Ref	
Yes	20.6% (4,848)	1.07 (0.96, 1.19)	0.2151
Past 30-day tobacco cigarette use			
No/Don't know/Refuse to answer	17.6% (10,051)	Ref	
Yes	24.5% (2,919)	1.07 (0.95, 1.20)	0.2642
Past 30-day e-cigarette use			
No/Don't know/Refuse to answer	17.0% (10,745)	Ref	
Yes	36.8% (2,225)	1.89 (1.71, 2.08)	<0.0001
Past 30-day cannabis use			
No	13.9% (7,198)	Ref	
Yes	33.2% (5,771)	2.80 (2.61, 3.02)	<0.0001

^a474 respondents were excluded due to not reporting their highest level of education, and 5 respondents were excluded for not reporting awareness of Delta-8-THC.

addition, respondents in legal adult-use states reported lower Delta-8 awareness than respondents in states with legal medical marijuana (15.2% vs. 19.1%, AOR = 0.70, 95% CI = 0.58–0.85, $p < 0.001$)—see Table 3.

Use of Delta-8 products

Table 2 shows the percentages of respondents who reported use of Delta-8 products. In 2021, 6.7% of all respondents reported ‘ever using’ a Delta-8 product, including 3.9% who reported using a Delta-8 product in the past 30 days. Use of a Delta-8 product was higher in 2022 versus 2021, including for ‘ever use’ (9.5% vs. 6.7%; AOR = 1.56, 95% CI = 1.36–1.79, $p < 0.001$) (Table 4), and past 30-day use (4.8% vs. 3.9%; AOR = 1.31, 95% CI = 1.17–1.47, $p < 0.001$).

Respondents who had used Delta-8 reported a wide range of product forms (Table 2). Dried flower, vaping cannabis and edibles/foods were the most commonly reported forms in both 2021 and 2022.

Use of Delta-8 products varied by state marijuana laws. As Table 4 shows, compared to respondents living in states where Delta-9 cannabis remained illegal, ‘ever use’ of Delta-8 products was lower in states with legal medical Delta-9 cannabis (8.5% vs. 11.2%, AOR = 0.68, 95% CI = 0.58–0.79, $p < 0.001$) and states with legal adult-use Delta-9 cannabis (6.5% vs. 11.2%, AOR = 0.44, 95% CI = 0.36–0.55, $p < 0.001$). Delta-8 consumption was significantly lower in states with legal Delta-9 adult-use compared to states with only medical Delta-9 legalization (6.5% vs. 8.5%, AOR = 0.65, 95% CI = 0.52–0.82, $p < 0.001$) (Fig. 1).

Ever use of Delta-8 products was higher among those who had consumed marijuana within the past 30 days, used e-cigarettes, with no differences by tobacco or alcohol use (Table 4). Male sex-at-birth and younger age were associated with higher odds of consuming Delta-8 products, while lower education was associated with lower odds of consuming Delta-8 products. Only modest differences were observed by race and perceived income adequacy, with lower odds of use among those who identified as ‘other’ or multiple races and those who did not report their perceived income adequacy.

Discussion

Despite rapidly evolving cannabinoid markets, evidence on emerging product use remains limited. This is among a limited number of studies to provide national estimates of Delta-8-THC use in the United States. These findings highlight the challenges of assessing emerging cannabinoid product use in population-level surveys, given limited familiarity with THC forms.

In addition to asking about Delta-8, -9, and -10-THC, ICPS respondents were asked about Delta-4-THC products—a ‘bogus’ option to assess misreporting.

Table 4. Logistic Regression of Correlates of Ever Use of Delta-8-THC, 2021–2022 (N = 69,064)^a

Covariate	Weighted % (weighted n)	AOR (95% CI)	P level
Survey wave			
2021	6.7% (1,972)	Ref	
2022	9.5% (3,793)	1.56 (1.36, 1.79)	<0.0001
State-level Delta-9 cannabis laws			
Illegal	11.2% (2,080)	Ref	
Medical	8.5% (1,683)	0.68 (0.58, 0.79)	<0.0001
Legal adult-use	6.5% (2,003)	0.44 (0.36, 0.55)	<0.0001
Sex at birth			
Male	9.8% (3,384)	1.36 (1.20, 1.55)	<0.0001
Female	6.9% (2,382)	Ref	
Age (in years)			
16–20	7.3% (630)	2.97 (2.17, 4.08)	<0.0001
21–35	13.1% (2,584)	3.49 (2.90, 4.19)	<0.0001
36–50	9.4% (1,862)	2.43 (1.94, 3.04)	<0.0001
51–65	3.3% (689)	Ref	
Highest education level			
<high school	6.6% (551)	0.49 (0.35, 0.68)	<0.0001
High school diploma or equivalent	8.6% (1,287)	0.75 (0.65, 0.87)	0.0003
Some college	8.2% (1,987)	0.84 (0.67, 1.05)	0.1165
Bachelor's degree or higher	9.1% (1,940)	Ref	
Race			
Non-Hispanic White	8.2% (3,772)	Ref	
Hispanic White	10.1% (674)	1.06 (0.91, 1.24)	0.4404
American Indian/Alaska Native	10.4% (79)	1.17 (0.60, 2.28)	0.6466
Asian	5.3% (134)	0.81 (0.64, 1.02)	0.0757
Black or African American	8.8% (848)	0.86 (0.70, 1.06)	0.1416
Native Hawaiian/Pacific Islander	5.5% (16)	0.68 (0.29, 1.60)	0.3688
Other/Multiracial	7.7% (197)	0.77 (0.61, 0.98)	0.0311
Unreported	5.0% (46)	0.74 (0.52, 1.06)	0.0942
Income adequacy			
Very difficult	9.1% (677)	Ref	
Difficult	8.5% (1,207)	0.91 (0.75, 1.10)	0.2984
Neither easy nor difficult	7.6% (1,695)	0.86 (0.69, 1.06)	0.1580
Easy	8.1% (1,129)	0.87 (0.66, 1.14)	0.3076
Very easy	10.9% (946)	1.14 (0.89, 1.47)	0.2897
Don't know	5.6% (88)	0.64 (0.45, 0.92)	0.0156
Refuse to answer	3.4% (23)	0.40 (0.20, 0.78)	0.0086
Past 30-day alcohol use			
No/Don't know/Refuse to answer	8.0% (3,627)	Ref	
Yes	9.1% (2,138)	0.92 (0.79, 1.06)	0.2525
Past 30-day tobacco cigarette use			
No/Don't know/Refuse to answer	7.5% (4,269)	Ref	
Yes	12.6% (1,496)	1.05 (0.95, 1.18)	0.3880
Past 30-day e-cigarette use			
No/Don't know/Refuse to answer	7.1% (4,460)	Ref	
Yes	21.6% (1,305)	2.24 (1.98, 2.54)	<0.0001
Past 30-day cannabis use			
No	4.5% (2,307)	Ref	
Yes	19.9% (3,458)	4.78 (4.26, 5.37)	<0.0001

^a474 respondents were excluded due to not reporting their highest level of education, and 5 respondents were excluded for not reporting both education and Delta-8-THC use.

Delta-4 is a synthetic THC isomer developed for research purposes which, to our knowledge, does not exist in commercial products. Nevertheless, up to 12% of respondents reported hearing about Delta-4-THC—similar to awareness of Delta-9-THC products. This finding suggests the need for consumer education on product contents, their active ingredients, and their

potential effects. In addition, monitoring and surveillance should allow respondents to submit product photos in surveys, and develop methods for reviewing and coding them. As an extension of the ICPS survey, a subset of participants who reported using Delta-8 products were asked to upload images of their product. An analysis of the images indicated Delta-8 on the packaging.²⁹ However, data suggests that many cannabinoid hemp products are mislabeled and contain very different levels of cannabinoids when tested.^{30–32} Regulations for packaging, labeling, and corresponding testing are warranted.

Notwithstanding reporting challenges, approximately one-fifth of respondents reported awareness of Delta-8 products, with awareness increased from 15% in 2021 to 22% in 2022. Self-reported ‘ever use’ of Delta-8 products was approximately 7% in 2021 and 10% in 2022, and approximately half of ‘ever users’ reported past 30-day use. Respondents who had used Delta-8-THC reported using diverse product forms, consistent with the dynamic and growing market. Between 2021–2022, flower (likely infused with Delta-8), vapes, and edible products were the most reported product forms, followed by oral liquids. The popularity of these forms is generally consistent with ‘conventional’ Delta-9-THC product forms.³³

Despite labeling requirements in all states with legal adult-use Delta-9 cannabis marketplaces, many consumers reported being unaware of Delta-9-THC products, with lower awareness in states with legalized adult-use cannabis. Lower awareness of Delta-9-THC may be because consumers think more broadly about THC and not the specific isomer (e.g., Delta-9); indeed, state-mandated THC labels often do not specify ‘Delta-9’. These findings could also reflect increased media coverage of Delta-8-THC around the time of data collection.^{34,35} Previous studies have found that few consumers know the THC levels of the cannabis products they use.^{26,27} Collectively, these findings demonstrate high potential for misreporting of product types in population levels, including Delta-8-THC.

As hypothesized, awareness and use of Delta-8 products was associated with the state-level Delta-9 cannabis laws. Awareness and use were highest in states where both medical and recreational or adult-use Delta-9 cannabis remained prohibited, and lowest in states with legalized adult-use Delta-9 cannabis. For example, in 2022, ‘ever use’ of Delta-8 was approximately twice as high in illegal vs. adult-use states (13.0% vs. 7.0%). These findings support the hypothesis that Delta-8

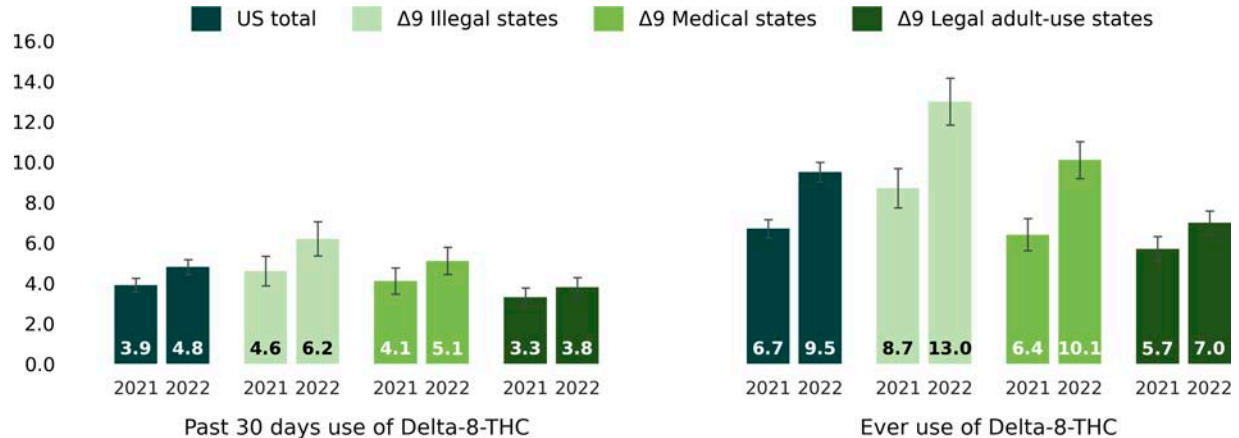


FIG. 1. Prevalence of Delta-8-THC use by state policy code.

products may be marketed as alternatives to traditional cannabis, exploiting federal law loopholes in jurisdictions where these products remain prohibited. Data from the national Monitoring the Future study in the U.S. found a similar policy relationship for Delta-8-THC use in youth.²⁰

Despite potential misreporting, these findings suggest rising awareness and use of Delta-8-THC products. Given consumer confusion, consistent data sources are essential to track patterns of use over time. Ongoing monitoring is warranted to see whether this trend continues as hemp policies and cannabinoid markets evolve in the U.S. Triangulation of population-based survey data with other data sources (e.g., market and sales data) is important to better understand use patterns.

Limitations

This study is subject to several limitations. First, the ICPS study recruited participants using non-probability-based sampling, which may limit the representativeness of the findings. Data were weighted by age group, sex, region, education and smoking status to match the national demographics. The sample excludes adults over age 65, who may have lower cannabis awareness and use; therefore, estimates may overestimate prevalence across all ages. Second, self-reported THC use is subject to misreporting, particularly when distinguishing between THC product types. A study strength is the use of a 'bogus' option to assess misreporting, which should be incorporated into other self-reported surveys of Delta-8 and other THC types. Third, cannabis policy data used in this study were limited to state-level and do not account for local-level policy

implementations. Finally, this study did not examine cannabinoid hemp policy data. At the time of data collection, few state legislatures had acted to ban or regulate hemp products, and inconsistent implementation could have led to unclear conclusions.

Conclusions

This is among a limited number of studies to assess awareness and use of THC isomers, including Delta-8 products, across a large U.S. sample of older teens and adults. Findings suggest that consumers often struggle to accurately report use of different THC isomers. Consumer education is warranted to help consumers identify products and understand their potential effects. Incorporating product images into surveillance may improve reporting accuracy. ICPS data suggest Delta-8-THC awareness and use increased between 2021 and 2022 and were highest in states without legal medical or adult-use Delta-9 cannabis. Continued monitoring is needed to assess how changes in the cannabinoid marketplace might impact these trends.

Informed Consent

All survey respondents provided informed consent prior to participation; further details regarding this process can be found at: <https://cannabisproject.ca/methods/>.

Authors' Contributions

G.S. and D.H. contributed to the study concept and drafted the initial version of the article. M.I. conducted the data analysis. All authors contributed to the interpretation of the findings, reviewed and approved the final article, and consented to its submission.

Data Availability

The data underlying this study are available from the corresponding author upon reasonable request (david.hammond@uwaterloo.ca).

Author Disclosure Statement

No competing financial interests exist.

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Supplementary Material

Supplementary Table S1

References

1. ElSohly MA, Radwan MM, Gul W, et al. Phytochemistry of Cannabis sativa L. In: Progress in the Chemistry of Organic Natural Products. Vol 103. Springer; 2017, pp. 1–36; doi:10.1007/978-3-319-45541-9_1
2. 115th U.S. Congress. *H.R. 2—Agriculture Improvement Act of 2018*. 2018. Available from: <https://www.congress.gov/bill/115th-congress/house-bill/2> [Last accessed: December 27, 2018].
3. Brightfield Group. The Rise of Hemp-Derived THC: Consumer Trends and Market Insights. 2024. Available from: <https://blog.brightfieldgroup.com/the-rise-of-hemp-derived-thc-products> [Last accessed: February 24, 2025].
4. U.S. Food and Drug Administration. Cannabis Products and the Potential Impact on Patients. 2024. Available from: <https://www.youtube.com/watch?v=76awXuwxNE0> [Last accessed: February 24, 2025].
5. WHO Expert Committee on Drug Dependence. Critical Review: Isomers of THC. WHO; 2018.
6. Hanus L, Krejci Z. Isolation of two new cannabinoid acids from Cannabis sativa L. of Czechoslovak origin. *Acta Univ Palacki Olomuc Fac Med* 1975;74:161–166.
7. Attorney General Letter to Congress on the Five-Year Reauthorization of the Farm Bill. 2024. Available from: <https://ag.hawaii.gov/wp-content/uploads/2024/03/Corrected-Ltr-Concerning-Five-Year-Farm-Bill-Reauthorization.pdf> [Last accessed: February 24, 2025].
8. Schauer GL. Written testimony, delivered before the house committee on oversight and accountability health care and financial services subcommittee for a hearing on “Hemp in the Modern World: The Yearslong Wait for FDA Action”. 2023. Available from: https://oversight.house.gov/wp-content/uploads/2023/07/CANNRA-Written-Testimony_07-2023_Final.pdf [Last accessed: July 15, 2024].
9. U.S. Food and Drug Administration. FDA, FTC Continue Joint Effort to Protect Consumers Against Companies Illegally Selling Copycat Delta-8 THC Food Products. FDA; 2024. Available from: <https://www.fda.gov/news-events/press-announcements/fda-ftc-continue-joint-effort-protect-consumers-against-companies-illegally-selling-copycat-delta-8> [Last accessed: February 24, 2025].
10. U.S. Food and Drug Administration. FDA, FTC warn of risks to children from copycat food products containing delta-8 THC. AAP News; 2024. Available from: <https://www.fda.gov/media/182538/download#:~:text=Concerns%20related%20to%20delta%208%20THC%20and%20children&text=31%2C%202023%2C%20the%20FDA%20received,confusion%20and%20loss%20of%20consciousness> [Last accessed: February 24, 2025].
11. Burgess A, Hays HL, Badeti J, et al. Delta-8 tetrahydrocannabinol, delta-10 tetrahydrocannabinol, and tetrahydrocannabinol-O acetate exposures reported to America's Poison Centers. *Clin Toxicol (Phila)* 2024; 62(4):256–266; doi: 10.1080/15563650.2024.2340115
12. U.S. Food and Drug Administration. 5 Things to Know about Delta-8 Tetrahydrocannabinol—Delta-8 THC. FDA; 2022. Available from: www.fda.gov/consumers/consumer-updates/5-things-know-about-delta-8-tetrahydrocannabinol-delta-8-thc [Last accessed: August 16, 2023].
13. West Virginia Poison Center. West Virginia Poison Center Substance Abuse Alert #WV003: Reported Cases of Adverse Reactions to Delta-8 THC Products in West Virginia. West Virginia Poison Center; 2021.
14. Michigan Poison Center. Emerging Public Health Concern: Delta-8. Michigan Poison Center; 2021.
15. Marijuana Policy Project. What are state regulators doing? 2023. Available from: <https://www.mpp.org/policy/federal/delta-8/what-are-state-regulators-doing/> [Last accessed: July 1, 2025].
16. Brosnan M. Six States Pass Hemp Laws; More Wait in the Wings. CRB Monitor; 2024. Available from: <https://news.crbmonitor.com/2024/05/6-states-pass-hemp-laws-more-wait-in-the-wings/#:~:text=Already%20this%20year%2C%20six%20states,on%20the%20manufacturers%20and%20retailers> [Last accessed: July 1, 2025].
17. National Agricultural Law Center. Legal Challenges to State Hemp Laws and Regulations. 2023. Available from: <https://nationalaglawcenter.org/legal-challenges-to-state-hemp-laws-and-regulations/> [Last accessed: July 1, 2025].
18. Kruger JS, Kruger DJ. Delta-8-THC: Delta-9-THC's nicer younger sibling? *J Cannabis Res* 2022;4(1):4; doi: 10.1186/s42238-021-00115-8
19. Livne O, Budney A, Borodovsky J, et al. Delta-8 THC use in US adults: Sociodemographic characteristics and correlates. *Addict Behav* 2022; 133:107374; doi: 10.1016/j.addbeh.2022.107374
20. Harlow AF, Miech RA, Leventhal AM. Adolescent Δ8-THC and marijuana use in the US. *JAMA* 2024;331(10):861–865; doi: 10.1001/jama.2024.0865
21. Kruger DJ, Kruger JS. Consumer experiences with Delta-8-THC: Medical use, pharmaceutical substitution, and comparisons with Delta-9-THC. *Cannabis Cannabinoid Res* 2023;8(1):166–173; doi: 10.1089/can.2021.0124
22. Wilson-Poe AR, Smith T, Elliott MR, et al. Past-year use prevalence of cannabidiol, cannabigerol, cannabinol, and Δ8-tetrahydrocannabinol among US Adults. *JAMA Netw Open* 2023;6(12):e2347373; doi: 10.1001/jamanetworkopen.2023.47373
23. Satybaldiyeva N, Yang KH, Kepner WE, et al. U.S. state marijuana and delta-8-tetrahydrocannabinol laws and delta-8-tetrahydrocannabinol use. *Am J Prev Med* 2025;69(6):108026; doi: 10.1016/j.amepre.2025.108026
24. Hammond D, Goodman S, Wadsworth E, et al. Evaluating the impacts of cannabis legalization: The International Cannabis Policy Study. *Int J Drug Policy* 2020;77:102698; doi: 10.1016/j.drugpo.2020.102698
25. Smith TW, Bailar B, Couper M. Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys (8th ed.). American Association for Public Opinion Research. AAPOR: Oakbrook Terrace; 2015.
26. Lineham J, Wadsworth E, Hammond D. Self-reported THC content and associations with perceptions of feeling high among cannabis consumers. *Drug Alcohol Rev* 2023;42(5):1142–1152; doi: 10.1111/dar.13664
27. Hammond D. Communicating THC levels and ‘dose’ to consumers: Implications for product labelling and packaging of cannabis products in regulated markets. *Int J Drug Policy* 2021;91:102509; doi: 10.1016/j.drugpo.2019.07.004
28. Cundiff JM, Matthews KA. Is subjective social status a unique correlate of physical health? A meta-analysis. *Health Psychol* 2017;36(12): 1109–1125; doi: 10.1037/hea0000534
29. Robichaud MO, Spillane TE, Kennedy RD, et al. Product characteristics, warnings, and marketing appeals conveyed on Delta-8-THC product packaging in the United States and Canada. *J Stud Alcohol Drugs* 2026; 87(2):209–221; doi: 10.15288/jsad.25-00034
30. Freedman DA, Patel AD. Inadequate regulation contributes to mislabeled online cannabidiol products. *Pediatr Neurol Briefs* 2018;32:3; doi: 10.15844/pedneurbriefs-32-3
31. Sparr-Jaswa A. Potency and purity concerns in unregulated hemp products: A rapid review to inform public safety. Thomas Jefferson University; 2024. Available from: https://jdc.jefferson.edu/mpchapstone_presentation/566/#:~:text=Results%20showed%20that%20many%20hemp,in%20many%20of%20the%20products [Last accessed: August 14, 2025].
32. Johnson L. Lab study: Over 50% of hemp delta-9 products are mislabeled, and get you higher than cannabis. CBD Oracle; 2022. Available from: <https://cbdoracle.com/news/hemp-delta-9-thc-products-lab-study-consumer-safety-and-legality/> [Last accessed: August 14, 2025].
33. Hammond D, Goodman S, Wadsworth E, et al. Trends in the use of cannabis products in Canada and the USA, 2018–2020: Findings from the International Cannabis Policy Study. *Int J Drug Policy* 2022;105:103716; doi: 10.1016/j.drugpo.2022.103716

34. King S. How Some THC is Legal - For Now. Rolling Stone; 2021. Available from: <https://www.rollingstone.com/culture/culture-features/delta-8-thc-legal-weed-explained-1113859/> [Last accessed: February 25, 2021].
35. Richtel M. This Drug Gets You High, and Is Legal (Maybe) Across the Country. New York Times; February 27, 2021.

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Abbreviations Used

AAPOR = American Association for Public Opinion Research
AOR = Adjusted OR
CBD = Cannabidiol
CI = Confidence Interval
FDA = Food and Drug Administration
FTC = Federal Trade Commission
ICPS = International Cannabis Policy Study
THC = Tetrahydrocannabinol
WHO = World Health Organization