



Cannabis Use and Adverse Childhood Experiences Among Connecticut High School Students

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Abstract

Adverse childhood experiences (ACEs) may be predictors of cannabis use among youth. Our study aimed to examine the prevalence of ACEs and assess the relationship between exposure to individual ACEs and cannabis use behavior among Connecticut high school students. We conducted a retrospective, cross-sectional analysis using a representative sample of 1760 high school students who participated in the 2021 Connecticut Youth Risk Behavior Survey. We examined lifetime and past 30-day cannabis use history by exposure to eight different ACEs. Group differences were investigated using descriptive statistics and generalized linear models. 20.6% reported lifetime cannabis use and 11.1% reported past 30-day cannabis use. ACEs ranged in prevalence from 5.4% for sexual abuse to 35.6% for verbal abuse. Each ACE examined in this analysis was associated with elevated prevalence of lifetime and past month cannabis use. ACEs were common among Connecticut high school students and students exposed to ACEs were more likely to report using cannabis.

Keywords Cannabis · ACEs · High school · Adolescent · YRBSS

Cannabis use, especially heavy chronic use, is associated with a variety of negative physical and mental health consequences including increased risk of motor vehicle crashes, low birth weight among offspring, bronchitis symptoms, psychosis, and cannabis use disorder (CUD) (National Academies of Sciences Engineering and Medicine Health and Medicine Division, 2017). A substantial proportion of cannabis users eventually develop CUD and younger age of first cannabis use may be an important risk factor for progression to CUD (National Academies of Sciences Engineering and Medicine Health and Medicine Division, 2017; Leung et al., 2020; Lopez-Quintero et al., 2011).

Adult-use cannabis was legalized in Connecticut in 2021 with legal sales for adults 21 years of age and older beginning in January 2023. It remains to be seen how legalization will affect cannabis use behavior in Connecticut and whether regulatory controls will adequately limit access by underage residents. Historically, self-reported cannabis use among Connecticut adolescents has been stable (King et al., 2023), but the prevalence of past month cannabis use among Connecticut adults increased by an average of 0.7% per

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year between 2017 and 2021 and then by 3.9% from 2021 to 2022 (Centers for Disease Control and Prevention, 2022; King et al., 2023). Recent data has shown younger people perceive cannabis use as being less harmful to one's health, use it more than older age groups, and have the highest rates of cannabis-related adverse health outcomes (King et al., 2023). With wider access to legal cannabis in Connecticut, it will be important to monitor whether and how these policies affect cannabis-related health outcomes in the state.

Adverse childhood experiences (ACEs) are potentially traumatic events during childhood and adolescence that may increase the risk of a variety of negative health outcomes and health risk behaviors including cannabis use (Afifi et al., 2020; Felitti et al., 1998; Hughes et al., 2017; Scheidell et al., 2018). The pioneering CDC-Kaiser Permanente ACEs study report demonstrated experiencing one or more ACEs was common and associated with a variety of health risk behaviors and adverse health outcomes. It suggested those who are exposed to ACEs may adopt substance use or other risky behaviors as a method of coping with difficult emotions because they provide immediate psychological or pharmacological benefit (Felitti et al., 1998). In the past two decades, ACE questions have been added to public health surveys conducted by federal and state agencies. Researchers in Nevada used statewide health behavior survey data to characterize the relationship between ACEs and cannabis use among middle and high school students in their state and found that approximately one-quarter of high-schoolers experienced one ACE and 10% experienced four or more. They demonstrated experiencing a single ACE was associated with past month cannabis use and that the relationship was dose-responsive (Clements-Nolle et al., 2022).

Given that experiencing at least one ACE is common and single-ACE exposure is associated with cannabis use among adolescents (Clements-Nolle et al., 2022), our primary study objective was to examine the relationship between exposure to individual ACEs and cannabis use behavior among Connecticut high school students. We hypothesized each ACE would be associated with increased prevalence of lifetime and past month cannabis use. Our secondary objective was to describe the prevalence of ACEs in this population.

Methods

Study Design and Data

This study was a retrospective cross-sectional analysis of Connecticut data from the Youth Risk Behavior Surveillance System (YRBSS). The YRBSS is coordinated by the Centers for Disease Control and Prevention (CDC) to collect data on specific health risk behaviors that contribute to leading causes of death and disability among youth and adults in the USA (Centers for Disease Control and Prevention, 2021). It employs one national survey and multiple state, local, territorial, and tribal-level surveys, referred to as site-level surveys. Site-level surveys utilize a two-stage cluster sampling design to select a representative sample of ninth through 12th grade students. This is accomplished using a specialized software (PCSample) developed by CDC and Westat (Brener et al., 2013). Stage one involves selecting public schools using school enrollment size-based probability. Stage two involves randomly selecting classes from required subjects or periods. Surveys are administered every other year in odd years (Brener et al., 2013; Underwood et al., 2020). The 2021 Connecticut Youth Risk Behavior Survey (YRBS) was completed by 1760 students from 25 public, charter, and vocational high schools in Connecticut during the fall. Students completed a self-administered, anonymous, 99-item

questionnaire. Survey procedures were designed to protect the privacy of students and local parental permission procedures were followed before survey administration. The school response rate was 50%, the student response rate was 80%, and the overall response rate was 40% (Connecticut Department of Public Health, 2023).

Measures

The 2021 Connecticut YRBS included eight core questions on the lifetime prevalence of ACEs. These questions, developed by the CDC based on results from the landmark CDC-Kaiser Permanente ACEs study (Felitti et al., 1998), were included in the YRBS for the first time in 2021. The questions on household mental illness, household substance use, incarceration of a parent or guardian, and sexual abuse by someone five or more years older were binary (“yes” or “no”). The questions on domestic violence, verbal abuse, physical abuse, and physical neglect reported the frequency in which the students experienced each ACE (“never,” “rarely,” “sometimes,” “most of the time,” “always”). These four questions were recategorized into a binary yes/no ACE exposure based on prior literature as shown in Table 1 (Bynum et al., 2010; Clements-Nolle et al., 2022; Oklahoma State Department of Health, 2023).

Since 2005, the Connecticut YRBS has included standard questions on cannabis use. Two of these questions measure the frequency of cannabis use: one question asks about the number of times the respondent used cannabis in their lifetime; the second asks about the number of times they used cannabis in the past 30 days. Both continuous variables were dichotomized into binary variables and coded as “yes” if the student indicated they used cannabis one or more times and “no” if they used cannabis zero times.

Statistical Analysis

R (version 4.1.3; R Core Team) and “survey” package (version 4.1–1; Thomas Lumley) were used for all analyses to account for the YRBS complex sampling design. Responses were weighted to be representative of all Connecticut high school students and adjusted for nonresponse and oversampling (Underwood et al., 2020). Descriptive statistics were computed for basic demographics and exposures. We examined prevalence estimates and surrounding 95% confidence intervals (CI) to explore differences in cannabis use prevalence by ACE exposure. Coefficients of variation (CV) were calculated to evaluate the statistical validity of prevalence estimates. CV’s greater than 15% were flagged in all tables. We then used generalized linear models to further investigate the association between exposure to each ACE and lifetime and past month cannabis use. Unadjusted models included an individual ACE exposure as the predictor variable and cannabis use history as the outcome variable. Adjusted models controlled for age, sex, and race/ethnicity.

Results

Demographic characteristics and the overall prevalence of ACEs and cannabis use history are presented in Table 2. The prevalence of lifetime cannabis use among high school students was 20.6%. Past month cannabis use prevalence was 11.1%. Prevalence of each ACE varied greatly, ranging from 5.4% for sexual abuse to 35.6% for verbal abuse.

Table 1 Operational definitions for cannabis use and adverse childhood experiences, Connecticut 2021 Youth Risk Behavior Survey

Operational definition	Survey question	Responses coded “yes”
Lifetime cannabis use	During your life, how many times have you used marijuana?	One or more times
Past month cannabis use	During the past 30 days, how many times did you use marijuana?	One or more times
Verbal abuse	During your life, how often has a parent or other adult in your home sworn at you, insulted you, or put you down?	Sometimes, most of the time, always
Domestic violence	During your life, how often have your parents or other adults in your home slapped, hit, kicked, punched, or beat each other up?	Rarely, sometimes, most of the time, always
Physical abuse	During your life, how often has a parent or other adult in your home hit, beat, kicked, or physically hurt you in any way?	Rarely, sometimes, most of the time, always
Household mental illness	Have you ever lived with someone who was depressed, mentally ill, or suicidal?	Yes
Household substance use	Have you ever lived with someone who was having a problem with alcohol or drug use?	Yes
Incarceration	Have you ever been separated from a parent or guardian because they went to jail, prison, or a detention center?	Yes
Physical neglect	During your life, how often has there been an adult in your household who tried hard to make sure your basic needs were met, such as looking after your safety and making sure you had clean clothes and enough to eat?	Never, rarely, sometimes
Sexual abuse	Has an adult or person at least 5 years older than you ever made you do sexual things that you did not want to do?	Yes

Table 2 Demographic characteristics, cannabis use, and adverse childhood experiences among Connecticut high schoolers, Connecticut 2021 Youth Risk Behavior Survey

Characteristic	N ^a	% (95%CI) ^b
Age		
14 years old or younger	39,900	25.3 (21.4–29.6)
15 years old	37,500	23.7 (19.4–28.6)
16 years old	38,100	24.1 (20.3–28.5)
17 years old	36,100	22.9 (17.7–29.0)
18 years old or older	6,400	4.0 (3.1–5.2)
Sex		
Male	80,400	51.1 (46.2–55.9)
Female	77,100	48.9 (44.1–53.8)
Race/ethnicity		
Hispanic/Latino	42,700	27.2 (19.4–36.8) ^f
Non-Hispanic Black	19,900	12.7 (7.6–20.4) ^f
Non-Hispanic White	80,500	51.4 (37.4–65.1)
Non-Hispanic other	13,600	8.7 (6.8–11.0)
Cannabis use		
Lifetime ^c	31,300	20.6 (17.0–24.8)
Past month ^d	17,000	11.1 (8.8–14.0)
ACEs ^e		
Verbal abuse	55,700	35.6 (33.3–38.0)
Domestic violence	24,900	16.0 (13.4–19.0)
Physical abuse	46,300	29.8 (26.3–33.5)
Household mental illness	49,500	33.5 (29.8–37.4)
Household substance use	39,700	26.7 (23.8–29.9)
Incarceration	15,600	10.5 (8.2–13.4)
Physical neglect	15,400	10.4 (8.2–13.1)
Sexual abuse	8,500	5.4 (4.4–6.7)

^aN is the weighted estimate of students in each category (rounded to nearest 100)

^bPercentages are weighted to be representative of all students attending high school in Connecticut

^cDefined as using cannabis at least one in their lifetime

^dDefined as using cannabis at least once in the past 30 days

^eAdverse childhood experiences

^fEstimates with coefficients of variation greater than 15% may have limited statistical validity

Table 3 includes prevalence estimates and both unadjusted and adjusted odds of lifetime cannabis use by exposure to each ACE. More than half of students who had been sexually abused used cannabis in their lifetime, relative to 18.6% of those who had not. Unadjusted odds ratios (ORs) of lifetime cannabis use ranged from 2.1 (95%CI=1.4–3.1, $p=0.001$) for physical neglect to 5.2 (95%CI=2.9–9.2, $p<0.001$) for sexual abuse. Adjusted odds ratios (aORs) of lifetime cannabis use ranged from 2.1 (95%CI=1.4–3.1, $p=0.003$) for physical neglect to 4.9 (95%CI=2.4–10.0, $p=0.002$) for sexual abuse. Six of the eight ACEs explored had aORs of lifetime cannabis use greater than three; the remaining two ACEs had aORs above two. None of the aORs had 95% confidence intervals containing one.

Table 3 Associations between adverse childhood experiences and lifetime cannabis use among Connecticut high schoolers, Connecticut 2021 Youth Risk Behavior Survey

ACEs ^a	N ^b	% (95%CI) ^c	Unadjusted odds ratio (95%CI), <i>p</i> ^d	Adjusted odds ratio (95%CI), <i>p</i> ^e
Verbal abuse				
Yes	17,700	33.8 (27.7–40.4)	3.2 (2.3–4.3), < .001	3.1 (2.1–4.6), < .001
No	13,600	13.9 (10.6–18.1)	1 [Reference]	1 [Reference]
Domestic violence				
Yes	9300	39.1 (31.2–47.7)	3.0 (2.2–4.3), < .001	3.1 (2.0–4.9), < .001
No	22,000	17.5 (14.5–21.0)	1 [Reference]	1 [Reference]
Physical abuse				
Yes	14,600	33.0 (27.3–39.3)	2.6 (2.0–3.5), < .001	2.7 (1.9–3.9), < .001
No	16,500	15.7 (12.5–19.5)	1 [Reference]	1 [Reference]
Household mental illness				
Yes	17,300	36.3 (28.6–44.7)	3.8 (2.6–5.6), < .001	3.9 (2.5–6.0), < .001
No	12,600	13.1 (10.4–16.3)	1 [Reference]	1 [Reference]
Household substance use				
Yes	14,600	38.1 (31.1–45.5)	3.6 (2.5–5.1), < .001	3.6 (2.4–5.3), < .001
No	15,600	14.6 (11.4–18.6)	1 [Reference]	1 [Reference]
Incarceration				
Yes	6,500	44.3 (34.8–54.3)	3.6 (2.6–4.9), < .001	3.8 (2.5–5.7), < .001
No	23,700	18.1 (14.8–21.9)	1 [Reference]	1 [Reference]
Physical neglect				
Yes	4,800	33.4 (27.9–39.5)	2.1 (1.4–3.1), 0.001	2.1 (1.4–3.1), 0.003
No	25,500	19.5 (15.5–24.3)	1 [Reference]	1 [Reference]
Sexual abuse				
Yes	4,300	54.3 (39.1–68.7)	5.2 (2.9–9.2), < .001	4.9 (2.4–10.0), 0.002
No	26,700	18.6 (15.3–22.5)	1 [Reference]	1 [Reference]

^aAdverse childhood experiences^bN is the weighted estimate of students in each category who used cannabis in their lifetime (rounded to nearest 100)^cPercentages are weighted to be representative of all students attending high school in Connecticut^dOdds ratios, 95% confidence intervals, and *p*-values from an unadjusted generalized linear model^eOdds ratios, 95% confidence intervals, and *p*-values from a generalized linear model adjusted for age, sex, and race/ethnicity

Table 4 includes prevalence estimates and both unadjusted and adjusted odds of past month cannabis use by exposure to each ACE. Students with a history of sexual abuse had the highest past month cannabis use prevalence of any group investigated (31.8%), followed by those who were exposed to domestic violence (24.1%) and those who had been separated from a parent or guardian due to incarceration (23.9%). Unadjusted ORs of past month cannabis use ranged from 2.0 (95%CI = 1.2–3.3, *p* = 0.010) for physical neglect to 4.2 (95%CI = 2.4–7.4, *p* < 0.001) for sexual abuse. aORs of past month cannabis use ranged from 1.9 (95%CI = 1.1–3.3, *p* = 0.029) for physical neglect to 3.6 (95%CI = 1.9–7.0, *p* = 0.003) for sexual abuse. Five of the eight ACEs explored had aORs of past month cannabis use greater than three and none of the 95% confidence intervals around the aORs for any ACE exposure contained one.

Table 4 Associations between adverse childhood experiences and past month cannabis use among Connecticut high schoolers, Connecticut 2021 Youth Risk Behavior Survey

ACEs ^a	N ^b	% (95%CI) ^c	Unadjusted odds ratio (95%CI), <i>p</i> ^d	Adjusted odds ratio (95%CI), <i>p</i> ^e
Verbal abuse				
Yes	10,700	20.1 (15.3–25.8)	3.7 (2.5–5.6), < .001	3.4 (2.0–5.9), 0.001
No	6,200	6.3 (4.5–8.8) ^f	1 [Reference]	1 [Reference]
Domestic violence				
Yes	5,800	24.1 (17.8–31.8)	3.3 (2.0–5.5), < .001	3.2 (1.7–6.0), 0.004
No	11,200	8.8 (6.6–11.6)	1 [Reference]	1 [Reference]
Physical abuse				
Yes	8,800	19.6 (15.5–24.6)	3.0 (2.1–4.2), < .001	2.9 (1.9–4.6), 0.001
No	8,100	7.6 (5.6–10.2)	1 [Reference]	1 [Reference]
Household mental illness				
Yes	9,600	19.6 (14.8–25.6)	3.4 (2.2–5.2), < .001	3.3 (2.0–5.4), 0.001
No	6,500	6.7 (4.9–9.3) ^f	1 [Reference]	1 [Reference]
Household substance use				
Yes	8,400	21.5 (15.9–28.3)	3.4 (2.2–5.4), < .001	3.2 (2.0–5.2), 0.001
No	7,900	7.3 (5.4–10.0)	1 [Reference]	1 [Reference]
Incarceration				
Yes	3,600	23.9 (16.6–33.1) ^f	3.0 (2.1–4.3), < .001	2.9 (1.8–4.5), 0.001
No	12,500	9.5 (7.5–12.1)	1 [Reference]	1 [Reference]
Physical neglect				
Yes	2,700	18.6 (13.1–25.6) ^f	2.0 (1.2–3.3), 0.010	1.9 (1.1–3.3), 0.029
No	13,500	10.3 (7.8–13.4)	1 [Reference]	1 [Reference]
Sexual abuse				
Yes	2,500	31.8 (20.8–45.2) ^f	4.2 (2.4–7.4), < .001	3.6 (1.9–7.0), 0.003
No	14,300	9.9 (7.8–12.6)	1 [Reference]	1 [Reference]

^aAdverse childhood experiences^bN is the number of students who used cannabis in the past 30 days (rounded to nearest 100)^cPercentages are weighted to be representative of all students attending high school in Connecticut^dOdds ratios, 95% confidence intervals, *p*-values from an unadjusted generalized linear model^eOdds ratios, 95% confidence intervals, *p*-values from a generalized linear model adjusted for age, sex, and race/ethnicity^fEstimates with coefficients of variation greater than 15% may have limited statistical validity

Discussion

We conducted a retrospective cross-sectional analysis of Connecticut YRBS data to explore differences in cannabis use between high school students who did and did not experience individual ACEs. We found that in 2021, ACEs were common among Connecticut high school students. According to our prevalence estimates, approximately 8,500 students had been sexually abused, 24,900 had witnessed domestic violence, 46,300 had been physically abused, and 55,700 were verbally abused. Our study also found that the likelihood of cannabis use is greater in students who experienced an ACE. Every ACE investigated was associated with an elevated odds of lifetime and past

month cannabis use. Experiences of sexual abuse had the greatest odds of both lifetime and past month cannabis use of any ACE investigated. Adjusting the generalized linear models for age, sex, and race/ethnicity had minimal effect on the associations found between individual ACE exposures and cannabis use behavior.

These findings are comparable to results of previous studies that relied on other data sources with different survey questionnaires and study designs (Afifi et al., 2020; Scheidell et al., 2018). Afifi and colleagues found that all individual ACEs examined (except for spanking) were associated with increased odds of past year and typical month cannabis use (Afifi et al., 2020). They found emotional abuse was associated with typical month cannabis use at an unadjusted OR of 2.79 (95%CI=1.78–4.39) and an aOR of 2.69 (95%CI=1.66–4.36). Their results related to the association between typical month cannabis use and household mental illness were even more similar to the results of this study: the unadjusted OR was 3.65 (95%CI=2.25–5.90) and the aOR was 3.68 (95%CI=2.19–6.17). Like the present study, adjusting for covariates typically had a minor effect on the association between ACE exposure and cannabis use history (Afifi et al., 2020). Scheidell and colleagues' results had mixed comparability to the results of this study: while they also found each ACE was associated with lifetime cannabis use among adolescents in unadjusted models, ORs tended to be smaller. For example, emotional abuse was associated with lifetime cannabis use at an unadjusted OR of 1.60 (95%CI=1.39–1.84) and physical abuse at an unadjusted OR of 1.89 (1.60–2.24). Adjusted models were not comparable to this study because they adjusted for each other ACE in addition to demographic factors. It should be noted many of the ACE questions were administered in adulthood and differed in their wording (Shin & Miller, 2012). In addition, their study included a national sample of seventh to 12th graders and the adolescent questionnaire was administered in 1994–1995 (Scheidell et al., 2018).

Our study has several strengths. The complex sample design of the YRBS is constructed to provide highly accurate prevalence estimates for a wide variety of health behaviors among youth (Brener et al., 2013; Underwood et al., 2020). Estimates derived from the data provide a reliable snapshot of the burden of self-reported cannabis use and ACEs in the entire Connecticut high school-enrolled adolescent population, making it an ideal source for this analysis (Underwood et al., 2020). Additionally, a literature review conducted prior to the analysis identified only one other study on this topic using YRBSS data (Clements-Nolle et al., 2022). There is a growing body of literature on the association between ACEs and cannabis use (Afifi et al., 2020; Hughes et al., 2017; Scheidell et al., 2018), but this analysis may be the first that has applied YRBSS data to explore disparities in cannabis use by individual ACE exposure rather than cumulative ACE exposure. While cumulative ACE exposure scores are worthy of further exploration, such aggregate measures have the potential to obscure relationships between individual ACE types and specific outcomes. Examining individual ACEs made it possible to investigate the association between a particular exposure and cannabis use behavior.

On the other hand, the cross-sectional, complex survey design and limited geographic scope of the survey used for this analysis impose limitations due to the potential for sampling bias, reporting bias, and lack of generalizability to the entire US adolescent population. In addition, the coronavirus disease 2019 (COVID-19) pandemic likely affected population-level behaviors and postponed YRBS data collection (the Connecticut YRBS is typically administered in the spring, but the 2021 survey was administered in the fall), which may have affected prevalence estimates. Of particular note is the difference in self-reported cannabis use prevalence between 2019 and 2021 (King et al., 2023). Because questions on ACEs were not included in prior YRBS questionnaires, it

was not possible to determine whether disparities in cannabis use by ACE exposure were unique to 2021.

There are also limitations stemming from the nature of the analytical approach we used. Though we incorporated age, sex, and race/ethnicity into adjusted models, we did not control for other potential confounders. Scheidell and colleagues found that sexual abuse was no longer significantly associated with cannabis use among adolescents after adjusting for additional sociodemographics and other traumas (Scheidell et al., 2018). This is particularly notable in the light of our results: Connecticut high school students with sexual abuse histories had the highest prevalence point estimates and aORs of both lifetime and past month cannabis use of any group. Additionally, some prevalence estimates had CVs greater than 15%, suggesting limited validity.

Subsequent studies could extend the work presented here by utilizing a more complex analytical approach, incorporating potential protective factors, or by applying a study design that allows for causal inference. It may be possible to improve prevalence estimates from YRBS data by pooling multiple survey years together to obtain larger sample sizes for each ACE exposure. Finally, future surveys conducted in a less tumultuous societal atmosphere (i.e., in the absence of a global public health emergency) may provide a different picture of the associations between individual ACEs and cannabis use behavior.

The prevalence of cannabis use and ACEs among adolescents emphasizes the importance of ongoing surveillance of both of these public health concerns and the need for additional research on the connection between childhood traumatic events and substance use. The cross-sectional nature of the study does not allow for causal inference, but our results indicate that Connecticut children who have experienced potentially traumatic events may benefit from targeted, evidence-based substance use prevention programs. Though adolescent cannabis use has historically been fairly stable in Connecticut, surveillance systems like the YRBSS will be vital in the coming years for monitoring trends in the wake of large and rapid changes in the cannabis policy landscape. In summary, our findings indicate that ACEs are common among Connecticut high school students and are closely associated with both lifetime and past month cannabis use.

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Data Availability Data used for this study are available upon request. To request data, please refer to the instructions described here: <https://portal.ct.gov/DPH/Health-Information-Systems--Reporting/Hisrhome/Connecticut-School-Health-Survey>.

Declarations

The authors have no relevant financial or non-financial interests to disclose.

Conflict of Interest The authors declare no competing interests.

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