

Expanded Adverse Childhood Experiences (ACEs) and Adult Cannabis Use: A Latent Class Analysis

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**Douglas C. Smith¹, Rachel C. Garthe¹, Alex Lee¹, Shongha Kim¹,
Magdelene Thebaud¹, & Lucy Kovacevic¹**

¹School of Social Work, University of Illinois at Urbana-Champaign

ABSTRACT

In addition to traditionally assessed abuse, neglect, and household dysfunction, adverse childhood experiences (ACEs) include adversities like racial discrimination, community violence, and bullying. Prior research established associations between the original ACEs and substance use, but few used Latent Class Analysis (LCA) to examine patterns of ACEs. Examining patterns of ACEs may yield additional insights beyond cumulative risk studies focusing only on the number of different ACEs experiences. Therefore, we identified associations between latent classes of ACEs and cannabis use. Studies on ACEs rarely examine cannabis use outcomes, which is important as cannabis remains one of the most commonly used substances and is associated with negative effects on health. Yet it is still unclear how ACEs influence cannabis use. Participants were adults in Illinois ($n = 712$) recruited through Qualtrics' online quota-sampling method. They completed measures of 14 ACEs, past 30-day and lifetime cannabis use, medical cannabis use (DFACQ) and probable cannabis use disorders (CUDIT-R-SF). Latent class analyses were performed using ACEs. We identified four classes, labeled: *Low Adversity*, *Interpersonal Harm*, *Interpersonal Abuse and Harm*, and *High Adversity*. The largest effect sizes ($p < .05$) were observed for those in the *High Adversity* class, who had elevated risks for lifetime (OR = 6.2), 30-day (OR = 5.05), and medicinal cannabis use (OR = 17.9) relative to those in the *Low Adversity* class. Those in the *Interpersonal Abuse and Harm* and *Interpersonal Harm* classes also had increased odds ($p < .05$) for lifetime (OR = 2.44/OR = 2.82), 30-day (OR = 4.88/OR = 2.53), and medicinal cannabis use (OR = 2.59/OR = 1.67(ns)) relative to those in the *Low Adversity* class. However, no class with elevated ACEs had higher odds for CUD relative to the *Low Adversity* class. Additional research could further disentangle these findings using extensive measures of CUD. Additionally, as participants in the *High Adversity* class had higher odds of medicinal cannabis use, future research could carefully study their consumption patterns.

Key words: = adverse childhood experiences; cannabis use; community violence; racial discrimination; bullying; latent class analysis

In the seminal study on adverse childhood experiences (ACEs; Felitti et al., 1998), Kaiser Permanente and the Centers for Disease Control and Prevention (CDC) identified ten ACEs that were associated with an increased risk for negative health outcomes in adulthood. These ACEs include abuse (e.g., physical, verbal/psychological, and sexual abuse), neglect (e.g., physical, and emotional neglect), and household dysfunction, including exposure to

intimate partner violence, having an adult in the household with substance use problems or mental illness, or having a relative incarcerated. Approximately 61% of adults in the United States have experienced at least one of these ACEs (Jones et al., 2019), which are associated with multiple health and psychosocial problems through the life course (Albaek et al., 2018; Hughes et al., 2017; Patterson et al., 2014).

Since this work, increasingly more research,

Corresponding Author: Douglas C. Smith, Ph.D., School of Social Work, University of Illinois at Urbana-Champaign. 1010 W. Nevada Street, Urbana, IL 61801. Email: smithdc@illinois.edu

such as the Philadelphia Expanded ACE study, focused on adding ACEs pertaining to ethnic minorities and those living in marginalized and distressed communities. They included several new items (i.e., Expanded ACEs hereafter) such as witnessing violence, feeling discrimination, being bullied, living in foster care, or feeling unsafe in one's neighborhood (Cronholm et al., 2015).

Expanding ACEs research to racial and ethnic minority children was critical, as they are more likely to experience a higher number of ACEs (Child and Adolescent Health Measurement Initiative, 2018), and also experience different types of adversities. For example, the Philadelphia Expanded ACEs study found that over 40% of the participants witnessed violence, over 30% felt discriminated against, and over a quarter of the participants felt unsafe in their own neighborhood (Cronholm et al., 2015). The expanded ACEs broadened the concept of childhood adversity by including experiences at the neighborhood or community level.

ACEs and Substance Use

Clinical and longitudinal studies show the cumulative effects of different childhood adversities are associated with adults' substance use (Bryant et al., 2020; Davis et al., 2021; Leza, et al., 2021). A recent scoping review ($k=12$) found elevated ACEs among those with substance use disorders (SUD; Leza et al., 2021). Experiencing one or more of the ACEs was associated with the presence of a substance use disorder in a large sample of patients seen in Federally Qualified Health Centers (Bryant, Coman, & Damian, 2020). Young adults who experienced ACEs were also less likely to transition out of heavy substance use over time, implying that the presence of ACEs leads to more recalcitrant problematic use (Davis et al., 2021).

Beyond cumulative risk models. Although the overall quantity of childhood adversities matters, specific patterns of adversities may also be important. For example, Wade Jr. and colleagues (2016) found that for participants from lower socioeconomic backgrounds, the expanded ACEs were more strongly associated with substance use than the original ACEs. Thus, although many studies have used the cumulative number of ACEs as predictors, it may be that some patterns

of ACEs may be relevant. In other words, it may be that it is important to examine which specific ACEs are clustering together, which could extend the prior work on how the overall quantity of ACEs associate with substance use.

Latent class analysis (LCA), one of several person-centered approaches, allows researchers to identify unobserved groups of individuals that share similar characteristics (Nylund-Gibson & Choi, 2018). LCA can be a potential alternative that addresses the limitations inherent to cumulative risk models (Merians et al., 2019). For example, instead of cumulatively adding the total number of ACEs reported, LCA enables researchers to identify the patterns among ACEs that occur frequently from a given sample (e.g., Merians et al., 2019; Shin et al., 2018). By just examining cumulative risk (i.e., counting the number of ACEs), researchers are unable to examine patterns of exposure to ACEs that are distinct for sub-populations. Further, there is variation in the composition of ACEs asked across studies (Jacobs et al., 2012); thus, examining combinations of specific ACEs for sub-populations using LCA will provide a more nuanced and detailed examination than cumulative risk models. Being included in these groups, or classes, can then be used to examine distinctive risks for outcomes (i.e., differences in risk variables by classes) while still explaining the co-occurrence of ACE experiences (Merians et al., 2019).

Prior LCA Studies on ACEs

Although some studies have used LCA to identify specific patterns of ACEs, we could only locate one study that used the expanded set of ACEs and examined associations with substance use (Shin et al., 2018). Other studies have used the original, not the expanded ACEs (Merians et al., 2019), or not examined associations with substance use. Our study adds to this limited research by using LCA with the expanded ACEs, and examining the associations between classes and cannabis outcomes.

Prior class solutions. Using only nine ACEs, Merians and colleagues (2019) found a four-class solution in a sample ($n = 8,997$) of college students. The four classes of ACEs were: 1) low ACEs, 2) emotional and physical child abuse, 3) moderate risk of non-violent household dysfunction, and 4) high ACEs. The high ACEs

group showed greater mental health problems, lower physical health outcomes, negative alcohol consequences, and poorer academic performance, compared to the low ACEs group (Merians et al., 2019). Lee and colleagues (2020) adolescent study ($n = 10,784$) used the expanded ACEs, but did not measure substance use as an outcome. They also identified four classes, including: 1) low adversity, 2) household dysfunction, 3) community violence, and 4) child maltreatment. Youth in the community violence class experienced greater post-traumatic stress disorder (PTSD) symptoms than the low adversity class. The child maltreatment class had greater levels of depression, anxiety, and PTSD symptoms than the low adversity class. Finally, Shin and colleagues (2018) was the only study we could locate using LCA with the expanded ACEs and measuring substance use. They, too, found four distinct classes when considering 13 types of ACEs, including the expanded ACEs. The classes were: 1) low ACEs, 2) household dysfunction and community violence, 3) emotional ACEs, and 4) high/multiple ACEs. Adults in the high/multiple ACEs class had the highest risk for alcohol-related problems, tobacco use, and negative psychological symptoms. Adults experiencing household dysfunction and community violence were more likely to experience negative psychological symptoms compared to those with low adversity. In summary, studies using ACEs generally report four class solutions, and only one study used the expanded ACEs and reported substance use outcomes.

Lack of cannabis studies. These LCA studies using expanded ACEs have largely ignored cannabis use as an outcome. This is unfortunate as cannabis use is highly prevalent and associated with numerous risk behaviors and health consequences (Cha et al., 2016; Galli, et. al., 2011; Leung et al., 2020; Leung et al., 2019; Marel et al., 2019; National Academy of Sciences, Engineering, and Medicine (NASEM), 2017; SAMHSA, 2020; Volkow & Baylor, 2019). Many states have also passed laws permitting medicinal and recreational use of cannabis (National Conference of State Legislatures, 2022). To our knowledge, no studies have looked at how clusters of expanded ACEs are associated with medicinal cannabis use.

Current Study

As the presence of ACEs may exacerbate the risks for addiction and increase the stability of problematic cannabis use (Davis et al., 2021), additional research is needed on which patterns of ACEs confer the most risk. The current study analyzes data from a large online survey completed in Illinois. We used a latent class analysis (LCA) to determine various classes of ACEs, and then test their association with cannabis use, medicinal use, and probable Cannabis Use Disorder (CUD). Thus, this study addresses the field's current overreliance on statistical approaches that use cutoff scores of numbers of ACEs, and the lack of research on cannabis outcomes.

METHODS

Participants

Full demographic information appears in Table 1. This sample included adults from 75% of the counties in Illinois (76 of 102 counties). We compared population estimates to our quota-sampled participants (US Census Bureau, 2022). Representation of Black, Latino and multiracial participants matched up well with statewide estimates. However, we found that our sample included fewer non-Hispanic Whites (53.4% in our sample vs. 60% in statewide estimates), more Native Americans (10.3% versus 0.6%), more females (57.7% versus 50.6%), and more older adults (22.8% versus 16.6%). Regarding income, the state median household income in 2020 was \$68,428. We collected categorical income, so it was not directly comparable to Census Bureau data, as we were unable to calculate a median.

Procedure

All procedures were approved by the office of human subject's protection at the authors' university before data collection. A Qualtrics Panel was utilized to quota-sample adults to approximate the socio-demographic characteristics of Illinoisans as well as possible.

Table 1. *Socio-demographic information for the sample (N = 712)*

Variable	N	%
Age Categories		
18 to 24	219	30.8%
25 to 40	204	28.7%
41 to 60	127	17.8%
61 and older	162	22.8%
Gender Identity		
Female	411	57.7%
Male	294	41.3%
Transgender or Gender Expansive	7	1.0%
Race		
White	380	53.4%
Hispanic or Latino/Latina/Latinx	104	14.6%
African American or Black	81	11.4%
Native American, Native Hawaiian, Pacific Islander, or Another Identity	73	10.3%
Asian or Asian American	67	9.4%
Biracial or Multiracial	7	1.0%
Ethnicity		
Hispanic or Latino/Latina/Latinx	126	17.7%
Highest Level of Education		
Some High School	30	4.2%
High School Diploma or GED	151	21.2%
Some College or Technical School	147	20.6%
Completed Technical program or Associate Degree	91	12.7%
Bachelor's Degree	173	24.3%
Graduate Degree	118	16.6%
Current Work Status		
Work Full-time	294	41.3%
Work Part-time	104	14.6%
Student	86	12.1%
Retired	105	14.7%
Unemployed or Laid-off	45	6.3%
Unable to Work/On Disability	24	3.4%
Looking for work	29	4.1%
Keeping house or raising children	25	3.5%
2019 Annual Household Income (before Taxes)		
Less than \$10,000	75	10.5%
\$10,000-\$29,999	131	18.4%
\$30,000-\$54,999	159	22.3%
\$55,000-\$99,999	203	28.5%
More than \$100,000	144	20.2%
Community Type		
City of Chicago	137	19.2%
Ten Counties Surrounding Chicago	294	41.3%
Other Suburban or Urban Counties	178	25.0%
Rural Counties	103	14.5%

Qualtrics (Qualtrics, Provo, UT) provides an online distribution service that can send a survey to a demographically and politically representative group of people (Boas et al., 2018). Qualtrics has panels of “participants” or individuals that will complete surveys for compensation. Quota sampling constraints were included, and individuals were recruited based on race and ethnicity, sex, household income, age group, and community type, to approximate a representative sample of Illinois adults.

These participants were notified via email and invited to participate in the survey for a given incentive. The email invitation was simple and generic, with no specifics as to the topic of the survey itself. These participants were given a link and told to follow the link if they would like to participate for the given incentive and told the duration of the survey. Qualtrics incentives, given directly from Qualtrics (not the research team), are often given on a point system. These points accumulate and can be redeemed for prizes.

If a participant wished to participate in the survey, they were provided with detailed informed consent information. Qualtrics included a sensitive topic disclaimer at the start of the survey, and participants were able to skip any questions that they did not wish to answer. Finally, resources were provided to participants in the case that the questions led to any feelings of discomfort. Surveys were available to Qualtrics Panelists from mid-October 2020 to December 1, 2020. The surveys took approximately 30 minutes to complete, and a total of 712 Illinois adult residents completed the survey.

Measures

Adverse Childhood Experiences & Expanded Items. Participants were asked about fourteen ACEs that occurred before the age of 18. First, nine of ten original ACE items were asked (Felitti et al., 1998), including childhood abuse (i.e., physical and verbal abuse), neglect (i.e., physical and emotional neglect), and household dysfunction (i.e., parental divorce or separation; exposure to intimate partner violence within the household; and having an adult or someone in the household with substance use problems, mental illnesses, or who was involved in the criminal-legal system). The item on experiencing sexual childhood abuse was not asked per guidance from

the Qualtrics team. In addition, five extended ACEs were asked, including childhood experiences with community violence, racial/ethnic discrimination, bullying, dating violence, and foster care involvement. Participants responded to each ACE item using a 1 = yes or 0 = no response. These dichotomous items were individually entered into the latent class model.

Cannabis Use. Recency of cannabis use was assessed with one item, “When was the last time, if ever, you used cannabis, marijuana, hashish, blunts, or other forms of THC (vaped cannabis, edibles, herb, reefer, weed)?” Participants selected the response option that best represented their frequency of use (i.e., responses included: Never; Over a year ago; 10-12 months ago; 7-9 months ago; 4-6 months ago; 1-3 months ago; less than a month ago; last week; this week; yesterday; today; I am currently high). For this study, response options were coded as lifetime (i.e., responses including: have used cannabis 30+ days ago to over a year ago), and past 30-day cannabis use (i.e., responses including: less than a month ago to I am currently high). In addition, we assessed for medicinal use of cannabis with one item: “Do you have a physician or doctor’s recommendation to use cannabis for medicinal purposes?” Responses included yes, no, and yes, but I use it for both medicinal and recreational purposes. Any use of cannabis for medicinal purposes was coded as medicinal use (medicinal use of cannabis = 1; no medicinal use of cannabis = 0). Items were derived from the Daily sessions, Frequency, Age of onset, and Quantity of Cannabis Use Inventory (DFAQ-CU; Cuttler & Spradlin, 2017).

Items on medicinal and recreational use are highly relevant in Illinois. Effective January 1st, 2014, Illinois implemented the Compassionate Use of Medical Cannabis Program Act (410 ILCS 130), allowing patients with qualified medical conditions to access cannabis. Since January 2020, individuals over 21 can legally possess, purchase, and consume recreational cannabis in Illinois through The Cannabis Regulation and Tax Act (410 ILCS 705).

Cannabis Use Disorder Screener. The Cannabis Use Disorder Identification Test-Revised (CUDIT-R-SF) is a three-item self-report screener for assessing participant’s problematic cannabis use within the past six months (Bonn-Miller et al., 2016). Sensitivity (78%) and

specificity (76% to 78%) for identifying CUD was high across two samples at a cutoff score of two (Bonn-Miller et al., 2016). If participants indicated cannabis use in the past six months, they were asked these three items assessing problematic cannabis use (e.g., “How often during the past 6 months, did you find that you were not able to stop using cannabis once you had started?”), negative consequences of use (e.g., “How often do you use cannabis in situations that could be physically hazardous, such as driving, operating machinery, or caring for children?”), and intentions to quit using cannabis (“How often have you thought about cutting down, or stopping your use of cannabis?”). Response options to these items ranged on a scale of 0 (never) to 4 (4 or more times a week), and the screener had adequate reliability ($\alpha = .80$). Items were summed, and individuals meeting the cutoff for probable CUD were coded as meeting or not meeting the CUDIT cutoff (1=meets; 0 = does not meet).

Sociodemographic Variables. Additionally, we examined sociodemographic factors in relation to classes of adversity. These variables included: race (1 = White, 0 = non-White), gender identity (1 = Male, 0 = Female or Another), highest education level (1= high school or GED diploma or lower, 2 = Associate’s Degree or higher; and 3 = some college or higher education), annual household income (0 = \leq \$34,999/year, 1 = between \$35,000-\$74,999/year, and 2 = \geq \$75,000/year), and age (in years).

Data Analysis

A latent class analysis (LCA) was used to explore subgroups of adults with similar item-response patterns to the 14 ACEs assessed (Asparouhov & Muthén, 2014a). All analyses were conducted using Mplus version 8.1 (Muthén & Muthén, 1998-2018). First, models were identified with an increasing number of classes, examining which fit the data best. To assess and compare model fit, we used several statistical fit indices, including the Bayesian Information Criterion (BIC) and the sample size adjusted BIC (aBIC), which were examined for the model with the lowest values. The BIC is considered the most reliable fit statistic and a strong indicator of model selection (Weller et al., 2020). Entropy and average latent class probabilities were examined, looking for values closer to 1.00. Finally, the Lo-

Mendell Rubin Adjusted test was examined to see if adding another class significantly improved the model fit (Nylund-Gibson & Masyn, 2016; Tofighi & Enders, 2008). Second, once the best-fitting model was selected, the three-step auxiliary procedure was utilized to examine associations between latent class membership, socio-demographic variables, and cannabis use variables (Asparouhov & Muthén, 2014b). Descriptively, we examined cross-tabulations and chi-square difference tests when examining categorical sociodemographic factors and class membership. Next, we calculated odds ratios with 95% Confidence Intervals to see if there was an association between race, gender, education, income, and age and class membership. Finally, odds ratios with 95% Confidence Intervals were calculated to see if adults in the different classes reported greater odds of using cannabis (i.e., lifetime, past 30-day, or medicinal use) or greater CUD screening scores.

RESULTS

Descriptive Statistics

Approximately 63% of the sample had experienced at least one of the nine original ACEs; 29% had experienced four or more of these original ACEs. The most endorsed ACEs were experiencing emotional abuse (40%), having parents separated or divorced (33%), experiencing physical abuse (31%), experiencing emotional neglect (30%), or having someone with mental illness in the household (28%). Additionally, five extended ACEs were asked, including exposure to community violence (48%), experiencing racial discrimination (43%), bullying at school (65%), experiencing dating violence (29%), and being in foster care (14%). In terms of cannabis use, about 49% of the sample had used cannabis at least once in their lifetime. About 19% had used cannabis in the past 30 days, and 16% used cannabis for medicinal use. Approximately 16% of participants screened for having probable CUD (≥ 2 on CUDIT-R-SF).

LCA of ACEs

Model fit statistics appear in Table 2. The four-class solution had adequate fit when examining

Table 2. Model Fit Indices Comparing Two to Six Classes

	2 Classes	3 Classes	4 Classes	5 Classes	6 Classes
Log likelihood	-4595.357	-4414.121	-4359.840	-4326.648	-4299.050
BIC	9381.188	9117.237	9107.198	9139.333	9182.658
ABIC	9289.106	8977.526	8919.858	8904.365	8900.061
Counts & Proportions					
Class 1	238 (33.43%)	132 (18.54%)	177 (24.86%)	97 (13.62%)	64 (9.00%)
Class 2	474 (66.57%)	218 (30.62%)	239 (33.57%)	59 (8.29%)	112 (15.29%)
Class 3	-	362 (50.84%)	162 (22.75%)	155 (21.77%)	75 (10.53%)
Class 4	-	-	134 (18.82%)	162 (22.75%)	50 (7.02%)
Class 5	-	-	-	239 (33.57%)	175 (24.58%)
Class 6	-	-	-	-	236 (33.15%)
Entropy	0.890	0.841	0.773	0.784	0.778
Average Class Probabilities	0.966-0.972	0.908-0.946	0.807-0.922	0.810-0.885	0.74-0.88
Lo-Mendell Rubin Adjusted Test	2006.85*	358.83*	107.47*	65.72*	54.64

Note. The four-class solution was selected, and the fit indices are bolded in the table.

* p < .05.

entropy and average class probabilities; the four-class solution also had the lowest BIC value. Though the five-class solution also showed adequate model fit (i.e., both solutions had a significant Lo-Mendell Rubin Adjusted test), the BIC value started to increase. Also, the fifth class represented a small proportion of the sample (8%), and the fifth class did not contribute anything conceptually different from the four-class solution. Based on these criteria and indices, we selected the four-class solution.

We labeled the four classes identified as adults: 1) with low levels of ACEs, but experiencing bullying (*Low Adversity*, n = 239, 34%), 2) who reported community violence, racial discrimination, and bullying (*Interpersonal Harm*, n = 162, 23%), 3) who experienced abuse in addition to community violence, racial discrimination, and bullying (*Interpersonal Abuse and Harm*, n = 177, 25%), or 4) who experienced many adversities (*High Adversity*, n = 134, 19%). See Figure 1 for a plot of these item probabilities.

Associations between Class Membership and Sociodemographic Variables

First, we examined cross tabulations of class membership by race, gender, education, and income (see Table 3). Chi-square difference tests revealed significant differences in class membership by race, gender, and income. For example, individuals who identified as White were more likely to be in the *Low Adversity* class, while individuals who identified as another racial identity were more likely to be in the *High Adversity* class. Similar results were seen when examining the odds of class membership by race (see Table 4). White participants had lower odds of being in the *High Adversity* (OR = 0.53) and *Interpersonal Abuse and Harm* (OR = 0.59) classes compared to the low adversity class. There were also significant differences by gender. Individuals identifying as male were more likely to be in the *High Adversity* class than individuals identifying as female or another gender identity. Again, results from

the odds ratio tests showed that male participants were more likely to be in the *High Adversity* class compared to the *Low Adversity* (OR = 2.48) and *Interpersonal Abuse and Harm* (OR = 2.09) classes. Additionally, male participants were more likely to be in the *Interpersonal Harm* class than the *Low Adversity* (OR = 2.44) class.

The chi-square test revealed significant differences by income level; however, none of the odds ratio tests were significant. As shown in Table 3, the cross-tabulated differences may exist specifically within the *High Adversity* class. More participants with an annual income of less than \$35,000 were in the *High Adversity* class (44.8%), compared to those in the other two income categories. Education was not associated with class membership or odds of class membership. Finally, age was examined in relation to class membership. Older adults had lower odds of being in the *High Adversity* (OR = 0.96), *Interpersonal Harm* (OR = 0.98), and *Interpersonal Abuse & Harm* (OR = 0.98) classes compared to the *Low Adversity* class. In summary, class membership was associated with race, gender, and age. Income and education were not associated with class membership.

Associations between Class Membership, Cannabis Use, and CUD

Class membership was associated with differing levels of risk for cannabis use and CUD. For all odds ratios with 95% Confidence Intervals, please see Table 5.

Cannabis use. Adults in the *High Adversity* class had significantly greater odds of lifetime cannabis use (OR = 6.20), past 30-day cannabis use (OR = 5.05), and medicinal cannabis use (OR = 17.90), compared to the *Low Adversity* class. Adults in the *Interpersonal Harm* and *Interpersonal Abuse and Harm* classes both had higher odds of lifetime cannabis use (OR = 2.82, OR = 2.44, respectively) and past 30-days cannabis use (OR = 2.53, OR = 4.88, respectively) compared to the *Low Adversity* class. Adults in the *Interpersonal Abuse and Harm* class also had higher odds of medicinal use (OR = 2.59) than the *Low Adversity* class. Adults in the *High Adversity* class showed significantly greater odds of lifetime cannabis use (OR = 2.19, OR = 2.54, respectively), and medicinal cannabis use (OR = 10.75, OR = 6.90, respectively) compared to the *Interpersonal Harm* and *Interpersonal Abuse and Harm* classes.

For the CUD outcome, those in the *High Adversity* class had higher odds than those in both the *Interpersonal Abuse and Harm* and *Interpersonal Harm* classes. However, these two latter classes were not significantly different from each other on CUD. Furthermore, the odds for CUD in the *Low Adversity* class were not significantly different than those for the three other classes.

DISCUSSION

This study is one of only a few studies to examine patterns of expanded ACEs and determine their associations with substance use (Lee et al., 2020; Shin et al., 2018). It is a novel study of how the expanded ACEs cluster together and are associated with cannabis use and CUD.

Classes of Adversity

The current study found that among a diverse sample of adults residing in Illinois, 63% experienced at least one of the nine original ACEs. Similar to other studies, the most endorsed adversity was experiencing emotional abuse (e.g., Merians et al., 2019). In addition, we examine the expanded ACEs, which were experienced by many adults. About half of the sample had experienced exposure to community violence and/or racial discrimination. Approximately two out of three adults experienced bullying at school. These numbers highlight the importance of screening for these expanded ACEs among adults, contributing to a growing body of literature (Alvanzo et al., 2020; Shin et al., 2018; Merians et al., 2019).

We selected a four-class model of adversity experiences: *High Adversity*, *Interpersonal Harm*, *Interpersonal Abuse & Harm*, and *Low Adversity*. Although other researchers also found four classes of ACEs, the naming and composition of these classes differs depending on which ACEs were measured. Low adversity classes (Lee et al., 2020; Merians et al., 2019; Shin et al., 2018) and high adversity classes are common (Merians et al., 2019; Shin et al., 2018). However, some classes found here such as the *Interpersonal Abuse and Harm* class appear similar to those in other studies (e.g., experienced emotional abuse and expanded ACEs; Shin et al., 2018). Yet, it is difficult to make complete comparisons given different measures used across studies. For example, some studies

Figure 1. Latent class analysis of ACEs and expanded ACEs.

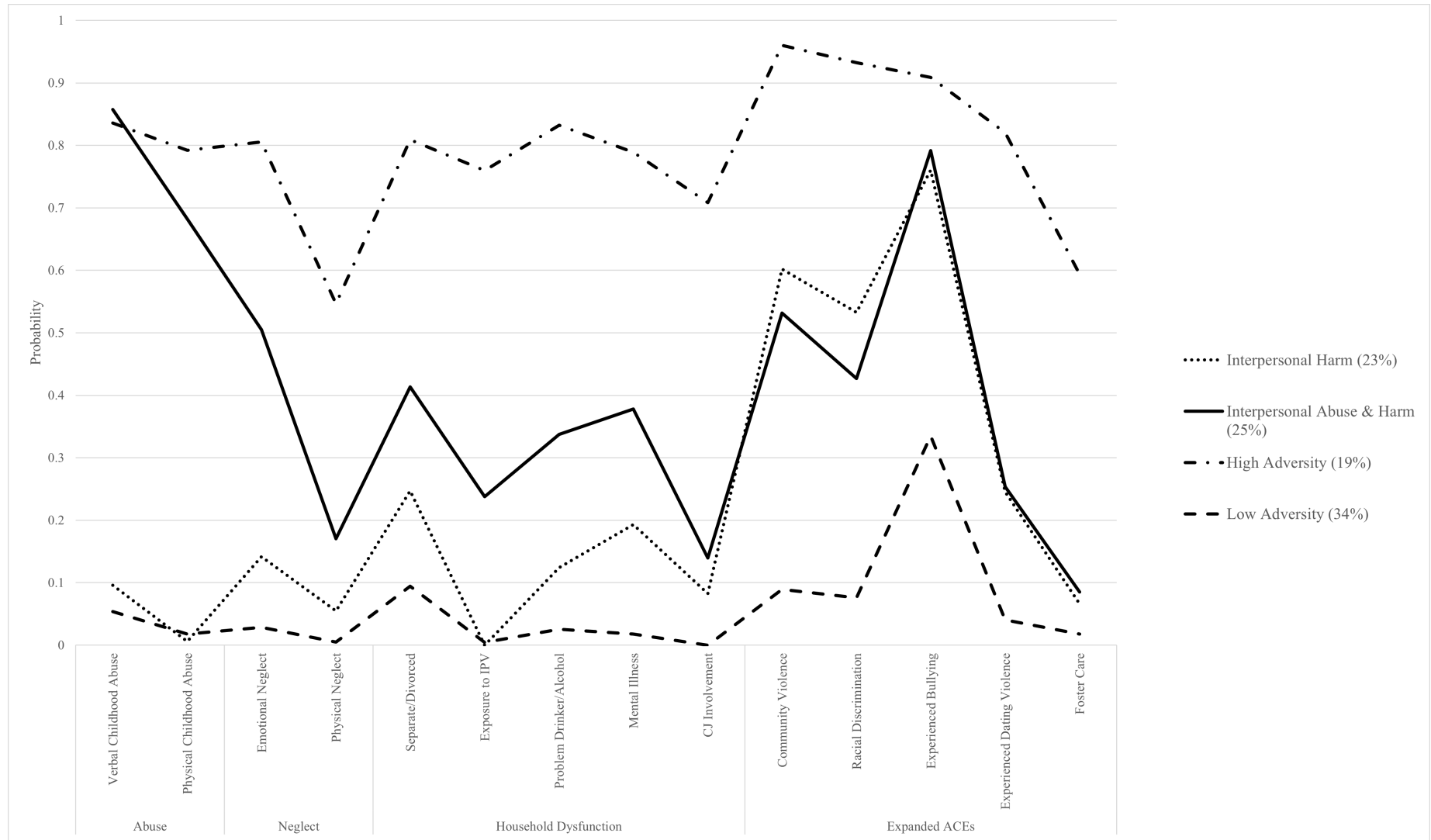


Table 3. *Sociodemographic Factors by Class Membership.*

	Low Adversity (n = 239)		High Adversity (n = 134)		Interpersonal Harm (n = 162)		Interpersonal Abuse & Harm (n = 177)		χ^2	p
	N	% Within class	N	% Within class	N	% Within class	N	% Within class		
Race										
White (53.4%)	154	64.4%	59	44.0%	82	50.6%	85	48.0%	18.98	<.001
Non-White (46.6%)	85	35.6%	75	56.0%	80	49.4%	92	52.0%		
Gender Identity										
Male (41.3%)	91	38.1%	63	47.0%	78	48.1%	62	35.0%	8.84	.032
Female or Another (58.7%)	148	61.9%	71	53.0%	84	51.9%	115	65.0%		
Highest Level of Education										
HS/GED or lower (25.4%)	54	22.6%	43	32.1%	38	23.5%	46	26.0%	6.19	.402
Some college or higher education (20.6%)	48	20.1%	24	17.9%	33	20.4%	42	23.7%		
Associate's or higher degree (53.9%)	137	57.3%	67	50.0%	91	56.2%	89	50.3%		
Annual Household Income										
≤\$34,999 (33.0%)	63	26.4%	60	44.8%	50	30.9%	62	35.0%	21.47	.002
\$35,000-74,999 (33.7%)	90	37.7%	26	19.4%	63	38.9%	61	34.5%		
≥\$75,000 (33.3%)	86	36.0%	48	35.8%	49	30.2%	54	30.5%		

Note. HS/GED = High School Diploma or General Education Development Diploma.

Table 4. Associations between Latent Classes of Expanded ACEs and Sociodemographic Factors

	Odds Ratios [95% Confidence Intervals]					
	Low Adversity ^a to High Adversity	Low Adversity to Interpersonal Harm	Low Adversity to Interpersonal Abuse & Harm	Interpersonal Harm to High Adversity	Interpersonal Abuse & Harm to High Adversity	Interpersonal Harm to Interpersonal Abuse & Harm
White Race	0.53 [0.31, 0.93]	0.56 [0.30, 1.05]	0.59 [0.35, 0.98]	0.96 [0.52, 1.76]	0.91 [0.50, 1.66]	1.06 [0.57, 1.95]
Male Gender	2.48 [1.43, 4.31]	2.44 [1.31, 4.53]	1.19 [0.70, 2.01]	1.02 [0.58, 1.80]	2.09 [1.15, 3.80]	0.49 [0.26, 0.91]
Education: HS/GED or lower	1.03 [0.54, 1.97]	1.03 [0.54, 1.97]	1.02 [0.56, 1.84]	1.16 [0.59, 2.31]	1.01 [0.51, 2.01]	1.15 [0.57, 2.33]
Education: Some college or higher education	0.88 [0.44, 1.76]	0.88 [0.44, 1.76]	1.32 [0.73, 2.41]	0.81 [0.37, 1.74]	0.66 [0.31, 1.39]	1.22 [0.59, 2.51]
Income ≤\$34,999 (33.0%)	1.46 [0.76, 2.80]	1.46 [0.76, 2.80]	1.27 [0.67, 2.41]	0.95 [0.46, 1.99]	1.14 [0.56, 2.32]	0.83 [0.37, 1.87]
Income \$35,000-74,999 (33.7%)	0.53 [0.27, 1.02]	0.53 [0.27, 1.02]	1.11 [0.62, 1.98]	0.35 [0.17, 0.75]	0.47 [.22, 1.00]	0.75 [0.36, 1.55]
Age	0.96 [0.94, 0.97]	0.98 [0.96, 0.99]	0.98 [0.96, 0.99]	0.98 [0.96, 1.00]	0.98 [0.96, 1.00]	1.00 [0.98, 1.02]

Note. ^a Reference class is listed first. Odds ratios that are significant at $p < .05$ are in bold. Covariates were included in each multinomial logistic.

Table 5. Associations between Latent Classes of Expanded ACEs and Cannabis Use Variables

	Odds Ratios [95% Confidence Intervals]					
	Low Adversity ^a to High Adversity	Low Adversity to Interpersonal Harm	Low Adversity to Interpersonal Abuse & Harm	Interpersonal Harm to High Adversity	Interpersonal Abuse & Harm to High Adversity	Interpersonal Harm to Interpersonal Abuse & Harm
Past year use	6.20 [3.50, 11.00]	2.82 [1.43, 5.56]	2.44 [1.38, 4.32]	2.19 [1.26, 3.82]	2.54 [1.47, 4.39]	0.86 [0.48, 1.55]
30-day use	5.05 [2.45, 10.41]	2.53 [1.03, 6.22]	4.88 [2.42, 9.87]	2.00 [1.04, 3.85]	1.03 [.58, 1.84]	1.93 [.99, 3.78]
Medicinal Use	17.90 [8.29, 38.68]	1.67 [.56, 4.99]	2.59 [1.10, 6.07]	10.75 [4.89, 23.6]	6.9 [3.55, 13.4]	1.56 [.62, 3.51]
CUD	1.36 [.92, 1.99]	0.94 [.53, 1.63]	1.03 [.71, 1.50]	1.45 [1.09, 1.92]	1.31 [1.14, 1.52]	1.10 [.82, 1.48]

Note. ^a Reference class is listed first. Odds ratios that are significant at $p < .05$ are in bold. Covariates were included in each multinomial logistic regression. Each variable was examined separately. CUD = Probable Cannabis Use Disorder.

used childhood history of sexual abuse as an ACE, but our study was not able to because of human subjects concerns (Merians et al., 2019; Shin et al., 2018). Using common items in future LCA analyses would facilitate comparisons across studies.

Associations with Cannabis Use Outcomes

Use and medicinal use. Not surprisingly, participants in the *High Adversity* class had higher odds of lifetime, past 30-day and medicinal use of cannabis, when compared to all three other classes. This finding echoes prior research, which states exposure to multiple ACEs is associated with a numerous behavioral health risks, including substance use (Merians et al., 2019; Shin et al., 2018). Providers treating clients with many ACEs should consider routinely screening for cannabis use and educating themselves about emerging research on cannabis (e.g., vaping, concentrates, dabbing, CBD to THC ratio).

There were no differences in cannabis or medicinal use between members of the *Interpersonal Harm* and *Interpersonal Abuse and Harm* classes. Both groups experienced community violence, racial discrimination, and bullying, and the latter also experienced verbal, physical and emotional abuse. It is unclear why the addition of abuse did not elevate the odds of cannabis use for members of the *Interpersonal Abuse and Harm* class relative to the *Interpersonal Harm* class. Future research may clarify this finding. Additionally, although members of both these classes had higher odds of use, this may be partially explained by having more young people in these classes. The prevalence of cannabis use is lower among older individuals (Compton et al., 2019).

Exposure to community violence, perceived discrimination, and dating violence, were all elevated in the *Interpersonal Harm* group relative to the *Low Adversity* class. Thus, these factors may explain some differences in increased odds for substance use for the former relative to the latter. Most prior studies on the association between ACEs and substance use only use the original ACES (Leza et al., 2018). Our findings validate the importance of using these expanded ACEs in future cannabis use research.

Probable cannabis use disorder (CUD). It is curious that relative to the *Low Adversity* class,

none of the other three classes had higher odds of screening positive for a probable CUD. The only differences found here were that there were elevated odds for CUD among those in the *High Adversity* class relative to those in both the *Interpersonal Abuse and Harm* and *Interpersonal Harm* classes.

We offer two possible explanations for the non-significant differences between the *Low Adversity* group and the other three groups. First, those in the *Low Adversity* group had elevated bullying, which is associated with adult CUD (Vaughn et al., 2010). Second, those in the *Low Adversity* group were slightly younger, and younger age is associated with increased frequency of cannabis use (SAMHSA, 2020). Third, our measure of CUD was the short form of a screening measure for CUD. Thus, although it has high sensitivity and specificity in predicting CUD, it may not be a good proxy for CUD severity. This is important because nationally the prevalence of mild CUD has increased, but severe CUD has not (Compton et al., 2019). Finally, our models are unadjusted, so several unmeasured variables may have impacted these findings (e.g., receipt of treatment, current traumatic symptoms).

Limitations

This study's findings should be interpreted keeping the following limitations in mind. First, the ACEs were measured via retrospective recall, which results in larger correlations with outcomes than when they are prospectively measured (Reuben et al., 2016). Furthermore, we completed this study during the COVID-19 pandemic, so it is unclear how pandemic related lockdowns affected cannabis use and disordered use, which could have impacted study results. For example, the prevalence of probable CUD in this study was higher than what we would expect from representative prevalence surveys. We found that about 16% of participants screened positive for a probable CUD, whereas national surveys from 2019, the most recently available from before the pandemic, reveal that only 5.8% of adults ages 18-25 and 1% of adults over age 25 meet criteria for CUD (Substance Abuse and Mental Health Services Administration, 2020). Additionally, this study was cross-sectional, so it is not possible to infer causation from study results. Next, our variable for race/ethnicity was dichotomous, only

comparing White vs. Non-white participants. Future research could use more granular comparisons with specific races and ethnicities in comparisons. Additionally, we were unable to ask about sexual abuse as an ACE due to human subjects concerns, which could have affected our analyses. Finally, the study participants were sampled from a Qualtrics Panel, and because quota sampling was used, this study is not truly representative of the adults in Illinois and may not be generalizable to adults outside of Illinois.

Implications and Future Research Directions

We conclude with discussing two main implications of this study. First, we suggest that researchers gain a better understanding of how exposure to violence and racial discrimination are associated with cannabis use. The odds of cannabis use were elevated in our *Interpersonal Abuse and Harm* and *Interpersonal Harm* classes, which were characterized by high levels of these types of ACEs in addition to bullying and abuse. Second, we discuss how it is important to study cannabis consumption patterns of individuals experiencing many adversities.

Classes with racial discrimination and community violence, with or without other adversities, were associated with risks for cannabis use. There is increasingly more emphasis on studying substance use from a Social Determinants of Health (SDOH) perspective, including racism and community violence (Bluthenthal, 2021). This study affirms the importance of additional research in this area.

Additionally, adults with *High Adversity* had higher odds of medicinal cannabis use, yet did not have elevated odds for probable CUD relative to the low ACEs group. However, they did have elevated risks for probable CUD relative to the two interpersonal harm groups. These findings should be replicated and disentangled in future prospective longitudinal research. Some individuals with high levels of ACEs may use medicinal cannabis safely without considerably higher risk of CUD relative to those with low levels of ACEs, especially if they are following lower risk cannabis use guidelines such as not inhaling deeply, using lower THC concentration products, and avoiding smoking cannabis (Fisher et al., 2017). Future research could examine the cannabis consumption patterns of individuals

experiencing high childhood adversity who are using for medical purposes.

Conclusion

This study found elevated risks for cannabis use, but not probable CUD, among the three classes experiencing multiple ACEs. It is among only a handful of studies that examines the expanded ACEs, uses person-centered analytic strategies, and tests the associations of class membership with cannabis use during adulthood. Additional research with more extensive measures of CUD is needed, and we also recommend examining patterns of medicinal use among individuals experiencing extensive childhood adversities. Such studies may inch us toward having a better understanding of developing safety guidelines for cannabis use among those experiencing ACEs.

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