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Prevalence Of Adverse Childhood Experiences (ACEs) From The 2017 Illinois Behavioral Risk Factor Surveillance System (BRFSS) Using The Principal Component Analysis (PCA)

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Abstract

This data brief presents the results of a study that estimates the prevalence of Adverse Childhood Experiences (ACEs) in Illinois, utilizing both the 95% confidence interval and Principal Component Analysis (PCA) approaches, which were applied to the 2017 Illinois BRFSS-ACE data. The study found that ACEs are prevalent in Illinois, with 58.5% of adults reporting at least one ACE. Additionally, PCA revealed a three-component structure of ACEs, suggesting that the original 11 ACE items available in the BRFSS survey could be reduced to better understand the underlying structure of ACEs in Illinois. These findings have significant implications for future research and intervention efforts aimed at addressing the impact of ACEs experienced by children in Illinois.

Keywords

+ Adverse Childhood Experiences

+ Principal Component Analysis

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Introduction

Adverse Childhood Experiences (ACEs) are traumatic events that occur during childhood and can have a profound and lasting effect on individuals' well-being and overall quality of life throughout their lifespan. These experiences, as described in **Table 1**, may put children at risk for violence, chronic health problems, mental illness, and substance abuse in adulthood. ACEs can have a tremendous impact on future violence victimization and perpetration, and lifelong health and opportunity; in addition to negatively impact education, job opportunities, and earning potential.

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Table 1: Type of adverse childhood experiences (ACEs) and associated negative health outcomes

- ACE category: Emotional abuse
  - Examples: Constant criticism, insults, belittling a child
  - Negative health outcome: Anxiety, depression, suicidal ideation
- ACE category: Household dysfunction
  - Examples: Substance abuse, depression, domestic violence, parental incarceration (or criminal behavior by a household member)
  - Negative health outcome: Substance abuse, mental health disorders, interpersonal violence
- ACE category: Neglect
  - Examples: Failure to provide adequate food, shelter, or medical care for a child
  - Negative health outcome: Chronic diseases, developmental delays, mental health disorders
- ACE category: Physical abuse
  - Examples: Hitting, kicking, burning a child
  - Negative health outcome: Chronic pain, cardiovascular disease, obesity, mental health disorders
- ACE category: Parental separation
  - Examples: Separation or divorce, especially if it involves a conflict of violence
  - Negative health outcome: Mental health disorders, substance abuse, behavioral problems
- ACE category: Sexual abuse
  - Examples: Unwanted sexual touching, intercourse, exposure
  - Negative health outcome: Sexual dysfunction, sexually transmitted infections, mental health disorders

Why is it important to look at ACEs data? ACEs can accumulate and their effects last beyond childhood. The effects of ACEs can add up over time and affect a person throughout their life. Children who repeatedly and chronically experience adversity can suffer from TOXIC STRESS. Toxic stress happens when the brain endures repeated stress or danger, then releases FIGHT-OR-FLIGHT HORMONES like cortisol. The INTERNAL ALARM SYSTEM increases heart rate and blood pressure and damages the digestive and immune systems. Toxic stress can disrupt ORGAN, TISSUE, AND BRAIN DEVELOPMENT. Over time this can limit a person's ability to process information, make decisions, interact with others, and regulate emotions. These consequences may follow a person into adulthood.

ACEs are associated with at least five of the 10 leading causes of death. The impact of adverse childhood experiences on health outcomes has been well documented in the literature. According to a study by the Centers for Disease Control and Prevention (CDC), 61% of adults surveyed across 25 states reported experiencing at least one type of ACE, while approximately 1 in 6 adults reported four or more types of ACEs during their childhood. The study also found that up to 1.9 million cases of heart disease and 21 million cases of depression could have been potentially avoided by preventing ACEs [1]. The economic and social costs of

ACEs to families, communities, and society have been shown to be substantial. The same CDC study estimates that the cost associated with ACEs totals hundreds of billions of dollars each year.

These findings regarding the prevalence and impact of ACEs on health outcomes underscore the need for additional research on the topic of ACEs in Illinois. **By examining the structure and prevalence of ACEs, health professionals, and policymakers can identify effective interventions that prevent or mitigate the negative impacts of these experiences, particularly in communities with high rates of exposure.** With this objective in mind, this data brief pursues three purposes:

1) Provide the most up-to-date and comprehensive information on ACEs in Illinois to increase awareness and promote actions.
2) Provide statistical results on the 2017 ACE data in Illinois using appropriate modeling techniques.
3) Use PCA to reduce the original ACE questions in the Illinois 2017 ACE dataset to a smaller set of components that capture the structure of ACEs in Illinois.

PCA is a statistical technique that can be utilized to identify underlying patterns in a data set and group related variables into components. Previous studies have employed PCA to identify the structure and categories of ACEs, however, to our knowledge, at the time of conducting this research, none have applied the PCA approach to uncover the structure of ACEs in Illinois, using the 2017 dataset. By applying PCA to the 2017 BRFSS ACE data, this data brief fills that gap, and ultimately explores the interrelationship between the different types of ACEs, providing insights into their underlying structure. The remaining part of this data brief is structured as follows.

Summary

Methods: The methods section describes the approach utilized to analyze the data, including the PCA methodology and techniques for reducing the original ACE questions to a smaller set of components.

Results: The results section presents the statistical results of the PCA, 95% confident interval analyses, and provides insights into the structure of ACEs in Illinois.

Discussion: The discussion section discusses the findings of the study, highlights limitations of the study and areas for future research.

Conclusion: The conclusion summarizes the key findings of the study.

To guide the analysis and interpretation of the 2017 BRFSS ACE data, the following research questions will be addressed:

Research question 1: What is the prevalence of ACEs in the 2017 BRFSS-ACE dataset and how does the confidence interval around the prevalence estimate inform our understanding of the overall ACEs in Illinois?

Research question 2: What are the key components or dimensions of ACEs that emerge from the PCA analysis and how do they relate to each other?

Research question 3: How does the use of PCA to reduce ACE items affect our understanding of prevalence of ACEs in Illinois?

Research question 4: How do the results of PCA analysis affect our understanding of the structure of ACEs in Illinois and how do they compare to previous studies?

Methods

Participants

This study utilized data from the 2017 Illinois BRFSS survey, which surveyed a representative sample of 5,545 adults aged 18 years and older residing in Illinois who were contacted via both landline and cell phone and asked to complete a questionnaire. The survey questionnaire included 11 questions about ACEs *(cf Table 9)*, and 80.5% (n=4,461) of the total sample of 5,545 adult participants completed all 11 questions. The 80.5% sample size was determined by excluding observations with 100% missing values related to the ACE questions.

To enhance the reliability of the sample, several steps were taken, including employing a complex survey design with strata defined by geographic area and sampling weights used to adjust for nonresponse. Additionally, demographic information on the sample is provided in the Results section of this data brief.

The Eight ACE Categories

The 11 original ACE questions were consolidated into eight categories *(cf Table 6)* for the present study. This categorization scheme aligns with established methodology and enables further contributions to the scientific literature on adverse childhood experiences. The first category, substance abuse, combined questions 2 and 3, which ask about living with individuals who engage in problem drinking, alcoholism, or illegal drug use. The second category, sexual abuse, combined questions 9, 10, and 11, which all relate to experiences of sexual abuse. The remaining six ACE questions were each used to form their own category, with the two multi-item categories (substance abuse and sexual abuse) forming their own group. The ACE items in the other six categories were: mental illness, emotional abuse, physical abuse, domestic violence, parental separation, and parental incarceration.

Data Preparation

Prior to statistical analyses, and to answer the research questions (*cf* Introduction), the implementation of thorough data preparation and quality assessment process was essential to ensure the accuracy and reliability of the analysis.

Table 2: Data Preparation and Quality Assessment

1. Merging files to create a comprehensive dataset.

2. Dichotomizing the state-added ACE questions to facilitate statistical analysis.

3. Identifying missing data patterns, checking for skewness and kurtosis, and handling missing data using appropriate methods.

4. Assessing the suitability of the data for PCA analysis using the Kaiser-Meyer-Olkin (KMO) measure, Bartlett's test of sphericity, and Cronbach rotated.

The publicly available BRFSS survey results file contains core questions administered by all states. However, this file does not include the state-added ACE module. To address this limitation, we combined the two files and used the merged file to calculate prevalence estimates.

As outlined in **Table 2**, after creating the merged file, several additional steps were conducted to prepare the data for statistical analysis, including dichotomizing the ACE questions, screening for missing data patterns, assessing the suitability of the data for PCA analysis, and assessing the internal consistency of the ACE categories.

The coding scheme used to assign binary values to each ACE category in this study was based on the approach used by previous researchers, which involved collapsing the original 11 ACE questions into eight categories and assigning a binary value of 0 or 1 to each category based on whether the respondent reported experiencing any ACE in that category. Responses of "don't know" or "refused" were coded as missing for all questions (e.g., Anna E. Austin et al., 2012)[2]**.** The ACE score was calculated based on the eight categories of ACEs assessed, with exposure to any single category counted as one point toward the ACE score.

To address missing data, mean imputation was utilized to replace missing values for the 11 ACE questions. Specifically, the PROC STDIZE procedure in SAS was used to impute the missing values with the mean of the observed values for each respective question. After imputation, cases with any missing values were excluded from the prevalence analysis.

Statistical Analysis

All statistical analyses were conducted using SAS 9.4™ software (SAS Institute Inc., Cary, NC, USA). To account for the complex sample design of the telephone surveys, CDC's weighting, primary sampling unit, and stratification variables available in the Illinois BRFSS dataset were utilized (procedures: proc SURVEYFREQ) to calculate the ACE prevalence estimates and obtain the 95% confidence interval of each original 11 ACE type.

Only weighted percentages were included in the analysis, as it accounts for the survey design and produces more accurate estimates.

Principal component analysis (PCA), a common multivariate statistical technique, was employed to reduce the complexity of the data into a smaller number of variables capturing the maximum variance. Previous studies have employed PCA to explore the structure of ACEs, and in this study, it (procedures: PROC PRINCOMP)[1] was used to investigate the structure of ACEs in Illinois, using the BRFSS-ACE survey, which include 11 ACE questions. Similarly, Jordan A. Gette et al (2021) utilized PCA to investigate the structure of ACEs using the World Health Organization's scoring system, which includes 13 ACE categories [3]. To determine the number of principal components to be retained for further analysis, the correlation structure of the variables in the IL BRFSS-ACE *(cf Table 7)* data was examined, and polychronic correlation coefficients were used for PCA analysis given the binary nature of the ACE variables.

Eigenvalues from the PCA analysis were used to retain the appropriate number of components and eigenvectors generated from the PCA were used to describe the correlation between the components and the original eight ACE categories *(cf Table 8)*. A higher eigenvector value indicates a stronger relationship between the category and the components. Eigenvectors > 0.34 were deemed statistically significant and categories were considered part of a component if they exhibited eigenvalues ≥ .85, a cutoff used to prevent over-extraction of principal components beyond what is necessary to explain the variance in the data.

Internal consistency of component 1 (household dysfunction) and component 2 (parental loss) was assessed using Cronbach's alpha. Cronbach's alpha coefficients were not calculated for component 3 (sexual abuse) due to its one-item nature. Alpha values range from 0 to 1, with higher values indicating higher internal consistency within each component. Gette et al (2021) cite Kline (2013) provide a complete list of alpha coefficients and associated interpretation *(cf. Table 3)* [4].

Table 3: Interpretation of Cronbach's Alpha coefficients following Kline's (2013) guidelines as cited in Gette et al. (2021).

n. Coefficient: Level of Acceptance

1. Above 90: Excellence

2. .80 to 89: Good

3. .70 to 79: Acceptable

4. .60 to 69: Questionable

5. .50 to 59: Poor

6. Below .50: Unacceptable

As previously mentioned, the Kaiser-Meyer Olin (KMO) test and Bartlett's (1950) Test of Sphericity were performed to verify that ACE items and categories available in the BRFSS-ACE data were suitable for PCA analysis. This essential step ensured that the data was of sufficient quality to proceed with PCA analyses. In Noora Shrestha (2021) [5], KMO values between 0.8 and 1.0 indicate the sampling is adequate while the Bartlett's test significant value <0.05 indicates that a factor analysis may be worthwhile for that dataset. To ensure that the components extracted were independent of each other, a correlation analysis was conducted. The 2017 BRFSS-ACE data utilized to perform PCA and 95% confidence interval analysis provided insights into the prevalence and structure of ACE in Illinois. The results section of the data brief will showcase the key findings for research questions 1 to 4 (*cf* Introduction).

Results

A total of 5,545 participants were included in the 2017 BRFSS-ACE survey, with the majority (3,071 or 55.38%) identified as female respondents. The question regarding sex identification was declined to answer by just

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[1] Proc factor was used to further explore the structure of ACE categories utilized to perform PCA analysis.

one respondent (0.02%) among the total participants. The racial identity and age group breakdown of the sample are provided in Table 4.

Table 4: Participant racial identity and age breakdown

Age Group	Percent	Racial Identity[2]	Percent
		Non-Hispanic	*87.66*
18-24	6.37	White	69.43
25-34	11.90	Black	12.97
35-44	12.03	American Indian/Alaska Native (AIAN)	0.36
45-54	15.65	Asian	3.52
55-64	19.40	Native Hawaiian or Other Pacific Islander	0.09
65 or older	34.64	Multi-racial	1.06
		Other	0.23
		Hispanic	*11.65*

Prevalence and PCA of the 8 ACE Categories

In 2017, more than half 58.5% (95% CI: 56.5%-60.4%) of Illinois adults reported experiencing at least one ACE, indicating a high prevalence of ACEs among the adult population. The prevalence of ACEs varied among participants, with 22.8% reporting one ACE, 19.8% reporting two to three ACEs, and 15.9% reporting four or more. The study found that emotional abuse was the most prevalent ACE with 34.4% (95% CI: 32.6%-36.3%) of participants reporting it. Household substance abuse 26.7% (95% CI: 25.0%-28.5%) and parental separation 24.6% (95% CI: 22.9%-26.3%) were the next most prevalent ACEs. The prevalence of other ACEs, listed in descending order, was domestic violence (17.0%, 95% CI: 15.6%-18.5%), physical abuse (16.9%, 95% CI: 15.4%-18.4%), mental illness (16.3%, 95% CI: 14.9%-17.9%), sexual abuse (11.0%, 95% CI: 9.8%-12.3%), and parental incarceration (7.6%, 95% CI: 6.5%-8.8%) *(cf Table 6)*.

The prevalence of the eight ACE categories computed ranged from 4,240 (7.6%; Parental incarceration, *cf Table 6*) to 3,043 (34.4%; Emotional abuse, *cf Table 5*). The categories evinced correlations between .3 and .7 *(cf Table 6)*. Results of KMO testing (.82) and Bartlett's Test of Sphericity (p< .0001) suggested that the eight items were suitable for PCA.

The results of the PCA analysis provide insights into the underlying structure of ACEs in Illinois. PCA extracted three components for ACEs (Eigenvector >.34). The first component, household dysfunction (35.0%), comprised mental illness, substance abuse, domestic violence, physical abuse, and emotional abuse, with eigenvectors ranging from .36 to .42 *(cf Table 8)*; this component elicited Cronbach's alpha of .71. The second component, parental loss (12.6%), comprised parental separation and parental incarceration, with eigenvectors ranging from .42 to .62 *(cf Table 8)* and elicited Cronbach's alpha of .32. The third and final component was sexual abuse (10.7%), which had an eigenvector of .84 *(cf Table 8)*. Together these components account for 58.3% of the variation in the Illinois 2017 BRFSS-ACE data.

Discussion

The state's (IDPH) Injury and Prevention Program publishes the present data brief on ACEs using PCA approach to support the implementation of the 2018-2022 State Strategic Plan. Specifically, the goal of this study was to develop a data brief that offers a thorough analysis of ACEs in Illinois, incorporating comprehensive information, statistical findings, and the application of PCA to condense the initial ACE items into a more succinct set of components that accurately depict the structure of ACEs in the state. [6]. The present discussion section will focus on addressing the four research questions related to the PCA approach.

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[2] The percentages in the Table 4 do not add up to 100% because participants who responded with "don't know," "not sure," or "refused" to answer the question about racial identity were excluded from the analysis.

Table 5: Research Questions on the Application of Principal Component Analysis (PCA) to understand the Prevalence and Structure of Adverse Childhood Experiences (ACEs) Data in Illinois

Research Questions
1. What is the prevalence of adverse childhood experiences (ACEs) in the 2017 BRFSS-ACE dataset and how does the confidence interval around the prevalence estimate inform our understanding of the overall ACEs in Illinois?
2. What are the key components or dimensions of ACEs that emerge from the principal component analysis (PCA) and how do they relate to each other?
3. How does the use of PCA to reduce ACEs items affect our understanding of the prevalence of ACEs in Illinois?
4. How do the results of PCA analysis affect our understanding of the structure of ACEs in Illinois and how do they compare to previous studies?

By addressing these research questions, it is the aim of this brief to contribute to a better understanding of the prevalence and structure of ACEs in Illinois, which can help to develop effective interventions and policies to address the negative impact of ACEs.

Research question 1:   What is the prevalence of ACEs in the 2017 BRFSS-ACE dataset and how does the confidence interval around the prevalence estimate inform our understanding of the overall ACEs in Illinois?

The prevalence of ACEs in Illinois in 2017 was high with 58.5% (95% CI: 56.6-60.4%) of adults reporting experiencing at least one ACE. The confidence intervals for the ACE categories varied with the widest confidence interval observed for emotional abuse (95% CI: 32.6-36.3%) and the narrowest for parental incarceration (95% CI: 6.5-8.8%). The confidence intervals around each prevalence estimate provide an indication of the precision of the estimate with wider intervals suggesting less precision. Overall, the high prevalence of ACEs in Illinois highlights the importance of addressing these issues and implementing effective interventions to reduce the impact of ACEs on individuals in the state.

Research question 2:   What are the key components or dimensions of ACEs that emerge from the PCA analysis and how do they relate to each other?

Table 7 displays the calculated correlation matrix used to carry out the PCA. This matrix allowed us to determine which ACEs contributed to significant variation to the PCA components. Notably, the data brief took a set of eight variables to find existing correlations between ACE types. Based on the correlation matrix, the PCA was used to reduce the dimensionality of the original 11 ACE items available in the BRFSS dataset to fewer components.

The results of the PCA indicated that the resulting eight ACE categories obtained after grouping of the original 11 ACE items could further be reduced to three components:

- Component 1 or household dysfunction
- Component 2 or parental loss
- Component 3 or sexual abuse

The term "dysfunctional household" was used in this data brief to refer to households that experienced common occurring events, such as mental illness, substance abuse, domestic violence, physical abuse, and emotional abuse, all of which have eigenvectors greater than or equal to .35. Notably, ACE categories of mental illness and physical abuse have relatively lower eigenvectors, indicating they are less strongly associated with the identified component.

Additionally, the data brief considered "parental loss" to include separation and incarceration (with eigenvectors also greater than or equal to .35) of family members. Finally, the data brief found that "sexual abuse," which is a distinct component with an eigenvector of .84, could not be further defined because it was derived by the PCA as a one-item ACE component. The results further indicate that the ACE component with

the highest prevalence is household dysfunction (consisting of five items), followed by parental loss (consisting of two items) and sexual abuse (consisting of one item). These findings have added to our knowledge of the structure of ACE data compiled in the Illinois 2017 BRFSS survey.

As a case in point, **Table 8** demonstrates a negative eigenvector value (-0.47) for the loading factor value at the intersection of row six (Physical abuse) and column three (Parental Loss) based on the principal component analysis, suggesting a negative relationship between physical abuse and parental loss, which indicates that individuals who experienced physical abuse in their childhood were less likely to have also experienced parental loss. It should be highlighted that the negative value calculated is not included in the components of this analysis, given that eigenvectors with values lower than 0.35 were excluded. It is further enough to emphasize the negative correlation between physical abuse and parental loss is not a key finding in the context of this PCA analysis. The PCA analysis highlights the interconnectedness of different types of ACEs, indicating that interventions that target household dysfunction, parental loss, and sexual abuse may be effective in reducing the risk of exposure to childhood adversity.

Research question 3: How does the use of PCA to reduce ACEs items affect our understanding of prevalence of ACEs in Illinois?

The use of PCA to reduce ACE items affects our understanding of the prevalence of ACEs in Illinois by identifying three main components that account for 58.3% of the variation in the data with household dysfunction (domestic violence, substance abuse, emotional abuse, physical abuse, mental illnesses) being the highest prevalent component followed by parental loss (parental incarceration and parental separation) and sexual abuse. These components allow for a more nuanced understanding of the structure of ACEs in Illinois, which can aid in the development of targeted interventions for those affected by ACEs. Furthermore, the PCA analysis does not change the overall prevalence of ACEs in Illinois, which was found to be high (≥1 ACE 58.5%), with emotional abuse (34.4%), substance abuse (26.7%), and parental separation (24.6%) being the most prevalent ACE categories *(cf Table 6)*.

Research question 4: How do the results of PCA analysis affect our understanding of the structure of ACEs in Illinois and how do they compare to previous studies?

As previously discussed (*cf* Results section), the results of the PCA analysis have shed light on the structure of ACEs in Illinois. In comparison to previous studies (e.g., Gette et all, 2021) the PCA analysis in this study identified similar categories of ACEs, such as substance abuse and mental illness as items of the household dysfunction component and sexual abuse[3] as an item of the (sexual) abuse component. However, in this study, the inclusion of additional ACE items in the household dysfunction component (domestic violence, emotional abuse, and physical abuse) on the one hand, and parental loss component (parental incarceration and parental separation) on the other hand, resulted in a slightly different structure of ACEs in Illinois. Each category in the model only met the >.34 cutoff for one component, and none were included in multiple components *(cf Table 8)*.

Limitations of the 2017 BRFSS-ACE Data

The 2017 BRFSS survey provided valuable insights into the structure of ACEs. However, there are important limitations associated with the data that this study acknowledges. First, the BRFSS survey collects self-reported data, which is subject to recall and social desirability bias [7]. Second, the specific formatting of the ACE questions may introduce potential measurement errors due to the way they elicit certain types of responses. Third, the BRFSS survey relies on a cross-sectional design making casual conclusion impossible [8]. Fourth, ACEs measured in the BRFSS survey sample do not include all people who do not live in institutions or groups of quarters, namely because interviews are conducted in English and Spanish. Folks who speak languages other than English and Spanish were not able to be interviewed in their speaking language, resulting in a selection bias [9]. Perhaps of little concern, the ACE questions were offered as an optional module and Illinois has only included them twice, in 2013 and 2017, thus limiting the availability of Illinois-

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[3] The sexual abuse category was excluded in (Gette et all, 2021) because it evinced an eigenvector of .43 which did not meet the eigenvector threshold set at ≥ .45 compared to ≥ .35 cutoff eigenvector value chosen in the present analysis, suggesting that Gette et al would have included this category in their analysis had the cutoff eigenvector been set to >34.

specific ACE information. Taken together the PCA results discussed in this data brief should not be discounted based on the highlighted shortcomings though consideration of such caveats is essential when using the 2017 Illinois ACE survey data. Lastly, a full discussion of limitations associated with the BRFSS-ACE data the current study focuses on is beyond the scope of this data brief and warrants further examination in future studies.

Measurement Validity

Besides the aforementioned limitations associated with the 2017 BRFSS survey, the alpha values calculated in the PCA model were either disregarded for the sexual abuse component due to its one-item nature (alpha value is missing) or deemed to be very low for the parental loss component (alpha value of .32). However, for the household dysfunction component, the alpha value was acceptable at .71, as shown in **Table 3**. Previous studies, such as Vaske et al. (2017) cited by Gette et al. (2021), have found that the alpha assessment may not be reliable for components consisting of few items. Similarly, Raykov et al. (2010) cited by Gette et al. (2021) suggest that alpha values are typically lower for binary data and when using formative modeling techniques. Furthermore, Edwards (2011) cited by Gette et al. (2021) notes that alpha values may not be significant for PCA components since it is not expected that components will necessarily correlate and exhibit internal consistency. It is worth noting that the current PCA component structure still holds value despite the low or missing alpha values for the parental loss component and sexual abuse component, respectively. Finally, replication of these findings in future studies is essential to determine the stability of the present structure across different samples.

Methodological limitations

The present data brief utilizes a PCA approach to analyze the composition of ACE items in the 2017 Illinois BRFSS survey, building upon existing literature. The resulting eight categories offer a more straightforward component structure, explaining 58.3% of the total variance. While this finding is noteworthy, additional research is needed to explore the limitations of the BRFSS survey and how different scoring methods or methodological variability may affect the variability of ACE measures. This study, consistent with previous research by Gette et al [4], found that under the binary coding scheme individuals are assigned a "yes" for a specific ACE category as long as they endorse having experienced at least one of the experiences within that category. This coding approach may conceal the underlying patterns of ACEs since individuals who report a single ACE in a category may have different experiences compared to those who report multiple ACEs within the same category. Therefore, it is imperative for assessment purposes to examine the data and construct components that reflect the data. As an illustration, out of the 11 proposed categories in the Illinois BRFSS survey, only three self-reliant components, household dysfunction, parental loss, and sexual abuse surfaced in the eight-category PCA. Furthermore, it is worth noting that 55.38% of the sample consists of female respondents, which could limit the applicability of the findings since endorsement of ACEs experiences could be biased. As an illustration, prior research has identified variations in childhood abuse rates depending on gender, as stated in Gette et al's reference to Ashraf et al. (2019) and Moody et al. (2018) [4]. Therefore, to ensure that the proposed three-component solution can be generalized across various settings, it is crucial to replicate the current findings by including more data from multiple years and different states with both predominantly male and non-predominant male/female samples, thereby avoiding the potential influence of the current study's characteristics. Ultimately, it is suggested to investigate the gender-specific disparities in the categories of ACEs experienced by individuals. Apart from duplicating the present ACEs structure, upcoming research could explore how the relationship between ACEs and racial identity varies across different racial and ethnic groups. It is also essential to examine the role that racial identity plays in moderating the relationship between ACEs and negative outcomes, such as mental health disorders or substance abuse.

Conclusion

This data brief concludes that ACEs are prevalent among adults in Illinois. The prevalence analysis highlights emotional abuse, substance abuse, and parental separation as the most common types of ACEs experienced. The high prevalence of ACEs in Illinois underscores the need of addressing these issues and implementing effective interventions to reduce their impact. The PCA analysis identified a three-component structure (household dysfunction, parental loss, and sexual abuse) that account for 58.3% of the variation in the data, providing a foundation for future research to explore the three components' associations with various

negative health outcomes. These findings contribute to a more nuanced understanding of the structure of ACEs in Illinois, enabling the development of targeted interventions for those affected. However, it is crucial to consider the limitations associated with the 2017 BRFSS survey data and the methodology employed in this study. Additionally, future research should aim to replicate the current findings in more diverse samples and settings and explore the influence of factors, such as gender, race, and ethnicity, on the prevalence and structure of ACEs. By addressing these limitations and expanding our understanding of ACEs, we can develop more targeted and effective interventions to reduce the negative impacts of adverse childhood experiences on individuals and communities in Illinois.

We all have a role in preventing ACEs. It is important to know that ACEs and their associated harms are preventable. Creating and sustaining safe, stable, nurturing relationships and environments for all children and families can prevent ACEs and help all children reach their full health and life potential.

CDC produced a resource, [Preventing Adverse Childhood Experiences (cdc.gov)](), featuring six *(cf Table 10)* strategies to prevent ACEs from happening in the first places as well as strategies to mitigate the harms of ACEs . The science of ACEs also reveals opportunities to improve the lives of all children and adults. Positive childhood experiences *(cf Table11)* can help the economy. The primary prevention of ACEs — stopping ACEs before they start — would benefit the economy and relieve pressures on healthcare systems.

Appendix.

Table 6: The prevalence of adverse childhood experience (ACE)-Illinois, 2017.

ACE Category	Prevalence and 95% Confidence	
	% (N)	95% CI
≥1 ACE	58.5 (2373)	56.6 - 60.4
1 ACE	22.8 (1013)	21.3 - 24.5
2-3 ACEs	19.8 (804)	18.2 - 21.4
4+ ACEs	15.9 (556)	14.5 - 17.4
1. Emotional abuse	34.4 (1393)	32.6%-36.3%
2. Substance abuse †	26.7 (1073)	25.0%-28.5%
3. Parental separation	24.6 (920)	22.9%-26.3%
4. Domestic violence	17.0 (663)	15.6%-18.5%
5. Physical abuse	16.9 (668)	15.4%-18.4%
6. Mental illness	16.3 (663)	14.9%-17.9%
7. Sexual abuse *	11.0 (463)	9.8%-12.3%
8. Parental incarceration	7.6 (233)	6.5%-8.8%
Total N= 5,545.		
†Substance abuse is calculated from questions about alcohol abuse and drug abuse.		
*Sexual abuse is calculated from questions about being sexually touched by an adult, being forced to touch an adult sexually, or being forced to have sex with an adult.		

Table 7: Polychronic correlation among the adverse childhood experience (ACEs)-Illinois, 2017

ACE Category	Correlations							
	1	2	3	4	5	6	7	8
1. Mental illnesses	-							
2. Substance abuse	.56	-						
3. Parental incarceration	.46	.66	-					
4. Parental separation	.37	.43	.45	-				
5. Domestic violence	.51	.61	.48	.49	-			
6. Physical abuse	.50	.46	.36	.30	.66	-		
7. Emotional abuse	.52	.51	.35	.32	.65	.70	-	
8. Sexual abuse	.49	.46	.33	.34	.47	.46	.41	-

Note: All correlations are significant at p< .0001. The minimum and maximum correlations are highlighted in blue with the Min (corr) =.30 and the Max (corr) = .70.

Table 8: Principal components eigenvectors of adverse childhood experience (ACEs)-Illinois, 2017

ACE Category	A 3-Component Solution		
	Household Dysfunction	Parental Loss	Sexual Abuse
Mental illnesses	**.36**	.04	.31
Substance abuse	**.40**	.23	-.06
Parental incarceration	.27	**.62**	-.22
Parental separation	.29	**.42**	-.07
Domestic violence	**.42**	-.13	-.22
Physical abuse	**.37**	-.47	-.18
Emotional abuse	**.39**	-.38	-.24
Sexual abuse	.29	-.05	**.84**

Bold indicates that the item eigenvector comprises the corresponding component at ≥.35. In addition, negative values were not considered to be part of the components.

Appendix (Continued).

Table 9: The adverse childhood experience (ACE) questions and response options-Illinois, 2017

Question	Response
1. Did you live with anyone who was depressed, mentally ill, or suicidal?	Y/N
Substance abuse	
2. Did you live with anyone who was a problem drinker or alcoholic?	Y/N
3. Did you live with anyone who used illegal street drugs or who abused prescription medications?	Y/N
4. Did you live with anyone who served time or was sentenced to serve time in a prison, jail, or other correctional facility?	Y/N
5. Were your parents separated or divorced?	Y/N
6. How often did your parents or adults in your home ever slap, hit, kick, punch or beat each other up?	Ni/A
7. Before age 18, how often did a parent or adult in your home ever hit, beat, kick, or physically hurt you in any way? Do not include spanking.	Ni/A
8. How often did a parent or adult in your home ever swear at you, insult you, or put you down?	Ni/A
Sexual Abuse	
9. How often did anyone at least 5 years older than you or an adult ,ever touch you sexually?	Ni/A
10. How often did anyone at least 5 years older than you or an adult try to make you touch sexually?	Ni/A
11. How often did anyone at least 5 years older than you or an adult force you to have sex?	Ni/A

Illinois Behavioral Risk Factor Surveillance System(BRFSS). Y=Yes/N=No Ni=Never/A=At Least One

Table 10. Strategies and Approaches for Preventing Adverse Childhood Experiences (ACEs)

Preventing ACEs	
Strategy	**Approach**
Strengthen economic supports to families	• Strengthening household financial security • Family-friendly work policies
Promote social norms that protect against violence and adversity	• Public education campaigns • Legislative approaches to reduce corporal punishment • Bystander approaches • Men and boys as allies in prevention
Ensure a strong start for children	• Early childhood home visitation • High-quality child care • Preschool enrichment with family engagement
Teach skills	• Social-emotional learning • Safe dating and healthy relationship skill programs • Parenting skills and family relationship approaches
Connect youth to caring adults and activities	• Mentoring programs • After-school programs
Intervene to lessen immediate and long-term harm	• Enhanced primary care • Victim-centered services • Treatment to lessen the harms of ACEs • Treatment to prevent problem behavior and future involvement in violence • Family-centered treatment for substance use disorders

Appendix (Continued).

Table 11: How to Create Positive Childhood Experiences

Strengthen families' financial stability	Promote social norms that protect against violence	Help kids have a good start
• Paid time off • Child tax credits • Flexible and consistent work schedules	• Positive parenting practices • Prevention efforts involving men and boys	• Early learning programs • Affordable preschool and childcare programs
Teach healthy relationship skills	**Connect youth with activities and caring adults**	**Intervene to lessen immediate and long-term harms**
• How to handle conflict • Negative feeling management • Pressure from peers • Healthy non-violent dating relationships	• School or community mentoring programs • After school activities	• ACEs education • Therapy • Family-centered treatment for substance abuse

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