First-time exploration of adverse childhood experiences among adults in Delaware using BRFSS data: A cross-sectional study

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ABSTRACT

Objective: In 2019, for the first time, Delaware collected adverse childhood experiences (ACEs) data through the population-based Behavioral Risk Factor Surveillance System (BRFSS). The main objective of this study was to explore and delineate the prevalence of ACEs and determine their association with select chronic conditions/risk behaviors.

Study design: A cross-sectional population-based study.

Methods: Delaware BRFSS 2019 data (N = 3,879) were analyzed. This includes 2,015 respondents with at least one ACE and 1,882 without ACE. Logistic regression was performed using SAS complex weighting procedures to compare the prevalence odds of selected conditions while controlling for age, gender, and race/ethnicity in Delawareans with and without ACEs. Delaware BRFSS participant response rate was 38.2% comparable to other federal survey responses.

Results: Nearly one in four adults reported high ACEs scores (≥3). Emotional abuse was the most common ACE. ACEs were significantly associated with poorer health outcomes. High ACE scores were more prevalent among women, multiracial/minority race groups, bisexual, lesbian/gay sexually oriented, younger age group, and less educated. Associations between high ACEs score and selected health conditions/behaviors remained statistically significant even after controlling for socio-demographic characteristics.

Conclusion: Reporting of ACEs data is critical for Delaware’s progress towards a Trauma-Informed State. A particularly disturbing finding was that a high number of young adults reported 3 or more ACEs. Strong association with chronic conditions, particularly mental health was a significant cause for concern. Study results present a first-time expansive coverage, providing stakeholders with a unique opportunity to prioritize evidence-based decisions in Trauma-Informed Delaware.

1. Introduction

According to the 2020 report released by the United Health Foundation, Delaware’s low health ranking is driven by a high prevalence of adverse childhood experiences (ACEs) [1]. First State lags considerably behind the nation on childhood adversity score. ACEs pose a significant challenge to the health of Delawareans. Defined as traumatic events or conditions, such as abuse, neglect, dysfunctional household that occur in childhood (0–17 years) of age, ACEs have health consequences across the life span [2,3]. Toxic stress attributed to adversity or trauma in childhood is known to alter gene expression, immunity, organ function, and brain development leading to health risk behaviors (smoking, heavy drinking, injury, sexually transmitted infections, teen pregnancy, etc) and subsequently a wide range of chronic diseases such as cancer, diabetes, heart disease, depression [2-5]. Not surprisingly, individuals who experience six or more ACEs are predicted to have their life expectancy shortened by 20 years.4

Recognizing that consequences of ACEs occur across the lifespan and include a significant association with negative health outcomes, there is a critical need for a detailed exploration and delineation of ACEs in Delaware. Research findings will help provide valuable evidence enabling the State of Delaware to continue its progress and bolster existing efforts to become a more Trauma-Informed State. Targeted characterization of the ACEs population will guide state health care providers and regional policymakers in coordinating collaborative opportunities and prioritization of resources -a roadmap for establishing the infrastructure required for Trauma-Informed Delaware.

It is important to note ACEs prevalence reported by America’s Health

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Rankings are based on National Survey of Children’s Health (NSCH) data, U.S. Department of Health and Human Services [6]. NSCH surveys adults about a child’s health currently in their household. When dealing with sensitive questions related to traumatic experiences, there are bound to be differences in how an adult answers questions about their own past and how an adult answers these questions for a child. This issue is aptly addressed by the Centers for Disease Control and Prevention’s, Behavioral Risk Factor Surveillance system (BRFSS), a population-based survey of health conditions and risk behaviors administered annually to adults 18 and older across the United States [7]. Starting in 2009, CDC gave states the option to collect ACEs data as a part of the BRFSS questionnaire. A major difference between NSCH and BRFSS collection of adverse experiences data is that BRFSS surveys adults 18 years or older about their own health and traumatic experiences in childhood. Moreover, the BRFSS ACEs module provides an additional advantage. It enables exploration of the cumulative effect of ACEs on health outcomes such as chronic conditions and risk behaviors across the lifespan.

Although as early as 2009, states began a collection of ACEs data as a part of BRFSS questionnaires, it was not until 2019 that Delaware administered the ACEs module for the first time. Thus BRFSS 2019 data provides a pioneer opportunity to delve into ACEs and their association with health conditions among adult Delawareans. This study examines the cumulative effect of ACEs on selected chronic conditions and risk behaviors in Delaware using BRFSS 2019 data. The main objective of this study was to examine the prevalence of ACEs by selected sociodemographic groups and determine ACEs association with selected chronic conditions/risk behaviors among Delaware adults.

The timing of this study could not have been better. In October 2018, Delaware Governor John Carney signed Executive Order #24 (EO24), which launched a formal and official effort to make Delaware a Trauma-Informed State [8]. A “trauma-informed approach” is defined as a profound paradigm shift on a continuum of implementation where organizations move through stages of becoming trauma aware, trauma-sensitive, trauma-responsive to being fully trauma-informed [9]. Over the past several decades, Delaware has built a solid foundation of awareness, knowledge, and training in trauma care. Thousands of individuals have been trained, and a growing awareness of ACEs and the impact of trauma has permeated Delaware schools and government agencies [8].

EO 24 underscores the collection, evaluation, and reporting of Delaware ACEs data on an ongoing basis to make evidence-driven policy decisions. This study characterizes and presents findings on ACEs in Delaware. The overall goal of this study is to facilitate targeted interventions and evidence-based policies responsive to community needs and priorities, as part of ongoing efforts to make Trauma-Informed Delaware a reality.

2. Methods

2.1. Data source

This study uses a cross-sectional study design using data from the Centers for Disease Control and Prevention’s (CDC) Behavioral Risk Factor Surveillance System (BRFSS)- an annual survey that collects data on health-related risk behaviors and health conditions from noninstitutionalized adults 18 and older within 50 states, the District of Columbia, and U.S. territories. The telephone (landline and cell phone) based BRFSS questionnaire is designed to include a core set of questions used by all states and additional optional modules [10]. In 2009, an ACE module was added to the BRFSS questionnaire. However, it was not until 2019 that Delaware opted to administer and collect ACE data for the first time through BRFSS. The BRFSS ACE module is comprised of 11 questions that were collapsed into eight categories of adverse experiences: three types of abuse (physical, emotional, and sexual) and five types of household challenges (household member substance misuse, incarceration, mental illness, parental divorce, or witnessing intimate partner violence) (Table 1). All questions refer to the time period before respondents were 18 years old.

In order to maintain consistency across states, the BRFSS sets standard protocols for data collection. These standards allow for state-to-state data comparison in data. The BRFSS uses two samples: one for landline telephone respondents and one for cellular telephone respondents. In order to conduct the BRFSS, states obtain samples of telephone numbers from the CDC. Disproportionate stratified sampling (DSS) has been used for the BRFSS landline sample since 2003. The cellular telephone sample is randomly generated from a sampling frame of confirmed cellular area code and prefix combinations. Cellular telephone respondents are randomly selected with each having an equal probability of selection. CDC provides a separate cellular telephone sample to each state, according to the total number of complete that the state is targeting for that year. CDC receives and tracks monthly data submissions from the states. Once CDC receives and validates the entire year of data for a state by running end programs and assigns weights. Data weighting is an important statistical process that attempts to adjust for any differences in the data collection process among states.

Table 1

| ACE Category | Survey Question | Response Options | Scoring |
|--------------|----------------|-----------------|--------|
| Physical abuse | “How often did your parent or an adult in your home ever hit, beat, kick, or physically hurt you in any way? Do not include spanking.” | Never/Once/More than once | 1 = Once or More than once 0 = Never |
| Sexual abuse | “How often did anyone at least 5 years older than you or an adult ever touch you sexually?” | Never/Once/More than once | 1 = Once or More than once 0 = Never |
| Emotional abuse | “How often did a parent or adult in your home ever swear at you, insult you, or put you down?” | Never/Once/More than once | 1 = Once or More than once 0 = Never |
| Child abuse | “Did you live with anyone who was depressed, mentally ill or suicidal?” | Yes/No | 1 = Yes 0 = No |
| Substance abuse | “Did you live with anyone who was a problem drinker or alcoholic?” | Yes/No | 1 = Yes to one or more of the two questions included in this category 0 = No to both questions in this category |
| Incarcerated member | “Did you live with anyone who served time or was sentenced to serve time in a prison, jail or other correctional facility?” | Yes/No | 1 = Yes 0 = No |
| Violence | “How often did your parents or adults in your home ever slap, hit, kick, punch or beat each other up?” | Never/Once/More than once | 1 = Once or More than once 0 = Never |
| Parental separation/divorce | “Were your parents separated or divorced?” | Yes/No | 1 = Yes 0 = No |

*All questions refer to the time period before respondents were 18 years old.*
remove bias in the sample. The BRFSS weighting process includes two steps: design weighting and iterative proportional fitting (also known as “raking” weighting). BRFSS’s new weighting protocols have ensured that data are representative of the population on a number of demographic characteristics including sex, age, race, education, marital status, homeownership, phone ownership (landline telephone, cellular telephone, or both), and sub-state region [10,11].

Complex survey procedures with appropriate stratification and weighting of the data were applied to the study sample. Potential bias resulting from selection probabilities and noncoverage among segments of the population was reduced through weighting in this study. The complex survey methodology and analytical procedures for BRFSS are designed to produce prevalence estimates that can be generalized to Delaware adults statewide [10].

In 2019, the BRFSS response rate for Delaware was landline (39.5%); cellphone (37.1%), and combined (38.2%) comparable to other federal survey responses [10]. Data from 3,897 respondents were analyzed. This included 2,015 Delawareans with at least one ACE and 1,882 without ACE.

2.1.1. Definitions

Self-reported exposure to any single ACE category was counted as one point toward the final ACE score (range: 0 to 8) (Table 1). “Don’t know” or “refused” responses were coded as missing for all questions. ACEs scores were further categorized on the number of ACEs reported: zero, one or two, and three or more. ACEs score of three or more were considered high scores whereas ACEs scores of 1–2 were considered as low scores. This low/high grouping is in accordance with the “Adverse Childhood Experiences Among Adults” life course indicator for the Life Course Metrics Project and has been utilized in other state-level analyses on ACEs [12–14].

In addition, content and scoring of BRFSS adverse childhood experience items has been examined at length earlier [15].

Demographic categories were defined in detail. Age was categorized into six groups: 18–24, 25–34, 35–44, 45–54, 55–64, and 65 years or older. Sex was categorized as female or male. Race was categorized into White, Black, Hispanic, American Indian/Alaska Native, Asian, and Other (including Pacific Islander, Multiracial, and something else). Income was categorized into the following groups: less than $15,000, $15,000–$25,000, $25,000–$35,000, $35,000–$50,000 and $50,000 or above. Education was categorized into less than high school, high school graduate, any college, and college graduate. Health care coverage was determined as any kind of health care coverage, including health insurance, prepaid plans such as health maintenance organizations (HMOs), or government plans such as Medicare, or Indian Health Service or no health care coverage.

Veteran status and sexual orientation were two additional sociodemographic characteristics included in the characterization of ACEs among adults in Delaware. Prior research attributes enlistment in the military as an act of escape from a higher burden of ACEs. Adults who responded yes to the question, “Have you ever served on active duty in the United States Armed Forces, either in the regular military or in a National Guard or military reserve unit?” were included as veterans. Studies also show a higher prevalence of ACEs amongst sexual minorities compared to their heterosexual counterparts [16]. Delawareans who self-identified as lesbian, gay, bisexual, or transgender were together defined as the “sexual minority” category.

Outcomes of interest in this study were related to chronic conditions and health risk behaviors. Self-reports of physician-diagnosed chronic conditions were used to identify respondents with cardiovascular diseases (stroke, angina, or heart attack), chronic obstructive pulmonary disorder (COPD), arthritis, asthma, cancer, diabetes, and depression. Furthermore, the self-reported status of health in general and 14 or more days of poor physical and mental health (past month) were also studied. Current smoking, past-month heavy drinking (4 or more drinks for females or 5 or more drinks for males on one occasion), and overweight/obesity (body mass index greater than or equal to 25) were assessed as health risk behaviors.

2.2. Statistical analyses

SAS complex survey procedures were used to calculate overall and subpopulation prevalence estimates of each adverse childhood experience category and ACE score. Prevalence estimates of various health risk factors and chronic conditions were also examined by ACE score. In addition, logistic regression was used to examine the association between ACE score and various health risk factors and conditions, while controlling for selected demographic characteristics (income, education, age, gender, and race/ethnicity). Data analyses were conducted using SAS version 9.4 (SAS Institute, Inc). Survey weights were used throughout analysis to reduce bias resulting from selection probabilities and noncoverage. Two-tailed tests were used to test for significant differences in prevalence between population subgroups (p < 0.05).

3. Results

Emotional abuse, physical abuse and substance abuse by a household member were the three most common adverse childhood experiences reported by Delawareans. Over 1 in 4 adults reported experiencing emotional abuse (27.3%) followed by physical abuse (22.6%) and substance abuse by a household member (22.2%) (Table 2).

Overall, 52.7% of adults in Delaware experienced at least one, and 34.2% experienced two or more ACEs. Table 3 presents the sociodemographic characteristics by ACEs exposure. Sex, race/ethnicity, age group, and sexual orientation were found to have a significant association with ACEs exposure among Delawareans. Women, American Indian/Alaska Native, Other racial (multiracial, Native Hawaiian/Pacific Islander, multiracial and other), Hispanic ethnicity, and lower-income groups were more likely to experience higher (≥3) ACEs score. Adults in the younger age groups reported more exposure to 3 or more ACEs. By sexual orientation, 3 or more ACEs prevalence was significantly higher amongst gay/lesbian/bisexual/transgender adults as compared to heterosexuals.

More veterans (33.3%) reported 1–2 ACEs as compared to 29.7% non-veterans in Delaware. However, the results were not found to be statistically significant.

Adults with higher ACE scores had a significantly higher prevalence of asthma, COPD, kidney disease, arthritis, and depression. In addition, respondents with high ACEs were more likely to be current smokers and heavy drinkers. Adults with ACEs also reported a significantly higher prevalence of 14 or more days of poor physical health in the past month and 14 or more days of poor mental health in the past month (Table 4).

Logistic regression analysis of the association between ACEs exposure and the health outcomes examined found that adults with 3 or more ACEs exposure had higher odds of having most of the selected chronic physical conditions, with adjusted odds ratios (AORs) ranging from 1.6 (95% CI = 1.2–2.3) for asthma to 2.4 (95% CI = 1.6–3.6) for COPD

Table 2: Prevalence of Adverse Childhood Experiences (ACE) among adults aged 18 years and older by ACE category— Behavioral Risk Factor Surveillance System (BRFSS), Delaware, 2019.

| Category                             | % (95% CI) |
|--------------------------------------|------------|
| Incarcerated household member        | 7.1 (5.7, 8.3) |
| Sexual abuse                         | 9.2 (8.1, 10.5) |
| Violence between adults in household | 13.9 (12.3, 15.4) |
| Mentally ill household member        | 13.5 (11.9, 15.2) |
| Physical abuse                       | 22.6 (20.7, 24.5) |
| Substance abuse in household         | 22.2 (20.2, 24.2) |
| Parental Separation/Divorce         | 21.5 (19.6, 23.5) |
| Emotional abuse                      | 27.3 (25.4, 29.3) |

a Percentages are weighted estimates.
compared with those reporting zero ACEs. After adjusting for income, education, age, sex, and race/ethnicity, odds of depression (AOR = 3.2, 95% CI = 2.4–4.3), being a current smoker. (AOR = 2.1, 95% CI = 1.6–2.5) or heavy drinkers (AOR = 2.1, 95% CI = 1.4–2.9), were also significantly higher among adults in Delaware with higher ACE score (Table 5).

4. Discussion

Delaware BRFSS participant response rate was 38.2% comparable to other federal survey responses. Prevalence of low (1–2) ACEs score was comparable amongst men and women. However, women were at greater risk of having experienced 3 or more ACEs. Prevalence of higher ACEs was also observed among the younger (18–34 years) age group. Spotlight on ACEs over recent years resulting in increased awareness may be a contributing factor along with a willingness to disclose and the ability to recall adverse childhood experiences in younger Delawareans [17, 18]. Multi-decade increases in parental divorce, parental drug abuse, and parental incarceration may also be contributing factors. [19]. Increased mortality amongst older age groups with more adverse childhood experiences could be another reason [20, 21].

ACEs prevalence showed significant differences by race/ethnicity. American Indian/Alaska Native, Other races (multiracial, other, Native Hawaiian/Pacific Islander) and Delawarean adults reporting Hispanic ethnicity had a higher prevalence of three or more types of adverse childhood experiences, compared with whites. The cumulative effect of living in under-resourced segregated neighborhoods with limited socioeconomic opportunities among these groups can exacerbate toxic stress due to ACEs and worsen health outcomes over the life span [3, 17, 22].

Surprisingly, this study does not find Delaware Blacks to have a higher burden of ACEs as reported in prior research [1, 3, 17].

A higher prevalence of ≥3 ACEs was noted among gay/lesbian/bisexual/transgender adults in Delaware. Possible contributory factors may be as follows: 1) sexual minority groups may experience significant disadvantages at home compounded by the increased likelihood of abuse outside the home; 2) abuse may trigger a shift in sexual orientation, and 3) sexual minorities are more likely to perceive and report parent incarceration may also be contributing factors. [19].
Adult Delawareans with low educational attainment were associated with a high ACEs score. Children exposed to ACEs may face limited education opportunities, a possible precursor for lack of financial stability across the life span [3,27].

ACE exposure can lead to the adoption of health-risk behaviors such as smoking, substance use, injury, sexually transmitted infections, teen pregnancy, and involvement in sex trafficking [3]. Exposure to adversity can also result in a wide range of chronic diseases such as cancer, diabetes, heart disease, and depression, across the lifespan [3,21]. Adult Delawareans with high ACEs score had a significantly higher prevalence of asthma, COPD, kidney disease, arthritis, and depression. They were more also more likely to be current smokers and heavy drinkers. Adults with high ACEs scores also reported a significantly higher prevalence of fair or poor general, physical and mental health. A significantly higher prevalence of chronic conditions underscores the importance of continued focus on ACEs in Delaware. Early intervention and trauma-informed care can mitigate the impact of ACEs on health outcomes.

This study is not without limitations. BRFSS survey does not include institutionalized populations (nursing homes, long-term care facilities, correctional institutions, etc.). The self-reporting nature of BRFSS responses may result in underreporting and bias. Data captured on chronic conditions include only that were confirmed by a doctor or health professional, possibly underestimating undiagnosed conditions. BRFSS data is limited in its capacity to assess the severity or duration of ACEs [28]. Despite these limitations, this study provides invaluable data to facilitate targeted trauma-informed interventions in Delaware.

5. Conclusion

Reporting of ACEs data is critical for Delaware’s progress towards a Trauma-Informed State. Study results present a first-time expansive coverage of adverse childhood experiences with a goal to facilitate evidence-based trauma-informed practices and policies in the First State.

A particularly disturbing finding was that a high number of young Delawareans reported 3 or more ACEs. Trauma-informed practices to prevent childhood adversity in the first place and to intervene with those who have been exposed to ACEs may prevent health risk behaviors in Delaware youth and ensuing negative health outcomes. Embracing and infusing trauma-informed practices might also help to break the multi-generational cycle of adverse childhood experiences as these age groups are most likely to start families or raise children. Rightly deemed as a high priority public health issue, Healthy People 2030 has a developmental objective to reduce the number of young adults (ages 18–25 years) who report three or more ACEs [27].
Unresolved ACEs trauma and toxic stress result in the amplification of multiple negative health outcomes. In addition, trauma experienced in childhood can limit educational attainment leading to socioeconomic disadvantages across the lifespan. These negative experiences place a great economic burden on families, communities, and society.

The intention of Trauma-Informed Care is not to treat symptoms or issues related to ACEs but rather to provide support services in a way that is accessible and appropriate to those who may have experienced trauma [5]. Progress towards this goal requires clarification on the standards of practice of trauma-informed care; transformation of organizations, agencies and institutions that serve and impact the lives of Delawareans every day; and policy change as a priority, until Trauma-Informed Delaware becomes a reality. Detailed characterization of ACEs amongst Delawareans bolsters ongoing efforts to advance the First State in its journey to becoming a more Trauma-Informed State.

### Table 5

**Association between adverse childhood experience score[6, b] and health conditions, health risk behaviors, and socioeconomic challenges — Behavioral Risk Factor Surveillance System (BRFSS), Delaware, 2019.**

| Outcome | 1-2 | 3 or more |
|---------|-----|-----------|
| Chronic Condition: | | |
| Coronary heart disease/ Angina | 1.3 | p = 1.6 | p = |
| Heart attack/Myocardial infarction | 0.8 | p = 1.8 | p = |
| Stroke | 1.3 | p = 1.1 | P = |
| Arthritis | 1.2 | 0.2837 | (0.7-1.9) | 0.5991 |
| Asthma | 1.3 | p = 1.6 | p = |
| Chronic obstructive pulmonary disease | 1.3 | p = 2.4 | p = |
| Cancer (excluding skin) | 1.1 | p = 1.3 | p = |
| Kidney disease | 1.6 | 0.0436 | (0.7-2.1) | 0.5642 |
| Diabetes | 0.9 | p = 0.9 | p = |
| Overweight or obesity† | 0.9 | p = 1.2 | P = |

| Mental health | | |
| Depression | 1.4 | p = 3.2 | p < |
| Fair or poor general health | 1.1 | p = 1.4 | p = |
| Health | 1.6 | 0.9756 | (1.1-1.9) | 0.0160 |
| 14+ days poor physical health | 0.9 | p = 1.9 | p = |
| 14+ days poor mental health | 1.1 | p = 2.3 | p < |
| Health risk behavior | | |
| Current smoker | 1.4 | p = 2.1 | p < |
| Heavy drinker | 1.7 | p = 2.1 | p < |
| Socioeconomic challenge | | |
| Less than high school education | 1.1 | p = 1.5 | p = |
| Income less than $15,000 | 0.7 | p = 1.3 | P = |
| No health insurance | 0.8 | p = 1.2 | P = |

| Note: frequencies presented are unweighted. Percentages and confidence intervals are weighted. |
|---|---|---|
| Abbreviation: CI = confidence interval. |
| † Based on the number of adverse childhood experience types reported. |
| ‡ Referent group had zero adverse childhood experiences; all models were adjusted for socioeconomic status (income, education), sex, age group, and race/ethnicity. |

The negative impact of ACEs amongst Delawareans is evident from the strong association with chronic conditions and risk behaviors. Disproportionate ACEs burden on vulnerable and disadvantaged Delaware communities is of particular concern. These are the families least likely to have accessible, affordable, and affordable safety nets such as medical providers and educators, either because they are struggling with mental illness, or because they lack basic socio-economic resources. Not surprisingly, the strongest association of ACEs was with poor mental health outcomes in adulthood. Strong links between ACEs and adult mental well-being emphasize the need for a life course approach to mental health. An important strategy in responding to the behavioral health impacts of exposure to trauma is the availability of an array of culturally responsive, trauma-specific treatment interventions.

### Ethical approval

Per 45 CFR 46.101, research using certain publicly available data sets does not involve “human subjects”. The data contained within BRFSS data set are neither identifiable nor private and thus do not meet the federal definition of “human subject” as defined in 45 CFR 46.102. Therefore, this research projects did not need to be reviewed and approved by the Institutional Review Board (IRB).

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### Declaration of competing interest

The author reports no conflicts of interest in this work.

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