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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 Preventions', 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 socio-demographic 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 non-institutionalized 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 completes 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

Table 1
ACE categories and scoring: BRFSS ACE module survey questions and response options.

ACE Category	Survey Question[a]	Response Options	Scoring
Childhood abuse			
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?" " … try to make you touch them sexually?" " … force you to have sex?"	Never/ Once/More than once	1 = Once or more than once of the three questions included in this category 0 = Never to all three questions in this category
Emotional abuse	"How often did a parent or adult in your home ever swear at your, insult you, or put you down?"	Never/ Once/More than once	1 = Once or More than once 0 = Never
Household Dysfunction			
Mentally ill household member	"Did you live with anyone who was depressed, mentally ill or suicidal?"	Yes/No	1 = Yes 0 = No
Substance abuse in household	"Did you live with anyone who … " " … was a problem drinker or alcoholic?" " … abused prescription medications?"	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 household 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 between adults in household	"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

[a] 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 .[16] 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.

	% (95% CI)[a]		
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.

Table 3
Sociodemographic characteristics of adults in the study population, by adverse childhood experience score* — Behavioral Risk Factor Surveillance System (BRFSS), Delaware, 2019.

	Adverse childhood experience score					
	0		1-2 (low score)		3 or more (high score)	
	No.	**% (95% CI)§**	**No.**	**% (95% CI)§**	**No.**	**%(95% CI)§**
Total	1,882	47.3 (45.1–49.6)	1,138	29.8 (27.8–31.9)	877	22.8 (20.9–24.7)
Sexp1						
Men	870	47.9 (44.7–51.3)	529	31.4 (28.3–34.5)	342	20.6 (17.9–23.5)
Women	1012	46.7 (43.7–49.8)	609	28.4 (25.6–31.2)	535	24.9 (22.2–27.5)
Age group (years)¶						
18-24	100	39.9 (31.7–48.1)	59	24.1 (16.4–31.8)	88	36.0 (27.6–44.3)
25-34	209	46.1 (39.5–52.7)	110	26.4 (20.3–32.5)	117	27.5 (21.5–33.5)
35-44	229	47.9 (41.9–54.0)	127	27.4 (21.8–33.0)	129	24.7 (19.7–29.6)
45-54	275	46.9(41.7–52.1)	178	30.2 (25.4–35.1)	164	22.9(18.8–26.9)
55-64	370	46.9 (41.7–52.1)	230	31.7 (27.3–36.1)	190	21.4 (17.8–24.9)
≥65	699	51.8 (48.1–55.4)	434	34.7 (31.2–38.3)	189	13.5 (11.1–15.9)
Race/ethnicity**p2						
White	1248	45.5 (42.9–48.1)	796	30.1 (27.7–32.5)	592	24.4 (22.1–26.7)
Black	226	45.0 (39.1–50.9)	147	31.6 (25.9–37.2)	120	23.4 (18.2–28.7)
American Indian/AN	13	42.4 (20.7–64.1)	10	25.9 (5.7–46.1)	8	31.8(10.5–53.0)
Asian	45	71.2 (57.9–84.5)	20	26.6(13.4–39.7)	5	2.2 (0.0–4.6)
Other	53	45.2 (33.1–57.2)	27	22.9(12.6–33.2)	44	31.9 (21.1–42.8)
Hispanic	239	54.9 (47.7–62.1)	113	27.1 (20.3–33.9)	94	18.0 (13.2–22.8)
Educationp3						
Less than High School	209	46.2 (39.2–53.1)	112	29.0(22.4–35.6)	87	24.9 (18.1–31.6)
Graduated High School	483	46.4(42.3–50.5)	305	29.1 (25.3–32.9)	264	24.5(21.0–28.0)
Attended College	456	46.0(41.6–50.4)	263	30.0 (25.8–34.3)	234	23.9(20.1–27.8)
Graduated College	712	49.2 (45.5–52.9)	458	31.4 (28.0–34.8)	288	19.4 (16.5–22.2)
Incomep4						
Less than $15,000	126	46.0 (37.7–54.2)	76	23.7 (17.2–30.2)	94	30.3(22.2–38.4)
$15,000 to <$25,000	220	43.8 (37.5–50.1)	146	32.6(26.5–38.6)	122	23.6 (18.6–28.6)
$25,000 to <$35,000	128	41.5(33.7–49.2)	84	26.3 (19.4–33.1)	83	32.3(24.7–39.8)
$35,000 to <$50,000	162	38.7(31.7–45.7)	123	32.0 (25.1–38.9)	117	29.4 (22.3–36.4)
$50,000 and more	737	43.2(39.9–46.6)	517	33.4 (30.0–36.7)	342	23.4 (20.4–26.4)
Insurancep5						
Yes	1660	47.1(44.7–49.5)	1035	30.6(28.4–32.9)	774	22.3(20.3–24.2)
No	215	49.4(42.4–56.5)	101	23.5(17.6–29.4)	97	27.1(20.4–33.7)
Sexual Orientation ¶						
Heterosexual	1839	48.5(46.2–50.8)	1096	30.3(28.1–32.5)	784	21.2(19.3–23.2)
Gay/lesbian/bisexual/transgender	43	24.5(15.8–33.1)	42	20.6 (13.2–28.1)	93	54.9(45.0–64.9)
Veteransp6						
Yes	270	48.3(42.3–54.3)	176	33.3(27.4–39.1)	107	18.4 (14.0–22.9)

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. $^{p1} = 0.0749$ $^{p2} = 0.0002$ $^{p3} = 0.5015$ $^{p4} = 0.1195$ $^{p5} = 0.1826$ $^{p6=}0.1408$ ¶$p < 0.001$ from chi-squared test of independence. ** Participants self-reporting as white, black, American Indian/Alaska Native, Asian, and Other (Native Hawaiian or Other Pacific Islander, multiracial, or other) were non-Hispanic; Hispanic participants could be of any race.

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 [13,17].

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 ACEs [23–25].

Contrary to prior research [26], Delaware veterans did not report a higher prevalence of ACEs.

Table 4
-Prevalence of health conditions, health risk behaviors, and socioeconomic challenges by adverse childhood experience score[a,b] — Behavioral Risk Factor Surveillance System (BRFSS), Delaware, 2019.

	Adverse childhood experience score					
	0		1–2		3 or more	
	No.	**% (95% CI)**	**No.**	**% (95% CI)**	**No.**	**% (95% CI)**
Prevalence						
Chronic Condition						
Coronary heart disease [e]	85	4.0(2.8–5.1)	48	5.5 0.8 3.8 7.2	73	4.0 0.8 2.5 5.6
Heart attack/Myocardial infarction [f]	103	4.5(3.4–5.6)	64	4.1 0.7 2.8 5.4	53	5.1 0.9 3.4 6.7
Stroke [g]	98	3.8 (2.8–4.7)	64	4.9 3.3 6.5	43	3.1 1.9 4.3
Asthma [h]	242	12.5 (10.5–14.5)	152	15.4 (12.0–18.9)	170	21.6 (17.3–25.9)
Chronic obstructive pulmonary disease [i]	149	6.6 (5.3–8.0)	107	8.7 (6.6–10.9)	123	11.9 8.6 15.1
Cancer (excluding skin) [j]	198	7.9 (6.4–9.3)	132	9.4 (7.3–11.5)	80	8.0 (5.4–10.6)
Kidney disease [k]	91	3.8 (2.6–4.9)	67	6.2 (4.2–8.3)	36	3.2 (1.9–4.6)
Diabetes [l]	275	14.2 (12–16.3)	176	14.0 (11.3–16.8)	111	10.0 (7.5–12.5)
Overweight or obesity[c,m]	1083	68.6 (65.3–71.8)	729	68.4 (64.1–72.6)	592	70.1 (65.5–74.7)
Arthritis [n]	568	24.7 (22.2–27.2)	389	28.7 (25.1–32.3)	346	31.4 (27.2–35.6)
Mental health						
Depression[d]	228	12.6 (10.5–14.7)	182	16.2 (13–19.4)	295	35 (30.3–39.8)
Health risk behavior						
Current smoker[d]	640	35.9 (32.8–38.9)	503	44.8 (40.6–49.1)	460	50.5 (45.7–55.3)
Heavy drinker[d]	167	12.0 (9.7–14.4)	149	18 (14.4–21.7)	173	25.2 (20.6–29.8)
14+ days poor [o] physical health	233	10.9 (9.1–12.8)	144	11.2 (8.8–13.6)	172	17.4 (13.6–21.2)
14+ days poor[¶¶] mental health	173	10 (7.9–12.0)	115	10.9 (8.0–13.7)	186	24.0 (19.5–28.6)
General Health [p]	362	17.7 (15.4–20.1)	211	18.3 (15.0–21.6)	208	21.4 (17.3–25.5)

Note: frequencies presented are unweighted. Percentages and confidence intervals are weighted.
Abbreviation: CI = confidence interval.
[a] Based on the number of adverse childhood experience types reported.
[b] Referent group had zero adverse childhood experiences; all models were adjusted for socioeconomic status (education, income)sex, age group, and race/ethnicity.
[c] Overweight: body mass index ≥25 kg/m2; obesity: body mass index ≥30 kg/m2.
[d] $p < 0.0001$.
[e] $p = 0.2299$.
[f] $p = 0.6803$.
[g] $p = 0.1888$.
[h] $p = 0.0003$.
[i] $p = 0.0036$.
[j] $p = 0.04995$.
[k] $p = 0.018$.
[l] $p = 0.056$.
[m] $p = 0.8353$.
[n] $p = 0.0165$.
[o] $p = 0.0014$.
[p] $p = 0.2671$.

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 multigenerational 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].

Table 5
Association between adverse childhood experience score[a,b] and health conditions, health risk behaviors, and socioeconomic challenges — Behavioral Risk Factor Surveillance System (BRFSS), Delaware, 2019.

Adverse childhood experience score				
	1–2		**3 or more**	
Outcome	**Adjusted odds ratio(95% CI)**			
Chronic Condition				
Coronary heart disease/ Angina	1.3 (0.8–2.1)	p = 0.2171	1.6 (0.9–2.6)	p = 0.0924
Heart attack/Myocardial infarction	0.8 (0.5–1.3)	p = 0.4311	1.8 (1.2–2.9)	p = 0.0095
Stroke	1.3 (0.8–2.1)	p = 0.2837	1.1 (0.7–1.9)	P = 0.5991
Arthritis	1.2 (0.9–1.5)	p 0.1194	2.2 (1.7 2.9)	p < 0.0001
Asthma	1.3 (0.9–1.8)	p = 0.1557	1.6 (1.2–2.3)	p = 0.0041
Chronic obstructive pulmonary disease	1.3 (0.9–1.9)	p = 0.1408	2.4 (1.6–3.6)	p < 0.0001
Cancer (excluding skin)	1.1 (0.8–1.5)	p = 0.5550	1.3 (0.9–2.1)	p = 0.2030
Kidney disease	1.6 (1.1–2.6)	p = 0.0436	1.2 (0.7–2.1)	p = 0.5642
Diabetes	0.9 (0.7–1.2)	p = 0.4845	0.9 (0.6–1.2)	p = 0.4006
Overweight or obesity[c]	0.9 (0.7–1.2)	p = 0.7181	1.2 (0.9–1.6)	P = 0.2998
Mental health				
Depression	1.4 (1.1–1.9)	p = 0.0391	3.2 (2.4–4.3)	p < 0.0001
Fair or poor general Health	1.1 (0.8–1.3)	p = 0.9756	1.4 (1.1–1.9)	p = 0.0160
14+ days poor physical health	0.9 (0.7–1.4)	p = 0.9785	1.9 (1.4–2.7)	p < 0.0001
14+ days poor mental health	1.1 (0.8–1.6)	p = 0.6460	2.3 (1.6–3.2)	p < 0.0001
Health risk behavior				
Current smoker	1.4 (1.1–1.8)	p = 0.0018	2.1 (1.6–2.5)	p < 0.0001
Heavy drinker	1.7 (1.2–2.4)	p = 0.0025	2.1 (1.4–2.9)	p < 0.0001
Socioeconomic challenge				
Less than high school education	1.1 (0.7–1.5)	p = 0.8035	1.5 (0.9–2.3)	p = 0.0553
Income less than $15,000	0.7 (0.5–1.1)	p = 0.1081	1.3 (0.8–2.1)	P = 0.2584
No health insurance	0.8 (0.5–1.2)	p = 0.2061	1.2 (0.8–1.9)	p = 0.3145

Note: frequencies presented are unweighted. Percentages and confidence intervals are weighted.
Abbreviation: CI = confidence interval.
[a] Based on the number of adverse childhood experience types reported.
[b] Referent group had zero adverse childhood experiences; all models were adjusted for socioeconomic status (income, education),sex, age group, and race/ethnicity.
[c] Overweight: body mass index ≥25 kg/m2; obesity: body mass index ≥30 kg/
.

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, available, 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.

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 [8]. 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.

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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References

[1] United Health Foundation, America’s health rankings, Available from, https://www.americashealthrankings.org/explore/annual/measure/ACEs_8/state/DE, 2020. (Accessed 9 June 2021).
[2] W.H. Foege, Adverse childhood experiences. A public health perspective, Am. J. Prev. Med. 14 (4) (1998) 354–355.
[3] Centers for Disease Control and Prevention, Preventing adverse childhood experiences, Available from, https://www.cdc.gov/violenceprevention/aces/fastfact.html, 2020. (Accessed 1 June 2021).
[4] D.W. Brown, R.F. Anda, H. Tiemeier, et al., Adverse childhood experiences and the risk of premature mortality, Am. J. Prev. Med. 37 (5) (2009) 389–396.
[5] J.P. Shonkoff, Capitalizing on advances in science to reduce the health consequences of early childhood adversity, JAMA Pediatr. 170 (2016) 1003–1007.
[6] National Survey of Children’s Health, U.S. Department of Health and Human Services, Health Resources and Services Administration (HRSA), Maternal and Child Health Bureau (MCHB), 2019. Available from, https://mchb.hrsa.gov/data/national-surveys. (Accessed 10 June 2021).
[7] Centers for Disease Control and Prevention, Behavioral risk factor surveillance system, Available from, https://www.cdc.gov/brfss/about/index.htm. (Accessed 10 June 2021).
[8] Office of the Governor, Executive Order 24, 2018. Available from, https://governor.delaware.gov/executive-orders/eo24/. (Accessed 1 June 2021).
[9] Missouri Department of Mental Health, Missouri model: a developmental framework for trauma-informed, Available from, https://children.wi.gov/Documents/TIC-Framework-Wisconsin-Resources.pdf, 2014. (Accessed 15 June 2021).
[10] Centers for Disease Control and Prevention, The BRFSS Data User Guide, Department of Health and Human Services, Atlanta, 2020. Available from, https://www.cdc.gov/brfss/annual_data/2019/pdf/overview-2019-508.pdf. (Accessed 1 June 2021).
[11] Centers for Disease Control and Prevention, Behavioral Risk Factor Surveillance System 2019 Summary Data Quality Report, Department of Health and Human

Services, Atlanta, 2020. Available from, https://www.cdc.gov/brfss/annual_data/2019/pdf/2019-sdqr-508.pdf. (Accessed 1 June 2021).
[12] Association of Maternal & Child Health Programs, The life course metric project, Available from, http://www.amchp.org/programsandtopics/data-assessment/Documents/Tip%20Sheet_ACES_LC-0102_Final.pdf, 2015. (Accessed 15 June 2021).
[13] Adverse Childhood Experiences Among Kansas Adults: 2014 Kansas Behavioral Risk Factor Surveillance System Survey. Kansas Department of Health and Environment, Bureau of Health Promotion, 2015. Available from, http://www.kdheks.gov/brfss/PDF/ACE_Report_2014.pdf. (Accessed 11 March 2021).
[14] Adverse Childhood Experiences (ACEs) and Associations with Alcohol Consumption, Smoking, Depression and Perceived Poor Health – 2016 Oklahoma Behavioral Risk Factor Surveillance System, 2019. Available from, https://cste.confex.com/cste/2019/meetingapp.cgi/Paper/11233. (Accessed 11 March 2021).
[15] D.C. Ford, M.T. Merrick, S.E. Parks, et al., Examination of the factorial structure of adverse childhood experiences and recommendations for three subscale scores, Psychol Violence 4 (2014) 432–444.
[16] S.E. McCabe, T.L. Hughes, B.T. West, R.J. Evans-Polce, P.T. Veliz, K. Dickinson, V. V. McCabe, C.J. Boyd, Sexual orientation, adverse childhood experiences, and comorbid DSM-5 substance use and mental health disorders, J. Clin. Psychiatr. 81 (6) (2020; Dec 1) 20m13291.
[17] M.T. Merrick, D.C. Ford, K.A. Ports, et al., Vital signs: estimated proportion of adult health problems attributable to adverse childhood experiences and implications for prevention — 25 states, 2015–2017, MMWR Morb. Mortal. Wkly. Rep. 68 (2019) 999–1005.
[18] Z. Giano, D.L. Wheeler, R.D. Hubach, The frequencies and disparities of adverse childhood experiences in the U.S, BMC Publ. Health 20 (2020) 1327.
[19] D. Finkelhor, Trends in adverse childhood experiences (ACEs) in the United States, Child Abuse Negl. 108 (2020) 104641.
[20] V.J. Felitti, R.F. Anda, D. Nordenberg, D.F. Williamson, A.M. Spitz, V. Edwards, et al., Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: the adverse childhood experiences (ACE) study, Am. J. Prev. Med. 56 (6) (2019) 774–786.
[21] R.F. Anda, M. Dong, D.W. Brown, V.J. Felitti, W.H. Giles, G.S. Perry, et al., The relationship of adverse childhood experiences to a history of premature death of family members, BMC Publ. Health 9 (1) (2009) 106.
[22] T.D. Vannorsdall, C.A. Munro, The link between childhood adversity and latelife mental health: evidence for the influence of early-life experiences or illusory correlations? Int. Psychogeriatr. 29 (3) (2017) 357–358.
[23] A.J. Sedlak, J. Mettenburg, M. Basena, I. Peta, K. McPherson, A. Greene, Fourth National Incidence Study of Child Abuse and Neglect (NIS-4), vol. 9, US Department of Health and Human Services, Washington, DC, 2010.
[24] J.P. Andersen, J. Blosnich, Disparities in adverse childhood experiences among sexual minority and heterosexual adults: results from a multi-state probability-based sample, PLoS One 8 (1) (2013), e54691.
[25] K.A. Ports, D. Ford, M.T. Merrick, Adverse childhood experiences and adult sexual victimization, Child Abuse Negl. 51 (2016) 313–322.
[26] J.R. Blosnich, M.E. Dichter, C. Cerulli, S.V. Batten, R.M. Bossarte, Disparities in adverse childhood experiences among individuals with a history of military service, JAMA Psychiatr. 71 (9) (2014 Sep) 1041–1048.
[27] Healthy People 2030, Violence prevention, Available from, https://health.gov/healthypeople/objectives-and-data/browse-objectives/violence-prevention 2021. (Accessed 1 March 2021).
[28] R.F. Anda, L.E. Porte, D.W. Brown, Inside the adverse childhood experience score: strengths, limitations, and misapplications, Am. J. Prev. Med. 59 (2) (2020) 293–295.