

The Impact of Adverse Childhood Experiences (ACE) on Health-Related Quality of Life, Mental Health, and Hospitalizations in Delaware

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Emotional stress early in life causes long-term changes in brain circuits, potentiating many psychiatric disorders such as PTSD, depression, and substance abuse.^{1,2} There is compelling evidence to suggest that adverse childhood experiences (ACEs) increase the likelihood of physical and psychological illnesses in later years.³⁻⁵ ACEs have also been linked to various health conditions such as obesity, heart, lung and liver diseases, alcohol and tobacco dependence, IV drug abuse, prostitution, and an overall poor quality of life.^{3,6-9} ACEs account for almost two thirds of serious drug use, with a dose-response observed for each additional adverse event experienced by the child.⁹ While sexual abuse is only a fraction of such adverse childhood experiences, emotional, and physical as well as household dysfunction, contribute to high-risk behaviors and poor health outcomes.⁵ Consequently, ACEs have been associated with a long-term increase of healthcare utilization and costs.¹⁰⁻¹⁵

According to the Centers for Disease Control and Prevention (CDC), the estimated prevalence of ACEs in the U.S. is 60 percent.¹⁶ Although national estimates have been previously reported, limited information is available about the prevalence and influence of ACEs in Delaware. Therefore, we estimated the Delaware-specific prevalence and assessed the influence of adverse childhood experiences on mental health, substance use, and overall well-being among Delaware residents.

METHODS

Data and Sample

We used data from the 2015 Delaware Household Health survey (DEHHS), a dual-frame (i.e., landline and cell phone) random-digit dialing (RDD) survey conducted by Delaware Public Health Institute (DPHI) and modeled on the Public Health Management Corporation's (PHMC) southeastern Pennsylvania (SEPA) Household Health Survey. The survey was administered to Delaware's non-institutionalized population living in households containing at least one person age 18 or older in Delaware's three counties; Kent, New Castle, and Sussex. The DEHHS survey was conducted from September 30, 2015 through December 20, 2015. For this study, we utilized 2015 Delaware data with a total sample (n) of 2,609 observations, which included a module on ACEs and several self-reported health outcome measures. The landline response rate for DE was 26% and the cell phone response rate of 30%, as compared to the CDC funded Behavior Risk Factor Surveillance System (BRFSS) responses for DE 45% and 40% respectively. The 2015

DEHHS survey also contains population weights derived through iterative proportional fitting (raking) using gender, household income, and race and ethnicity consistent with the complex survey design and sampling strategy. Of the 2,609 responses, a total of 2,609 (100%) responded to the ACE module and complete data for variables of interest was available for 2,506 respondents (96%). Our final analytic sample therefore comprised of 2,506 responses.

Because the percent of missing data was less than five percent we did not impute missing data.¹⁷ This study was exempted from institutional review board approval.

Measures

Our three primary outcome variables of interest were (1) self-reported health status, (2) current mental health status, and (3) current substance abuse. Self-reported health status was ascertained by asking respondents, “Would you say that in general your health is excellent, very good, good, fair, or poor?” with response choices 1 = Excellent; 2=Very Good; 3=Good; 4=Fair; and 5=Poor. We dichotomized the self-reported health measure into two mutually exclusive categories (1 = Fair/Poor Health; 0 = Good/Excellent). Mental health status was measured in DEHSS as, “Have you ever been diagnosed with a mental health condition including clinical depression, anxiety disorder, or bipolar disorder?” with a dichotomous outcome measure (1 = Yes; 2 = No). Similarly, substance abuse was measured in DEHSS as, “Have you ever been told by a doctor or other health professional that you have/had a substance abuse problem?” with a dichotomous outcome measure (1 = Yes; 2 = No).

Our primary exposure variable was adverse childhood experiences (ACEs), which was measured in the DEHSS as a composite index and calculated using the number of “yes” responses to questions measuring three categories of childhood abuse (verbal, physical, and sexual) and five categories of household dysfunction (household mental illness, incarcerated household members, household substance abuse, parental separation/ divorce, and witnessing domestic violence) to which the respondent was exposed during childhood. ACEs questions included in the survey are detailed in Figure 1. The ACEs score had good reliability ($\alpha = 0.76$); therefore, we categorized the ACE score into two mutually exclusive categories of “exposed” (one or more) and “unexposed” (ACE score of zero).

Figure 1. Delaware Household Health Survey questions and prevalence of self-reported adverse childhood experiences (ACEs) among respondents aged 18 years or older, Delaware 2015.

Variable	Sample size (n)	Percent (95% CI)
Exposed to Adverse Childhood Experiences (ACE before 18)		
1. Did a parent or other adult in the household often or very often swear at you, insult you, put you down, humiliate you, OR act in a way that made you afraid that you might be physically hurt?	353	15 (13.1-16.8)
2. Did a parent or other adult in the household often or very often push, grab, slap, throw something at you; OR ever hit you so hard that you had marks or were injured?	365	15.3 (13.4-17.1)
3. Did an adult or person at least 5 years older than you ever touch or fondle you have you touch their body in a sexual way, OR attempt or actually have oral, anal, or vaginal intercourse with you?	226	9.3 (7.8-10.8)
4. Did you often or very often feel that no one in your family loved you, thought you were important or special, OR your family didn't look out for each other, feel close to each other, or support each other?	341	14.6 (12.8-16.4)
5. Did you often or very often feel that you didn't have enough to eat, had to wear dirty clothes, and had no one to protect you; OR your parents were too drunk or high to take care of you or take you to the doctor if you needed it?	112	4.9 (3.7-6)
6. Were your parents ever separated or divorced?	751	32.6 (30.2-35)
7. Was your mother or stepmother often or very often pushed, grabbed, slapped, kicked, bitten, hit with a fist, hit with something hard, had something thrown at her, OR ever repeatedly hit for at least a few minutes or threatened with a knife or gun?	203	8.7 (7.3-10.2)
8. Did you live with anyone who was a problem drinker or alcoholic or who used street drugs?	528	21.1 (19-23.2)
9. Was a household member depressed or mentally ill, or did a household member attempt suicide?	274	12.1 (10.4-13.7)
10. Did a household member go to prison?	181	7.9 (6.5-9.3)

Note: Sample size is unweighted

Percentages and 95% CI were calculated using sampling weights

Statistical Analysis

We estimated the prevalence rates and estimated 95% confidence intervals (CI) for selected covariates and then performed bivariate analyses for our hypothesized predictor ACE score using Rao-Scott chi-square test to account for complex survey design and utilized $p < 0.05$ for significance. Adjusted odds ratios (AOR) with corresponding 95% CIs were estimated using a minimal sufficient set of covariates identified to reduce confounding bias based on a priori knowledge that included gender, age, and race and ethnicity. All analyses were performed using SAS 9.3.¹⁸

RESULTS

Figure 2 details the ACEs questions and prevalence estimates of individual ACEs questions. Parental separation and/or divorce was the most commonly reported adverse childhood experience (32%; 95%CI: 30.2-35.0); followed by living with a member who abused substances (21%; 95%CI: 19.0-23.2); experiencing physical abuse (15%; 95%CI: 13.4-17.1); and experiencing verbal abuse (15%; 95%CI: 13.2-16.8). More than 55 percent of the Delaware residents indicated having been exposed to one or more adverse childhood experiences (see table

2). Specifically, approximately 23 percent (95% CI: 21.3-25.6) of the Delaware respondents reported having experienced one adverse childhood event; approximately 19 percent (95%CI: 16.6-20.7) of the Delaware respondents reported having experiences two to three adverse childhood events; and approximately 14 percent (95%CI: 12.1-15.6) of Delaware respondents reported having experienced four or more adverse childhood events.

Figure 3 presents the prevalence estimates and characteristics of the Delaware respondents 18 and older who reported their overall health as being poor or fair, having been diagnosed with a mental health problem, and substance abuse problem. Of the 2,506 adult respondents 18 and older, 17 percent (95%CI: 15.1-18.9) indicated having taken poor or fair health; 17 percent (95%CI: 15.1- 19.0) indicated having been diagnosed with a mental health condition; and slightly over 10 percent (95%CI: 9.0-12.1) having been diagnosed with a substance abuse problem.

Figure 2. Characteristics of study population of adults age 18 years and older that participated in the Delaware Household Health Survey, Delaware 2015.

Variable	Sample size (n)	Percent (95% CI)
Outcome variable(s)		
Health Status (fair or poor)	475	17 (15.1-18.9)
Mental Health (diagnosed with)	409	17.1 (15.1-19)
Substance abuse (diagnosed with)	229	10.6 (9-12.2)
Predictors		
<i>Adverse Childhood Experiences(before 18)</i>		
Unexposed	1,152	44.1 (41.6-46.6)
Exposed (one adverse experience)	598	23.5 (21.3-25.6)
Exposed (two to three adverse experiences)	434	18.6 (16.6-20.7)
Exposed (four or more adverse experiences)	322	13.8 (12.1-15.6)
Demographics		
Gender		
Male	1,051	46.9 (44.4-49.4)
Female	1,455	53.1 (50.6-55.6)
Age		
18-24 years	176	11.4 (9.6-13.2)
25-34 years	277	17.3 (15.2-19.4)
35-44 years	314	13.5 (11.8-15.2)
45-64 years	930	34.9 (32.5-37.2)
65 or more years	809	22.9 (21-24.8)
Education		
Less than High School	204	7.6 (6.3-9)
High School Graduate/Technical School/GED	874	33.6 (31.3-36)
Some college	592	24.6 (22.4-26.8)
College graduate	836	34.1 (31.7-36.5)
Poverty		
Below 100% of federal poverty guidelines	315	13.2 (11.4-14.9)
Above 100% of federal poverty guidelines	2,191	86.9 (85.1-88.6)
Race and Ethnicity		
Non-Hispanic White	1,719	67.1 (64.7-69.4)
African American or Black	470	19.2 (17.2-21.2)
Hispanics/Latino(a)	175	7.8 (6.5-9.2)
Other races	142	6 (4.7-7.2)
Place of Residence		
Greater Wilmington	636	26.2 (24.3-28.1)
Rest of New Castle County	617	32.1 (29.7-34.4)
Kent County	552	19.4 (17.5-21.2)
Sussex County	701	22.4 (20.7-24.1)

Note: Sample size is unweighted

Percentages and 95% CI were calculated using sampling weights

Figure 3. Percentage of Delaware residents who reported adverse childhood experiences (ACEs) by self-reported health status, mental health, and substance abuse conditions

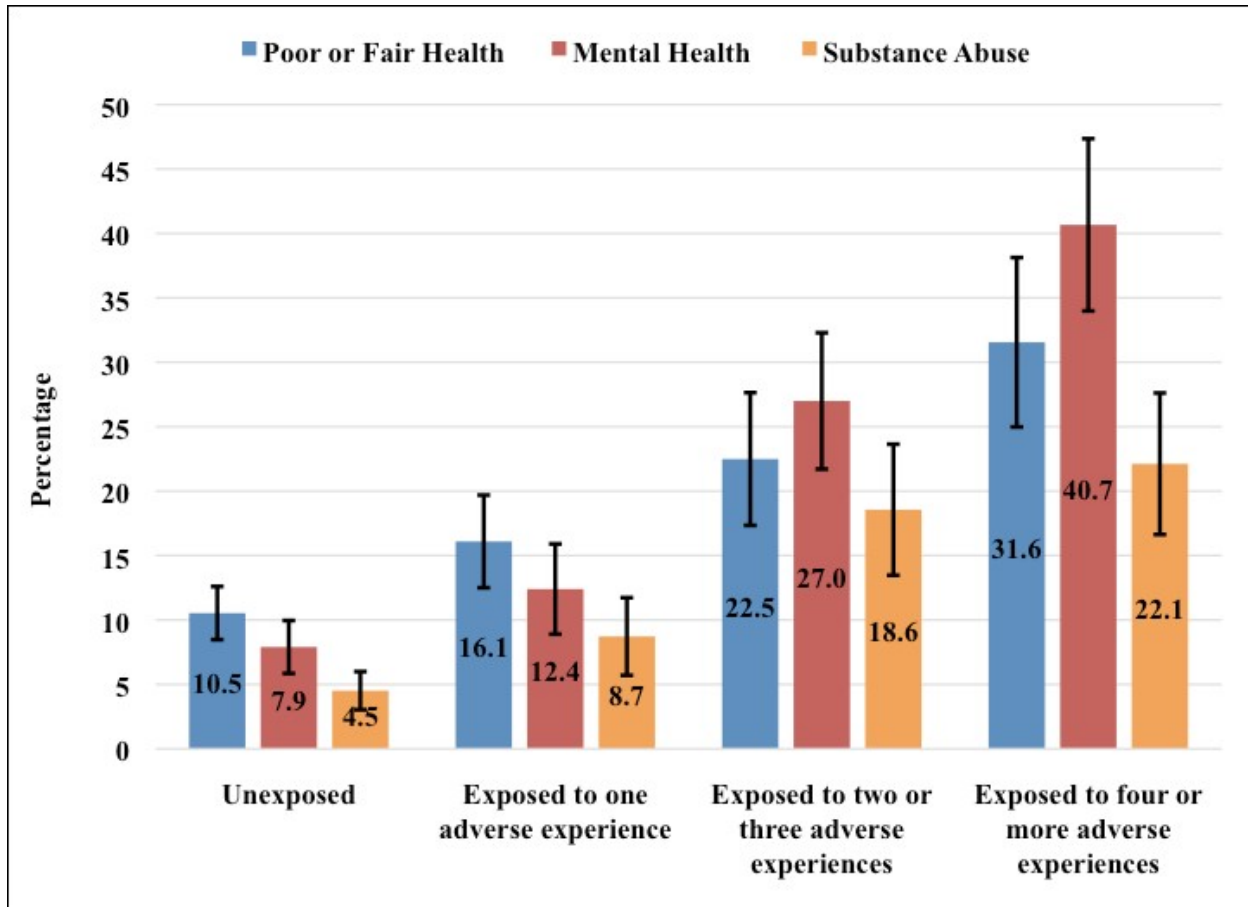


Figure 4 presents crude and adjusted odds ratio for our primary outcomes of interest stratified by increasing exposure levels of ACEs (no ACEs to ≥ 4 ACEs). Those adults who were exposed to one adverse childhood experience were 80 percent more likely to have reported poor or fair health (OR = 1.8; 95%CI: 1.3-2.5) compared to those who did not report an ACE. Adults reporting two or three ACEs were nearly three times more likely to report poor or fair health compared to those adults who did not experience an ACE (OR = 2.9; 95%CI: 2.0-4.2) and four times more likely to report poor or fair health (OR = 4.6; 95%CI: 4.0; 95%CI, 2.4-7.0) as compared to those who did not report any ACEs.

Figure 4. Odds ratios for the association between adverse childhood experiences and self-reported health status, mental health, and substance abuse conditions of adults aged 18 years and older in Delaware, 2015.

Variable	Self-reported Health Status ¹		Mental Health ²		Substance Abuse ³	
	Unadjusted	Adjusted Model	Unadjusted	Adjusted Model	Unadjusted	Adjusted Model
Predictors						
<i>Adverse Childhood Experiences (before 18)</i>						
Unexposed	1.0 (Referent)	1.0 (Referent)	1.0 (Referent)	1.0 (Referent)	1.0 (Referent)	1.0 (Referent)
Exposed to one experience	1.6 (1.2-2.3)	1.8 (1.3-2.5)	1.7 (1.1-2.5)	1.6 (1-2.5)	2 (1.2-3.4)	2.1 (1.2-3.6)
Exposed to two or three experiences	2.5 (1.7-3.6)	2.9 (2-4.2)	4.3 (2.9-6.4)	4.2 (2.8-6.3)	4.8 (3-7.8)	5 (3.1-8.2)
Exposed to four or more experiences	3.9 (2.7-5.7)	4.6 (3.1-6.8)	8 (5.4-11.9)	8 (5.3-12.1)	6 (3.8-9.6)	6.8 (4.1-11.2)

Note: Models are adjusted for gender, age, race and ethnicity, and are adjusted odds ratios (AOR) with 95% confidence intervals (CI).

¹Would you say that in general your health is?

²Have you ever been diagnosed with any mental health condition, including clinical depression, anxiety disorder or bipolar disorder?

³Ever been told that you have/had a substance abuse problem?

With regards to mental health, we found a similar dose-response relation. For instance, those who reported being exposed to one adverse childhood experience were 60 percent more likely to have been diagnosed with a mental health condition (OR = 1.6; 95%CI: 1.1-2.5) as compared to those who were unexposed to an ACE; four times more likely to have been diagnosed with a mental health condition (OR = 4.2; 95%CI: 2.8-6.3) when exposed to two or three ACEs; and finally eight times more likely to have been diagnosed with a mental condition (OR = 8.0; 95%CI: 5.3-12.1) when exposed to four or more adverse childhood experiences as compared to persons who reported no ACE. Finally, with regards to substance abuse, we found that those who reported being exposed to one adverse childhood experience were two times more likely to be diagnosed with a substance abuse problem (OR = 2.1; 95%CI: 1.2-3.6) as compared to those who were unexposed to ACE; five times more likely to be diagnosed with a substance abuse problem (OR= 5.0; 95%CI: 3.1-8.2) when exposed to two or three ACEs; and nearly seven times more likely to be diagnosed with a substance abuse problem (OR = 6.8; 95%CI: 4.1-11.2) when exposed to four or more adverse childhood experiences.

DISCUSSION

Our results suggest that adverse childhood experiences contribute to the overall well-being of individuals in Delaware; whether related to self-reported health, mental health, and/or substance abuse problems. Despite the variation within individual ACEs questions, the overall Delaware ACE prevalence estimate (55%) was similar to national estimates (60%). The cumulative effect of ACEs on these health outcomes, as evidenced from a dose-response relation, suggests that adverse childhood experiences may have deleterious effects in adulthood.

Although the ACEs questions differed from the questions in BRFSS and other studies; the prevalence estimates for ACE in Delaware population were similar to other national estimates¹⁹ and are consistent with other studies that systematically reviewed the impact of ACEs on health outcomes.³ For example, BRFSS estimates reflect that 57 percent of the respondents reported one or more ACEs, while the DEHHS estimates are nearly identical (56%).

Although similar, prevalence of ACEs was higher among women in Delaware (57%) as compared to men (54%); and similar to BRFSS with regards to a decreasing prevalence of ACEs with increasing age. One- third of the respondents indicated that their parents were divorced and/or separated, and one-fifth of respondents indicated that they lived with someone who was an alcoholic and/or abused substances. Verbal and physical abuse was also commonly reported by the respondents in their recall of adverse childhood experiences, as well as living with someone who was mentally ill. We found evidence for a dose-response relation suggesting the cumulative effect of adverse childhood experiences and health.

The fact that ACEs impact neurodevelopment through epigenetic mechanisms suggests that adverse environmental conditions may fundamentally alter the way individuals respond to stress.¹⁹ The cumulative effect of ACEs on health outcomes suggests the importance of identifying opportunities to intervene early childhood.

While we conceptualized mental health and substance abuse as health outcomes in this study, these outcomes are perhaps intermediaries to general well-being and as such should be explored in future studies as mediating factors.

A recent study compared if retrospective ACE measures were similar to prospective ACE measures and found that ACE measures were distributed similarly despite moderate agreement.²⁰

The study further found that retrospective measures such as this study had stronger associations to life outcomes that were measured subjectively (such as self-reports) as compared to prospective measures and as such recommended to use objective outcome measures.²⁰

There are a few potential limitations to this study. Recall bias with respect to subjective self-reported measures, may contribute to an underestimate and/or overestimate of certain health outcomes.²⁰ An interesting finding was that certain personality traits were related to recall on ACEs.²⁰ Nonetheless, given the fact that there are very few anthropometric measures in BRFSS and/or DEHHS for objectively measuring health outcomes, currently the best available measures are self-reports. Furthermore, face-to-face surveys conducted by the National Health Interview Survey (NHIS) and the National Health and Nutrition examination survey (NHANES) have suggested that the prevalence estimates corroborate with those of the BRFSS.²¹

While DEHHS survey is similar to the BRFSS, it is important to note that it is the first Delaware specific survey that captured ACEs as well as other measures similar to BRFSS. As such DEHHS survey response percentages were considerably lower as compared to the BRFSS survey and hence, there are some limitations to the external validity. Because there were no comparable ACEs data in BRFSS, these estimates may at best serve as preliminary. The DEHHS sample was almost half of the typical BRFSS Delaware sample and, as such, the precision of the estimates derived from DEHHS are relatively wider as compared to typical estimates obtained in BRFSS. Furthermore, both landline (26%) and cell phone (30%) response percentages for the DEHHS were lower than the CDC-funded Delaware BRFSS responses of 45% and 40%, respectively. Despite these limitations, DEHHS provided us with ACE estimates consistent with other studies and can potentially inform future research and policy directives regarding minimizing risk factors and increasing protective factors related to adverse childhood experiences.

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