

Childhood Adversity and Adult Chronic Disease

An Update from Ten States and the District of Columbia, 2010

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Background: Adverse childhood experiences (ACEs), including child abuse and family dysfunction, are linked to leading causes of adult morbidity and mortality. Most prior ACE studies were based on a nonrepresentative patient sample from one Southern California HMO.

Purpose: To determine if ACE exposure increases the risk of chronic disease and disability using a larger, more representative sample of adults than prior studies.

Methods: Ten states and the District of Columbia included an optional ACE module in the 2010 Behavioral Risk Factor Surveillance Survey, a national cross-sectional, random-digit-dial telephone survey of adults. Analysis was conducted in November 2012. Respondents were asked about nine ACEs, including physical, sexual, and emotional abuse and household member mental illness, alcoholism, drug abuse, imprisonment, divorce, and intimate partner violence. An ACE score was calculated for each subject by summing the endorsed ACE items. After controlling for sociodemographic variables, weighted AORs were calculated for self-reported health conditions given exposure to zero, one to three, four to six, or seven to nine ACEs.

Results: Compared to those who reported no ACE exposure, the adjusted odds of reporting myocardial infarction, asthma, fair/poor health, frequent mental distress, and disability were higher for those reporting one to three, four to six, or seven to nine ACEs. Odds of reporting coronary heart disease and stroke were higher for those who reported four to six and seven to nine ACEs; odds of diabetes were higher for those reporting one to three and four to six ACEs.

Conclusions: These findings underscore the importance of child maltreatment prevention as a means to mitigate adult morbidity and mortality.

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Introduction

Adverse childhood experiences (ACEs), including exposure to abuse and household dysfunction, are associated with leading causes of adult morbidity and mortality and premature death.¹⁻³ Although there is a large body of ACE research, the

representativeness of previous ACE-related studies in the U.S. is limited because most relied on data collected in the mid-1990s with a medically insured sample of predominantly white, middle-aged adults from Southern California.¹ The objectives of the current study were to describe the prevalence of ACE exposure and examine whether it increases the likelihood of chronic disease and disability using the largest, most representative U.S. sample to date.

Methods

The Behavioral Risk Factor Surveillance System (BRFSS) is an annual, state-based, random-digit-dial telephone survey that collects data from noninstitutionalized U.S. adults (aged ≥18 years) regarding health conditions and risk factors. The current study included 53,998 respondents from DC and ten states (HI, ME, NE, NV, OH, PA, UT, VT, WA, and WI) where the 2010 BRFSS included an optional ACE module. Data were weighted to

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account for the probability of selection and nonresponse and to match the age, race/ethnicity, and gender composition within each state. The median response rate was 37.0%. This study was exempt from IRB review and data were analyzed in November 2012.

The ACE module asks adults if they experienced any of nine ACEs before age 18 years. Three assess childhood abuse (sexual, physical, and emotional), and six assess household dysfunction (having lived with parents/adults who separated/divorced, had a mental illness, abused alcohol, abused drugs, were incarcerated, or were involved in intimate partner violence).

The BRFSS also asks adults about current health conditions. Three items are a subjective self-assessment of fair or poor general health, frequent mental distress (mental health was not good for ≥ 14 of the last 30 days), and disability (limited in any activities because of physical, mental, or emotional problems or has a health problem requiring use of special equipment). The remaining BRFSS items ask the respondent if they had ever been diagnosed with nongestational diabetes, myocardial infarction, coronary heart disease, stroke, or asthma by a healthcare professional.

A composite ACE score was calculated for each respondent based on the sum of ACEs endorsed and divided into four score categories: zero, one to three, four to six, and seven to nine. Lifetime ACE prevalence estimates within each ACE score category were calculated and stratified by demographic variables: sex, age group, race/ethnicity, education level, and annual household income. These demographic variables were controlled for in a multivariate logistic regression calculating the AORs for eight health outcomes given exposure to each ACE score category. To test for a dose–response relationship, the number of ACEs experienced was entered as a continuous predictor variable, with demographic variables, in logistic regression models predicting each health condition. All analysis was done with SAS Systems for Windows, version 9.3.

Results

No ACEs were reported by 40.6% of respondents, 44.1% reported one to three ACEs, 12.7% four to six ACEs, and 2.6% seven to nine ACEs (Table 1). Sexual abuse was reported by 10.9%, physical abuse by 16.0%, and emotional abuse by 35.1% of the sample. Among household-dysfunction ACEs, the prevalence of household member incarceration was 5.9%; drug abuse, 9.4%; intimate partner violence, 15.0%; mental illness, 16.4%; alcohol abuse, 21.7%; and parental separation/divorce, 28.1%.

The highest ACE scores (i.e., four to six and seven to nine) were reported by a higher percentage of women compared to men; Hispanic, black, American Indian/Alaskan native, and multiracial Americans compared to white Americans; those who had not graduated college or technical school compared to those who had; and those earning $< \$25,000$ per year compared to those earning $> \$50,000$ per year (Table 1).

Exposure to one to three, four to six, and seven to nine ACEs was associated with greater odds of reporting fair/poor general health, frequent mental distress, disability, myocardial infarction, and asthma relative to no

ACE exposure (Table 2). Exposure to four to six and seven to nine ACEs was associated with a higher likelihood of coronary heart disease and stroke; exposure to one to three and four to six ACEs was associated with greater odds of diabetes compared to those with no ACE exposure. There was a linear dose–response relationship between the number of ACEs experienced and each health condition, after controlling for demographic variables (all $p < 0.01$).

Discussion

The trajectory from adverse childhood experiences to adult morbidity might be explained by the influence of toxic stress and allostatic load. Toxic stress refers to intense or chronic stress that is more severe than stress from everyday life challenges.⁴ Allostasis refers to physiologic adaptations (e.g., rapid heart rate, increased blood pressure) induced by catecholamines and glucocorticoids in response to acute stress.⁵ High allostatic load occurs when toxic stress causes excessive activation of stress hormones, which can damage the metabolic, cardiovascular, immune, and nervous systems.⁶ Particularly for children, nervous system development can be disrupted, including growth of brain regions linked to planning, problem solving, self-regulation of behavior, and management of emotions.⁷ This could predispose a child to cognitive, behavioral, social, and mental and physical health challenges, which in turn increase the risk for unhealthy behaviors.^{7,8} ACEs have been linked to risk behaviors like smoking, alcohol and drug abuse, having multiple sexual partners, poor diet, and inactivity, all of which contribute to the development of chronic disease and disability.¹

This study has several limitations. BRFSS data are cross-sectional, and thus can only establish associations and not causality. Similar to recent telephone surveys, this study had a low median response rate, and bias may have been introduced because cell phone–only homes were not included in the sampling design. The study's reliance on participant disclosure and recall might also introduce bias. Those who experienced ACEs may be less comfortable disclosing and older participants may have worse recall of childhood adversity. Conversely, adults who experienced chronic or severe childhood adversity or who were less healthy at the time of the survey may be more prone to recall ACEs. Finally, the ACE score only captures breadth of adversity, not critical dimensions like frequency or severity.

Future ACE studies should be designed to better understand intermediate factors between ACEs and poor health, as well as factors that buffer risk, for example, by measuring ACEs among young adults and following

Table 1. Percentage of adults reporting each ACE score category by demographic characteristics

Demographic characteristic	Sample, n (%)	Weighted % (95% CI)			
		0 ACEs	1–3 ACEs	4–6 ACEs	7–9 ACEs
Total	53,998	40.6 (39.7, 41.5)	44.1 (43.2, 45.0)	12.7 (12.1, 13.3)	2.6 (2.3, 2.9)
Sex					
Male	21,322 (39.5)	41.3 (39.9, 42.8)	45.4 (43.9, 46.9)	11.2 (10.3, 12.2)	2.1 (1.6, 2.6)
Female	32,676 (60.5)	40.0 (38.9, 41.1)	42.9 (41.8, 44.0)	14.1 (13.3, 14.9)	3.1 (2.7, 3.6)
Age group					
18–24 years	1,532 (2.8)	34.3 (30.0, 38.9)	46.8 (42.4, 51.3)	16.1 (13.3, 19.5)	2.7 (1.9, 3.9)
25–34 years	4,062 (7.5)	33.6 (31.0, 36.3)	44.9 (42.1, 47.7)	16.1 (14.3, 18.2)	5.4 (4.3, 6.9)
35–44 years	6,988 (12.9)	36.3 (34.1, 38.5)	45.5 (43.3, 47.7)	14.8 (13.3, 16.5)	3.4 (2.7, 4.4)
45–54 years	10,445 (19.3)	37.6 (35.9, 39.4)	45.0 (43.3, 46.8)	15.1 (13.8, 16.4)	2.3 (1.9, 2.7)
55–64 years	13,245 (24.5)	43.3 (41.7, 45.0)	44.7 (43.0, 46.4)	10.6 (9.7, 11.6)	1.4 (1.1, 1.9)
65+ years	17,726 (32.8)	56.4 (55.0, 57.8)	38.8 (37.4, 40.2)	4.5 (4.0, 5.1)	0.4 (0.3, 0.5)
Race/ethnicity					
White, non-Hispanic	43,405 (80.4)	41.5 (40.5, 42.5)	44.0 (43.0, 45.0)	12.2 (11.5, 12.9)	2.3 (2.0, 2.7)
Black, non-Hispanic	2,611 (4.8)	30.3 (26.4, 34.5)	47.9 (43.7, 52.2)	17.1 (14.0, 20.7)	4.7 (3.3, 6.8)
Asian, non-Hispanic	2,527 (4.7)	60.5 (55.1, 65.7)	36.1 (31.1, 41.5)	3.2 (2.3, 4.5)	^a
Native Hawaiian/Pacific Islander, non-Hispanic	205 (0.4)	46.3 (34.1, 59.0)	38.3 (27.5, 50.4)	13.4 (8.2, 21.2)	^a
American Indian/Alaskan Native, non-Hispanic	401 (0.7)	29.5 (20.2, 40.9)	44.0 (34.3, 54.2)	20.7 (14.7, 28.4)	5.8 (3.3, 9.9)
Other, non-Hispanic	323 (0.6)	46.3 (36.5, 56.4)	38.6 (30.2, 47.8)	10.0 (6.5, 15.1)	^a
Multiracial, non-Hispanic	1,980 (3.7)	20.9 (17.2, 25.3)	44.5 (38.8, 50.3)	26.1 (21.3, 31.7)	8.5 (5.6, 12.6)
Hispanic	1,872 (3.5)	31.1 (27.5, 35.0)	47.6 (43.3, 52.1)	17.4 (14.3, 21.1)	3.8 (2.4, 5.9)
Don't know/not sure/missing	674 (1.2)	41.3 (34.5, 48.5)	47.0 (39.7, 54.5)	8.3 (5.1, 13.1)	^a
Education					
Did not graduate high school	3,192 (5.9)	34.2 (30.9, 37.7)	41.8 (38.3, 45.5)	18.3 (15.7, 21.2)	5.7 (4.1, 7.7)
Graduated high school	15,590 (28.9)	39.8 (38.2, 41.5)	43.3 (41.7, 45.0)	13.8 (12.6, 15.1)	3.0 (2.5, 3.7)
Attended college or technical school	14,748 (27.4)	37.2 (35.6, 38.8)	44.8 (43.1, 46.5)	14.9 (13.7, 16.2)	3.1 (2.5, 3.9)
Graduated college or technical school	20,379 (37.8)	44.8 (43.3, 46.4)	44.6 (43.0, 46.1)	9.2 (8.4, 10.1)	1.4 (1.1, 1.9)
Income					
<\$15,000	4,158 (7.7)	30.8 (27.6, 34.3)	41.5 (37.9, 45.3)	21.0 (18.2, 24.1)	6.6 (5.1, 8.7)
\$15,000 to <\$25,000	7,944 (14.7)	36.0 (33.7, 38.4)	42.4 (39.9, 44.9)	17.0 (14.9, 19.2)	4.6 (3.6, 6.0)
\$25,000 to <\$35,000	5,972 (11.1)	38.4 (35.8, 41.0)	45.5 (42.9, 48.2)	13.5 (11.6, 15.6)	2.6 (1.9, 3.7)
\$35,000 to <\$50,000	7,700 (14.3)	43.0 (40.7, 45.3)	43.8 (41.5, 46.1)	11.6 (10.2, 13.1)	1.7 (1.2, 2.2)
>\$50,000	22,248 (41.2)	40.9 (39.6, 42.3)	45.8 (44.4, 47.2)	11.4 (10.6, 12.4)	1.8 (1.4, 2.4)
Don't know/not sure/missing	5,976 (11.1)	49.5 (46.8, 52.3)	39.5 (37.0, 42.2)	8.8 (7.4, 10.4)	2.2 (1.5, 3.2)

^aUnstable estimate, relative standard error ≥ 0.30 .
ACE, adverse childhood experience.

Table 2. Association of adult health conditions by ACE score

Health condition	0 ACEs	1–3 ACEs	4–6 ACEs	7–9 ACEs
Fair or poor general health				
% (95% CI)	11.4 (10.5, 12.3)	13.5 (12.7, 14.4)	20.9 (18.9, 23.1)	28.9 (23.7, 34.7)
AOR (95% CI)	ref	1.4 (1.2, 1.5)	2.3 (1.9, 2.7)	3.5 (2.5, 4.9)
Frequent mental distress				
% (95% CI)	4.9 (4.3, 5.5)	9.8 (9.0, 10.6)	21.2 (18.9, 23.6)	32.4 (26.8, 38.5)
AOR (95% CI)	ref	2.0 (1.7, 2.3)	3.9 (3.2, 4.8)	6.0 (4.3, 8.2)
Diabetes				
% (95% CI)	8.6 (8.0, 9.3)	8.7 (8.0, 9.4)	8.1 (7.0, 9.4)	7.0 (5.1, 9.6)
AOR (95% CI)	ref	1.2 (1.1, 1.4)	1.4 (1.1, 1.7)	1.4 (1.0, 2.1)
Myocardial infarction				
% (95% CI)	4.0 (3.6, 4.4)	3.9 (3.5, 4.4)	3.5 (2.7, 4.4)	2.8 (1.7, 4.7)
AOR (95% CI)	ref	1.3 (1.1, 1.5)	1.6 (1.2, 2.2)	1.9 (1.1, 3.4)
Coronary heart disease				
% (95% CI)	4.5 (4.1, 5.0)	3.8 (3.5, 4.3)	3.1 (2.5, 3.8)	5.1 (2.8, 9.1)
AOR (95% CI)	ref	1.1 (1.0, 1.3)	1.4 (1.1, 1.8)	3.8 (1.9, 7.8)
Stroke				
% (95% CI)	2.8 (2.5, 3.2)	2.6 (2.3, 3.0)	2.4 (1.9, 3.2)	2.6 (1.6, 4.3)
AOR (95% CI)	ref	1.2 (1.0, 1.4)	1.4 (1.0, 2.0)	2.0 (1.1, 3.5)
Asthma				
% (95% CI)	7.2 (6.4, 8.0)	9.0 (8.3, 9.7)	13.6 (12.0, 15.4)	18.9 (14.7, 24.1)
AOR (95% CI)	ref	1.2 (1.1, 1.4)	1.8 (1.4, 2.1)	2.4 (1.7, 3.3)
Disability				
% (95% CI)	19.0 (18.0, 20.1)	22.8 (21.8, 23.9)	33.6 (31.2, 36.1)	44.4 (38.4, 50.5)
AOR (95% CI)	ref	1.4 (1.3, 1.6)	2.7 (2.4, 3.2)	4.7 (3.6, 6.1)

Note: Boldface indicates statistical significance ($p < 0.05$). AOR controls for gender, age, race/ethnicity, income, and education level. ACE, adverse childhood experience.

them longitudinally. Future work might also modify the ACE questionnaire to better quantify the frequency and severity of ACEs. Finally, the ACE questionnaire may also need to be expanded to address additional types of adversity experienced outside the home environment, like school bullying or neighborhood violence.⁹

Conclusions

Using the largest, most representative sample of Americans to date, this study demonstrates that the prevalence of childhood adversity is high, with approximately 60% of respondents reporting at least one ACE. The odds of reporting several adult health conditions increased given ACE exposure, in a dose–response relationship. These findings highlight that risk for adult chronic disease and

disability may begin as early as childhood. They also suggest that more research is needed to evaluate who is most susceptible to the chronic effects of adversity and how coping and resilience factors may interrupt the pathway between adversity and chronic disease. Child maltreatment prevention could play a vital role in the mitigation of the leading causes of adult morbidity and mortality.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of CDC.

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