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Associations Between Adverse Childhood Experiences, High-Risk Behaviors, and Morbidity in Adulthood

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Abstract

Introduction—Adverse childhood experiences (ACEs) are associated with early mortality and morbidity. This study evaluated the association among ACEs, high-risk health behaviors, and comorbid conditions, as well as the independent effect of ACE components.

Methods—Data were analyzed on 48,526 U.S. adults from five states in the 2011 Behavioral Risk Factor Surveillance System survey. Exposures included psychological, physical, and sexual forms of abuse as well as household dysfunction such as substance abuse, mental illness, violence, and incarceration. Main outcome measures included risky behaviors and morbidity measures, including binge drinking, heavy drinking, current smoking, high-risk HIV behavior, obesity, diabetes, myocardial infarction, coronary heart disease, stroke, depression, disability due to poor health, and use of special equipment due to disability. Multiple logistic regression assessed the independent relationship between ACE score categories and risky behaviors/comorbidities in adulthood, and assessed the independent relationship between individual ACE components and risky behaviors/comorbid conditions in adulthood controlling for covariates.

Results—A total of 55.4% of respondents reported at least one ACE and 13.7% reported four or more ACEs. ACE score of 4 was associated with increased odds for binge drinking, heavy drinking, smoking, risky HIV behavior, diabetes, myocardial infarction, coronary heart disease, stroke, depression, disability due to health, and use of special equipment due to disability. In addition, the individual components had different effects on risky behavior and comorbidities.

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Conclusions—In addition to having a cumulative effect, individual ACE components have differential relationships with risky behaviors, morbidity, and disability in adulthood after controlling for important confounders.

Introduction

According to CDC, an estimated 3.4 million children in the U.S. were reported as being abused or neglected in 2012.¹ The estimated lifetime cost of childhood maltreatment is \$124 billion each year, and one in four children will experience some form of childhood maltreatment in their lifetime.¹ Adverse childhood experiences (ACEs) include psychological, physical, and sexual forms of abuse as well as household dysfunction such as substance abuse, mental illness, violence, and incarceration.² Originally examined through the ACE study by Kaiser Permanente, this scale has established that ACEs are associated with early mortality, increased comorbid conditions, and increased prevalence of the leading causes of death in adulthood.^{2,4–8} Moreover, associations have also been found between the number of ACEs and increased risk for disease conditions in adulthood such as cancer, heart disease, stroke, obesity, diabetes, and chronic obstructive pulmonary disease.^{2–8,15–17}

The impact of ACEs on health outcomes in adulthood has garnered attention as a public health concern because of recent inclusion of the ACE scale in large population surveys such as the Behavioral Risk Factor Surveillance System (BRFSS).^{2,3,7,9–17} For instance, recent examination of ACEs and chronic disease across ten states and the District of Columbia found a dose–response relationship between the number of reported ACEs and chronic health conditions, with reports of four or more ACEs being associated with higher likelihood of coronary heart disease and stroke, as well as greater odds of diabetes among those reporting one to three and four to six ACEs.¹⁸ Additional examination of ACEs using BRFSS has found a significant association between ACE frequency and greater geriatric depression, insufficient sleep, and chronic obstructive pulmonary disease prevalence by sex.^{19–22} Further, among individuals with a history of military service, men in the volunteer era reported greater frequency of ACEs in all components compared to men with no history of military service.²³ Although inclusion of the ACE scale in national surveys such as BRFSS has added to understanding of the impact that ACEs have at the population level, a better understanding of both the cumulative and differential impact of individual ACE components on health outcomes is needed to guide investigation into mechanisms and development of interventions taking these underlying determinants into account.

Current gaps in the literature include lack of national estimates, limited information on the differential effects of ACE components on risky behavior and health outcomes in adulthood, and the potential mechanisms through which childhood events influence adult health. To further advance the field, this paper aimed to:

1. replicate and validate findings on the association between cumulative ACE scores and high-risk health behaviors and comorbid conditions in U.S. adults using the BRFSS 2011 data; and

2. address a gap in the literature by examining differential relationships between individual ACE components and high-risk health behaviors and comorbid conditions in adulthood.

Methods

Study Sample

Data was from the 2011 BRFSS, a cross-sectional telephone survey of non-institutionalized adults aged 18 years in the U.S. coordinated by CDC and conducted by state health departments using random-digit dialing to landline and cellular telephones.^{1,24} Data analysis took place in calendar year 2014. Standardized questionnaires are developed by CDC and state public health departments to include a standard core, optional modules, and state-added questions.^{1,24} This sample only used data from the five states that administered the full ACE module: Minnesota, Montana, Vermont, Washington, and Wisconsin.

Measures

Age, gender, race, marital status, education, employment, region of the U.S., and income were collected from all BRFSS survey individuals. Age was categorized as 18–34, 35–54, 55–64, and 65 years. Gender was dichotomized. Race was categorized as white, black, Hispanic, and other. Marital status was characterized as married, divorced, and not married. Education was categorized as less than high school, high school graduate, some college, and college graduate. Employment was categorized as unemployed, employed, and retired. Region was categorized as Northeast, Midwest, South, and West. Income was categorized as <\$15,000, \$15,000–\$24,999, \$25,000–\$34,999, \$35,000–\$49,999, and \$50,000.

The ACE module is an 11-item survey where respondents are asked if they experienced a variety of adverse events during their childhood (prior to age 18 years). Questions include:

1. lived with anyone who was depressed, mentally ill or suicidal;
2. lived with anyone who was a problem drinker or alcoholic;
3. lived with anyone who used illegal drugs or abused prescription drugs;
4. lived with anyone who served time in a correctional facility;
5. experienced parental separation or divorce;
6. witnessed parents or adults in the home slap, hit, kick, punch, or beat each other;
7. being slapped, hit, kicked, punched, or beat by parents or adults in the home;
8. being sworn at, insulted, or put down by parents or adults in the home;
9. being touched sexually by adult or anyone 5 years older than respondent;
10. being made to touch sexually an adult or anyone 5 years older than respondent; and
11. being forced to have sex with an adult or anyone 5 years older than respondent.

For analyses investigating ACE scores, counts were created for the number of questions respondents answered they had experienced the event. ACE scores were then categorized as

0, 1, 2, 3, and 4. For analyses investigating the influence of specific types of adverse events, questions were categorized by component into: physical abuse, sexual abuse, verbal abuse, mental illness in home, substance abuse in home, separation/divorce in home, violence in adults at home, and incarceration at home based on prior research.

Smoking status was categorized as current smoker or not current smoker based on the tobacco use section. Binge drinking and heavy drinker were dichotomized based on the answers to questions in the alcohol consumption section. High-risk HIV behavior was dichotomized based on responding *yes* to having been in situations where the respondent used intravenous drugs in the past year, been treated for a sexually transmitted or venereal disease in the past year, given or received money or drugs in exchange for sex in the past year, and or had anal sex without a condom in the past year. Obesity was calculated using the response to questions regarding height and weight to calculate BMI and then categorized as >25 or not. The chronic health condition section was used to identify if responded indicated *yes* to diagnosis by a doctor, nurse, or healthcare professional for diabetes, myocardial infarction, coronary heart disease, stroke, or depression. Disability due to poor health was identified by respondents answering *yes* to whether they were limited in any way in activities because of physical, mental, or emotional problems. Use of special equipment due to disability was identified by respondents who answered *yes* to use of equipment such as a cane, wheelchair, special bed, or special telephone.

Statistical Analysis

Stata, version 13 was used for all analyses. Data were analyzed using complex sampling procedures taking into account stratification, clustering, and sample weight. First, among those administered the ACE module, the ACE scores (five categories) were compared by sample demographics using chi-square statistics. Second, the relationships between ACE score categories and risky behaviors and comorbidities in adulthood were examined using chi-square statistics. Third, multiple logistic regression was used to assess the independent relationships between ACE score categories and risky behaviors and comorbidities in adulthood controlling for relevant confounders. Separate models were run, with each risky behavior and comorbid conditions as the outcome; ACE score category as the primary independent variable; and age, race, gender, marital status, educational attainment, employment, region, and income as covariates. Finally, multiple logistic regression was used to assess the independent relationship between individual ACE components and risky behaviors and comorbid conditions in adulthood controlling for relevant confounders. Separate models were run, with each risky behavior and comorbid conditions as the outcome; individual ACE components as independent variables; and age, race, gender, marital status, educational attainment, employment, region, and income as covariates. Variables were included in the models based on having at least a *p*-value of 0.25 in bivariate analysis or being clinically relevant based on prior research. A two-sided *p*-value of <0.05 was used to assess statistical significance.

Results

A total of 506,467 participants completed the 2011 BRFSS, with 48,526 participants completing the ACE module. Of these, 55.4% reported at least one ACE and 13.7% reported four or more ACEs. Table 1 shows the sample demographics by ACE score category. Increasing ACE scores were associated with being younger, being female, being a minority, having lower education, and having lower income. Table 2 shows the outcomes by ACE score category. Binge drinking, heavy drinking, current smoking status, high-risk HIV behavior, depression, disability due to poor health, and use of special equipment showed statistically significant differences by ACE score. A dose–response effect was suggested with more risky behavior, depression, and disability as scores increased.

Table 3 shows results from the multiple logistic regression model for the relationship between ACE score categories and outcomes (risky behaviors and morbidities). In general, as ACE score increased, the OR for risky behaviors and morbidities increased. Specifically, an ACE score of 4 was associated with increased odds for binge drinking (AOR=1.50, 95% CI=1.24, 1.80), heavy drinking (AOR=1.80, 95% CI=1.39, 2.32), smoking (AOR=2.70, 95% CI=2.24, 3.24), risky HIV behavior (AOR=4.34, 95% CI=2.78, 6.76), diabetes (AOR=1.39, 95% CI=1.09, 1.77), myocardial infarction (AOR=1.86, 95% CI=1.33, 2.60), coronary heart disease (AOR=1.63, 95% CI=1.17, 2.27), stroke (AOR=1.52, 95% CI=1.04, 2.22), depression (AOR=5.12, 95% CI=4.34, 6.05), disability due to health (AOR=3.20, 95% CI=2.73, 3.76), and use of special equipment due to disability (AOR=1.78, 95% CI=1.41, 2.26).

Table 4 shows results of the multiple logistic regression model for the relationships between individual ACE components and outcomes (risky behaviors and morbidities). In general, the individual components had differential relationships with risky behavior and comorbidities. Specifically, an increased odd for binge drinking was associated with verbal abuse (AOR=1.29, 95% CI=1.11, 1.50). Increased odds for smoking was associated with sexual abuse (AOR=1.26, 95% CI=1.01, 1.56), verbal abuse (AOR=1.22, 95% CI=1.04, 1.44), substance abuse (AOR=1.38, 95% CI=1.19, 1.60), and separation/divorce (AOR=1.52, 95% CI=1.30, 1.78). Increased odds for risky HIV behavior was associated with sexual abuse (AOR=2.03, 95% CI=1.28, 3.23) and incarceration of adults (AOR=2.21, 95% CI=1.37, 3.56). Increased odds for obesity was associated with sexual abuse (AOR=1.59, 95% CI=1.31, 1.92) and decreased odds for obesity with mental illness in the home (AOR=0.87, 95% CI=0.75, 1.00). Increased odds for diabetes was associated with sexual abuse (AOR=1.45, 95% CI=1.08, 1.94), verbal abuse (AOR=1.22, 95% CI=1.01, 1.47), and decreased odds of diabetes with violence in adults (AOR=0.76, 95% CI=0.60, 0.97). Increased odds of myocardial infarction was associated with incarceration of adults (AOR=1.85, 95% CI=1.17, 2.92). Increased odds of coronary heart disease was associated with verbal abuse (AOR=1.36, 95% CI=1.07, 1.73), and decreased odds of coronary heart disease with separation/divorce (AOR=0.72, 95% CI=0.55, 0.95). Increased odds for depression was associated with physical abuse (AOR=1.36, 95% CI=1.12, 1.64), sexual abuse (AOR=1.80, 95% CI=1.49, 2.17), verbal abuse (AOR=1.64, 95% CI=1.41, 1.90), mental illness in adults (AOR=2.78, 95% CI=2.39, 3.24), substance abuse in adults (AOR=1.23, 95% CI=1.06, 1.41), incarceration of adults (AOR=1.32, 95% CI=1.03, 1.69),

and decreased odds of depression with separation/divorce in adults (AOR=0.80, 95% CI=0.69, 0.94). Increased odds of disability due to poor health was associated with physical abuse (AOR=1.48, 95% CI=1.24, 1.76), sexual abuse (AOR=1.34, 95% CI=1.11, 1.62), verbal abuse (AOR=1.35, 95% CI=1.18, 1.55), mental illness in adults (AOR=1.64, 95% CI=1.41, 1.91), and substance abuse in adults (AOR=1.22, 95% CI=1.08, 1.38). An increased odd of use of special equipment was associated with physical abuse (AOR=1.37, 95% CI=1.06, 1.77).

Discussion

This study validates previous findings on adverse childhood experiences using data from five states in the 2011 BRFSS. Results showed that ACEs are associated with higher odds of risky behavior, morbidity, and disability in adulthood after controlling for relevant demographic and socioeconomic factors. Results support the hypothesized dose–response effect of increasing exposure to ACEs on the presence of risky behaviors and morbidity in adulthood. As exposure to ACEs increases, the odds of current smoking, risky HIV behavior, depression, and disability due to poor health increase significantly. More importantly, this study shows that in addition to having a cumulative effect, individual ACE components have a differential relationship with risky behaviors and comorbid conditions in adulthood after controlling for important confounders. For example, though all ACE components except violence in adults showed a significant independent effect on depression, only physical abuse had an independent effect on use of special equipment, only verbal abuse had an independent effect on binge drinking, and only incarceration had an independent effect on myocardial infarction. Sexual abuse and verbal abuse were the two ACE components that independently affected most of the outcomes investigated in this study, including smoking, risky HIV behavior, obesity, diabetes, coronary heart disease, depression, and disability due to poor health. This suggests that the individual ACE components may exert their effect on risky behaviors and outcomes through different mechanisms.

The estimates of those reporting at least one ACE (55.3%) are consistent with the original ACE study conducted by Kaiser (52%), and within the range reported in the literature (46.4% to 79.5%).^{2,4,6,14–16,18,25,26} These results are also consistent with the literature in showing that ACEs have a dose–response effect in increasing exposure to risky behaviors and morbidity in adulthood.^{2,4,15,18,34–37} For instance, Felitti et al.² showed a graded relationship between ACE scores and odds of behaviors/conditions, and Chartier and colleagues³⁴ found respondents who reported four or more adverse experiences in childhood had 172% increased odds of comorbid conditions, compared with those reporting zero. In addition, Gilbert et al.¹⁸ reported exposure to more ACEs was associated with greater odds of reporting fair/poor health, frequent mental distress, and disability. For the five states included in this analysis, the greatest magnitude of effect was a 2.7-fold increase in smoking, 3.2-fold increase in disability due to health, 4.3-fold increase in risky HIV behavior, and 5.1-fold increase in depression for those reporting four or more ACEs.

In addition to prior findings, this is one of the first studies to evaluate the differential effect of individual ACE components on risky behaviors, disability, and morbidity in adulthood.

Two broad mechanisms have been suggested on how ACEs lead to comorbidity in adulthood:

1. delayed consequences of various adverse coping methods such as overeating, smoking, drug use, and promiscuity; and
2. chronic stress mediated by biological reactions.²⁷

Based on the life course perspective, ACEs exert their influence by:

1. decreasing optimal growth during the initial stages of life;
2. increasing the rate at which functioning is lost in later stages of life.²⁸

For instance, those reporting physical abuse had 48% greater odds of reporting disability due to poor health and 37% greater odds of reporting special use of equipment due to disability. Injury in early stages of life due to physical abuse may limit optimal development, leading to disability as a delayed consequence of physical injuries. Alternatively, sexual abuse was associated with an 80% increased odds of depression, 59% increased odds of obesity, and 45% increase odds of diabetes. Physiologic reactions to psychosocial stress (including altered neuroendocrine hormone levels, toxic stress, and allostatic load) are hypothesized to cumulate and interact, resulting in damage to metabolic, cardiovascular, immune, and nervous systems.^{28,18} This early damage could result in increased loss of functioning in later stages of life, resulting in chronic diseases such as obesity and diabetes. Additionally, it is hypothesized that risky behaviors such as smoking are a result of the cognitive and social disruption from an early age and an unhealthy coping mechanism leading to further damage.^{18,9} Future studies are needed to test these hypothesized mechanisms, through the use of causal maps as suggested by Blane and colleagues.²⁸ There is also the need for better understanding of the mediating and moderating role of social determinants of health on the effect of ACEs on behavior and outcomes in adulthood in diverse populations and whether ACEs contribute to known disparities in health.^{29–33}

Limitations

This study has several limitations. Not all states were administered the ACE module, so data cannot be generalized to the U.S. population. This limitation can only be overcome by expansion of the ACE survey to all states as a required module for BRFSS. Limitations also include the cross-sectional design of the study precluding discussion of causality, exclusion of people without telephones, and limitations related to self-report of ACEs. Although it is difficult to validate the extent self-report reflects the “true” situation, Dube et al.³⁸ found high test–retest reliability in both the individual questions and the overall ACE score, suggesting consistency of the ACE measurement. Finally, though this study used variables based on the literature, not all potential confounders were available in the data set.

Conclusions

This study validates the results of prior studies on the adverse effect of cumulative exposure to ACEs and further advances the field by providing data on differential influences of ACE components on risky behavior, morbidity, and disability in adulthood. An important next step is for CDC to expand administration of ACE questions to all 50 states to provide

nationally representative estimates, and incorporate ACE scores into national surveys like National Health and Nutrition Examination Survey, which collect clinical and laboratory measures, to allow examination of potential biological mechanisms. Second, large-scale longitudinal studies are needed to allow more detailed assessment of potential risk factors and predictors of ACEs and pinpoint when certain processes are most harmful or helpful.²⁸ Finally, targeted behavioral, psychosocial, and policy interventions that involve various key disciplines including medicine, social work, public health, and the educational system are needed to improve recognition, treatment, and prevention of ACEs and their adverse consequences in adulthood.

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Table 1

Sample Demographics by ACE Score Categories

Characteristics	ALL (%)	Score 0 (%)	Score 1 (%)	Score 2 (%)	Score 3 (%)	Score 4 (%)	p-value
Age							<0.001
18-34	26.78	23.33	26.13	29.09	30.85	34.59	
35-54	37.13	32.19	39.18	39.73	41.83	44.98	
55-64	17.25	18.63	16.80	16.90	17.10	13.90	
65+	18.84	25.84	17.89	14.29	10.22	6.53	
Gender							0.007
Men	49.57	50.49	49.26	52.42	47.35	45.79	
Women	50.43	49.51	50.74	47.58	52.65	54.21	
Race							<0.001
White	85.24	87.12	84.76	83.87	82.67	82.54	
Black	3.02	1.56	3.57	4.48	5.04	4.48	
Hispanic	4.80	4.14	5.14	6.31	6.40	4.15	
Other	6.94	7.17	6.53	5.34	5.89	8.83	
Marital status							<0.001
Married	56.79	61.71	57.22	53.74	52.11	45.46	
Divorced	18.44	17.45	17.77	17.66	20.51	22.27	
Not married	24.77	20.85	25.01	28.60	27.38	32.27	
Education							<0.001
>High school	9.91	8.46	9.87	9.91	10.54	14.30	
High school graduate	28.45	28.74	27.40	27.65	28.41	29.90	
Some college	33.37	31.13	33.05	34.47	36.50	38.40	
College graduate	28.26	31.66	29.67	27.97	24.56	17.40	
Employment							<0.001
Unemployed	21.98	17.50	22.05	21.60	22.89	36.16	
Employed	59.81	58.38	60.35	64.23	65.35	56.59	
Retired	18.21	24.12	17.60	14.18	11.76	7.24	
Region							<0.001
NorthEast	3.72	3.79	3.81	3.43	3.83	3.51	

Characteristics	ALL (%)	Score 0 (%)	Score 1 (%)	Score 2 (%)	Score 3 (%)	Score 4 (%)	p-value
MidWest	56.14	59.87	56.18	54.15	52.92	47.58	
West	40.15	36.34	40.01	42.42	43.25	48.92	
Income							<0.001
>15k	7.27	5.48	8.01	5.73	7.03	13.12	
15k-25k	17.14	15.14	15.73	18.68	19.64	22.71	
25k-35k	13.42	13.84	12.61	13.56	11.69	14.23	
35k-49k	15.76	16.48	15.16	14.00	17.33	15.16	
50k	46.40	49.07	48.49	48.03	44.31	34.79	

Note: Boldface indicates statistical significance ($p < 0.05$).

%, Overall percent for whole sample (All) and ACE score categories.

Table 2**High Risk Behaviors and Morbidity by ACE Score Categories**

Behavior	All (%)	Score 0 (%)	Score 1 (%)	Score 2 (%)	Score 3 (%)	Score 4 (%)	p-value
Binge drinking	19.84	15.83	20.47	24.46	24.12	25.34	<0.001
Heavy drinking	7.52	5.77	7.31	9.24	9.72	10.75	<0.001
Smoking status-current	17.89	10.67	17.91	21.47	24.25	34.46	<0.001
High risk HIV behavior	3.05	1.19	2.66	3.35	5.21	8.18	<0.001
Obesity	62.67	61.73	63.45	62.90	64.86	63.01	0.492
Diabetes	8.97	8.74	9.19	9.07	8.66	9.44	0.894
Myocardial Infarction	3.91	4.15	3.59	3.21	3.15	4.67	0.114
Coronary heart disease	3.85	4.04	3.72	3.82	3.43	3.74	0.842
Stroke	2.47	2.34	2.73	2.27	2.69	2.56	0.754
Depression	15.99	8.32	13.53	19.74	24.50	36.71	<0.001
Disabled due to poor health	23.73	18.74	22.96	25.53	24.41	39.14	<0.001
Use of special equip due to disability	6.91	6.09	7.07	6.87	6.17	9.80	<0.001

Note: Boldface indicates statistical significance ($p < 0.05$).

%, Overall percent for whole sample (All) and ACE score categories.

Table 3

Multiple Logistic Regression Models for Relationship Between ACE Score Categories and Outcomes

	Score 1 AOR (95% CI)	Score 2 AOR (95% CI)	Score 3 AOR (95% CI)	Score 4 + AOR (95% CI)
Binge drinking	1.29 ^{**} (1.11; 1.50)	1.47 ^{***} (1.23; 1.77)	1.50 ^{***} (1.21; 1.88)	1.50 ^{***} (1.24; 1.80)
Heavy drinking	1.25 [*] (1.01; 1.53)	1.51 ^{**} (1.17; 1.95)	1.64 ^{**} (1.21; 2.22)	1.80 ^{***} (1.39; 2.32)
Smoking	1.61 ^{***} (1.36; 1.91)	1.90 ^{***} (1.57; 2.31)	2.10 ^{***} (1.68; 2.64)	2.70 ^{***} (2.24; 3.24)
Risky HIV behavior	1.94 ^{**} (1.22; 3.06)	1.87 [*] (1.12; 3.15)	3.35 ^{***} (2.02; 5.55)	4.34 ^{***} (2.78; 6.76)
Obesity	1.08 (0.96; 1.22)	1.06 (0.92; 1.23)	1.14 (0.96; 1.37)	1.16 (0.98; 1.37)
Diabetes	1.25 [*] (1.05; 1.50)	1.32 [*] (1.06; 1.63)	1.36 [*] (1.06; 1.75)	1.39 ^{**} (1.09; 1.77)
Myocardial infarction	1.07 (0.81; 1.40)	1.08 (0.78; 1.50)	1.12 (0.75; 1.67)	1.86 ^{***} (1.33; 2.60)
Coronary heart disease	1.21 (0.94; 1.56)	1.39 [*] (1.04; 1.86)	1.32 (0.95; 1.83)	1.63 ^{**} (1.17; 2.27)
Stroke	1.35 (0.98; 1.86)	1.22 (0.83; 1.81)	1.64 [*] (1.09; 2.46)	1.52 [*] (1.04; 2.22)
Depression	1.60 ^{***} (1.36; 1.89)	2.67 ^{***} (2.24; 3.19)	3.38 ^{***} (2.77; 4.12)	5.12 ^{***} (4.34; 6.05)
Disability due to health	1.42 ^{***} (1.24; 1.63)	1.70 ^{***} (1.46; 1.98)	1.72 ^{***} (1.44; 2.06)	3.20 ^{***} (2.73; 3.76)
Use of special equipment due to disability	1.22 (0.97; 1.54)	1.32 [*] (1.05; 1.67)	1.34 [*] (1.04; 1.73)	1.78 ^{***} (1.41; 2.26)

Note: Model incorporates individual ACE categories as binary outcomes adjusting for age, race, gender, marital status, educational attainment, employment, region, and income.

Results show AOR and 95% CI.

Boldface indicates statistical significance

*
 $p < 0.05$,

**
 $p < 0.01$,

 $p < 0.001$.

Table 4
Multiple Logistic Regression Model for Relationship Between Individual ACE Components and Outcomes

	Physical abuse AOR (95% CI)	Sexual abuse AOR (95% CI)	Verbal abuse AOR (95% CI)	Mental illness AOR (95% CI)	Substance abuse AOR (95% CI)	Separation/divorce AOR (95% CI)	Violence in adults AOR (95% CI)	Incarceration AOR (95% CI)
Binge drinking	0.90 (0.73; 1.12)	1.13 (0.89; 1.44)	1.29 ^{**} (1.11; 1.50)	0.96 (0.81; 1.15)	1.09 (0.95; 1.26)	1.09 (0.94; 1.26)	1.10 (0.90; 1.33)	1.03 (0.79; 1.35)
Heavy drinking	0.80 (0.59; 1.08)	1.03 (0.75; 1.41)	1.23 (0.98; 1.54)	1.08 (0.85; 1.38)	1.16 (0.95; 1.42)	1.20 (0.98; 1.46)	1.26 (0.96; 1.67)	1.18 (0.83; 1.66)
Smoking	1.14 (0.92; 1.40)	1.26 [*] (1.01; 1.56)	1.22 ^{**} (1.04; 1.44)	0.85 (0.71; 1.02)	1.38 ^{***} (1.19; 1.60)	1.52 ^{***} (1.30; 1.78)	1.13 (0.93; 1.36)	1.17 (0.92; 1.48)
Risky HIV behavior	1.35 (0.87; 2.08)	2.03 [*] (1.28; 3.23)	1.15 (0.79; 1.66)	1.38 (0.94; 2.03)	1.34 (0.92; 1.94)	1.10 (0.76; 1.61)	0.80 (0.50; 1.28)	2.21 ^{**} (1.37; 3.56)
Obesity	0.97 (0.81; 1.16)	1.59 ^{***} (1.31; 1.92)	1.10 (0.97; 1.25)	0.87 [*] (0.75; 1.00)	1.03 (0.92; 1.15)	0.99 (0.87; 1.12)	0.97 (0.83; 1.14)	0.93 (0.74; 1.18)
Diabetes	1.10 (0.85; 1.42)	1.45 [*] (1.08; 1.94)	1.22 [*] (1.01; 1.47)	1.00 (0.80; 1.25)	1.11 (0.93; 1.32)	1.00 (0.83; 1.22)	0.76 [*] (0.60; 0.97)	1.06 (0.73; 1.54)
Myocardial infarction	1.31 (0.98; 1.74)	0.98 (0.67; 1.43)	1.13 (0.88; 1.46)	1.19 (0.84; 1.69)	1.22 (0.96; 1.55)	0.93 (0.71; 1.23)	0.92 (0.68; 1.23)	1.85 [*] (1.17; 2.92)
Coronary heart disease	1.21 (0.91; 1.61)	1.14 (0.79; 1.63)	1.36 [*] (1.07; 1.73)	1.11 (0.78; 1.57)	1.07 (0.84; 1.38)	0.72 [*] (0.55; 0.95)	1.04 (0.79; 1.38)	1.38 (0.83; 2.31)
Stroke	1.14 (0.76; 1.71)	1.18 (0.80; 1.75)	1.04 (0.74; 1.45)	1.15 (0.80; 1.65)	1.12 (0.82; 1.52)	1.09 (0.81; 1.48)	0.96 (0.63; 1.44)	1.50 (0.85; 2.65)
Depression	1.36 ^{**} (1.12; 1.64)	1.80 ^{***} (1.49; 2.17)	1.64 ^{***} (1.41; 1.90)	2.78 ^{***} (2.39; 3.24)	1.23 ^{**} (1.06; 1.41)	0.80 ^{**} (0.69; 0.94)	0.92 (0.77; 1.11)	1.32 [*] (1.03; 1.69)
Disability due to poor health	1.48 ^{***} (1.24; 1.76)	1.34 ^{**} (1.11; 1.62)	1.35 ^{***} (1.18; 1.55)	1.64 ^{***} (1.41; 1.91)	1.22 ^{**} (1.08; 1.38)	0.94 (0.82; 1.09)	0.94 (0.79; 1.11)	1.29 (0.99; 1.68)
Use of special equipment due to disability	1.37 [*] (1.06; 1.77)	1.20 (0.92; 1.58)	0.98 (0.80; 1.21)	1.15 (0.91; 1.43)	1.12 (0.93; 1.36)	1.14 (0.87; 1.50)	0.93 (0.72; 1.19)	1.25 (0.84; 1.85)

Note: Model incorporates individual ACE categories as binary outcomes adjusting for age, race, gender, marital status, educational attainment, employment, region, and income.

Results show AOR and 95% CI.

Boldface indicates statistical significance

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$.