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Impact of Adverse Childhood Experiences on Adult Health in Colorado

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Background

Adverse childhood experiences (ACEs) are traumatic or stressful experiences, such as abuse, which occur during childhood or adolescence. Existing research shows that these negative early life experiences have long-lasting effects on an individual's well-being. However, the burden of these experiences among Colorado adults was previously unknown.

The ACE Study

The ACE Study is a collaboration between the Centers for Disease Control and Prevention (CDC) and Kaiser Permanente, enrolling more than 17,000 Kaiser members from a clinic in California between 1995 and 1997 into an ongoing prospective study. Study participants completed a standardized physical exam and a follow-up questionnaire which collected information on childhood maltreatment and family dysfunction, as well as information on their current health status and behaviors.[1] This questionnaire evaluated ten types of ACE: emotional abuse, physical abuse, sexual abuse, emotional neglect, physical neglect, domestic violence toward mother, household substance abuse, household mental illness, parental separation or divorce, and incarcerated household member.

Results from the initial recruitment phase showed that ACEs are common, with nearly two-thirds of participants experiencing at least one type of ACE while growing up.[2] The ACE Study, along with many other replications since then, has established strong evidence of a correlation between the number of ACEs an individual is exposed to and a variety of health risk behaviors and chronic conditions.[2-4] Adults with a history of one or more ACE have been shown to have poorer mental and physical health outcomes, with those exposed to four or more showing the greatest detriment to their well-being and longevity.[2,4]

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ACE and the Behavioral Risk Factor Surveillance System

The Behavioral Risk Factor Surveillance System (BRFSS) is an annual nationwide telephone survey of non-institutionalized adults ages 18 and older conducted by each state in collaboration with CDC. The sampling and weighting methodology of BRFSS allows for the generalization of results to the adult population of the area sampled, providing a platform for obtaining representative data on the adult prevalence of ACEs nationwide.

Questions from the ACE Study were modified for use as an optional module beginning with the 2009 administration of the BRFSS. The module consists of 11 questions measuring eight types of abuse and household dysfunction that occurred before age 18: emotional abuse, physical abuse, sexual abuse, household domestic violence, household substance abuse, household mental illness, parental separation or divorce, and incarcerated household member.

Twenty-nine states and the District of Columbia have asked the ACE module at least once as of 2014. Colorado included the questions for the first time in 2014 with a sponsorship from the Colorado Department of Human Services Office of Early Childhood. This report aims to describe the prevalence of ACEs among Colorado's adult population as well as the association these experiences have with poor health behaviors and outcomes.

Methods

Sample

The Colorado BRFSS administers multiple survey versions each year in order to accommodate a larger number of questions and meet state-specific data needs. All respondents are asked the CDC core questions and are then randomly split into one version of the survey to answer a series of optional and state-added questions. The ACE questions were asked on one of three versions implemented in 2014. Respondents who terminated the call prior to the ACE module (n=486) or refused to answer one or more of the ACE questions (n=178) were excluded from the analysis. The final sample for this analysis included 3,677 respondents.

Adverse Childhood Experiences Module and Scoring
Emotional abuse **[More than once]** How often did a parent or adult in your home ever swear at you, insult you, or put you down?
Physical abuse **[Once/more than once]** How often did a parent or adult in your home ever hit, beat, kick, or physically hurt you in any way? Do not include spanking.
Sexual abuse **[Once/more than once to any question]** How often did anyone at least 5 years older than you or an adult, ever touch you sexually? How often did anyone at least 5 years older than you or an adult, try to make you touch them sexually? How often did anyone at least 5 years older than you or an adult, force you to have sex?
Household mental illness **[Yes]** Did you live with anyone who was depressed, mentally ill, or suicidal?
Household substance abuse **[Yes to either question]** Did you live with anyone who was a problem drinker or alcoholic? Did you live with anyone who used illegal street drugs or who abused prescription medications?
Household domestic violence **[Once/more than once]** How often did your parents or adults in your home ever slap, hit, kick, punch or beat each other up?
Parental divorce/separation **[Yes]** Were your parents separated or divorced?
Incarcerated household member **[Yes]** Did you live with anyone who served time or was sentenced to serve time in prison, jail or other correctional facility?

ACE score

An individual's experiences are summarized as an ACE score. One point is assigned for each type of ACE the respondent was exposed to, resulting in a cumulative score ranging from zero to eight. Responses were categorized as exposed using definitions provided in a previous CDC study of the BRFSS module for each type of ACE (sidebar).[5] Responses of *never*, *no*, or *don't know* were defined as unexposed. A single occurrence of emotional abuse was also assigned to unexposed. Adults with at least one ACE were then categorized as having a low score (one to three ACEs) or high score (four or more ACEs).

Health-related quality of life

Fair or poor health was assigned to those who rated their general health as such. Frequent physical distress, frequent mental distress, and frequent activity limitations were defined as experiencing 14 or more days of poor physical health, poor mental health, and activity limitations due to poor physical or mental health, respectively. Those who reported zero days of poor physical and mental health, and therefore not asked the latter, were assigned to no activity limitation.

Health-risk behaviors and conditions

Current smoking includes adults who have smoked at least 100 cigarettes and now smoke on some days or every day. Males who reported having 15 or more drinks and females who had eight or more drinks per week in the past 30 days were classified as heavy drinkers. Females who had four or more drinks and males who had five or more drinks on a single occasion in the past 30 days were defined as binge drinkers. A body mass index of 30 or greater, as calculated from self-reported height and weight, is considered obese.

Chronic health conditions

Respondents who reported being limited in activities because of physical, mental, or emotional problems or having a health problem that requires the use of special equipment were categorized as having a disability. Those ever diagnosed as having a depressive disorder, arthritis, diabetes (except during pregnancy), chronic obstructive pulmonary disease (COPD), kidney disease, or cancer (excluding skin) were classified as having that condition. Ever being diagnosed with a heart attack, angina, coronary heart disease, or stroke was defined as having cardiovascular disease. Current asthma was assigned to those ever diagnosed and still having the condition.

Analysis

Data were weighted and analyzed using SAS 9.3 to produce descriptive statistics on the prevalence of ACEs in the Colorado adult population and to explore potential associations between ACE scores and these 17 indicators of poor health. Non-overlapping confidence intervals were used to determine statistically significant differences in prevalence between demographic groups and ACE scores. Multiple logistic regression was performed in SAS-callable SUDAAN to calculate adjusted odds ratios (aOR) for the associations between number of ACEs and each indicator of poor adult health, while controlling for the effects of age, sex, race/ethnicity, and educational attainment. No ACE was used as the referent group in each model.

Adjusted odds ratios greater than 1.0 with a 95 percent confidence interval that did not include 1.0 signify a statistically significant increase in the odds of the outcome.

Results

Prevalence of ACEs among Colorado adults

ACEs are common among adult Coloradans, with 61.7% being exposed to at least one type of ACE (Figure 1). More than one-third of adults have a history of multiple types of ACE. Nearly 15 percent of adults experienced four or more ACEs, and some adults have a history of all eight types (0.4%). Parental divorce/separation, emotional abuse, and having a substance-abusing household member were each cited by more than a quarter of adults (Figure 2). Physical abuse (18.9%), living with someone who had a mental illness (17.0%), and domestic violence (16.4%) were also common experiences. One in every ten adults were sexually abused before age 18, and the prevalence was three times higher among females (data not shown). Six percent of Coloradans had a household member who spent time in prison.

Figure 1. Distribution of ACE scores among Colorado adults, BRFSS 2014.

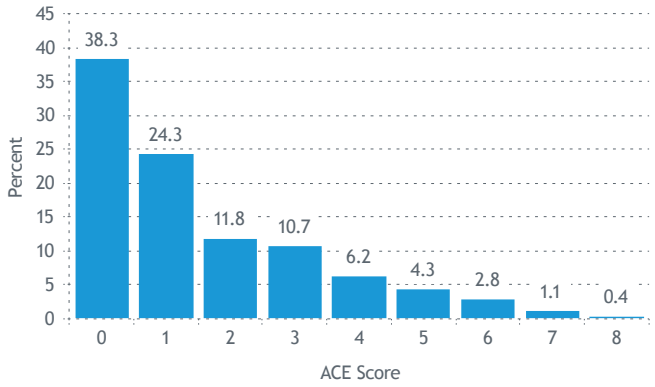
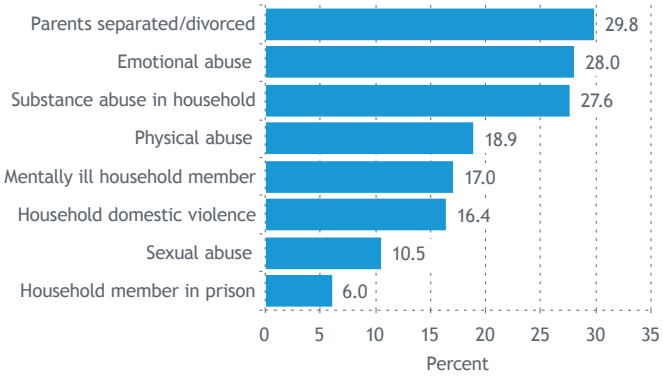


Figure 2. Prevalence of adverse childhood experiences, by type, BRFSS 2014



ACEs are common across all demographic groups (Table 1). However, there are some groups who are more disproportionately burdened by these experiences than their demographic counterparts. Prevalence of one or more ACEs was significantly higher among non-Hispanic Black adults (78.5%), those who didn't complete high school (72.6%), lesbian gay and bisexual adults (81.2%), and those living in urban areas of the state (62.7%). Females had a higher prevalence of four or more ACEs (17.4%). Prevalence of any ACEs was lowest among older adults (44.9%).

Table 1. Prevalence of ACE scores among Colorado adults by select characteristics, BRFSS 2014.

		No ACE		Low ACE		High ACE	
	Sample Size	Percent	95% confidence interval	Percent	95% confidence interval	Percent	95% confidence interval
Overall	3,677	38.3	(36.2-40.5)	46.9	(44.6-49.2)	14.8	(13.1-16.5)
Sex							
Male	1,584	40.5	(37.2-43.7)	47.4	(44.0-50.8)	12.1	(9.7-14.5)
Female	2,093	36.2	(33.4-39.1)	46.4	(43.4-49.4)	17.4	(15.0-19.8)
Age							
18-24 years	169	32.1	(23.6-40.6)	51.1	(42.1-60.1)	16.8	(9.8-23.8)
25-34 years	316	26.8	(21.4-32.2)	55.3	(49.0-61.6)	17.9	(13.2-22.6)
35-44 years	488	34.3	(29.3-39.4)	46.4	(41.0-51.7)	19.3	(14.7-23.9)
45-54 years	631	36.8	(32.0-41.6)	47.7	(42.8-52.7)	15.5	(11.9-19.0)
55-64 years	913	44.7	(40.7-48.6)	41.9	(37.9-45.8)	13.5	(10.8-16.2)
65+ years	1,160	55.1	(51.5-58.7)	39.2	(35.6-42.8)	5.7	(4.2-7.3)
Race/Ethnicity							
White, non-Hispanic	2,993	39.6	(37.2-42.1)	45.8	(43.2-48.3)	14.6	(12.7-16.5)
Black, non-Hispanic	78	21.5	(11.5-31.5)	60.2	(47.1-73.2)	18.3	(7.5-29.2)
Hispanic	400	36.8	(31.0-42.5)	49.4	(43.3-55.5)	13.8	(9.2-18.5)
Other, non-Hispanic	124	37.0	(25.5-48.5)	45.4	(33.5-57.4)	17.6	(8.0-27.1)
Education							
Less than high school	187	27.4	(19.8-35.0)	55.4	(46.1-64.6)	17.2	(9.0-25.5)
High school graduate	871	38.4	(33.9-43.0)	47.0	(42.4-51.7)	14.5	(11.1-17.9)
Some college or more	2,608	39.8	(37.2-42.3)	45.7	(43.0-48.3)	14.6	(12.7-16.5)
Annual Household Income							
Less than $25,000	673	34.7	(29.8-39.5)	47.5	(42.2-52.9)	17.8	(13.7-21.9)
$25,000-49,999	795	34.6	(29.8-39.4)	47.7	(42.7-52.7)	17.7	(13.6-21.8)
$50,000 or more	1,781	41.1	(38.1-44.1)	45.7	(42.6-48.9)	13.1	(11.0-15.3)
Sexual Orientation							
Heterosexual	3,503	38.8	(36.6-41.0)	46.3	(44.0-48.6)	14.9	(13.1-16.6)
Gay, lesbian, or bisexual	104	18.8	(10.1-27.6)	65.5	(53.3-77.7)	15.7	(7.0-24.3)
Region †							
Urban county	2,740	37.3	(34.9-39.7)	47.6	(45.1-50.2)	15.0	(13.1-16.9)
Rural county	937	44.4	(40.0-48.8)	42.2	(37.8-46.7)	13.3	(10.1-16.5)

† Counties were classified as urban or rural using the 2014 County Designations published by the Colorado Rural Health Center.[6]

Adams, Arapahoe, Boulder, Broomfield, Clear Creek, Denver, Douglas, Elbert, El Paso, Gilpin, Jefferson, Larimer, Mesa, Park, Pueblo, Teller, Weld were designated as urban.

Rural included Alamosa , Archuleta , Baca, Bent, Chaffee, Cheyenne, Conejos, Costilla, Crowley, Custer, Delta, Dolores, Eagle, Fremont, Garfield, Grand, Gunnison, Hinsdale, Huerfano, Jackson, Kiowa, Kit Carson, Lake, La Plata, Las Animas, Lincoln, Logan, Mineral, Moffat, Montezuma, Montrose, Morgan, Otero, Ouray, Philips, Pitkin, Prowers, Rio Blanco, Rio Grande, Routt, Saguache, San Juan, San Miguel, Sedgwick, Summit, Washington, Yuma.

Prevalence of and associations with select health indicators by ACE score

The unadjusted prevalence for many of these poor health indicators shows an increasing trend as the number of ACEs goes up (Table 2). This is most evident for current smoking, obesity, disability, depression, asthma, and the health-related quality of life indicators.

Table 2. Prevalence of select health indicators by ACE score, BRFSS 2014.

	No ACE		Low ACE Score		High ACE Score	
	Percent	95% confidence interval	Percent	95% confidence interval	Percent	95% confidence interval
Health-related quality of life						
Fair or poor health	10.0	(8.0-12.0)	12.7	(10.6-14.8)	18.2	(13.8-22.6)
Frequent physical distress	6.7	(5.2-8.3)	10.1	(8.2-12.0)	15.2	(11.3-19.2)
Frequent mental distress	5.5	5.5 (3.5-7.5)	10.2	(8.1-12.4)	17.4	(13.0-21.8)
Frequent activity limitations	3.5	(2.4-4.5)	5.6	(4.2-7.1)	9.0	(5.8-12.3)
Health risk behaviors and conditions						
Current smoking	9.3	(7.4-11.3)	17.8	(15.0-20.5)	28.2	(22.5-33.8)
Heavy drinking	5.7	5.7 (3.7-7.6)	7.4	(5.7-9.1)	7.8	(4.5-11.1)
Binge drinking	12.8	(10.1-15.4)	19.9	(17.1-22.8)	19.3	(13.8-24.9)
Obesity	19.1	(16.5-21.8)	22.3	(19.3-25.2)	27.8	(21.8-33.7)
Chronic conditions						
Depression	8.2	(6.4-10.1)	18.5	(15.9-21.1)	33.4	(27.5-39.4)
Disability	17.6	(15.2-19.9)	21.0	(18.4-23.5)	32.4	(26.9-38.0)
Arthritis	23.0	(20.6-25.5)	25.3	(22.6-27.9)	27.7	(22.7-32.7)
Current asthma	6.5	(4.6-8.5)	8.6	(6.6-10.5)	13.3	(9.2-17.4)
Chronic obstructive pulmonary disease	2.8	(2.0-3.6)	4.3	(3.1-5.5)	5.4	(3.5-7.4)
Cardiovascular disease	6.5	(5.2-7.8)	5.9	(4.6-7.3)	6.1	(4.1-8.0)
Diabetes	7.8	(6.2-9.5)	6.5	(5.2-7.9)	7.8	(5.1-10.5)
Kidney disease	2.4	(1.6-3.2)	2.1	(1.2-2.9)	3.2	(1.3-5.0)
Cancer	6.0	(4.8-7.1)	5.2	(4.1-6.4)	9.4	(6.1-12.7)

After controlling for the effects of age, sex, race/ethnicity, and educational attainment, adults with low ACE scores had significantly higher odds of being in fair or poor health; experiencing frequent physical distress, mental distress, and activity limitations; being diagnosed with depression, arthritis, and COPD; and having a disability than adults without any ACEs (Table 3). The odds of smoking and binge drinking were also increased for adults with a history of one to three ACEs. The increase in odds ranged from 1.5 to nearly three times across these indicators.

Adults who were exposed to four or more ACEs demonstrated a greater number and increased intensity of associations with the poor health indicators. Adults in this group had increased odds of being in fair or poor health; experiencing frequent physical distress, mental distress, and activity limitations; being diagnosed with depression, arthritis, COPD, cardiovascular disease, and cancer; and having a disability than those with a score of zero. The odds of smoking and having asthma were also significantly higher. Adults with high ACE exposure had odds ranging from two to nearly six times as high.

Depression had the strongest association for both low and high ACE scores, and the intensity of the relationship more doubled across groups. Current smoking and disability both demonstrated a similar graded increase in odds based on ACE score.

Table 3. Adjusted† odds ratios of select health indicators for low and high ACE scores, BRFSS 2014.

	Low ACE Score		High ACE Score	
	aOR	95% confidence interval	aOR	95% confidence interval
Health-related quality of life				
Fair or poor	1.50	(1.11-2.04)	2.60	(1.46-4.63)
Frequent physical distress	1.79	(1.31-2.46)	2.44	(1.37-4.34)
Frequent mental distress	1.77	(1.12-2.81)	2.08	(1.02-4.22)
Frequent activity limitations	1.87	(1.24-2.82)	2.22	(1.01-4.88)
Health-risk behaviors and conditions				
Current smoking	1.87	(1.37-2.55)	3.57	(2.14-5.94)
Heavy drinking	1.34	(0.85-2.10)	1.36	(0.53-3.51)
Binge drinking	1.52	(1.11-2.09)	1.80	(0.97-3.36)
Obesity	1.22	(0.96-1.56)	1.21	(0.75-1.96)
Chronic conditions				
Depression	2.63	(1.93-3.60)	5.52	(3.27-9.35)
Disability	1.59	(1.25-2.03)	2.66	(1.62-4.35)
Arthritis	1.74	(1.40-2.15)	2.13	(1.36-3.35)
Current asthma	1.40	(0.92-2.12)	2.12	(1.06-4.23)
Chronic	2.08	(1.41-3.06)	3.12	(1.65-5.90)
Cardiovascular	1.13	(0.82-1.56)	2.08	(1.20-3.60)
Diabetes	1.02	(0.74-1.40)	1.25	(0.65-2.39)
Kidney disease	1.11	(0.66-1.86)	0.76	(0.25-2.31)
Cancer	1.27	(0.93-1.72)	1.96	(1.10-3.47)

Bold numbers indicate statistically significant difference from referent group (No ACE).
† Adjusted for age, sex, race/ethnicity, and educational attainment.

Discussion

The prevalence and disparities found in Colorado are similar to those found in other states that have administered the ACE module in their BRFSS. The majority of adult Coloradans have experienced at least one ACE, with more than one-third being exposed to multiple types of ACE. Some demographic groups—lesbian, gay and bisexual and non-Hispanic Black adults—have experienced ACEs disproportionately.

The findings of this analysis were also consistent with many of the established associations between negative early life experiences and poor health behaviors and outcomes in adulthood. The same graded relationship between number of ACEs and strength of association was also found.

These long-lasting effects highlight the public health importance of these experiences and the utility in taking a life-course approach to addressing some of the leading causes of morbidity and mortality. The high prevalence and co-occurrence of ACEs suggests that a substantial proportion of the Colorado adult population may be impacted by these experiences. Preventing child maltreatment and household dysfunction, as well as efforts to instill resiliency in those affected, may benefit the overall health of Coloradans.

Limitations

The BRFSS does not survey adults living in institutions such as nursing facilities, group homes, or prisons; homeless adults; nor those without a residential or cellular telephone. Individuals in these situations may be disproportionately affected by ACEs, and their exclusion may result in an underestimate of prevalence.

This module does not ask about emotional and physical neglect as does the original and other ACE studies. This may result in failing to capture another subsection of at-risk adults.

These data do not measure nor indicate the severity or frequency of adverse childhood experiences. That is, an occurrence of once is counted the same as repeated exposures. The different types of ACE are treated equally in calculating the ACE score.

The ACE module does not assess where the events occurred and therefore cannot be used to determine which areas of the state have higher or lower rates of child maltreatment or household dysfunction.

Asking the ACE questions on only one of three versions limited the sample size available for analysis. A larger sample size would reduce the variance and corresponding confidence limits, which may result in a greater number of statistically significant associations congruent with the findings of larger studies. This also limited the ability to look at associations with other state-added questions, such as marijuana use, that were asked on a different version of the survey.

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