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ABSTRACT

Haunted by the Past: Adverse Childhood Experiences and Chronic Disease in Adulthood

By

Terrianna D. Woodard

July 29, 2019

INTRODUCTION: Beginning with the original Adverse Childhood Experiences (ACE) study, there has been increasing understanding and appreciation for the powerful relationship between traumatic experiences during childhood and subsequent health and life outcomes. Nearly half of all adults in the United States have experienced at least one adverse experience during childhood. The exposure to ACEs, traumatic events occurring prior to age 18, has been linked to chronic health conditions as well as social, emotional, physical, and cognitive problems.

AIM: The purpose of this thesis was to examine the relationship between ACE exposure and chronic disease outcomes, specifically heart disease, asthma, and depression.

METHODS: Logistic regression was used to assess the association between specific chronic disease outcomes and ACE exposure using secondary data from the 2016 Georgia Behavioral Risk Factor Surveillance System (BRFSS). The analysis looked at three different categories of ACE exposure; those due to household challenges, childhood abuse, and total ACEs.

RESULTS: Depression had the strongest association with ACE exposure in all three categories. Significant associations were observed between each chronic disease outcome and abuse.

DISCUSSION: The results indicate that exposure to a single ACE is associated with higher risk of having depression. The strength of the association between chronic diseases and ACEs varies by chronic disease outcome.

Haunted by the Past: Adverse Childhood Experiences
and Chronic Disease in Adulthood

By

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B.S., Xavier University of Louisiana

A Thesis Submitted to the Graduate Faculty
of Georgia State University in Partial Fulfillment

of the

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APPROVAL PAGE

Haunted by The Past: Adverse Childhood Experiences
and Chronic Disease in Adulthood

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July 29, 2019

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Author's Statement Page

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Terrianna D. Woodard

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CHAPTER 1: INTRODUCTION

Background

Beginning with the original Adverse Childhood Experiences (ACE) study, there has been increasing understanding and appreciation for the powerful relationship between traumatic experiences during childhood and subsequent health and life outcomes (Centers for Disease Control and Prevention, 2019). Studies have consistently shown that the prevalence of reported ACE exposure is high among US adults (>60%). The exposure to ACEs, traumatic events occurring prior to age 18, has been linked to chronic health conditions as well as social, emotional, physical, and cognitive problems (CDC, 2019). ACEs include both abuse (which can be physical, sexual, or emotional) and neglect, and household challenges (which include parental separation/divorce, household substance abuse, domestic partner violence, incarcerated parent, and mental illness in the household) (CDC, 2019). The latter exposures are more environmental and do not happen directly to the individual. The immediate impact of ACEs depends on the type of ACE the child experienced and how the child interprets and responds to the event.

Research has established that a relationship exists between ACEs and an individual's outcomes in terms of risk behaviors, disease, and quality of life Felitti et al. (2019). Most of the proposed mechanisms that influence, contribute, or cause this phenomenon are only speculations due to limitations in the current evidence Muscatell and Eisenberger (2012). The relationship between ACEs and chronic diseases is both indirect, related to the association between exposure to ACEs and increased risk for negative health behaviors, and direct, believed to be related to the physical and mental impacts of exposure to ACEs Felitti et al. (1998). Stress and inflammation are both hypothesized to mediate these direct effects. Disruption of neuroendocrine and immune functioning caused by toxic stress is associated with negative health outcomes, in addition to

other factors that have both indirect and direct impacts on exposed individuals due to chronic arousal of the body's physiological response to stress (Shonkoff, Boyce, & McEwen, 2009).

Children who are exposed to adverse experiences experience significant stress from these events. The body's hormonal response to stress is a protective mechanism used by the body to adapt and respond to what is perceived as threatening. Chronic stress, sometimes called toxic stress, is a known contributing factor to chronic diseases as it overburdens the body's defense system and can lead to dysfunctional processes (Muscatell & Eisenberger, 2012). For individuals who have repeated exposure to ACEs, excessive exposure to chronic stress can result in altered bodily responses that could possibly be the foundation for chronic disease in adulthood.

Inflammation is also facilitated by stress hormones (Frieri, O'Connor, & Nassef, 2015). Many diseases are more severe in the presence of inflammation. Research suggests that increased inflammation may be the result of stress-induced activation of the sympathetic nervous system and the hypothalamic pituitary-adrenal axis (Muscatell & Eisenberger, 2012). Overstimulation of both pathways has been linked to inflammation that increases risk for disease and also contributes to poorer health outcomes because of a weakened immune response (Muscatell & Eisenberger, 2012).

Based on the reviewed literature there is no study to knowledge that has sought to look at the relationship of different categories of ACEs and the selected chronic diseases. Most studies to date have examined the relationship that exists between the number of ACE exposures and various chronic disease outcomes. Although this is important, differentiating the relative impact of different categories of ACEs, is important for furthering our understanding of ACEs and informing interventions and policies directed at mitigating the impact of ACEs. Preventing the

negative impact of ACEs on children has the potential to reduce the incidence of chronic health conditions, reduced life potential, and premature death for future generations.

Research hypothesis

1. There will be a positive association between exposure to household challenges, childhood abuse, and total ACEs and chronic disease outcomes, specifically heart disease, asthma, and depression.
2. Depression will have a stronger association with household challenges, childhood abuse, and total ACEs than asthma and heart disease.

Rationale for this study

Many of the relationships between ACEs and negative health outcomes have been well-established, yet the mechanisms by which the changes occur are still unknown. Associations between ACEs and risk behaviors are commonly cited in the literature, but the biological processes by which changes occur are often left unexamined. Asthma, heart disease, and depression are unrelated diseases each of which have pathologic pathways associated with stress and inflammation. This study adds to the current literature by providing the examination of ACE exposure compared to no ACE exposure and demonstrates that one exposure can be significant in disease outcome. The additional examination of ACEs broken down into the subdomains ACEs (total), household challenges, and abuse provides additional insight to the impact of different types of ACE exposure.

CHAPTER 2: LITERATURE REVIEW

2.1 ACEs and Chronic disease

Since the groundbreaking ACE study conducted by Felitti et al. (1998), additional studies have confirmed the association between increased ACEs and increased risk of chronic disease. Felitti et al. (1998) found that health over the course of an individual's life is negatively impacted by ACEs. Prior to this study, research about childhood abuse focused on specific types of abuse and their outcomes. This study sought to evaluate the health impacts of additional types of abuse along with resulting risky behaviors. It was shown that other types of abuse as well as the number of exposures were negatively associated with health outcomes in adulthood. More than half of respondents reported at least 1 adverse childhood experience, with substance abuse by a parent being the most common exposure. Both an increased incidence of chronic diseases and an increased odds of risky health behaviors were observed when adults exposed to abuse or dysfunction as children were compared to those not exposed. Individuals with 4 or more exposures were more likely to participate in risky health behaviors and have one of the chronic disease outcomes including ischemic heart disease (including heart attack or use of nitroglycerin for exertional chest pain), any cancer, stroke, chronic bronchitis, or emphysema (COPD), diabetes, hepatitis or jaundice, and any skeletal fractures (as a proxy for risk of unintentional injuries).

In a recent study done by Felitti and colleagues (2019), the relationship between childhood exposure and disease conditions that are among the leading causes of mortality in the United States were examined. Responses from 13,494 patients who completed standardized medical evaluations at Kaiser Permanente's San Diego Health Appraisal Clinic between 1995 and 1996 were examined. 9,508 (70.5%) of the eligible patients responded to the questionnaire

and 50.9% of the responses were used after some were excluded due to missing information. More than half of the respondents experienced exposure to at least 1 ACE and 6.2% reported exposure to greater than 4 ACEs (Felitti, et al., 2019). They observed a significant dose response relationship between disease outcomes and ACE exposures. As the number of exposures increased, so did the odds of having a chronic disease. The most significant odds were among individuals who experienced 4 or more ACEs. The odds of developing chronic disease outcomes was significantly higher in individuals exposed to 4 or more ACEs, ranging from a 60% increased likelihood of having diabetes (OR = 1.6) to an almost four-fold increased likelihood (OR = 3.9) of having chronic bronchitis or emphysema, compared to those with no exposure (Felitti, et al., 2019). They found a significant (<0.05) dose response relationship between the number of exposures and the likelihood of chronic disease outcomes for 9 of the 10 diseases studied. They concluded that the impact of adverse childhood experiences on adult health status is strong and cumulative.

Brown et al. (2019) conducted a study to determine whether ACEs were associated with an increased risk of premature death using the data from the original ACE study. The responses of 17,337 adults ages 18 years and older during 1995–1997 were examined alongside follow up assessments using mortality records, conducted through December 31, 2006. During follow up, 1539 people died. Individuals with 6 or more ACEs died on average about 20 years earlier than those who had no exposure. The five leading causes of death, including diseases of the circulatory system, malignant neoplasms, diseases of the nervous system, diseases of the respiratory system, and diseases of the digestive system, accounted for 90% of all deaths among study participants. They observed a graded relationship between exposure to ACEs and disease outcomes. Those with more exposure were more likely to have a health condition that increased

their risk for premature death. The strong associations between ACEs and chronic disease that were seen at higher levels of ACE exposure led to the postulation that the increased risk of premature death may be the result of an acceleration in an individual's disease experience as a result of ACE exposure (Brown, et al., 2009).

Sonu, Post, and Feinglass (2019) examined the association of ACEs with early onset chronic disease conditions using data from the 2011 – 2012 Behavioral Risk Factor Surveillance System (BRFSS). The survey included the responses of 86,968 individuals 18 years or older from 9 states. Individuals who reported 4 or more ACEs had 2–4 times increased risk for having a chronic condition when compared to those with no ACE exposure. A dose dependent gradient was observed between most of the disease outcomes and 4 or more ACE exposures. Young adults exposed to 4 or more ACEs had a greater risk of chronic diseases and were more likely to report fair or poor health compared to those who did not have any exposure. With the exception of cancer, a statistically significant difference was observed for each chronic disease in individuals with 4 or more ACE exposures compared to those with no exposure (Sonu, Post, & Feinglass, 2019).

Gilbert et al. (2010) examined the relationship between ACEs and chronic disease using ACE data collected by ten states and the District of Columbia in the 2010 BRFSS. Their study was an effort to get a more representative sample than previous studies that used data from Kaiser Permanente's San Diego Health Appraisal Clinic. More than half of the respondents (about 60%) reported experiencing ACEs. Exposure to ACEs was associated with greater odds of reporting myocardial infarction, asthma, fair/poor general health reporting, and frequent mental distress and disability when compared to those with no exposure. Exposure to greater than four ACEs was associated with a higher likelihood of coronary heart disease and stroke when

compared to those with no exposure. A linear dose–response relationship was observed; individuals who reported multiple ACEs were more likely to report multiple health conditions.

2.2 ACEs and Depression

A meta-analysis and systemic review by Li, D'Arcy, and Meng (2015) reviewed English-language cohort studies from 1990 – 2014 that used documented measures of child maltreatment and diagnostic measures for depression and anxiety. The relationship between any type of childhood maltreatment and depression was analyzed based on five studies. Pooled estimates were used to calculate odds ratios (ORs) for depression in individuals who experienced any type of childhood maltreatment. Those with a history of maltreatment were 2.03 times more likely to have depression than those with no history of childhood maltreatment (Li, D'Arcy, & Meng, 2015). A sensitivity analysis was used to determine the effect of each study on the pooled OR. The calculated OR range after sensitivity analysis ranged from 1.69 (95% CI 1.09-2.64) to 2.24 (95% CI 1.33-3.79) and the combined OR was 1.91 (95% CI 1.27-2.85) (Li, D'Arcy, & Meng, 2015). Results remained significant, supporting the relationship between any childhood maltreatment and depression.

A sample of 8,051 individuals aged 60 and over from the 2010 BRFSS was used to evaluate the relationship between ACEs and depression in older age. A statistically significant relationship was observed for recurring ACE exposure after controlling for race, age, and gender (Ege, Messias, Thapa, & Krain, 2015). Individuals who witnessed multiple episodes of domestic violence with their parents were 2.69 times more likely to be depressed than those who did not. Those physically harmed multiple times by their parents were 4.55 times more likely to be depressed. Participants whose parents verbally abused them were 2.41 times more likely to be depressed than those not exposed. Individuals sexually abused multiple times were 3.93 times

more likely to be depressed. Those who were made to touch someone multiple times were 5.18 times more likely to be depressed than those who were not exposed. Individuals who were forced to have sex multiple times were 9.78 times more likely to be depressed than those who were not. After adjusting for all ACEs, a significant association was only observed in those who reported repeated physical abuse and forced sexual abuse.

A sample of 288 individuals aged 15 – 24 years old on a Native American reservation were evaluated in a cross-sectional study in 2011 (Brockie, Dana-Sacco, Wallen, Wilcox, & Campbell, 2015). Depression was measured using the Beck Depression Inventory (BDI), a 21-question self-reported rating scale to measure attitudes and symptoms of depression (American Psychological Association, 2019). Depression was observed in 21% of the group. After controlling for age, gender, tribal affiliation, and school attendance, depression symptoms were significantly associated with exposure to five of the six ACEs. Sexual abuse alone was not significantly related to depression. Physical abuse had the most significant association. Individuals who were exposed to physical abuse were 3.68 times more likely to have depression symptoms compared to those who were not exposed (Brockie, Dana-Sacco, Wallen, Wilcox, & Campbell, 2015).

2.3 ACEs and Asthma

Data from the 2011 to 2012 National Survey of Children's Health was used for a cross-sectional study to examine the relationship between ACEs and asthma (Wing, Gjelsvik, Nocera, & McQuaid, 2015). A sample of 92,427 eligible children were used for analysis. The prevalence of asthma was 14.6%. Children with 1 ACE were 1.58 times more likely to report asthma than those who were not exposed in the unadjusted model. As the number of ACEs increased, the odds of reporting asthma increased. Those who reported at least 5 ACEs were 2.42 times more likely to

report asthma compared to those who did not have any exposure. In the adjusted model the odds of reporting asthma remained significant. Asthma was 1.61 times more likely in those with exposure to 5 or more ACEs, compared to those without exposure. Children 5 and under with 3 or more ACEs were 4.94 times more likely to have parent-reported asthma than those with no exposure. A similar observation was seen in children ages 6 – 11; those exposed to 5 or more ACEs were 2.36 times more likely to have parent-reported asthma. There were no significant results observed in those ages 12 – 17. Overall, increased odds of reporting asthma increased as ACE exposure increased.

A systematic review by Exley, Norman, & Hyland (2015), looked at 12 studies assessing 31,524 individuals on the likelihood of developing asthma following ACE exposure. 10 of the 12 studies found a significant relationship between ACE exposure and asthma. Interestingly, the mental health difficulties of parents and the onset of asthma in children were also examined in four of the studies, three of which showed a positive association. Kozyrsky et al. reported a dose response relationship between severity of mental health difficulties and the likelihood of asthma onset (Exley, Norman, & Hyland, 2015).

2.4 ACEs and Heart Disease

Goodwin and Stein (2004) examined the relationship between childhood trauma and cardiac disease along with other physical disorders among US adults. They examined the relationship between physical abuse, sexual abuse, and neglect and specific diseases using data from the National Comorbidity Survey collected between September 1990 and February 1992. In their sample of 5,877 individuals aged 15 – 54, physical abuse was reported by 10.6% of the respondents, sexual abuse by 10.4% of the respondents and neglect by 2.9% of the respondents. After adjusting for differences in demographic characteristics, physical abuse during childhood

was found to be associated with an increased risk of cardiac disease and other physical disorders (Goodwin & Stein, 2004). Individuals who experienced childhood physical abuse were 2.1 times more likely to report cardiac disease compared to those with no exposure. There was not a significant relationship between cardiac disease and exposure to neglect. After adjusting for demographic characteristics, the relationship between sexual abuse and cardiac disease was significant. Individuals with a history of sexual abuse were 8.5 times more likely to report cardiac disease compared to individuals who were not exposed. This relationship remained significant after adjusting for demographic characteristics, anxiety and depressive disorders, and alcohol and substance dependence (OR 5.4, (95% CI 1.7, 16.9)).

The relationship between ischemic heart disease (IHD) and ACEs was examined by Dong et al. (2004). Data from 17,337 adult health plan members were collected from 1995 – 1997. An increase in the risk of IHD was observed in all but one of the ten categories (parental marital discord). IHD was reported by 10.6% of the participants. According to one of their models the risk of reporting IHD increased 20% with each ACE exposure reported (Dong, et al., 2004). Individuals who reported 7 or more ACE exposures were 3.6 times more likely to report IHD than those who had no exposure. The concluded that ACEs were interrelated and should not be assumed to be isolated events.

Data from the Georgia Stress and Heart study were examined by Su et al. (2015). This longitudinal study collected data over a 23-year period to evaluate the development of cardiovascular risk factors in youth and young adults (Su, et al., 2015). Sixty-nine percent of their sample reported ACE exposure. Young adults who experienced multiple traumatic events during childhood showed a faster increase in BP levels than those with no exposure (Su, et al., 2015). The difference was observed after 30 years of age and it was noted that at 38 years,

participants with exposure to 4 or more ACEs had higher systolic and diastolic blood pressure levels than those with no ACE exposure. Individuals with ACE exposure had higher BP in young adulthood compared to those with no exposure. The effect of ACE exposure on the development of increased BP in young adulthood was consistent across different population groups.

2.5 ACEs and Chronic Stress

A sample of 1223 young adults was studied in a cross-sectional study looking at the relationship between ACEs and psychological stress. Participants were followed from birth until their 20's. Psychological distress was reported by 28% of the sample and nearly 90% reported at least one ACE (Mayema, Norris, & Richter, 2018). All ACEs were individually associated with psychological distress except parental unemployment and divorce. Individuals who experienced one to five ACEs were three times more likely to report psychological distress when compared to those with no exposure. Individuals who experienced six or more ACEs were eight times more likely to report psychological distress than those with no exposure. 15% of the sample reported six or more ACE exposures and a significant dose response was observed in this group (Mayema, Norris, & Richter, 2018). Those with six or more ACE exposures were 11 times more likely to experience adult stress compared to those who reported 5 or less exposures or no exposure.

2.6 ACEs and Inflammation

Inflammatory markers have been increasingly reported in individuals with a history of childhood trauma (Baumeister, Akhtar, Ciufolini, Pariante, & Mondelli, 2015). A meta-analysis was conducted by Baumeister et al (2015) to examine whether pro-inflammatory phenotypes increase in response to early-life adversity. Twenty-five articles were examined that focused on three specific inflammatory makers thought to associated with increased inflammation. There

were consistently elevated levels of inflammation associated with childhood trauma. Significant associations were observed for sexual abuse and physical abuse. Due to a lack of data from the literature, the association was limited and not significant for emotional abuse. It was even more limited for parental absence, but the association was significant for one inflammatory marker. Based on their analysis, they concluded that there is evidence that childhood traumatic events have a significant impact on the inflammatory immune system with lasting effects into adulthood (Baumeister, Akhtar, Ciufolini, Pariante, & Mondelli, 2015).

The relationship of specific inflammatory markers in healthy adults who experienced childhood trauma was also evaluated by Hartwell et al. (2013) . The sample was collected from a larger unrelated study that evaluated gender differences in the stress response among individuals with and without cocaine dependence, but the only used data of individuals who were not addicted to cocaine. Each subject had a physical examination, filled out the Early Trauma Inventory, and a distress/mood scale was used to rate stress and anxiety. There was a significant positive relationship between the number of general traumas and specific inflammatory markers. They postulated that a relationship exists between childhood adversity exposure and the presence of inflammatory markers in adulthood.

The processes and mechanisms that occur as a result of ACE exposure are not well understood. Proposed mechanisms predict that exposure to toxic stress leads to reduced functioning of the body's defense systems. Studies that assessed autonomic and neuroendocrine responses have led to the theory that overstimulation leads to cellular changes that alter metabolic, immune, respiratory and cardiovascular functions making them more susceptible to disease (Cohen, Gianaros, & Manuck, 2016). The negative impact of ACE exposure has been consistently demonstrated in literature. However, there is still much to be discovered. The dose

response relationship has been a major focus but it fails to highlight that just one negative exposure can result in lifelong consequences. This study seeks to examine the impact of ACEs and the different categories of ACEs on depression, asthma, and cardiac disease, selected disease outcomes that have been associated with both stress and inflammation.

CHAPTER 3: METHODS AND PROCEDURES

A cross-sectional analysis was conducted using secondary data from Georgia's 2016 Behavioral Risk Factor Surveillance System (BRFSS) ACE module. The BRFSS is a collaborative effort between US states and territories and the Centers for Disease Control and Prevention. The ACE module is a set of questions asked in addition to the core questions that assess risk behaviors and disease in the survey. The ACE module is an optional module selected by the state to assess adverse childhood experiences from birth to age 18. A total of 5,381 Georgia residents who participated in the 2016 BRFSS were included in the study. It is conducted by phone to collect information on chronic health conditions, health-related behaviors, preventative care usage, and health-related risks (CDC, 2017).

Weighting adjustments were applied to ensure that findings were representative of the Georgia population. Data included information about Georgia residents' health risk behaviors, preventative services use, and chronic health conditions. Age, sex, race, income, marital status, general health, and education were used as controls. In addition to being examined as a whole, ACEs were categorized in two subdomains, either as a household challenges or abuse. There were six questions in the household challenges domain, assessing exposure to intimate partner violence, alcohol abuse, substance abuse, mental illness in the household, parental separation, and having an incarcerated household member. The abuse domain was composed of five questions that asked about emotional, sexual and physical abuse. Answering yes to any of the eleven questions meant that the individual had exposure to an ACE. The total number of ACEs (ACEs (total)) was calculated for each individual. The number of ACEs falling under each of the subdomains, household challenges (ACEs (household challenges)) and abuse (ACEs (abuse))

were also calculated. Each of these were then analyzed to assess their relationship to chronic disease outcomes.

3.1 Measures

Exposure Measures

The following questions were asked in the ACE module to assess exposure to household ACEs:

“Did you live with anyone who was depressed, mentally ill, or suicidal?”

“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?”

“ Did you live with anyone who served time or was sentenced to serve time in a prison, jail, or other correctional facility?”

“Were your parents separated or divorced?”

“How often did your parents or adults in your home ever slap, hit, kick, punch or beat each other up?” The responses were never, once, more than once, don’t know/not sure, and refused.

“Before age 18, 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. Would you say—” The responses were never, once, more than once, don’t know/not sure, and refused.

For all of the above, a positive response was counted as “exposure.”

To assess for abuse (ACEs (abuse)), the following questions were asked:

“How often did a parent or adult in your home ever swear at you, insult you, or put you down?” The responses were never, once, more than once, don’t know/not sure, and refused.

“How often did anyone at least 5 years older than you or an adult, ever touch you sexually?” The responses were never, once, more than once, don’t know/not sure, and refused.

“How often did anyone at least 5 years older than you or an adult, try to make you touch sexually?” The responses were never, once, more than once, don’t know/not sure, and refused.

“How often did anyone at least 5 years older than you or an adult, force you to have sex?” The responses were never, once, more than once, don’t know/not sure, and refused.

Similar to the household ACEs, any positive response was counted as an exposure.

If responses to questions were missing, the response was counted as missing.

Outcome Measures

Asthma

Asthma outcomes were measured using the question “Have you ever been told you have asthma?” The responses were dichotomized into yes or no. All missing or I don’t know responses were recorded as missing.

Depression

Depression outcomes were measured using the question “Have you ever been told you that you have a depressive disorder, including depression, major depression, dysthymia, or minor depression?” The responses were dichotomized into yes or no. All missing or I don’t know responses were recorded as missing.

Heart Disease

Heart disease was measured using the two questions “Have you ever been told you had a heart attack, also called a myocardial infarction?” and “Have you ever been told

you had angina or coronary heart disease?” A response of yes to either question was recorded as yes. All missing and I don’t know responses were recorded as missing.

3.2 Statistical Analysis

Logistic regression was used to measure independent associations between ACEs and the chronic disease outcomes using estimated prevalence odds ratios and 95% confidence intervals (CIs).

The proportion of study participants who experienced ACEs was estimated using Wald chi-square tests. The ACE score was categorized as 0 or 1+ and was evaluated overall and by the subdomains, household challenges and abuse. In order to more accurately estimate the association between ACEs and the chronic disease outcomes, analysis was controlled for sociodemographic factors (age, sex, race, income, marital status, and education). The associations between the ACEs and chronic disease outcomes were assessed at an alpha of 0.5. A relationship that had a p – value of <0.05 was considered statistically significant. The odds ratios for each outcome were compared among ACEs (total). ACEs (abuse) and ACEs (household challenges).

CHAPTER 4: RESULTS

4.1 Participant Characteristics

60.5% of the individuals reported ACEs (total) exposure. The sample demographic data and frequency of ACE exposures are shown in Table 1. The study population included 51.9% females and 48.1% males. The 35 – 54 age group made up the largest proportion of participants (35.3%). Those 18 – 34 year, 55 – 64, and 65 and older, made up 31.1%, 17.7%, and 16.0% of the sample, respectively. Individuals with some college education made up 30.0% of the sample. High school graduates made up 29.0% of the sample. College graduates made up 25.6% of the sample. 15.4% of individuals completed less than high school. The majority of the sample (56.3%) was composed of non-Hispanic white individuals. Non-Hispanic Blacks composed 29.7% of the sample. Hispanic participants made up 8.3% of the sample. 5.7% of the sample was composed of other/multi-race non-Hispanic individuals. The income for 43.0% of the sample was less than \$35,000 annually. Individuals with an income of \$75,000 or more made up 30.1% of the sample. Those who made between \$50,000 - \$75,000 composed 13.8% of the sample. The smallest income group represented were those who made between \$35,000 - \$50,000 (13.1%). 49.5% of the individuals were married. Those who were divorced, widowed, separated, and never married represented 46.6% of the sample. Individuals who were in a relationship but not married made up 3.9% of the sample. When ACE exposure was broken down into subdomains, a majority of respondents reported household challenges (52.7%) and over a third (36.9%) reported abuse.

4.2 ACEs (total) and Chronic Disease Outcomes

While the likelihood of having asthma in individuals who reported exposure to ACEs (total) was significantly higher than those without exposure prior to controlling for demographic

factors, after adjusting for demographic factors the association was no longer significant. In contrast, the association between depression and ACEs (total) remained significant. After adjusting for demographic factors, a person exposed to at least one ACE (total) was 2.3 times more likely to develop depression than someone with no exposure. The relationship between ACEs (total) and heart disease was not significant.

4.3 Household Challenges and Outcomes

Similar to the analysis for total ACEs, the likelihood of asthma in individuals who reported exposure to household challenges (ACEs (household challenges) was not significant after adjusting for demographic factors. After adjusting for demographic factors, however, individuals exposed to household challenges were 2.2 times more likely to report depression than those who were not exposed (p-value <.001). The relationship between household challenges and heart disease did not have a significant association.

4.4 Abuse and Outcomes

The relationship between abuse (ACEs(abuse) and asthma was also not significant after adjusting for demographic factors. A significant association (p-value <0.05) was observed for the relationship between depression and abuse. After adjusting, exposed individuals were 2.5 times more likely to report depression than those who were not exposed. The relationship between abuse and heart disease was not significant.

CHAPTER 5: DISCUSSION

The results support the relationship between ACEs and chronic disease outcomes, but indicate that there is variation by disease. This analysis did not support the previous published literature about the association between exposure to ACEs and heart disease or asthma. While unadjusted analysis supported a relationship between exposure to ACEs and asthma, after adjusting for demographic characteristics the associations were no longer significant.

The analysis supported a significant relationship between exposure to ACEs and depression. This included analysis looking at total ACEs (total) as well as the specific ACEs due to household challenges and abuse. Across all categories, exposure was associated with more than twice the likelihood of reporting depression.

While not supporting the research hypothesis that all three studied chronic diseases would show significant associations with ACEs, this study does support the second research hypothesis, showing a strong association between total ACEs and both categories of ACEs and depression.

While more people reported household challenges than abuse, the outcomes were more strongly related to abuse. A significantly stronger positive association was observed for depression and exposure to abuse. This difference could be related to the fact that abuse occurs directly to an individual. As stated earlier by Ege et al. (2015), the strength of the association is greatly impacted by the type of abuse to which an individual was exposed. The impact of household challenges could be less severe because the person is less directly affected. It is also possible that perception plays a role in the how the household environment is processed and whether or not it is internalized. There is also the possibility that conditions leading to household challenges ACE may be normalized. If something is perceived as normal, it may not trigger as strong of a stress response. A stressful experience cannot be assumed by uniform reference,

because an event may be stressful for some individuals but not others and such psychological reactions may prove maladaptive and relate to risk for disease (Cohen, Gianaros, & Manuck, 2016). Future studies would have to be conducted to examine this possibility further, as well as other factors leading to the differential impact of different categories of ACEs and their differential impacts on different chronic diseases.

5.1 Study Strengths and Limitations

A major strength of this study is that it can be generalized to residents of Georgia because it was analyzed with weighted data. The additional breakdown into subdomains allowed for a further level analysis because of the categorizing of ACE exposure and its effects. As with all studies, there are limitations. Recall bias is a strong limitation because participants were reporting on their experiences from childhood. Another limitation is that the study used cross-sectional data. Though the associations are significant, they do not imply a causal relationship between experiencing ACEs and depression because other factors that were not measured in this study may play a role. The role of stress and inflammation on disease outcome could not be adequately assessed with the current data, and therefore, it limited the ability to explore the relationship further.

5.2 Conclusions

The results of this study add to the current literature about the relationships between exposure to ACEs and asthma, heart disease, and depression. As demonstrated in this study, a single exposure to ACEs can have negative implications for health outcomes, and different categories of ACEs can have variable impacts on chronic diseases, especially depression. Much of the existing literature focuses on a dose-response relationship that marks the threshold in which exposure becomes significant. This study revealed that a single exposure to ACEs was not

significantly associated with asthma or heart disease, but did show a significant association with depression. This was true not only for ACEs (total), but also a single exposure to ACEs (household challenges) or ACEs (abuse). This would suggest that intervention efforts focused on preventing and mitigating the impact of ACEs are likely to help reduce the impact of depression later in life. This is especially important for public health, given that depression is the leading cause of disability globally. Based on the results of this study, a single exposure to an ACE is associated with more than twice the likelihood of a person reporting depression.

Interventions and policies aimed at preventing ACEs and mitigating their impact are important for supporting healthier communities and individuals. Successful prevention of ACE exposure has the potential to reduce the likelihood of reported depression in future generations. Reducing the prevalence of depression reduces the burden of the disease and its many manifestations, including suicide and disability. The physiological pathways connecting ACEs, stress, and inflammation also need further research and attention.

5.3 Tables

Table 1. Demographic Characteristics and ACEs Exposure Status of Respondents, 2016 Georgia BRFSS (N=5381)

PARTICIPANT CHARACTERISTICS	N (%)
AGE (Years)	
18-34	859 (31.08)
35-54	1451 (35.30)
55-64	1080 (15.97)
65+	1991 (17.65)
SEX	
Male	2200 (48.12)
Female	3180 (51.88)
EDUCATION	
Less than high school	620 (15.44)
High school graduate	1476 (28.98)
Some college	1383 (29.97)
College graduate	1882 (25.61)
RACE	
Non - Hispanic White	3312 (56.26)
Non - Hispanic Black	1392 (29.73)
Hispanic	293 (8.28)
Other/Multi-race Non - Hispanic	273 (5.74)
INCOME	
Less than \$35,000	1899 (43.02)
\$35,000 - \$49,000	611 (13.08)
\$50,000 - \$74,000	610 (13.83)
\$75,000	1232 (30.07)
MARITAL STATUS	
Married	2628 (49.53)
Div/Wid/Sep/Never Married	2593 (46.59)
Unmarried Couple	122 (3.89)
ACE (TOTAL)	
1 or More	2304 (60.54)
0	1815 (39.46)
ABUSE (EMOTIONAL, PHYSICAL, SEXUAL)	
Yes	1388 (36.89)
No	2699 (63.11)
HOUSEHOLD CHALLENGES	
Yes	1918 (52.72)
No	2200 (47.28)
ASTHMA	
Yes	525 (13.50)
No	3582 (86.50)
DEPRESSION	
Yes	715 (17.05)
No	3389 (82.95)
HEART DISEASE	
Yes	418 (7.42)
No	3697 (92.58)

Table 2. Prevalence of Asthma, Depression, and Heart disease by ACEs Exposure Status, 2016 Georgia BRFSS

ACE Exposure Category	Asthma	p-value	Heart Disease	p-value	Depression	p-value
ACE (Total)						
1 or more	338 (9.20)	0.005	241 (4.59)	0.647	520 (13.44)	0.0001
0	187 (4.30)		177 (2.82)		195 (3.61)	
Household Challenges						
Yes	288 (8.20)	0.0039	200 (3.81)	0.7224	450 (12.05)	<0.0001
No	237 (5.31)		217 (3.58)		265 (5.01)	
Abuse						
Yes	230 (6.32)	0.0004	141 (2.88)	0.5262	375 (10.07)	<0.0001
No	292 (7.23)		274 (4.54)		333 (6.94)	

Table 3. Crude and Adjusted Odds for Asthma, Depression, and Heart disease by ACE Exposure Status

	OR ¹ [95% CI]	OR ² [95% CI]
ASTHMA		
ACE (total)³	1.47 [1.12, 1.91]	1.20 [0.89, 1.61]
Household Challenges⁴	1.46 [1.13, 1.89]	1.13 [0.84, 1.52]
Abuse⁴	1.60 [1.23, 2.09]	1.31 [0.97, 1.77]
HEART DISEASE		
ACE (total)³	1.07 [0.81, 1.39]	1.27 [0.93, 1.74]
Household Challenges⁴	0.95 [0.73, 1.25]	1.19 [0.87, 1.63]
Abuse⁴	1.10 [0.83, 1.45]	1.38 [0.98, 1.94]
DEPRESSION		
ACE (total)³	2.82 [2.21, 3.60]	2.33 [1.76, 3.08]
Household Challenges⁴	2.49 [1.98, 3.13]	2.22 [1.71, 2.88]
Abuse⁴	3.03 [2.41, 3.81]	2.50 [1.91, 3.27]

¹ Crude model

² Model adjusted for age, sex, race, income, marital status, and education

³ The reference category is '0'

⁴ The reference category is 'No'

CHAPTER 6: REFERENCES

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