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ADVERSE CHILDHOOD EXPERIENCES AND HEALTH OUTCOMES

By

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A Thesis

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Abstract

Social scientists have studied the long-term effects of adverse childhood experiences (ACEs) on health outcomes for decades. More recently, researchers are beginning to focus on the short-term impact in early adulthood, as these years are foundational to future health behaviors and outcomes. Additionally, self-reporting is more accurate when assessed closer to the time of these experiences rather than further along in life. This study draws on 2019 Behavioral Risk Factor Surveillance System data to add to the current understanding of adverse childhood experiences and their impact on young adult health. Another important aspect of this study is being able to determine the number of adverse childhood experiences that must be experienced before a decline in health begins. The findings show there is an inverse relationship between adverse childhood experiences and health in young adults. Furthermore, the decline in health is significant when one has experienced at least three adverse childhood experiences.

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INTRODUCTION

Stressful or traumatic events occurring from birth until 18 years resulting in harm or potential for harm to a child's health, survival, development or dignity are called adverse childhood experiences (ACEs). ACEs encompass a host of detrimental experiences: emotional, physical, and sexual abuse; physical and emotional neglect; household dysfunction such as living in a home with violence; having family member(s) who misuse alcohol and other substances, have a mental illness, are or have been incarcerated; and parents who have been separated or divorced (Subramaniam et al. 2020). Childhood adversity has raised concern regarding outcomes well into adulthood. However, the focus has shifted from later in life to early adulthood (Nurius, Logan-Greene, and Green 2012).

Public health scholars have taken particular interest in identifying, understanding, and addressing causes linked to the unequal distribution of health and educational risks ranging from poor academic performance to premature death (Lee and Chen, 2017; Subramaniam et al. 2020). When an individual experiences one ACE, there is an increased chance of experiencing another. The accrual of risk factors increases the prospect of adverse cognitive and behavioral outcomes, as described by the cumulative risk hypothesis (Subramaniam et al. 2020). Similarly, Kerker et al. (2015) describe toxic stress as an exposure to chronic, severe and prolonged stress, occurring in the absence of protective factors. Early childhood is a particularly risky time period when dealing with excessive stress. It is well documented that as the developing brain and stress hormone levels become distressed, it leads to complications well into adulthood along with physiologic disturbances such as changes in immune function and increases in inflammatory markers related to poor health outcomes. However, late adolescence and early adulthood are also

sensitive periods in the life span for those experiencing chronic stress, trauma, and ACEs, a vastly understudied life stage and a major gap in the literature that this thesis addresses.

The majority of prior research on ACEs examines the long-term health outcomes of individuals who have these experiences. The goal of this study is to contribute to the current knowledge aimed at advancing the understanding of ACE impacts on health outcomes in young adults with focus on age, race, sex, and socioeconomic status. Specifically, this study addresses the following research questions: 1) Is there an inverse relationship between ACEs and health outcomes? 2) Is the relationship between ACEs and health outcomes mediated by socioeconomic status? 3) Is there a certain number of ACEs a person experiences before exhibiting negative health outcomes?

LITERATURE REVIEW

In the mid-1990s, a groundbreaking study by the Centers for Disease Control and Prevention (CDC) and Kaiser Permanente examined how adverse childhood experiences cause stress and what the lifelong consequences of those experiences are (Felitti, Vincent J. et al. 1998). The study revealed that the lifetime impact on health for those who have been exposed to more stressors throughout childhood are likely to be negative and that these individuals would have risk-taking behaviors later in life (Kerker et. al. 2015). This indicates one key point, there is a dose-response relationship where an increased number of ACEs leads to increased problems with behavioral, physical, and mental health throughout the life course (Nurius et al. 2012; Subramaniam et al. 2020; Mersky, Topitzes, and Reynolds 2013).

For those who experience one or more ACEs, the stress is often classified as toxic, or chronic. This is an important distinction from acute stress, which is characterized as a short-lived event that will not cause lasting anxiety or problematic repercussions. Toxic stress, on the other

hand, is experienced when an individual has been exposed to long-term, severe stress in the absence of protective factors such as supportive relationships and positive coping mechanisms (Kerker et al., 2015). ACEs influence health through exposure to traumatic events and unfavorable environments that are attributed to toxic stress (Cicchetti et al. 2016). In neurobiology and epidemiology, there is evidence that experiencing toxic stress early in life causes epigenetic modifications to gene expressions. These modifications impact the lifelong health and quality of life for the individual by changing the structure of the brain, resulting in brain dysfunction (Subramaniam et al. 2020).

Development and ACEs

The effects of adverse childhood experiences do not wait to reveal themselves until later in life. Almost instantaneously after an adverse experience, the physiological effects of toxic stress begin among very young children in at-risk populations. Childhood maltreatment interrupts normal brain development and can disrupt intellectual processes such as concentration, memory, language, and organizational skills that are essential for children functioning in school (Subramaniam et al. 2020). This leads to learning setbacks, lower grades and achievement scores, issues with school involvement, and school dropout. In addition, the number of ACEs experienced by an individual is predictive of outcomes when impacted by as few as one ACE (Fang et al. 2016). The consequences of these educational setbacks are decreased employment opportunities, less income, and difficulty building wealth in adulthood (Monnat and Chandler 2015).

There are also long-term effects that manifest from the brain disturbances and hormonal imbalances in children who experience trauma (Kerker et. al. 2015; Subramaniam et al. 2020). These problems persist through the life course, serving as carriers of stress to later pathology

(Nurius et al. 2012). Moreover, these disturbances and imbalances are also expressed in maladaptive behaviors such as depression, anxiety, aggression, and substance abuse (Leeb, Lewis, and Zolotor 2011).

The implications of exposure to ACEs in early childhood years is well established (Subramaniam et al., 2020), however, there is a dearth of ACE studies focusing on the young adult stage of life (Schilling et al. 2007; Mersky et al. 2013). The period right after high school is often a chaotic transitional period and should be considered a new stage of human development (Risman 2018). There is an increased frequency of experiencing major life events and higher rates of mental disorder during this stage compared to other stages of life (Shilling et al. 2007). Biological processes that occur during delicate stages of development in conjunction with snowballing exposures to adversity can magnify the association of any risk factor with another (Halfon et.al. 2017), thus making early adulthood a critical period in the life course to study the effects of ACE experiences.

Social Disadvantage and ACEs

The experience of ACEs differs based on demographic and socioeconomic classifications. Socially disadvantaged individuals such as women, racial and ethnic minorities, and those of low socioeconomic status are more likely to endure higher levels of emotional stress than men, non-Hispanic whites and those with higher socioeconomic status (Lee, Coe, and Ryff 2017). Regarding sex, for instance, research posits that females are more likely than males to have internalized disorders like depression and anxiety, whereas externalized disorders such as delinquency and drug use are more likely in males (Cavanaugh, Petras, and Martins 2015; Solomon, Åsberg, Peer, and Prince 2016). Females are also more likely to be victimized sexually

during childhood and to witness domestic violence, while males are more likely to experience physical abuse during childhood and substance abuse by family (Fang, Chuang, and Lee 2016).

The likelihood of exposure to social and economic disadvantage are greatest for racial and ethnic minorities who have encountered past and/or present discrimination. For example, the impact of childhood adversity of Blacks being compounded with experiencing racism and inequality causes more stress, intensifying adversity (Umberson, Williams, Thomas, Liu, and Thomeer 2014). Additionally, neglect and child abuse are closely correlated with poverty which is linked to decreased probability of employment and economic productivity in adulthood (Schafer, Ferraro, and Mustillo 2011), among a multitude of other negative outcomes. These are some of the major contributing factors to the disproportionate ACE burden that racial and ethnic minorities experience compared to other groups (Lee and Chen 2017).

Socioeconomic status includes resources such as money, education, reputation, influence, and social ties that protect health (Monnat and Chandler 2015). Many prior studies are biased towards predominantly white high school students with insurance coverage. Few have researched riskier populations who face adversity in terms of risk of trauma and poor health outcomes. For instance, low income, urban minorities' stress load is activated by lack of daily necessities such as food, shelter, and clothing before even considering ACEs (Mersky et al. 2013). Children from low socioeconomic homes report poorer self-rated health, increased chronic disease and mortality rates, and more functional difficulties in adulthood in comparison with children from homes with higher socioeconomic status (Monnat and Chandler 2015).

The toxic impact of ACEs in combination with frequently co-occurring social disadvantage such as lower levels of education, income and access to resources are related. These social determinants can differentially impact later-in-life physical and mental health

(Nurius et al. 2012). Researchers, now, urge socioeconomic disadvantage to be considered as a form of adversity when examining the effects of ACEs (Schilling et al. 2007), which I incorporate in the present analysis.

ACEs and Health Outcomes

Long-term detrimental outcomes that cascade through the lifespan ranging from poor academic performance to premature death is becoming an increasing concern of public health officials (Subramaniam et al. 2020). Toxic stress experienced in early childhood is shown to be linked to physiologic disturbances, such as changes in immune function and rises in inflammatory markers. Chronic health complications and mental health problems are related to experiencing a higher number of ACEs before the age of 5 (Kerker et. al. 2015). Mental health outcomes in early adulthood that stem from ACEs act as pathways to long-term physical and mental comorbidities, which range from anxiety and depression to suicidal tendencies, and many more (Mersky et al. 2013).

Individuals who suffer from ACEs can be more vulnerable to increases in mortality and many forms of morbidity, including autoimmune, liver, coronary, and pulmonary diseases (Kerker et. al. 2015). Stress stemming from childhood abuse may be responsible for chronic stimulation of the stress response system, which causes hypersensitivity or vulnerability to pain, as seen in disorders like fibromyalgia (Low and Schweinhardt 2012). Furthermore, there is a higher risk of asthma and other cardiorespiratory diseases, intestinal, bacterial and viral infections, and increased use of hospital care for victimized children (Lanier et al. 2009). Health concerns of neglect may include failure to thrive, untreated obesity, vitamin deficiencies, untreated medical conditions, and injuries (Leeb et al. 2011).

ACEs are linked to an increased risk of mental disorders including depression, anxiety, alcohol and substance use disorders, psychosis and suicide attempt and other health-damaging behaviors (Subramaniam et al. 2020). Fang et al. (2016) state that when compared to their male counterparts, females who endured ACEs were more likely to feel hopeless, smoke cigarettes, and have depression and anxiety disorders in adulthood, whereas males were more likely to express alcohol abuse or misuse and antisocial behavior in young adulthood (Schilling et al. 2007). Women are at an increased risk of psychosis following childhood sexual victimization compared with men, and not having social support was related to a higher risk of depression in women, but not in men (Fisher et al. 2009).

Experiencing ACEs strengthened the likelihood of frequent marijuana, tobacco, and alcohol use among men and women, with men having an increased chance of using either substance to some extent (Leban and Gibson 2020). Suicide completion is more frequent among males while suicidal ideation and attempt rates are higher among females (Fuller-Thompson et al. 2016). ACEs have been reported as influencing factors in HIV risk behaviors; as the number of ACE experiences increases, sexually transmitted diseases increase for both males and females. For males, the likelihood of HIV risk increases significantly with only one ACE experience, although the risk did not increase until they experienced three or more ACEs for females (Fang et al. 2016).

According to the literature, it is clear that sex, race, socioeconomic status, and number of ACE experiences matters. However, what researchers have yet to identify is how these factors influence individual health in late adolescence/early adulthood. In addition, the direct and indirect effect of these factors also remains unknown.

METHODS

Data

The dataset being used for this study is the 2019 Behavioral Risk Factor Surveillance System (BRFSS), a cross-sectional telephone survey conducted monthly by state health departments using both landline and cellular telephones with a standardized questionnaire and technical and methodologic assistance from the Centers for Disease Control and Prevention (CDC.gov/brfss). Data was collected in 49 states as well as the District of Columbia, Guam, and Puerto Rico at both the state and local levels from the United States' non-institutionalized adult residents ages 18 and over inquiring about their health-related risk behaviors, chronic health conditions and use of preventive services. The 2019 response rate for states and territories included in this survey had a median of 49.4% and ranged from 37.3% to 73.1%.

The BRFSS Adverse Childhood Experiences (ACE) module was adapted from the original CDC-Kaiser ACE Study and is used to collect information on child abuse and neglect and household challenges. This module is optional for each state's use every year. Seventeen states (Alabama, Delaware, Florida, Indiana, Iowa, Michigan, Mississippi, Missouri, New Mexico, North Dakota, Pennsylvania, Rhode Island, South Carolina, Tennessee, Virginia, West Virginia, and Wisconsin) used the ACE module in 2019. ACEs are categorized into two groups on the BRFSS ACE module: abuse and household challenges.

Measures

Table 1 displays the ACE module which includes 11 questions and is reflected as follows in the BRFSS:

Table 1

ACE Module		
Question	Variable Name	Response Options
Household Challenges		

Table 1 Continued		
Question	Variable Name	Response Options
1. Did you live with anyone who was depressed, mentally ill, or suicidal?	ACEDEPRS	Yes, No, Don't know/Not sure, Refused, and Not asked or Missing
2. Did you live with anyone who was a problem drinker or alcoholic?	ACEDRINK	Yes, No, Don't know/Not sure, Refused, and Not asked or Missing
3. Did you live with anyone who used illegal street drugs or who abused prescription medications?	ACEDRUGS	Yes, No, Don't know/Not sure, Refused, and Not asked or Missing
4. Did you live with anyone who served time or was sentenced to serve time in a prison, jail, or other correctional facility?"	ACEPRISN	Yes, No, Don't know/ Not Sure, Refused, Not asked or Missing
5. Were your parents separated or divorced?	ACEDIVRC	Yes, No, Don't know/ Not Sure, Parents not married, Refused, Not asked or Missing
Abuse		
6. How often did your parents or adults in your home ever slap, hit, kick, punch or beat each other up?	ACEPUNCH	Never, One, More than once, Don't know/Not Sure, Refused, Not asked or Missing
7. Not including spanking, (before age 18), how often did a parent or adult in your home ever hit, beat, kick, or physically hurt you in any way? Was it—	ACEHURT1	Never, Once, More than Once, Don't know/Not Sure, Refused, Not asked or Missing
8. How often did a parent or adult in your home ever swear at you, insult you, or put you down?	ACESWEAR	Never, Once, More than once, Don't know/Not Sure, Refused, Not asked or Missing
9. How often did anyone at least 5 years older than you or an adult, ever touch you sexually?	ACETOUCH	Never, Once, More than once, Don't know/Not Sure, Refused, Not asked or Missing
10. How often did anyone at least 5 years older than you or an adult, try to make you touch them sexually?	ACETTHEM	Never, Once, More than once, Don't Know/Not Sure, Refused, Not asked or Missing
11. How often did anyone at least 5 years older than you or an adult, force you to have sex?	ACEHVSEX	Never, Once, More than once, Don't know/Not sure, Refused, Not asked or Missing

In the statistical models, ACE questions will be treated in two ways; (1) as a continuous variable of 0 through 11 via the creation of an index combining all ACEs together, and (2) as a

categorical dummy variable treating groups of ACEs as 0 ACEs, 1 ACE, 2-4 ACEs, and 5+ ACEs. These models will be representative of persons ages 18 through 35.

General health is measured with the variable GENHLTH in the BRFSS and is the dependent variable for this study. The question associated with this variable is, “Would you say that in general your health is:”. The response options are Excellent, Very good, Good, Fair, Poor, Don’t know/Not sure, Refused, and Not asked or Missing. The general health variable is reverse coded so that higher values indicate better health.

The control, or mediating variables, are age, sex, race, income, and education. Age is imputed age value collapsed above 80 and coded as @_age80. Age is restricted to 18 to 35 years in the analytic sample. For the sex variable, male is the reference group. A series of dummy variables is used to represent race, with non-Hispanic whites as the reference group. Race is coded as @_IMPRACE. The question associated with the variable is an imputed race/ethnicity value with response options as White (non-Hispanic), Black (non-Hispanic), Asian (non-Hispanic), American Indian/Alaskan Native (non-Hispanic), Hispanic, other race (non-Hispanic). Income is coded as @_INCOMG in the BRFSS with the following income categories: Less than \$15,000, \$15,000 to less than \$25,000, \$25,000 to less than \$35,000, \$35,000 to less than \$50,000, \$50,000 or more, and Don’t know/Not sure/Missing. The question for education level is “What is the highest grade of school you completed?”. The response options are Never Attended School or Only Kindergarten, Grades 1 through 8 (Elementary), Grades 9 through 11 (some high school), Grade 12 or GED (high school graduate), College 1 year to 3 years (some college or technical school), College 4 years or more (College graduate). This variable is coded as EDUCA.

Analytic Approach

The research questions being addressed are: 1) Is there an inverse relationship between ACEs and health outcomes? 2) Is the relationship between ACEs and health outcomes mediated by socioeconomic status? 3) Is there a certain number of ACEs a person experiences before exhibiting negative health outcomes? Figure 1 shows a visual representation of the theoretical relationship among the variables in this study.

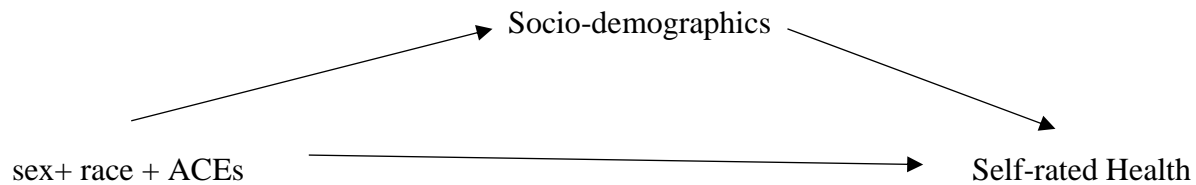


Figure 1. Illustration of Direct and Mediating Effects of Main Variables

Using OLS regression, I test research questions #1 and #2, the inverse effect of ACEs on self-rated health directly, and then test the relationship after controlling for age, sex, race, income, and education as confounding factors. To answer research question #3, I will test the full model on self-rated health, using Models 1 and 2 ACE (dummy) which will indicate the number of ACEs as a threshold through which poor health outcomes occur. The order of statistical models is as follows:

Model 1: $SRH = ACE \text{ (index)}$

Model 2: $SRH = ACE \text{ (index)} + \text{age}$

Model 3: $SRH = ACE \text{ (index)} + \text{sex}$

Model 4: $SRH = ACE \text{ (index)} + \text{income}$

Model 5: $SRH = ACE \text{ (index)} + \text{race}$

Model 6: $SRH = ACE \text{ (index)} + \text{education}$

Model 7: $SRH = ACE \text{ (index)} + \text{age} + \text{sex} + \text{income} + \text{race} + \text{education}$

Model 1: $SRH = ACE \text{ (dummy)}$

Model 2: SRH = ACE(dummy) + age + sex + income + race + education

RESULTS

The following regressions include unstandardized coefficients, standard errors, R-squared values, and significance levels ranging from $p < .05$ to $p < .001$. All analyses are reflective of individuals ages 18 through 35. For race, Non-Hispanic Whites are the reference group. Males are the reference group for sex.

Table 2. Demographic Information for ACE Module 2019

Demographic Information	Percent (N=74,211)
Age (years)	
18-20	13.7
21-23	15
24-26	15.9
27-29	17.4
30-32	18.5
33-35	19.6
Sex	
Male	51.8
Female	48.2
Income	
Less than \$15,000	7.8
\$15,000 to less than \$25,000	13.8
\$25,000 to less than \$35,000	8.8
\$35,000 to less than \$50,000	12.1
\$50,000 or more	38.4
Race	
White (non-Hispanic)	62.5
Black (non-Hispanic)	8.6
Asian (non-Hispanic)	4.6
American Indian/Alaskan Native (non-Hispanic)	1.8
Hispanic	17.2
Other race (non-Hispanic)	5.3
Education Level	
Never Attended or K-only	0.1
Grades 1-8 (Elementary only)	1.8
Grades 9-11 (Some high school)	5.0
Grade 12 or GED (High school graduate)	29.5
1-3 years college (Some college or Tech school)	30.7
4 or more years college (College graduate)	32.7

Table 3. ACE Score Frequency Table

Number of Adverse Childhood Experiences (ACE Score)	Percent (N=74,211)
0	26.6%
1-2	35.2%
3-4	17.8%
5+	20.5%

Experiencing ACEs negatively affects health, according to Model 1 in Table 4, and answers research question 1. That is, the direct relationship between ACEs and self-rated health is significant and negative (-.075). When adding age, sex and income into the equation in Models 2 through 4, ACEs continue to be a significant negative predictor of health. As expected, age is significant negative predictor of self-rated health (-.011), and income is a significant positive predictor (.016). After introducing race in Model 5, with white non-Hispanics as the reference category, all races with the exception of Asians report worse self-rated health compared to whites. Consistent with all previous models, the significance of ACEs on self-rated health remains (-.075). In Model 7, education is positively associated with self-rated health (.139), meaning that the higher educated respondents report better health. At last, in the full model including all socioeconomic variables simultaneously, the relationship between ACEs and self-rated health is attenuated but remains significantly negative (-.065), answering research question #2.

Table 4. Regression Coefficients for Health and ACEs by Control Variables

	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>	<u>Model 4</u>	<u>Model 5</u>	<u>Model 6</u>	<u>Model 7</u>
ACE Index	-.075*** (.003)	-.075*** (.003)	-.075*** (.003)	-.074*** (.003)	-.075*** (.003)	-.067*** (.003)	-.065*** (.003)
Age		-.011*** (.001)					-.016*** (.001)
Female			-.024 (.015)				-.035** (.015)
Income				.016*** (.003)			.007** (.003)

Table 4 (Continued)	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>	<u>Model 4</u>	<u>Model 5</u>	<u>Model 6</u>	<u>Model 7</u>
Race							
<i>Black, Non-Hispanic</i>					-.103*** (.024)		-.063** (.024)
<i>Asian, Non-Hispanic</i>					-.065 (.048)		-.130** (.048)
<i>American Indian/Alaskan Native, Non-Hispanic</i>					-.143** (.064)		-.063 (.064)
<i>Hispanic</i>					-.184*** (.023)		-.110*** (.024)
<i>Other race, Non-Hispanic</i>					-.074* (.040)		-.066* (.040)
Education						.139*** (.008)	.151*** (.008)
R-square	.042	.045	.042	.043	.046	.062	.073

Note: *p <.05; **p <.01; ***p <.001

Table 5 contains ACEs as a categorical dummy variable to answer the question of whether or not there is a threshold of ACE exposure where it begins to negatively affect health. ACE 1 represents having one ACE experience, ACE 2 having 2 to 4 ACE experiences, and ACE 3 having 5 or more ACE experiences. The reference group is ACEZero, not having an ACE experience. In Model 1, all ACEs categories are significant at the .001 level. However, health does not begin to significantly decline until one has experienced 2 to 4 ACEs. Model 2 reflects the ACE dummy variable with all control variables included. All variables are significant at the .001 level with health beginning to decline between experiencing 2 to 4 ACEs, remaining consistent from model 1 and answering research question #3.

Table 5. Regression Coefficients for ACEs as a Categorical Dummy Variable

	<u>Model 1</u>	<u>Model 2</u>
ACE 1	.094*** (.017)	.080*** (.017)
ACE 2	-.100*** (.015)	-.106*** (.014)

Table 5 (Continued)	Model 1	Model 2
ACE 3	-.309*** (.018)	-.253*** (.018)
Age		-.014*** (.001)
Female		-.079*** (.007)
Income		.013*** (.001)
Race		
<i>Black, Non-Hispanic</i>		-.043*** (.013)
<i>Asian, Non-Hispanic</i>		-.056*** (.017)
<i>American Indian/Alaskan Native, Non-Hispanic</i>		-.191*** (.027)
<i>Hispanic</i>		-.095*** (.010)
<i>Other race, Non-Hispanic</i>		-.126*** (.016)
Education		.167*** (.004)
R-Square	.005	.045

Note: *p <.05; **p <.01; ***p <.001

DISCUSSION

This study examines the relationship between self-rated health and ACEs. Previous research focused on individuals who are well into adulthood and could possibly have insufficient retrospective recall on past life experiences. The focus of this study is on individuals ages 18 through 35 for two reasons: 1) the transitional phase from adolescence into young adulthood is a critical time of transition, and 2) the self-reporting of health and childhood experiences are more accurate around the time of occurrence. Another important aspect of this study is being able to determine how many ACEs must be experienced before a decline in health begins. Previous research reports more ACE experiences are detrimental to health, but it is unclear at what level this occurs. However, it has been determined that females are more likely to get HIV if they

experience 3 or more ACEs whereas males only need one (Fang et al., 2016), but for general health, it is unknown if these thresholds apply.

The approach here is to investigate if the impact of ACEs on general health is reduced or removed after accounting for other proven socioeconomic predictors of health. Subramaniam et al. (2020) discuss the cumulative risk hypothesis and how the accrual of risk factors in addition to ACE experiences increases the potential of adverse outcomes. This is an important theoretical orientation for this research because ACEs often do not happen at this particular cross-section of time for young adults, but have most likely accumulated throughout their early childhood, childhood, and adolescence, and are now manifest into young adulthood.

This study contributes to the field of sociology addressing race, social class, inequality, and how social structures affect poverty. Income and education are foundational when considering primary risk factors such as food, shelter, ability to pay bills, and maintaining employment. Childhood maltreatment is the catalyst to disruptions of brain development leading to learning delays and school dropouts consequentially resulting in reduced opportunities for employment and less income (Monnat and Chandler 2015). Race is critical, as well, being that, historically, people of color continuously experience inequality and marginalization. Further, how does one's sex affect health outcomes when combined with these other variables? Cavanaugh, Petras, and Martins (2015) indicate men and women react to stressors differently leading to different health outcomes. Interestingly, however, sex is the only predictor in my models that is not a significant determinant of self-rated health, at least when modeled directly (Model 3).

Biological processes that occur during sensitive stages of development in conjunction with snowballing exposures to adversity can magnify the association of any risk factor with

another (Halfon et.al. 2017). Chronic toxic stress experienced in early childhood is shown to be linked to physiologic disturbances causing chronic health complications in individuals who suffer from ACEs (Kerker et. al. 2015). Mental health outcomes in early adulthood that stem from ACEs act as pathways to long-term physical and mental comorbidities, which range from anxiety and depression to suicidal tendencies (Mersky et al. 2013). Thus, ACEs greatly impact internal processes as well as external determinants in life.

Table 4 confirms previous studies and addresses research questions 1 and 2 with statistical significance. ACEs, alone, negatively affect health. Consequentially, if other risk factors are present, health outcomes and behaviors continue to significantly affect health. Table 5 states ACEs begin to negatively impact health when there have been 2 to 4 experiences. Further investigation via a sensitivity analysis reveals the number of ACEs where health decline begins is with 3 experiences. This finding is a unique contribution to the current literature and answers the third and most important question of this study.

Limitations

This study is not without limitations. The research is not nationally representative as the BRFSS ACE module is optional for each state. Only 17 of the 50 states chose to include this survey for 2019. ACEs are measured equally eliminating the significance of each ACE experience as some experiences such as sexual assault might be more impactful than living with someone who has been imprisoned on the individual. The income variable skews low due to the age of respondents and their education as some are just graduating high school. Although there is a wealth of information on ACE experiences and outcomes, this study lacks in providing protective factors to intervene or prevent adverse outcomes.

CONCLUSION

The effects of ACEs are capturing the attention of many fields of study being that the outcomes vary vastly. This study reiterates the findings of previous studies and contributes new findings that are of particular importance to all fields of study. With every ACE experience, health is adversely affected under all circumstances particularly after the third occurrence no matter age, sex, income, race, or education. The outcomes may differ as coping mechanisms and strategies are different for each individual. Yet, the effects of ACEs results in negative outcomes in the absence of protective factors. Furthermore, poor health in young adults is a great find considering youth do not typically report negatively about their health.

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