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Examining the Relationship between Adverse Childhood Experiences (ACEs) and Health-Risk Behaviors Among Adolescents in New Hampshire

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Undergraduate Honors Thesis

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May 2020

Abstract

Adverse Childhood Experiences (ACEs) are traumatic instances in the first 18 years of life including abuse, neglect, and household dysfunction or challenges. The Centers for Disease Control and Prevention (CDC) has outlined priority health-risk behaviors among adolescents as substance use, violent behaviors, unhealthy diet, physical inactivity, and unsafe sexual behaviors. Previous research has linked both ACEs and health-risk behaviors to negative health outcomes including disability, chronic disease, and substance use. That said, understanding and preventing risky behaviors among adolescents and working to reduce the lasting harm caused by ACEs can lead to healthier adults and communities going forward.

This research defines ACEs and adolescent health-risk behaviors using the New Hampshire 2015 Youth Risk Behavior Survey (YRBS) and examines the relationship between the two variables using SAS software. With SAS, adjusted odds ratios (aORs) and 95% confidence intervals (CIs) were estimated using binary logistic regression models while adjusting for covariates such as demographic information. The results showed positive associations between the engagement of health-risk behaviors and ACEs, food insecurity, grade-level, and the lack of at least one trusted adult for social support. The major finding was that for every incremental increase in ACE score, respondents were 1.71 times as likely to engage in health-risk behaviors. Furthermore, all these variables were statistically significant.

This research emphasizes the importance of awareness and public health interventions aimed at children and families that mitigate the impact of ACEs and prevent the onset of risky behavior choices to buffer against future health issues and social problems in adulthood.

Background

Health-Risk Behaviors in Adolescents

The CDC has identified six priority health-risk behaviors in adolescents which contribute to the leading causes of death and disability among American youth, and social problems throughout the country (Kentucky Cabinet for Health and Family Services [KY CHFS), 2010). For example, motor vehicle crashes, especially when caused by alcohol impairment, suicide, and increased rates of cardiovascular disease among persons aged 25 years or younger (Kann et al., 2016). The six priority health-risk behaviors related to these outcomes are as follows:

1. Alcohol and other drug use
2. Behaviors that contribute to unintentional injuries and violence (including suicide)
3. Tobacco use
4. Unhealthy dietary behaviors
5. Physical inactivity
6. Sexual behaviors that contribute to unintended teen pregnancy and sexually transmitted infections, including HIV

The behaviors outlined above are frequently “interrelated and are established during childhood and adolescence [often extending] into adulthood” (Kann et al., 2016). Results from the 2015 YRBS indicated that engagement in these priority behaviors is widespread among high-school students, which emphasizes the increased risk of morbidity and mortality that many American adolescents face. Furthermore, the risk of engaging in these behaviors is not equal among all adolescents. For example, research has asserted that having a chronic condition carries additional risks for engaging in health risk behaviors (Surís et al., 2008). One extremely strong risk-factor

for health-risk behaviors is prior out-of-home placement in the foster care system; almost 75% of teenagers in this category self-reported at least one health-risk behavior (Heneghan et al., 2015).

Adverse Childhood Experiences (ACEs)

The first study on ACEs was conducted by the CDC and Kaiser Permanente from 1995 to 1997 in Southern California. The retrospective study surveyed over 17,000 members of a Health Maintenance Organization, asking questions about childhood trauma and current health behaviors and status. They defined ACEs as traumatic instances in the first 18 years of life and broke them into three categories including abuse, neglect, and household dysfunction or challenges. For example, having a parent in prison or being sexually abused. The original ACE study found a “strong graded relationship between the breadth of exposure to abuse or household dysfunction during childhood and multiple risk factors for several of the leading causes of death in adults” including chronic disease and behaviors that increase the risk of future health complications (Felitti et al., 1998). Since the original ACE study was published, many researchers have examined ACEs further, not only recreating the outcomes found in 1998 but expanding upon ACEs by researching other effects associated with them. For example, beyond health outcomes, ACEs have also been associated with higher out-of-pocket healthcare costs, which inevitably lead to increased economic hardship (Schickedanz et al., 2019).

While numerous independent researchers have worked to track ACE prevalence, there have also been governmental efforts to do so on a national scale. For example, in 2009 the CDC began offering an ACE module that states can include in their Behavioral Risk Factor Surveillance System (BRFSS) questionnaire (Figure 1). The module consists of 11 questions, which correlate with the three ACE categories defined in the original ACE study. In 2009, six states included the

module in their BRFSS surveying. As of 2018, 42 states and Washington D.C have utilized the module at least once; the remaining states include Alabama, Delaware, Massachusetts, Mississippi, Missouri, North Dakota, Rhode Island, and Wyoming. Nationally, nearly two-thirds of surveyed adults report at least one ACE, and over a quarter of respondents report three or more ACEs. (Centers for Disease Control and Prevention [CDC], 2020). According to the 2016 National Survey of Children's Health (NSCH) 45% of children from birth through age 17 have experienced at least one ACE, as reported by a parent or guardian. Furthermore, one in ten children nationally has experienced three or more ACEs, qualifying them as especially high-risk. In all 50 states, economic hardship and divorce or separation from a parent or guardian are the most commonly reported ACEs (Sacks & Murphey, 2018).

In New Hampshire specifically, 49.5% of adults surveyed reported at least one ACE. Responses ranged from about one in every five persons (21.5%) reporting one ACE, to about one in every ten persons (10.2%) reporting four to seven ACEs. Furthermore, there was an association between self-reported health status and ACE exposure; 64% of respondents who reported their health status as "fair or poor" also reported ACE exposure, while only 47% of respondents who reported "excellent" health status reported ACE exposure (New Hampshire Department of Health and Human Services [NH DHHS], 2018).

The relationship between ACEs and Risk-Behaviors

Previous research has linked both ACEs and health-risk behaviors to lifelong challenges including disability, mental health issues, increased risk of violence and victimization, substance misuse, and even death as a result of the previously mentioned factors. Furthermore, research has

linked ACEs and health-risk behaviors to each other. In adults, an ACE score over 4 was associated with increased odds for health-risk behaviors such as binge drinking, heavy drinking, smoking, risky HIV behavior, and negative health outcomes including diabetes, myocardial infarction, coronary heart disease, stroke, depression, disability, and use of special equipment because of disability (Campbell et al., 2016). For behaviors such as smoking and heavy drinking, ACE scores have been found to have strong, dose-response relationships in adults (Dube et al., 2006; Salawu & Owoaje, 2013).

More recently, the relationship between ACEs and health-risk behaviors has been studied in adolescents specifically. Many studies focusing on adolescents are conducted retrospectively, by interviewing adults about their past experiences, but some utilize data from sources like the YRBS to learn about these associations as they form. In one retrospective study, ACEs were found to be strongly related to alcohol initiation in early and mid-adolescence, and the relationship between the two variables was found to be graded, meaning that for every ACE a respondent was exposed to, the odds they began drinking alcohol in early or mid-adolescence increased. (Dube et al., 2016). Additionally, there has been substantial research surrounding youth violence, since homicide and suicide remain two of the leading causes of death for Americans aged 10-24 years (Kann et al., 2016). One study found that ACEs including child abuse and neglect, and exposure to violence in the home and community increase the risk of adolescents perpetrating violence themselves (David-Ferdon et al., 2016). In general, these positive associations seem to be “largely driven by the co-existence of major stressful events in youths’ lives, namely household dysfunction and substance use” (Mitchell et al., 2018).

Overall, ACEs and health-risk behaviors have both been independently tied to negative health outcomes and social problems in the United States. Additionally, the two variables have a strong,

graded relationship with one another, which only emphasizes the risks associated with exposure to either. That said, understanding and preventing risky behaviors among adolescents and working to mitigate the lasting harm caused by ACEs can lead to healthier adults and communities going forward.

Objectives

The main objective of this research is to examine the relationship between ACEs and health-risk behaviors among New Hampshire (NH) adolescents by utilizing the 2015 NH Youth Risk-Behavior Survey (YRBS) data. I hypothesize that there will be a strong positive correlation between respondents' ACE scores and health-risk behavior scores. To accurately test this hypothesis, I first had to define ACEs and health-risk behaviors using the NH YRBS questionnaire from 2015.

Methods

Youth Risk-Behavior Surveillance System

As mentioned by my research objectives, I utilized the 2015 New Hampshire Youth Risk-Behavior Survey (YRBS) data for my research. The national Youth Risk-Behavior Surveillance System (YRBSS) was developed by the CDC in 1990, six years after the development of the national Behavioral Risk Factor Surveillance System (BRFSS) with a special focus on adolescents. Like the BRFSS, The YRBSS' focus is to monitor health behaviors that significantly contribute to the leading causes of death, disability, and social issues in the United States. The YRBSS covers national, state, territorial, tribal, and local levels through school-based surveys of 9th through 12th-grade students across the United States. The national YRBS is conducted every two years during schools' spring semester. The output data is considered representative of 9th through 12th-grade students in both private and public schools nationwide (CDC, 2018).

The YRBSS focuses on six priority categories of health behaviors among adolescents, as defined by the Centers for Disease Control and Prevention. Furthermore, more recent YRBSS surveys have included questions about the prevalence of obesity, asthma, and other priority health behaviors as identified (Kann et al., 2016).

Since YRBS data is published by the CDC, I was able to download the New Hampshire 2015 data necessary for my research and convert it into a SAS v.9.4 dataset for use. YRBS data has been widely used in academic literature, especially when examining the relationship between specific health-risk behaviors and varied health outcomes (Knight, 2019). New Hampshire

YRBS data is regarded as valid and reliable, with consistent findings to similar surveys (NH DHHS, n.d.).

Dependent Variable: Health-Risk Behavior Score

After securing the YRBS dataset, I built my dependent variable, called “Behave”, which measures the prevalence of selected health-risk behaviors among NH high school students. To do so I examined the entire NH 2015 YRBS questionnaire and extracted questions that align with the six priority behaviors defined by the CDC. In the end, I chose nine questions, which are listed below:

1. During the past 12 months, how many times were you in a physical fight in which you were injured and had to be treated by a doctor or nurse?
2. During the past 30 days, on how many days did you smoke cigarettes?
3. During the past 30 days, on how many days did you use an electronic vapor product?
4. During the past 30 days, on how many days did you have at least one drink of alcohol?
5. During the past 30 days, how many times did you use marijuana?
6. During your life, how many times have you taken a prescription drug (such as OxyContin, Percocet, Vicodin, codeine, Adderall, Ritalin, or Xanax) without a doctor’s prescription?
7. The last time you had sexual intercourse, did you or your partner use a condom?
8. During the past 7 days, how many times did you drink a can, bottle, or glass of soda or pop, such as Coke, Pepsi, or Sprite?

9. During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?

Most of my selected questions directly align with the CDC-defined priority risk behaviors for American adolescents. For example, the first listed question aligns with unintentional injuries and violence, the second and third with tobacco use, the fourth, fifth and sixth with alcohol and other drug use, the seventh with sexual behaviors related to unintended pregnancy and sexually transmitted infections (STIs), the eighth with unhealthy dietary behaviors and the ninth with physical inactivity. While I would have preferred a food-specific question for the unhealthy dietary behaviors' category, the soda question was the best match included in the YRBS questionnaire. Moreover, intake of sugar-sweetened beverages, including soda, is known to correlate with Americans' overall nutrition habits, and intake is regularly monitored by the CDC (Miller, 2017). Even though not all electronic vapor products contain tobacco, I chose to include question 3 in my independent variable since electronic cigarettes were the most commonly cited tobacco product used by American high school students last year, and their distribution is central to current public health policy issues (U.S Food and Drug Administration 2020; Wang, 2019).

Once I determined the YRBS questions I wanted to use, I re-coded them using JMP statistical software. For each of the 9 questions, I coded any prevalence of the unhealthy behavior as "1", and the absence of the same behavior as "0". For questions 1-6 any reported behavior, no matter the amount, was assigned a "1" while no use was given a "0". For question 7, both abstinence and condom-use were assigned a "0", while intercourse without condom use was assigned a "1". For question 8, I assigned a "1" to any respondents who reported daily soda intake, and a "0" to any respondents who reported less than daily intake. Although there is not a government recommendation for soda consumption in the United States, I defined the risky-behavior as daily

consumption because the Dietary Guidelines for Americans 2015–2020 recommend that U.S. residents “reduce sugar-sweetened beverage and sweet consumption to reduce intake of added sugars to less than 10% of calories per day” (Miller, 2017). Since the United States government does have a published guideline for physical activity, I used that in determining my scores for question 9. So, any respondent who reported 60 minutes of physical activity daily received a “0”, while respondents that did not were assigned a “1” (U.S. Department of Health and Human Services, 2018). My final Behave variable was a summation of the nine recoded questions, meaning outputs ranged from 0-9, where a score of “3” would mean a respondent performed three of the risky health behaviors described above. Lastly, I created a binary version of the Behave variable where respondents who engaged in two or less of the studied behaviors were assigned a “0” and respondents who engaged in three or more of the nine behaviors were assigned a “1”.

Independent Variable: ACE Score

The dependent variable in my research was the ACE measurement. The ACE score was formulated similarly to the Behave score, but in this case, I only used eight YRBS questions. The eight questions used to determine the ACE score are as follows:

1. Have you ever been physically forced to have sexual intercourse when you did not want to?
2. During the past 12 months, how many times did someone you were dating or going out with physically hurt you on purpose?
3. During the past 12 months, how many times did someone you were dating or going out with force you to do sexual things that you did not want to do?

4. During the past 12 months, have you ever been bullied on school property?
5. During the past 12 months, have you ever been electronically bullied?
6. Have you ever lived with anyone who had a problem with alcohol or drugs?
7. During the past 12 months, have either of your parents or other adults in your family been in jail or in prison?
8. Have you ever seen or heard adults in your home slap, hit, kick, punch or hurt each other?

The ACE components were re-coded in SAS software, using the same process as the Behave questions, where exposure to any of the experiences listed above resulted in a “1” and lack of exposure was assigned a “0”. The same sum equation was used with these eight questions to form the final ACE score variable used in my statistical analysis.

Statistical Analysis

All my analysis was conducted using SAS software. For my analysis, I used the binary version of the Behave variable, where “0” is no risky behavior engagement and “1” is any. Since I was looking to explain the relationship between one dependent binary variable, Behave, and one or more nominal, ordinal, interval, or ratio-level independent variables, I used binary logistic regression. Moreover, as shown in Figure 2, the distribution of the Behave variable was not normal, thus ruling out linear regression. Using logistic regression, I estimated adjusted odds ratios (aORs) and 95% confidence intervals (CIs). An odds ratio is a measure of association between two variables, one being exposure and the other an outcome. An odds ratio greater than 1 is a positive association, meaning the odds of the given outcome is stronger with the exposure. Whereas an odds ratio less than 1 is a negative association, meaning the odds of the given outcome are weaker with the exposure. Overall, aORs represent the constant effect of the

independent variable on the dependent variable, and the confidence interval assesses the significance of those findings. So, in this case, these models helped me evaluate associations between health-risk behavior scores and ACE scores.

Covariates

In addition to examining the effects of ACEs on adolescents' risky behavior choices, I adjusted for covariates by using other YRBS questions as additional independent variables in my models.

The additional questions I included are listed below:

1. What is your sex?
2. In what grade are you?
3. Are you Hispanic or Latino?
4. How often did you go hungry because there was not enough food in your home?
5. During the past 12 months, have you talked with at least one of your parents about the dangers of tobacco, alcohol, or drug use?

All five of these questions were coded using a "0", "1" binary for analysis. I included food security as a covariate due to past research that has observed "strong, graded, statistically significant associations between ACE score and severity of household food security" (Sun et al., 2016). I hypothesize that food insecurity will also have a positive relationship with risky behavior engagement.

Results

A total of 11,064 participants responded to the 2015 NH YRBS. The mean age of respondents was 15.96 years. Females constituted 49.13% of respondents. 89.81% of respondents reported partaking in at least one of the health-risk behaviors examined in my analysis. However, the 25% quartile and median scores among the NH high school students surveyed were only 1, whereas the 75% quartile is 3 (Figure 2). Among respondents who received a score of 1 for the Behave Binary variable, the least commonly reported behaviors were fighting which resulted in medical care (11%) and daily soda intake (25%). On the contrary, the most commonly reported risk behaviors among the same group of respondents were less than 60 minutes of physical activity per day (82%) and alcohol-consumption (78%) (Figure 3). Regarding ACEs, 54.57% of respondents reported experiencing at least 1 of the 8 adversities examined in my analysis. For the ACE score, the 25% quartile among the NH high school students surveyed is 0, the median 1, and the 75% quartile 2 (Figure 4). 16.74% of respondents reported at least three ACEs, defining them as especially high-risk.

The odds ratio outputs are displayed in Figures 5 and 6. I found an aOR point estimate of 1.71 for the ACE score, meaning that for every incremental increase in the ACE score, the odds of respondents performing risky behaviors are 1.71 times the odds of risky behaviors with no ACE exposure. The precise confidence limits displayed in Figure 6 further demonstrate the strength of the association. Based on the outputs displayed in Figure 5, engagement in health-risk behaviors are positively associated with ACEs, food insecurity, grade-level, and the lack of at least one trusted adult for social support. Furthermore, all these variables were statistically significant ($\alpha=0.05$).

Discussion

Significance of the Observed Associations

Overall, research supports the fact that there is a strong relationship between ACEs and health-risk behaviors among adults and adolescents, not only in New Hampshire but in the United States in general. Additionally, prior researchers have explored some of the underlying reasons for this association. For example, one study confirmed the finding that children with ACEs may initiate drinking earlier than their peers, but they also found that they may be more likely to drink to cope with problems, rather than for pleasure or to be social (Rothman et al., 2008). While it may seem obvious, this is an important distinction. ACEs can lead to life-long trauma, and risky behaviors are a dangerous coping mechanism, especially when life-long habits are often formed during adolescence. Problem Behavior Theory suggests that adolescents who engage in a socially defined problem behavior are more likely to engage in other behaviors of concern, which helps explain the compounding risks examined in many datasets (Clayton et al., 2019). For example, a 2013 study found that weapon carrying, suicide attempts and binge drinking were all statistically significant risk factors associated with frequent fighting among adolescents (Swahn et al., 2013). Since research has found associations between the different risk behaviors, the risk for children engaging in these behaviors to cope with ACEs is further intensified.

Associated Risk and Protective Factors

According to my findings, multiple factors affect the way the relationship between ACEs and risky behavior choices presents in NH adolescents. The findings associated with demographic and socioeconomic factors were expected based on past research and the implications of racial,

economic, and health disparities in the United States. National ACE research funded by the Annie E. Casey Foundation found the following:

Disturbingly, black and Hispanic children in almost all regions of the United States are more likely to experience ACEs than their white and Asian peers. To some extent, these racial disparities reflect the lasting effects of inequitable policies, practices, and social norms. Discriminatory housing and employment policies, bias in law enforcement and sentencing decisions, and immigration policies have concentrated disadvantage among black and Hispanic children and leave them disproportionately vulnerable to traumatic experiences like ACEs. (Sacks & Murphey, 2018).

Additionally, the association between engagement in health-risk behaviors and age has been consistently observed in existing research. In one study examining risky behavior choices independent of ACEs, it has been found that unhealthy behavior clustering (≥ 2 unhealthy behaviors) increased 7.7% from the 12-15 years age group to the 16-19 years age group (Mayne et al., 2020). The association between risky behavior and age is fortified when ACEs are considered. In a study including American teenagers in foster care, Heneghan et al. (2015) found that significantly more teens in the 15–17.5 year-old group report engagement in risky behaviors (81.2%) than their 12-14 year-old counterparts (54.4%). In another study examining drinking habits among teenagers, the total number of ACEs had a “very strong graded relationship to initiating alcohol use during early adolescence and a robust but somewhat less strong relationship to initiation during mid-adolescence” (Dube et al., 2006). Overall, numerous risk factors are associated with both ACEs and risky behavior engagement among adolescents, and understanding their effects can be monumental in both the mitigation and prevention of negative health outcomes.

The main protective factor examined in this research was adolescents' likelihood of having and confiding in a trusted adult in times of emotional distress. Like the risk factors discussed above, this protective factor is also supported by previous research. One study found that "positive and warm parent-youth relationships... are associated with healthy child and adolescent development and the prevention of violent behavior" (David-Ferdon et al., 2016). Furthermore, research has identified a positive and supportive relationship with at least one adult of "primary importance" in "preventing the negative effects of ACEs", which can include engaging in harmful coping mechanisms such as the risky behaviors discussed in this paper (Sacks & Murphey, 2018).

Further Research

Despite the consistency of the findings discussed throughout this paper, there is still room for improvement in these research areas. For one, this paper focused on ACEs as a cumulative score rather than examining the effect of specific ACE categories on the likelihood of adolescents engaging in risky behaviors. Previous research has already found that individual ACE components do have different effects on risky behavior and comorbidities (Campbell et al., 2016). For example, the independent effects of physical abuse and sexual abuse were stronger than the effects of family violence among respondents of the 2012 Canadian Community Health Survey (Wiens et al., 2020). Overall, these findings highlight an opportunity to expand upon the findings discussed in this paper.

Another important limitation of this research is the fact that both the Behave score and the ACE score were defined using a "never or ever" binary in re-coding and variable creation. With this method, it is assumed that any level of exposure to ACEs and any level of engagement in risky behavior is made equal, which is likely false. To strengthen this research, a natural progression

would be creating 3-level or multi-level variables where there is a distinction between low and high levels of ACE exposure, and risky behavior engagement. More sophisticated models using Poisson distributions could also be run, but were beyond the scope of this project.

Policy Implications

Given the information presented in this paper, there are many opportunities for policy and program development to help buffer against the negative effects of health-risk behaviors and help mitigate the effects of ACEs that may lead to the initiation of such behaviors in adolescents. First, there is an immediate need to develop and implement a consistent tool for the screening of ACEs in children and adolescents in pediatric and family practice settings. Specifically, there is a need to distinguish between ACE assessment and identifying current family psychosocial risks and child abuse. Generally, assessment of ACEs is “most effective when addressed in the larger context of history-taking and health promotion conversations to proactively promote positive health and resilience for children and families” (Bethell et al., 2017). Until there is a clear and consistent process implemented on local, state, and even national levels, there will always be discrepancies in the understanding, measuring, and therefore, treatment and prevention of ACEs. However, further research is required to adequately guide the routine use of ACE screening in a pediatric clinical setting “because previous research has focused more on adult populations and population-based assessment and research” (Bethell et al., 2017).

Considering the compounding risks associated with health-risk behaviors, programs must simultaneously address multiple risk factors to be most effective (Haye et al., 2014). Another important consideration in the development of preventative programs is the intergenerational effects of ACEs. According to past research, there is preliminary evidence that ACEs’ negative

effects can be transmitted from one generation to the next (Buss et al., 2017). According to one study, “infants born to women who experienced four or more ACEs were two to five times more likely to have poor physical and emotional health outcomes by 18 months of age” (Currie et al., 2020). Therefore, preventative efforts must utilize a public-health approach by using “intervention models that are explicitly two-generational: focusing simultaneously on the needs of adults (particularly parents) and children who have been exposed (or who are at risk of exposure) to ACEs” (Sacks & Murphey, 2018). Furthermore, program developers need to focus on the root causes of risky behavior habits among adolescents by channeling efforts towards the prevention of ACEs and other sources of trauma, while building resilience and promoting healthy coping mechanisms (Hughes et al., 2017). Fortunately, New Hampshire already has some policies in place that align with these recommendations. For example, in 2015 NH lawmakers tasked the state’s Wellness and Primary Prevention Council to establish a system of family resource centers to provide parental education and support for children from birth to age 5 (National Conference of State Legislatures, 2018). Additionally, the city of Manchester and an organization called Amoskeag Health have developed an Adverse Childhood Experiences Response team (ACERT) to address the needs of their community. The team is described below:

[ACERT is] made up of a police officer, a crisis services advocate, and a behavioral health professional. The team has been trained to respond to incidents as soon as the scenes have been secured by the police. The team will assess the situation and determine the next steps that could be taken for the child such as support groups, mental health counseling, early childhood education, or child-parent psychotherapy (Amoskeag Health, 2019).

The ability of such programs to mitigate the trauma associated with ACEs, thus preventing the onset of health-risk behaviors in adolescents, can be evaluated by utilizing data publications and continuing to support research surrounding these topics.

Conclusions

The relationship between ACEs, health-risk behaviors, and negative health outcomes in adults has been well-studied in adults. More recent research, including mine, have proven that these relationships begin forming much earlier, often by mid-adolescence. Engagement in health-risk behaviors among New Hampshire high schoolers is common and can lead to dangerous habits that contribute to some of the leading causes of death and disability in the country. According to my research using 2015 YRBSS data from NH, ACEs, class, ethnicity, and food insecurity all emerged as significant risk factors for the occurrence of risky health behaviors. Overall, these associations are alarming due to the negative health outcomes and social problems associated with these variables, which often span generations.

This research emphasizes the importance of awareness and public health interventions aimed at children that mitigate the impact of ACEs and prevent the onset of risky behavior choices to buffer against future health issues and social problems in adulthood. Ideally, I would advocate for a world where pediatricians, parents, and teachers are aware of associations like those I examined and are actively working to help build resilience in adolescents who are quickly approaching independence in adulthood.

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Appendix

Figure 1. BRFSS A Module

BRFSS Adverse Childhood Experience (ACE) Module

Prologue: I'd like to ask you some questions about events that happened during your childhood. This information will allow us to better understand problems that may occur early in life, and may help others in the future. This is a sensitive topic and some people may feel uncomfortable with these questions. At the end of this section, I will give you a phone number for an organization that can provide information and referral for these issues. Please keep in mind that you can ask me to skip any question you do not want to answer. All questions refer to the time period before you were 18 years of age. Now, looking back before you were 18 years of age---

- 1) Did you live with anyone who was depressed, mentally ill, or suicidal?
- 2) Did you live with anyone who was a problem drinker or alcoholic?
- 3) Did you live with anyone who used illegal street drugs or who abused prescription medications?
- 4) Did you live with anyone who served time or was sentenced to serve time in a prison, jail, or other correctional facility?
- 5) Were your parents separated or divorced?
- 6) How often did your parents or adults in your home ever slap, hit, kick, punch or beat each other up?
- 7) 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—
- 8) How often did a parent or adult in your home ever swear at you, insult you, or put you down?
- 9) How often did anyone at least 5 years older than you or an adult, ever touch you sexually?
- 10) How often did anyone at least 5 years older than you or an adult, try to make you touch sexually?
- 11) How often did anyone at least 5 years older than you or an adult, force you to have sex?

Response Options

<u>Questions 1-4</u>	<u>Question 5</u>	<u>Questions 6-11</u>
1=Yes	1=Yes	1=Never
2=No	2=No	2=Once
7=DK/NS	8=Parents not married	3=More than once
9=Refused	7=DK/NS	7=DK/NS
	9=Refused	9=Refused

Figure 2. Behave Variable Distribution

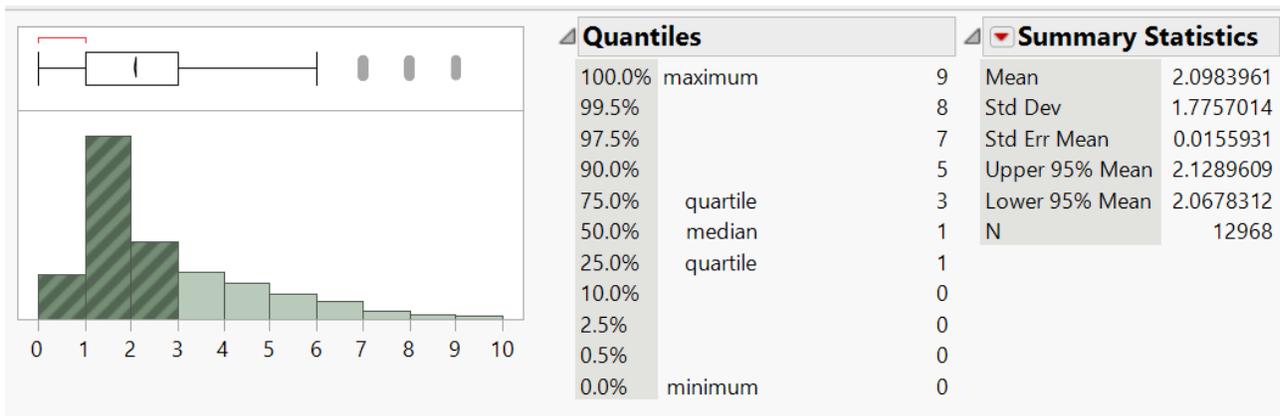


Figure 3. Distributions of Behave Components, Behave Binary=1

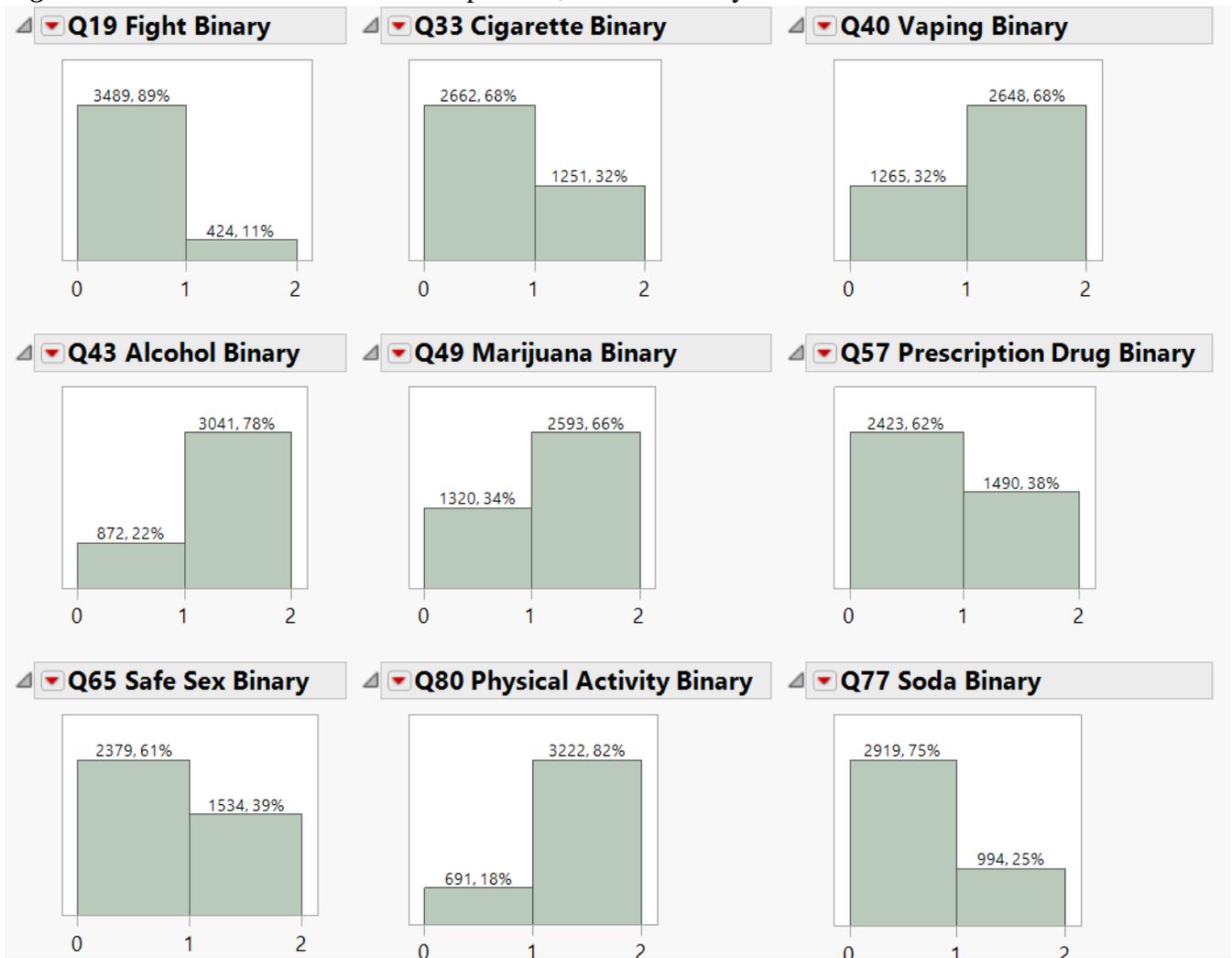


Figure 4. ACE Variable Distribution

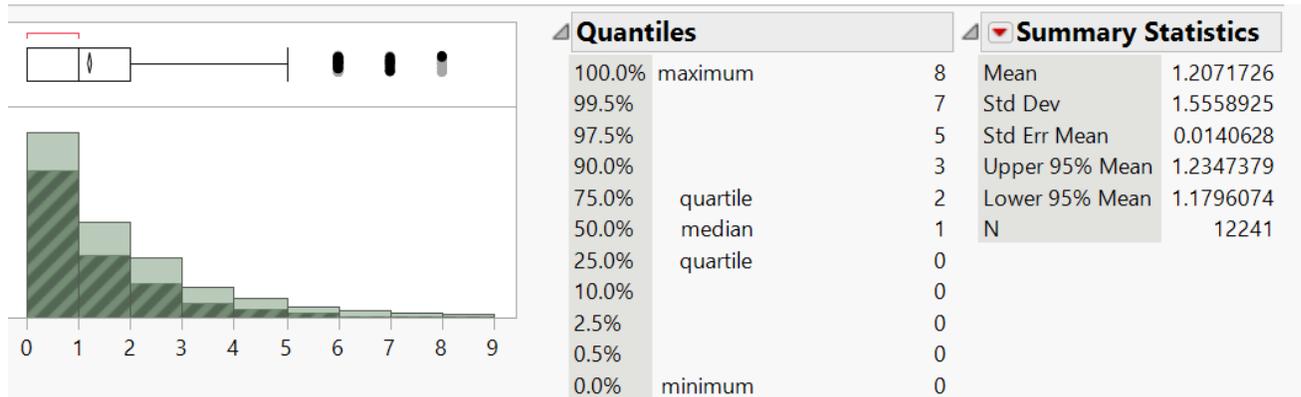


Figure 5. Odds Ratio Summary for Behave Variable and Covariates

Odds Ratio Estimates			
Effect	Point Estimate	95% Wald Confidence Limits	
ACE Score	1.710	1.654	1.767
Sex	0.745	0.679	0.817
Grade	1.669	1.599	1.741
Hispanic	1.190	0.975	1.452
Food insecurity binary	1.282	1.151	1.426
No adult support	1.204	1.100	1.317

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	74.5	Somers' D	0.498
Percent Discordant	24.7	Gamma	0.502
Percent Tied	0.9	Tau-a	0.208
Pairs	25607799	c	0.749

Figure 6. Odds Ratio Table

