

The effect of adverse childhood experiences on e-cigarette usage in people aged 18–30 in the US

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SUMMARY

Recently, e-cigarette usage has been increasing rapidly. Previous research has found that adverse childhood experiences (ACEs) are correlated to cigarette usage. However, there is limited data exploring if ACEs affect vaping. Therefore, in this work, we investigated the effects of ACEs on e-cigarette usage. More specifically, we investigated the effects of different types of ACEs, as well as education on vaping risks and exposure to vaping in the household on the likelihood of e-cigarette usage. We hypothesized that witnessing vaping in the household and facing ACEs such as loss of a parent and violence or substance abuse in the household or neighborhood would independently increase e-cigarette usage, and an education on the dangers of vaping would decrease e-cigarette usage. Seventy-four participants of all genders, ages 18–30, from the USA completed a nine question survey. Participants answered questions about basic background information, ACEs, and vaping habits. We found that 92.00% of respondents who never faced an ACE have never used an e-cigarette. 93.33% of respondents who have never been exposed to vaping in the household also have never used an e-cigarette. 61.92% of respondents who have been educated on the dangers of vaping never used e-cigarettes. Our results indicate that being educated on the dangers of vaping had no effect on e-cigarette usage. Experiencing ACEs or witnessing use of e-cigarettes in the household was associated with an increased use of e-cigarettes. As hypothesized, we found that different types of ACEs had different correlations with e-cigarette usage. Further research is recommended to determine the significance of the type of ACE in terms of e-cigarette usage risk.

INTRODUCTION

Recently, e-cigarette usage has been rapidly increasing in young adults. Youth e-cigarette usage rose 1,800% from 2011 to 2019 (1). E-cigarettes companies commonly market e-cigarettes as a healthy alternative to traditional cigarettes and target young adults in their marketing plans. However, e-cigarettes have proven to contain many unidentified chemicals that can be harmful to the respiratory system and overall health of young adults (2). Previous research has demonstrated that adverse childhood experiences (ACEs)

can generally be linked to risk behaviors (2). E-cigarette usage is a common risk behavior in young adulthood. ACEs are traumatic experiences faced by children under the age of 18 such as neglect, abuse, and household dysfunction, such as living with someone who struggles with mental illness or substance abuse, having an incarcerated relative, living with violence in the household or neighborhood, having divorced parents, or losing a parent (3).

Over 60% of American adults have experienced at least one ACE in their lifetime, and about a quarter have experienced three or more ACEs (1). ACEs can cause extremely high stress levels, termed “toxic stress,” that can interrupt brain development (3). Unlike normal stress levels, toxic stress can lead to negative effects on future wellbeing, such as engaging in risky behaviors (4-7). Specifically, previous research has shown that ACEs increase tobacco usage (8). Studies indicate that tobacco usage can be dependent upon the type of ACE experienced (8). Therefore, we hypothesized that e-cigarette usage is correlated with the type and number of ACEs faced. E-cigarette, or vaping, product use-associated lung injury, commonly referred to as E-cigarette or Vaping Use-Associated Lung Injury (EVALI), is a common negative health impact of vaping. As of February 2020, the Centers for Disease Control (CDC) has reported 2,807 hospitalized EVALI cases or deaths in the United States of America (9).

This study aimed to determine if ACEs are an indicator of future e-cigarette usage in participants aged 18–30. Education on the dangers of vaping as well as witnessing regular usage of e-cigarettes in the household was also studied to determine the effects on e-cigarette usage. We surveyed participants aged 18–30 to determine ACE history, education on the dangers of vaping, witnessing smoking in the household, and e-cigarette usage. We hypothesized that witnessing vaping in the household and facing ACEs would independently increase e-cigarette usage, and an education on the dangers of vaping would decrease e-cigarette usage. We also hypothesized that different types of ACEs would have varying effects on e-cigarette usage. Both experiencing ACEs and witnessing household smoking or vaping showed an increased likelihood of e-cigarette usage. As hypothesized, we found that different types of ACEs had different correlations with risk of e-cigarette usage. However, we found that contrary to our hypothesis, education had no effect on e-cigarette usage rates. These associations could then be used to implement strategies to target at-risk

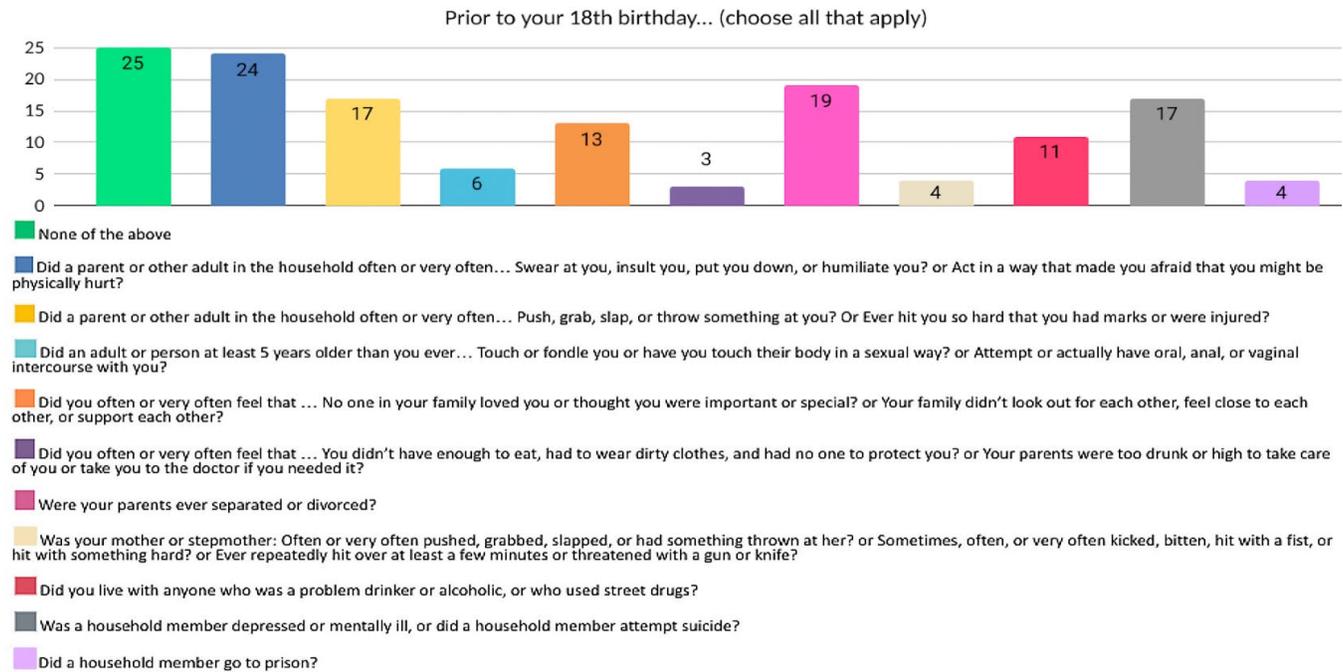


Figure 1: Number and type of ACEs faced by all 74 respondents. Participants were asked to check off which, if any, ACEs they faced prior to the age of 18.

populations, which could lower rates of both e-cigarette usage and vaping-related illnesses and deaths (3, 10-12).

RESULTS

A nine question online survey was sent out, asking respondents questions regarding basic background information, ACEs, and vaping habits. The survey received 74 completed responses from participants of all genders, ages 18–30, from the USA. The mean age of respondents was 23.9 ± 4.0 (n = 74). About 33.0% of the total respondents (n = 74) were males, 57.0% were females, 5.4% were non-binary, and 5.4% preferred not to specify their gender. Of the total respondents (n = 74), about 2.7% completed some high school with no diploma, 21.6% graduated high school with a diploma or the equivalent, 4.0% completed trade/technical/vocational training, 25.7% earned some college credit but no degree, 10.8% earned an associate's degree, 21.6% earned a bachelor's degree, 10.8% earned a master's degree, 1.4% earned a professional degree, and 1.4% earned a doctorate degree.

We found a positive correlation between e-cigarette usage and ACEs in participants ages 18–30 from the United States of America. Of all the participants (n = 74), 33.8% responded that they faced no ACEs during childhood, while 66.2% responded that they faced one or more ACEs in their childhood (Figure 1). 92.0% of the respondents who never faced an ACE (n = 25) also report never using an e-cigarette in their lifetimes; none of these 25 respondents reported vaping daily or on a regular basis (Figure 2). Of all respondents (n = 74), 36.5% reported prior vaping in some capacity. 92.6%

of respondents who have vaped in some capacity responded that they have faced one or more ACEs in their lifetime. 7.4% of respondents who have vaped (n = 27) responded that they have not faced ACEs.

The ACEs faced by respondents who have used an e-cigarette (n = 27) varied. 48.2% of these respondents reported that “prior to their 18th birthday; a parent or other adult in the household often or very often... swore at them, insulted them, put them down, humiliated them, or acted in a way that made them afraid that they might be physically hurt.”, 37.0% responded that “prior to their 18th birthday; a household member was depressed, mentally ill, or attempted

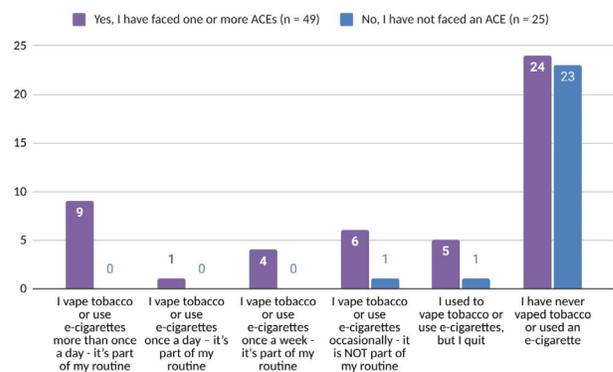


Figure 2: E-cigarette usage habits of the 25 respondents who have never faced an ACE vs. E-cigarette usage habits of the 49 respondents who have faced one or more ACEs. Respondents were asked to choose the option that most closely represents their experience with e-cigarette usage.

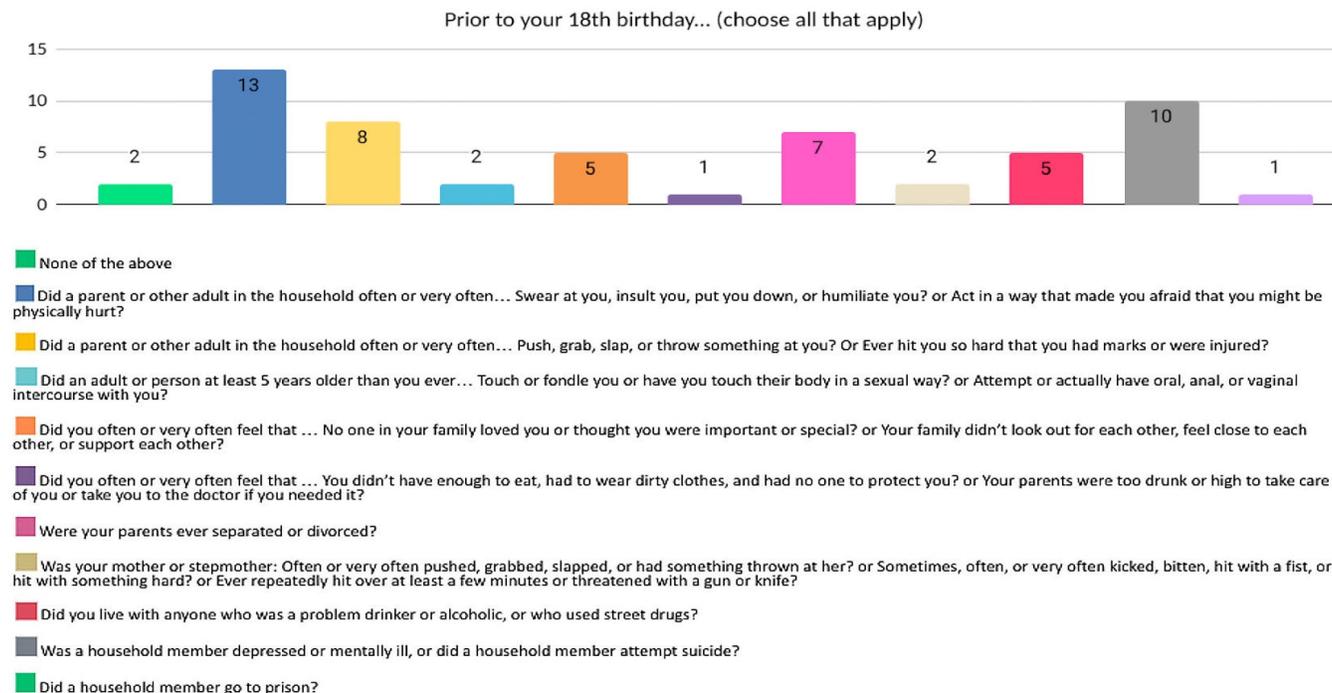


Figure 3: ACEs faced by the 27 respondents who responded that they have used an e-cigarette in their lifetime. Participants were asked to check off all of the ACEs they had faced prior to the age of 18, if any.

suicide.”, 29.6% responded that “prior to their 18th birthday; a parent or other adult in the household often or very often... pushed, grabbed, slapped, threw something at them, or hit them so hard that they had marks or were injured” (Figure 3).

Receiving education on the dangers of vaping had no effect on e-cigarette usage. 73.0% of total respondents (n = 74) were educated on the dangers of vaping in one or more ways. 70.2% of respondents who have never used an e-cigarette (n = 47) responded that they were educated on the dangers of vaping in one or more ways. 77.8% of the respondents who have used an e-cigarette (n = 27) also responded that they were educated on the dangers of vaping

in one or more ways (Figure 4).

The results suggest a positive correlation between witnessing smoking or vaping in the household and e-cigarette usage. 93.3% of respondents who have never witnessed someone in the household smoke or vape (n = 30) have never used an e-cigarette. This connection is also shown through the respondents who have vaped in their lifetimes. 92.6% of respondents who have used an e-cigarette (n = 27) responded that they witnessed someone in the household smoke or vape. Only 7.4% of these respondents who have used an e-cigarette in their lifetimes (n = 27) responded that they have never witnessed smoking or vaping in their household (Figure 5).

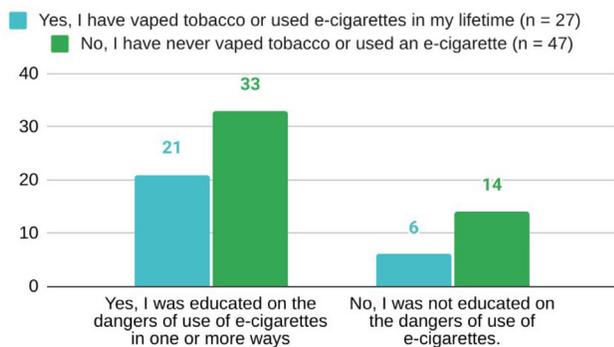


Figure 4: Education on the dangers of vaping received by the 47 respondents who have never used an e-cigarette vs. Education on the dangers of vaping received by the 27 respondents who have used an e-cigarette in their lifetimes. Participants were asked to check off all of the ways they were educated on the dangers of vaping, if any.

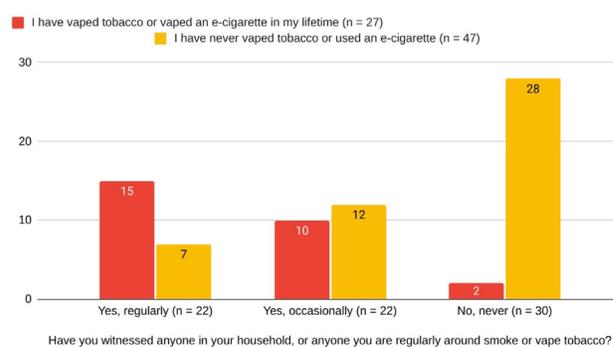


Figure 5: E-cigarette usage habits of the 44 respondents who have never witnessed smoking or vaping in their household vs. E-cigarette usage habits of the 30 respondents who have witnessed smoking or vaping in their household. Respondents were asked to choose the option that most closely represents their experience with e-cigarette usage.

DISCUSSION

E-cigarette use has become increasingly popular despite its association with many negative health impacts (1). ACEs increase the frequency of many risky behaviors, such as cigarette usage (2). However, the effect of ACEs on e-cigarette usage was unknown.

In this study, we surveyed participants aged 18–30 to measure the effects of ACEs, education on the dangers of vaping, and witnessing vaping in the household on e-cigarette usage. We found that facing ACEs corresponded with an increased risk of e-cigarette usage. Previous studies have shown that the majority of people will face at least one ACE in their lifetime, and in fact, we found that 66.2% of our respondents had faced more than one ACE in their lifetimes (1). It is possible that both e-cigarette usage and the number of ACEs faced increases linearly. Our findings showed that 92.0% of respondents who had never experienced an ACE had also never vaped. This finding suggests that having never experienced an ACE reduces the likelihood of using e-cigarettes later on in life. We also found that 92.6% of the respondents who have vaped had also faced an ACE, and only 7.41% of respondents who have vaped have never faced an ACE. A chi-square test of independence was performed to examine the relation between ACEs faced and e-cigarette usage. The relation between these variables was significant, $X^2(1, N = 74) = 13.2207, p = 0.000277$. These findings suggest that there is a strong association between ACEs and usage of e-cigarettes.

Because 7.41% of respondents who never faced an ACE still vape, ACEs are not the sole factor that causes e-cigarette usage. Other factors could include access to or witnessing e-cigarette usage, peer pressure or using e-cigarettes to try to fit into their environment, or lack of education on the dangers of vaping. However, through our study, we saw that education appears to have no effect on e-cigarette usage, but witnessing smoking or vaping in the household did display a linear relationship with e-cigarette usage.

We also studied the connection between the type of ACE faced and e-cigarette usage. While some specific ACEs were faced by larger proportions of respondents who have vaped, it cannot be determined from our available data if a specific ACE has a higher correlation to e-cigarette usage than another type of ACE. This is because the sample size for individual ACEs were relatively smaller than others so this would not provide a fair comparison. The most common adverse experience between respondents who had vaped was “having a parent or other adult in the household often or very often... Swear at you, insult you, put you down, or humiliate you, or act in a way that makes you afraid that you might be physically hurt.” While this could show that this ACE has the highest correlation to e-cigarette usage, it may be linked to our population, due to the fact that this was the most common ACE for our specific population. Our research did support our hypothesis that the types of ACEs would have

varying effects on e-cigarette usage. However, more research would be needed to determine if this claim is significant for a larger population.

We also hypothesized that education on the dangers of vaping would decrease the frequency of e-cigarette usage. We found that 70.21% of respondents who have never vaped were educated on the dangers of vaping in one or more ways. This result shows that education might not be an effective way to decrease the e-cigarette usage rates. However, we found that 77.78% of respondents who have vaped were also educated on the dangers of vaping. A chi-square test of independence was performed to examine the relation between education on dangers of e-cigarette usage and e-cigarette usage. The relation between these variables was not significant, $X^2(1, N = 74) = 0.4976, p = .480552$. These findings suggest that there is not a strong association between education on dangers of e-cigarette usage and usage of e-cigarettes.

The connection between e-cigarette usage and education on dangers of vaping may depend on factors that were not tested in the research. Quality and type of education, as well as age at the time of education, could contribute to the effectiveness of education at preventing e-cigarette usage. The age at time of education on the dangers of vaping may alter use of e-cigarettes. Factors outside of education such as peer pressure, witnessing vaping in the household, or ACEs may also influence the effectiveness of the education on the dangers of vaping in preventing e-cigarette usage. More research is necessary to determine if there is a correlation between education on the dangers of vaping and the use of e-cigarettes.

We also studied the correlation between witnessing e-cigarette usage or smoking in the household and the use of e-cigarettes. 93.33% of respondents who have never witnessed vaping or smoking in the household have never vaped, indicating that never witnessing vaping could be associated with a lower risk of e-cigarette usage. 92.60% of respondents who have vaped responded that they have witnessed smoking or vaping in the household, demonstrating an association between witnessing vaping in the household and e-cigarette use. A chi-square test of independence was performed to examine the relation between witnessing e-cigarette usage or smoking and e-cigarette usage. The relation between these variables was significant, $X^2(1, N = 74) = 19.3603, p = 0.000011$. These findings suggest that there is a strong association between witnessing e-cigarette usage or smoking and usage of e-cigarettes.

Still, 7.40% of respondents have vaped but have never witnessed smoking or vaping in the household. There are many possible explanations for this result; these respondents may be exposed to smoking or vaping in another location such as around friends or in a school setting, they may be facing other challenges in the household such as ACEs, and these respondents could also have a lack of knowledge on the dangers of e-cigarette usage from a lack of education on the

topic. One of the two respondents who had vaped before but not witnessed smoking or vaping in the household responded that they faced four ACEs in their childhood and received no education on the dangers of vaping. The other of these two respondents responded that they have never faced an ACE in their childhood, but also never received an education on the dangers of vaping. Further studies could formulate a stronger correlation on the effects of witnessing smoking or vaping in the household on the frequency of e-cigarette usage. Also, it could be studied how witnessing vaping in locations other than the household affects e-cigarette usage.

One limitation of the present study is the sample size. Overall, only 27 of our respondents had vaped in their lifetimes, which made it difficult to draw conclusions on the correlation between specific ACEs and e-cigarette use. A future study could use a larger sample size and limit participation to people who have vaped in their lifetimes. Future studies could also study vaping in people under 18, which would allow us to determine if the ages at which trauma or education on the dangers of e-cigarette usage occurs affect e-cigarette usage.

The present study was limited to the United States of America. Expanding this research to other parts of the world could indicate if connections between ACEs and e-cigarette usage vary throughout different countries. Future research could also be conducted to further the understanding of how ACEs correlate to risk behaviors later on in life. Alcohol abuse, like e-cigarette usage, is a type of health risk behavior. Finding connections between ACEs and alcohol usage would contribute to the understanding of ACEs effects on risk behaviors later on in life. Researching if ACEs are associated with the use of e-cigarettes at a younger age could also be beneficial research to expand this topic. Research could be done to see if ACEs affect the age at which someone first tries alcohol and vaping, as well as to see if ACEs have other negative associations with health risks such as loss of childhood memories.

Our findings improve our understanding of how ACEs affect e-cigarette usage. Our results indicate that facing ACEs and witnessing use of e-cigarettes or smoking in the household are connected to an increased risk of e-cigarette usage later in life. More research needs to be completed to understand which specific types of ACEs have the greatest impact on risk of e-cigarette usage, as well as how much of an impact education on the dangers of vaping has on lowering the frequency of e-cigarette usage. Still, our study suggests that treating the trauma of ACEs could reduce the rates of e-cigarette usage. Reducing home exposure to vaping or e-cigarette usage could also lower e-cigarette usage. Identification of ACEs effects on e-cigarette usage will facilitate the development of programs to educate on the dangers of vaping and provide therapy targeted to people facing ACEs. Targeted therapy and education programs would reduce the frequency of e-cigarette usage and in turn lower e-cigarette-related illnesses and deaths. Overall, these findings of our research could be used to reduce vaping and

vaping-related illness and death rates.

MATERIALS AND METHODS

We created and distributed a nine-question survey (**Appendix**). One question regarding ACEs faced in childhood was adapted from the ACE score quiz (13). The target population was participants ages 18-30 years old, from the United States of America, of any gender, race, and ethnicity. Using participants in a young adult age range allowed us to find a connection between ACEs faced and e-cigarette usage in a generation that grew up with prevalent exposure to e-cigarette products. Using respondents above the age of 18 allowed us to ensure all participants were legally able to complete our survey on their own without the need for parental consent. Participants were found through SurveyMonkey's target audience program, which emails SurveyMonkey users a link to the survey. Seven of the 81 responses were incomplete and therefore omitted, leaving 74 completed responses to be analyzed.

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Appendix

Adverse Childhood Experiences Effects On Use Of E-cigarettes In 18-30 Year Olds

Thank you for participating in our survey. Your feedback is important. The goal of this research study is to find out the effects of childhood experiences on the use of e-cigarettes. This is an anonymous survey, your name and personal information will not be recorded. Participation in this study is voluntary. If you agree to participate in this study, you will be asked about your childhood experiences, and your history with e-cigarettes. The survey consists of 9 questions total and should take no more than 5 minutes to complete. This survey will ask you about past trauma such as physical, emotional, and sexual abuse. You may stop the survey at any point if you feel uncomfortable. **Please note, you must be 18-30 years old to take part in this survey.**

* 1. I am over the age of 18, consent to participating in this survey, and understand the terms of my participation. By clicking Yes, you consent that you are willing to answer the questions in this survey.

- Yes
- No

* 2. What is your age?

* 3. To which gender identity do you most identify?

- Male
- Female
- Non-Binary
- I prefer not to say
- I prefer to self-describe (Please specify)

* 4. What is the highest degree or level of school you have completed?

- Some high school, no diploma
- High school graduate, diploma or the equivalent (for example: GED)
- Trade/technical/vocational training
- Some college credit, no degree
- Associate's degree
- Bachelor's degree
- Master's degree
- Professional degree
- Doctorate degree

* 5. Prior to your 18th birthday: (Check all that apply)

- Did a parent or other adult in the household often or very often... Swear at you, insult you, put you down, or humiliate you? or Act in a way that made you afraid that you might be physically hurt?
- Did a parent or other adult in the household often or very often... Push, grab, slap, or throw something at you? Or Ever hit you so hard that you had marks or were injured?
- Did an adult or person at least 5 years older than you ever... Touch or fondle you or have you touch their body in a sexual way? or Attempt or actually have oral, anal, or vaginal intercourse with you?
- Did you often or very often feel that ... No one in your family loved you or thought you were important or special? or Your family didn't look out for each other, feel close to each other, or support each other?
- Did you often or very often feel that ... You didn't have enough to eat, had to wear dirty clothes, and had no one to protect you? or Your parents were too drunk or high to take care of you or take you to the doctor if you needed it?
- Were your parents ever separated or divorced?
- Was your mother or stepmother: Often or very often pushed, grabbed, slapped, or had something thrown at her? or Sometimes, often, or very often kicked, bitten, hit with a fist, or hit with something hard? or Ever repeatedly hit over at least a few minutes or threatened with a gun or knife?
- Did you live with anyone who was a problem drinker or alcoholic, or who used street drugs?
- Was a household member depressed or mentally ill, or did a household member attempt suicide?
- Did a household member go to prison?
- None of the above

* 6. Have you ever used an e-cigarette or vaped tobacco? (Choose the option that most closely represents your experience with vaping tobacco or e-cigarette usage).

- I vape tobacco or use e-cigarettes more than once a day - it's part of my routine
- I vape tobacco or use e-cigarettes once a day – it's part of my routine
- I vape tobacco or use e-cigarettes once a week - it's part of my routine
- I vape tobacco or use e-cigarettes occasionally - it is NOT part of my routine
- I used to vape tobacco or use e-cigarettes, but I quit
- I have never vaped tobacco or used an e-cigarette

7. If you have used an e-cigarette or vaped tobacco, at what age did you first use an e-cigarette or start vaping tobacco? If you have never used an e-cigarette or vaped tobacco, leave this question blank.

* 8. Have you witnessed anyone in your household, or anyone you are regularly around smoke or vape tobacco?

- Yes, regularly
- Yes, occasionally
- No, never

* 9. Did you receive education on the dangers of using e-cigarettes or vaping tobacco? (Check all that apply)

- Yes, I was educated on the dangers of use of e-cigarettes through my school system.
- Yes, I was educated on the dangers of use of e-cigarettes from my parents or guardian.
- Yes, I was educated on the dangers of use of e-cigarettes in another way.
- No, I was not educated on the dangers of use of e-cigarettes.