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Academic Performance and E-Cigarette Use Among Teenagers

Jeremy Tan Rondael
Walden University

Walden University

College of Health Sciences and Public Policy

This is to certify that the doctoral study by

Jeremy Rondael

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Review Committee
Dr. Shanna Barnett, Committee Chairperson, Public Health Faculty
Dr. David Anderson, Committee Member, Public Health Faculty
Dr. W. Sumner Davis, University Reviewer, Public Health Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

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Abstract

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MPH, Grand Canyon University, 2014

BSHE, University of Nevada, Reno, 2010

Doctoral Study Submitted in Partial Fulfillment

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Abstract

Early e-cigarette use by youth has the capacity to create an early addiction to nicotine, increasing the risk of life-long dependency and the possible development of multiple cardiovascular and pulmonary diseases. Reinforced by the socioecological model, the purpose of this study was to determine if academic performance is associated with e-cigarette use among teenagers and young people and if the presence of adverse childhood events (e.g., cyberbullying in school and/or the presence of homelessness) mediated this association. This study included all respondents (N = 1,401) from the state of Nevada who answered the 2019 National Youth Risk Behavior Survey. Binary logistic regression determined that there was a positive association between academic performance and e-cigarette use (p = < .001). Students who reported mostly grades of F (p = .003, OR .219, 95% CI [.080, 5.422]) had a higher likelihood of using e-cigarettes. Mediation analysis with regression determined that the presence of cyberbullying had a direct effect on this relationship (B = -.027, p = .003, 95% CI [-.045, -.009]); however, it did not mediate this relationship (z = -.083, p = .407). The results of this study revealed positive associations between academic performance and e-cigarette among 17- and 18-year-olds, those reporting male sex, individuals of multiple races (non-Hispanic), and individuals unsure of their grades. These results can help improve current policy and public health programs related to low academic performance and cyberbullying. This evidence revealed critical identifiers to e-cigarette use among teenagers and young people. Implications for positive social change include the possible reduction of current and/or future smoking-behaviors.

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Dedication

To my friends and coworkers throughout these last few years who helped support me in my pursuit of this prestigious academic achievement, thank you. You have all helped me with this accomplishment, which was no easy task, and I cannot give enough gratitude to all of you who showered me with encouragement. I am proud to be part of such a highly distinguished community that could have only been completed through the support of such caring and gracious friends, coworkers, and peers.

To my family, I cannot thank you enough for helping me make it to this point of my life. Your love and support made this moment possible for me to accomplish my greatest accomplishment.

To my father Chito and my mother Rosario, you brought me to where I am today, not only as an educated professional but also as a well-respected adult and individual. I owe my success to you both, cultivating me into the man I am today.

To my older sister Linea, you have been such an inspiration to me to pursue the highest caliber of my character and scholastic achievement. Thank you for always being there for me when I struggled and encouraging me to never settle for less than what I could achieve. After all, we were lucky enough to blessed with the luxury of choice.

It is the example the three of you set for me that helped me realize that I can achieve more than I ever thought possible.

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I'd like to dedicate this to the professors and educators with whom I've worked who helped build the foundation of this study.

To my professors at University of Nevada, Reno and at Grand Canyon University, I've accomplished so much since I've left your universities. I'm proud to be an alumnus and to have graduated with my bachelor's and master's degree from both of your facilities.

To my professors and staff at Walden, every choice and resource that I used to get here was all because of your recommendations. To Dr. Bill Davis, you were one the main professors that acted as a preceptor to me during my first residency and you came full back full circle to be my University Research Reviewer. Dr. David Anderson, your additional support as my second committee member helped prepare me to refine my work into what it is today. It was because of your combined guidance that kept me on this path to succeed.

To Dr. Shanna Barnett, I could not have made it here had it not been for your direction, wisdom, and your unwavering support throughout this process. There have been countless conversations, revisions, and meetings over the course of this study, and I cannot imagine how I would have made it here without you.

From the bottom of my heart for everything you all have done for me, thank you.

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Section 1: Foundation of the Study and Literature Review

Introduction

In the United States, the use of e-cigarettes otherwise known as "vaping" (American Cancer Society [ACA], 2022), has been identified as the most frequent smoking-related behavior among teenagers and young people (Centers for Disease Control and Prevention [CDC], 2022; Food and Drug Administration [FDA], 2021; World Health Organization [WHO], 2021). Despite efforts made to restrict use and access by this age demographic (FDA, 2021), over 2 million users were nationally identified as high school and middle school students (CDC, 2022). E-cigarette use within this group has been associated with low academic performance (Sawdey et al., 2019) and experiencing various adverse childhood events (ACEs; Martinasek et al., 2021; Ofuchi et al., 2020), such as being identified as the victim of cyberbullying (Doxbeck, 2020) or the presence of homelessness (Durazo et al., 2021). However, there was a lack of evidence as to how these various factors interact, and if they (ACEs) mediated the association between academic performance and e-cigarette use among teenagers and young people. As the most widely used and recognized tobacco product among this group, it was critical to understand what kind of factors are associated with e-cigarette usage.

The results of this study may provide information to help predict e-cigarette use among teenagers and young people. With a focus on those who have suffered from different ACEs, which was positively associated with smoking-related behaviors and e-cigarette use, this study has the potential to create social positive change by predicting e-cigarette use based on measurable factors. Additionally, these results may enhance the

identification of experiences such as cyberbullying in school and emotional distress in the home environment as predictors of e-cigarette usage. This study has the potential for positive social change by increasing the knowledge factors that predict e-cigarette use.

This section contains the following components in this order: background, problem statement, purpose of the study, the research questions and hypotheses, the theoretical foundation of this study, the nature of the study, the literature search strategies, the literature review related to key variables, the theoretical framework, definitions, assumptions, scope and delimitations, significance, summary, and conclusion.

Background

Multiple studies and health authorities have determined that among all age groups, e-cigarette use was the highest among middle and high school students (CDC, 2022, FDA, 2021; WHO, 2021). Despite the rate of traditional cigarette use decreasing in recent years for teenagers and young people, e-cigarette use has been on the rise since 2018 (CDC, 2021b; Cullen et al., 2018; Dearfield et al., 2021; Sapru et al., 2020). From 2017 to 2019, the rate of e-cigarette use among teenagers and young people within Nevada increased to 45% of all surveyed individuals (CDC, 2022; Nevada Cancer Coalition, 2020). Recent evidence had determined that many adults who used traditional combustible tobacco products initiated as teenagers and young people (CDC, 2021b; Gaiha et al., 2020; Jenssen & Boykan, 2019; National Cancer Institute, 2020; Shinbashi & Rubin, 2020; U.S. Department of Health and Human Services [HHS], 2021), which suggests a critical focus on prevention within this age range (Blagev et al., 2019; Layden

et al., 2020). As teenagers and young people continue to use e-cigarettes, they become more vulnerable to harmful health consequences and then possibility of long-term use.

E-cigarettes can negatively affect the development of teenagers and young people despite not containing levels of nicotine equivalent to those in traditional combustible tobacco products because they include additional elements that can harm the body when ingested (Mooney-Leber & Gould, 2018). E-cigarettes contain numerous chemicals that are detrimental to the body when consumed, the most notable being nicotine, a dangerous substance that can negatively affect brain development in teenagers and young people (American Lung Association [ALA], 2021). The use of the e-cigarette by teenagers and young people can lead to life-long tobacco use and addiction with the development of habitual smoking behavior and practice, which has been nationally and globally identified as the most preventable health outcome (CDC, 2022; FDA, 2021; HHS, 2021; WHO, 2021). Furthermore, there was substantial evidence revealing that e-cigarette use can lead to various respiratory diseases (ACA, 2020). Hence, there was a need to understand what kind of factors may influence teenagers and young people to use e-cigarettes to help prevent such outcomes.

There is a multitude of research that has associated e-cigarette use in middle school and high school students with poor academic performance (Dearfield et al., 2021). Chadi et al. (2020) determined that teenagers and young people who used e-cigarettes were more likely to report grades of C or below compared to those who did not use e-cigarettes. Teenagers and young people who participate in e-cigarette behaviors are also more likely to suffer from truancy in school and form additional negative health risk

behaviors, such as consuming additional substances like marijuana or alcohol (McCabe et al., 2017). This evidence suggests that academic performance is an important factor in predicting if teenagers and young people may participate in e-cigarette use.

Teenagers and young people who suffer from an ACE are more likely to initiate in e-cigarettes and maintain smoking behaviors to cope with stress and anxiety (Martinasek et al., 2021). The probability of e-cigarette use increases as the number of ACEs rises among teenagers and young people, as one in five middle school students who had suffered from multiple ACEs had initiated in e-cigarettes, some admitting to starting under the age of 11 (Martinasek et al., 2021). The presence of childhood emotional abuse and trauma has shown a positive association with e-cigarette use among teenagers and young people and lifetime e-cigarette use (Shin et al., 2019). As such, teenagers and young people who may have suffered from ACEs are more likely to use e-cigarettes and develop into life-time users. With the rates of e-cigarette use among teenagers and young people climbing in recent years, an evaluation of different ACEs should be completed.

One ACE related to e-cigarette use is cyberbullying. Teenagers and young people who are victims of cyberbullying are more likely to use e-cigarettes (Ihongbe et at., 2021). Individuals who are identified as bully victims are often associated with negative outcomes, such as substance abuse and poor academic performance (Doxbeck, 2020; Ihongbe et al., 2021). Those who are bullied daily or almost daily are at a significantly higher risk to use e-cigarettes than those who are bullied once a week or less (Azagba et al., 2020). As different ACEs positively correlate with e-cigarette use, it was imperative

to understand the strength of these associations and if they can help predict future smokers. Thus, different ACEs are critical in determining if they are related to e-cigarette use among teenagers and young people.

The presence of homelessness has also been identified as an ACE that contributes to e-cigarette use. According to Durazo et al. (2021), most cigarette smokers who experience homelessness report using additional tobacco products such as e-cigarettes. More specifically, teenagers and young people who experience homelessness are three times more susceptible to use various tobacco products, including e-cigarettes (Glasser et al., 2022). Leavens et al. (2020) found that the frequency of tobacco product use and e-cigarette use within the homeless population increased from 2015 to 2018 and discovered higher rates of asthma and cancer. Furthermore, with teenagers and young people who experienced homelessness, almost 90% reported using cigarettes or alternative tobacco products such as e-cigarettes (Tucker et al., 2019). Additionally, homeless youth who classified as runaways or as unaccompanied were more likely to experience risky behaviors such as e-cigarette use (O'Brien et al., 2021). This makes teenagers and young people who suffer from this ACE another prime target for predicting e-cigarette use.

The use of e-cigarettes is still climbing among teenagers and young people, despite the recent decline in cigarette smoking behaviors in the United States (CDC, 2022; Dearfield et al., 2021; Sapru et al., 2020). As a preventable negative health behavior, avoiding the premature use of e-cigarettes and cigarette-related products can lead to lifelong positive effects and outcomes, such as extended life years and healthier physiological functions related to pulmonary and cardiac health (Levy et al., 2017). In

this study, I examined the gap in current literature and if there was an association between academic performance and e-cigarette use among teenagers and young people. Furthermore, I explored if the presence of ACEs affects this relationship. This study helps fill the gap in the literature regarding possible factors that may associate events in a teenager/young person's life and the age at which they may use in e-cigarettes.

As the only state without a comprehensive tobacco-free law (American Nonsmoker's Rights Foundation, 2022), Nevada is among the top 10 states in the nation for e-cigarette use (CDC, 2021b; Truth Initiative, 2022). Additionally, many teenagers and young people within Nevada associated e-cigarette use with the presence of ACEs (Williams et al., 2020). In 2021, Nevada was ranked as the state with the ninth highest rate of homelessness within the United States, with the city of Las Vegas among the top 30 cities (Security.org, 2021). By examining possible associations in teenagers and young people with e-cigarette use, this study may help prevent e-cigarette use among teenagers and young people in Nevada.

Problem Statement

Current research has suggested that with the increase of e-cigarette use among teenagers and young people within the United States, it was essential that associations to e-cigarette use be examined. This includes factors such as academic performance and the presence of ACEs. The state of Nevada has been identified with one of the highest e-cigarette usage rates within the country (Truth Initiative, 2022); therefore, focus on this location was prioritized. Teenagers and young people do not fully understand the negative health consequence of e-cigarettes on the human body, and due to their

misconceptions that e-cigarettes are a healthy alternative to traditional combustible tobacco, individuals in this age range are more susceptible to initiation (Gotts et al., 2019; Park et al., 2021; Ratajczak et al., 2018; Sapru et al., 2020). More research must be done to fortify what is known regarding the relationship between e-cigarette use with teenagers and young people.

Teenagers and young people who have been exposed to an ACE correlate to negative health behaviors such as e-cigarette use (Williams et al., 2020). Additional research has found that individuals who have experienced multiple ACEs increase the risk of initiating in smoking behaviors (Martinasek et al., 2021; Williams et al., 2020). Cyberbullying is one ACE considered common among teenagers and young people (Pichel et al., 2022), with a high association with e-cigarette initiation and usage (Yoon et al., 2019). Another ACE to consider among teenagers and young people is being homeless, which can cause stress and trauma and can also lead to e-cigarette use (Dzubur et al., 2022). These associations remain a critical factor in identifying correlations to e-cigarette use; however, another variable of interest among teenagers and young people is academic performance.

Recent studies have described e-cigarette use among teenagers and young people to be strongly associated with poor academic performance (Dearfield et al., 2021). Teenagers and young people who performed lowered in school were more likely to have used e-cigarettes (Jenson, 2018). As the school setting is one of the most influential environments identified within a teenager/young person's life (Maatta et al., 2020; McDonald-Harker et al., 2021; Pearson et al., 2021), understanding how it can influence

their decision to initiate in e-cigarettes must be recognized. Although these variables (academic performance and ACEs in the form of cyberbullying and the presence of homelessness) have been identified to independently associate with e-cigarette use, there is a need for additional research that examines them in conjunction with each other.

There is little evidence if certain adverse events, such as cyberbullying or the presence of homelessness, along with academic performance are related to a teenager or young person's decision to use e-cigarette products. This study focused on a gap in current literature regarding if there was an association between academic performance and ACEs (i.e., having been cyber bullied or presence of homelessness) and e-cigarette use among adolescents and young people in the state of Nevada.

Purpose of the Study

The purpose of this retrospective quantitative study was to determine if there was an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada. The independent variable (IV) was academic performance, and the dependent variable (DV) was e-cigarette use. Additionally, I aimed to determine if this association was mediated by the presence of ACEs through two mediating variables (MV): cyberbullying in the school environment and the presence of homelessness within the home environment.

Research Questions and Hypotheses

Research Question 1: Is there an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, controlling for age, sex, race, and ethnicity?

$H_0$1: There is no association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, controlling for age, sex, race, and ethnicity.

H_a1: There is an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, controlling for age, sex, race, and ethnicity.

Research Question 2: Is there an association between academic performance and e-cigarette use if mediated by the ACE of cyberbullying among teenagers and young people in the state of Nevada, controlling for age, sex, and race, and ethnicity?

$H_0$2: There is no association between academic performance and e-cigarette use if mediated by the ACE of cyberbullying among teenagers and young people in the state of Nevada, controlling for age, sex, and race, and ethnicity.

H_a2: There is an association between academic performance and e-cigarette use if mediated by the ACE of cyberbullying among teenagers and young people in the state of Nevada, controlling for age, sex, and race, and ethnicity.

Research Question 3: Is there an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, if mediated by the ACE of experiencing homelessness, controlling for age, sex, race, and ethnicity?

$H_0$3: There is an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, if mediated by the ACE of experiencing homelessness, controlling for age, sex, race, and ethnicity.

H_a3: There is no association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, if mediated by the ACE of experiencing homelessness, controlling for age, sex, race, and ethnicity.

Theoretical Foundation for the Study

The theory chosen to analyze these possible associations was Bronfenbrenner's (1974) social ecological model (SEM). As he recognized that human development was a result of how individuals interacted within various different ecological systems and social settings and key figures from each system, Bronfenbrenner discovered that human development was the result of two distinct layers: the upper and more visible layer being the immediate setting individuals were involved in, such as at home or in school for teenagers and young people, and the supporting layer that helps shape the upper layer, for example the neighborhood in which the individual grows (Bronfenbrenner, 1974; Kilanowski, 2017). The latest research included four main ecosystems: the microsystem as the layer, where the individual is the closet with family and at home; the mesosystem, where the individual is observed in their social environment; the exosystem, where the individual is involved with cultural and religious contexts; and the chronosystem, which examines the individual with historical context (Bronfenbrenner, 1974). The major ecological systems emphasized in this study were the microsystem, which contains the home setting, and the mesosystem, which contains the school setting. These two layers have been identified as most of the time common areas where teenagers and young people spend their time (see Pearson et al., 2021), both of which represent the immediate layers of developmental behaviors. Because of the SEM's focus on the environments that

are the most frequent to a teenager/young person as they develop behavior (home setting and school setting), it was the most ideal framework to align with this study.

Nature of the Study

This research study was quantitative in nature and used binary logistic regression analysis with mediation, focused on exploring the possible association between the IV of academic performance and the DV of e-cigarette use among teenagers and young people aged 12 to 18. Furthermore, mediation analysis with regression was completed with MVs to include two ACEs: cyberbullying and the presence of homelessness. Covariates included age, sex, race, and ethnicity. The data and identified variables used for this study originated from a national secondary data source, the 2019 National Youth Risk Behavior Surveillance System (YRBS), which was publicly accessible through online means for public use.

Literature Search Strategies

While performing the literature review, I used various academic search catalogs and resources, including EBSCO, Google Scholar, PubMed, and the U.S. National Library of Medicine. Key search terms to identify related literature related to e-cigarettes included *e-cigarettes, e-cig, electronic cigarettes, vape, vape pen, tobacco, tobacco smoking, cigarette, cigarettes, secondhand smoke, secondhand aerosol,* and *traditional combustible tobacco.* Keywords used for identifying literature related to the theoretical framework of this study emphasized *Urie Bronfenbrenner* and the *social ecological model.* Additional keywords to identify the target population and demographics included *teenagers, adolescents, young people, United States, Nevada, Las Vegas, Clark County,*

Clean Indoor Air Act, and *comprehensive tobacco smoking law.* When searching for the variables related to this study, terms included *adverse childhood event, cyberbullying, ACE, use, usage, initiation, homeless, homelessness, academic performance, academic achievement, scholastic achievement,* and *academic dishonesty.* Literature that met the criteria for this study included concurrent peer-reviewed journals within the last 5 years, no earlier than 2017, except for articles regarding Bronfenbrenner's SEM, identified as the theoretical framework for this study, articles that identified gaps in the literature, and research that defined landmark studies/discoveries. Additionally, the ACA, ALA, CDC, FDA, HHS, and WHO were searched for supplemental research on smoking practices, the discovered cumulative research on the effects of tobacco smoking, the presence of laws restricting access to tobacco products, and the ability to purchase tobacco products as it changed to adults over the age of 21. For the state of Nevada, research originated from Nevada Revised Statutes that were available electronically.

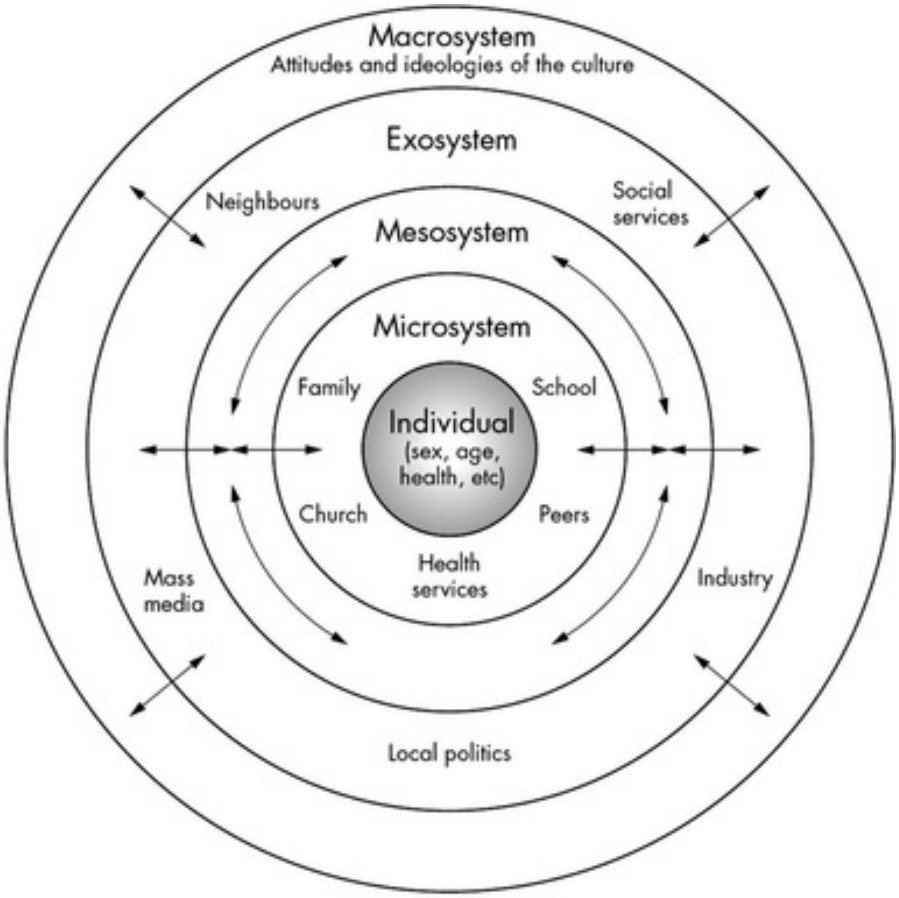
Theoretical Framework

The SEM was founded by Russian psychologist Bronfenbrenner in the 1970s, who recognized that the development of behaviors in an individual was a product of their interactions, with key figures in various organized ecosystems and ecological levels (Bronfenbrenner, 1974). According to Bronfenbrenner, these levels included the microsystem, which is the layer closest to the individual; the mesosystem, which involves the social context of an individual; the exosystem, which looks at the community of an individual; the macrosystem, which consists of values from society, religion, or culture; and the chronosystem, which examines historical content (See Figure 1 below;

Kilanowski, 2017). The SEM posits that multiple factors within a variety of different primary environments in an individual's life can influence and correlate to the creation of various behaviors that are developed over time (Bronfenbrenner, 1974). These factors can range from different structures and individuals that may affect how an individual perceives behavior, including the physical environment, the social environment, and the organizational environment (Maatta et al., 2020). Because this theory identified that both the environments that the teenager and/or young person is immersed in and the key individuals in those environments have strong associations to the creation and adoption of behavior, the SEM was chosen for this study as opposed to other health behavior theories.

Figure 1

Bronfenbrenner's Socioecological Model



Note: From Youth.gov. (2022). Environmental Influences. (https://youth.gov/youth-topics/environmental-influences) In the public domain.

While other health behavior theories and models can explain the adoption and maintenance of health behaviors, the SEM was chosen due to its recognition of the how the various environments shape the creation and adoption of behaviors. The health belief model explains that individuals have an innate desire to avoid contracting illness and will

believe that certain practices can help prevent or cure the related disease, but it does not consider environmental factors that may also facilitate or hinder the adoption of a health-related behavior (Jones et al., 2015). The theory of planned behavior has been recognized to predict if an individual has the intention to perform a certain behavior in order to achieve an expected outcome (Ajzen, 1991); however, in this study, I did not observe adolescents and young people with the intention to quit smoking or e-cigarette use, as the study was conducted to predict e-cigarette use, and I assumed that these individuals had not participated in smoking behaviors prior. The diffusion of innovations theory explains how the communication of an idea can diffuse quickly within a social system, but despite considering the environment in the adoption of behavior, this theory was more aligned towards new innovative ideas or practices that are to be adopted within large corporations and controlled systems and categorizes individuals based on the stage at which they want to adopt a new idea/concept (Dearing & Cox, 2018). Bandura's social cognitive theory explains that a person's behavior is a direct result of the environment; however, this does not determine how much of an influence the environment has, nor does it take into consideration motivation to initiate in new behaviors (Abdullah, 2019). The transtheoretical model examines the time in which behaviors can change from being a precontemplative idea to maintaining an action to prevent entering back into a negative behavior (Friman et al., 2017); however, like the theory of planned behavior, it is under the impression that the behavior is already being practiced in this target population and the study focuses on identifying if there are predictors to prevent the initiation of smoking-related behaviors. These theories and models did not align with the goal of this

study to determine if such associations between academic performance and ACEs can predict smoking behaviors in teenagers, which was why the SEM was ideal for the selected variables (academic performance, e-cigarette use, presence of cyberbullying, and the presence of homelessness) within the key constructs of home and school environments. Identifying such behaviors and their possible affiliations must be observed from a grander context in how the teenager and young person interacts with close peers and the systems those peers reside in.

Supportive relationships with individuals from all levels can strengthen a person's resolve against negative health outcomes and establishes a sense of safety and perceived risks within their unified social system (McDonald-Harker et al., 2021), which was why emphasis was placed on the microsystem and mesosystem of teenagers and young people. While perceptions for e-cigarette use and related harms in teenagers and young people are influenced by various interactions with advertisements and social media sources, the people like close friends and relatives and the main environments that they are involved in play stronger roles in reinforcing their judgement regarding their health (Park et al., 2019; Singh et al., 2020). Individuals in the primary caregiver roles are especially powerful, influencing health promotion interventions and behaviors in teenagers and young people acting as role models and examples to help instill risk perceptions related to negative behaviors such as smoking and the regulatory skills necessary to prevent initiating in such behaviors (Park et al., 2021). Teenagers and young people are highly receptive to those who provide them with care and supervision in these settings, such as parents, guardians, and educators, as these individuals shape their

behaviors from their observations such as beliefs and regulations (Maatta et al., 2020), which was why the home and school environments are so critical. Parental and family factors play key roles in programming healthy behaviors in the home setting, as they can extend such behaviors into community-level involvement and participation (O'Farrell et al., 2021). In this study, observing the teenagers and young people within their social systems and the way they interacted with significant figures around them in different environments was a key element in identifying what facilitates the development of health behaviors and perceived outcomes. It demonstrated that individuals who play major roles in a teenager's and young person's life can influence their behavior, as well as their perception in what is beneficial and/or harmful (Hu et al., 2021). The presence of these additional constructs within a teenager's or young person's life can directly affect the development of behavior.

Peer influence from any level/ecosystem has both positive and negative benefits when teenagers and young people are perceiving behaviors and health practices, as it recognizes this age group as owners of their personal experience that may be relatable to each other (McDonald-Harker et al., 2021). Social networks in both the home and family settings have strong correlations to the creation of different experiences, including health-related practices, demonstrating that it was appropriate to understand social influence from interpersonal relationships and how it affects health behavior and health-seeking behavior (Olaniyan et al., 2021). The school setting can serve as an ideal platform for teenagers and young people to explore problem-solving methods and strategies to help reach out to other students regarding protective elements to reduce and/or prevent the

initiation or continuation of negative behaviors like e-cigarette use and smoking (McDonald-Harker et al., 2021).

Teenagers and young people are at a critical stage in developing health-related behaviors and attitudes, as this age is when many beliefs are carried over as they mature into adults (O'Farrell et al., 2021). Thus, the ability of teenagers and young people to enforce decisions that can affect their personal health correlates to an array of factors consisting of individuals who teach them practices and the institutions that reinforce their ideas regarding health decision making (Gal, 2017). This also indicates that a poor home environment that exposes teenagers and young people to adversity, trauma, and stress (Glasser et al., 2022) as well as a lack of such powerful influential figures like parents and guardians who can teach and reinforce positive behaviors can easily guide individuals to risky behaviors and negative health outcomes (Labelle et al., 2020). The home and school environments house key figures that shape behavior development among teenagers and young people. Accordingly, this demonstrates that teenagers and young people have the capacity to absorb and replicate the same reasoning regarding their health based on the decisions of important individuals in their lives.

Teenagers and young people have the capability of being resilient in the sight of negative health behaviors as they interact with multiple levels in their lives to understand and perceive their own risks and benefits from all five systems/levels, as they can observe how e-cigarettes and smoking related behavior is perceived from the individual level to the policy level (McDonald-Harker et al., 2021; Rew et al., 2022). This becomes paramount when trying to identify possible events that predict the development of

negative behaviors as these behaviors stem from multiple levels that interact with each other. The example of bullying in grade school settings needs to be addressed by analyzing different developmental concepts such as age, sex, parent education with their children on abusive behaviors, and restricting the amount of exposure children have to violence (Eriksson et al., 2018). This displays both levels in which behavioral development comes from multiple sources in children: the initial layer of where children spend their time and the mitigating factors that can influence them in those contexts.

This review of research demonstrates how important it was to analyze not only the immediate people involved in a teenager/young person's life but also the environmental factors to understand how they influence behavior. These factors may affect their sense of morality in perceiving negative/unethical behaviors such as smoking/e-cigarette use. Despite various theories that may explain the beliefs associated with e-cigarette use and the interactions a teenager or young person may have that can influence their behavior, the SEM posits that behavior is influenced by multiple environmental/ecological systems and the direct contacts within each of those systems (Wold & Mittelmark, 2018). The individuals with whom teenagers and young people interact at school, as well as their parents/guardians with whom they relate at home, shape their perceptions on the positive and negative outcomes of their decision making. Therefore, this study addressed the home and school setting, with a focus on the SEM's definition of the microsystem and the mesosystem.

Literature Review Related to Key Variables and Concepts

The following sections provide a detailed and exhaustive review of current literature regarding the use of e-cigarettes among teenagers and young people. This review includes a conglomeration of studies that support the need to research e-cigarette use in teenagers and young people, as well as the key variables and concepts that pertain to this study. I explain the impact of tobacco smoking and e-cigarettes use in the United States, with a focus on the state of Nevada. I also provide an overview of key variables required for the study and how they relate to the research questions. Finally, I specify definitions, assumptions, scope, and delimitations of the study.

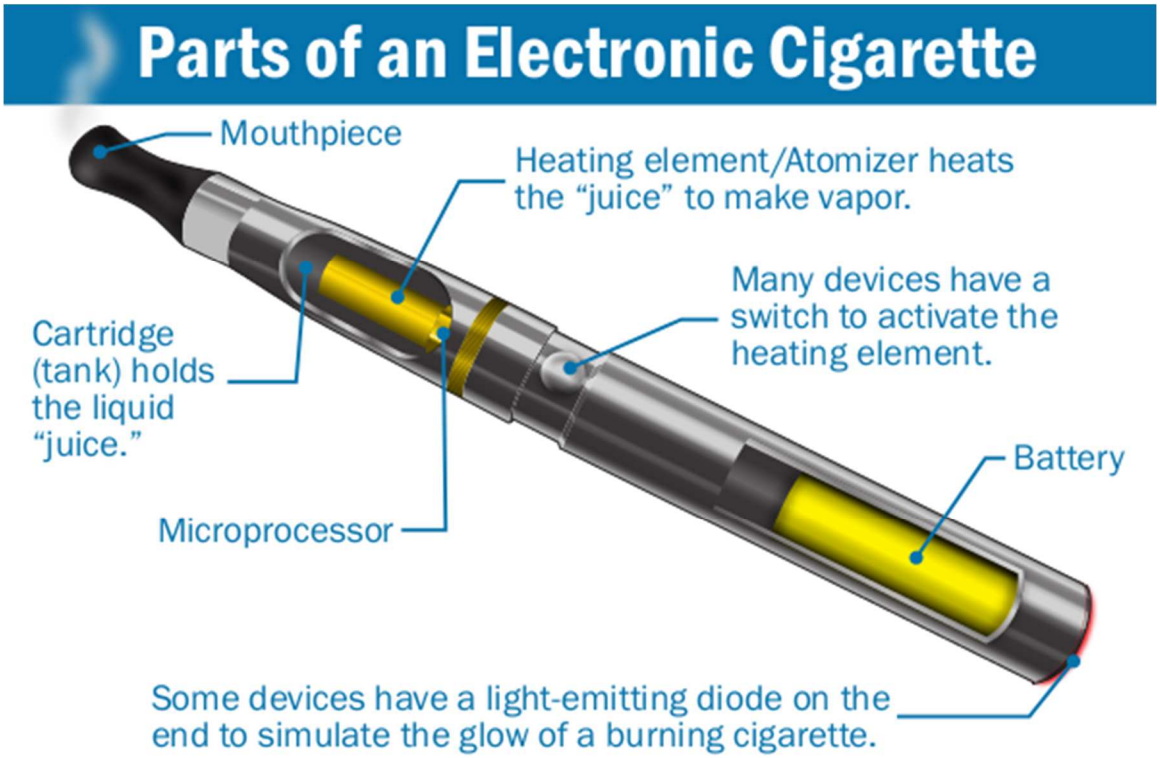
History of E-Cigarettes

The introduction of e-cigarettes started in China under pharmacist Hon Lik, who invented a product meant to replicate the effects of smoking without the harm associated with traditional combustible tobacco (Jenssen & Boykan, 2019; Sapru et al., 2020). As shown in Figure 2 below, the e-cigarette is composed of three components: the battery, the container/cartridge holding the e-cigarette liquid, and the mouthpiece (U.S. Fire Administration, 2017). This item was introduced in 2007 to the U.S. market as a method to reduce the amount of cigarette smoking among adults; however, it became clear that teenagers and young people were the primary users of e-cigarettes (Aaron, 2021; CDC, 2022; FDA, 2021; Sapru et al., 2020). Once e-cigarettes were introduced to the U.S. market, the number of users skyrocketed between both nonsmokers and cigarette users (Sapru et al., 2020). Use among Americans increased from 7 million in 2011 to 41 million in 2018, and in high school students from 220,000 in 2011 to over 3 million in

2018 (Shinbashi & Rubin, 2020). Accordingly, as the number of e-cigarette users increased, the form and shape of the e-cigarette also progressed.

Figure 2

Parts of an Electronic Cigarette



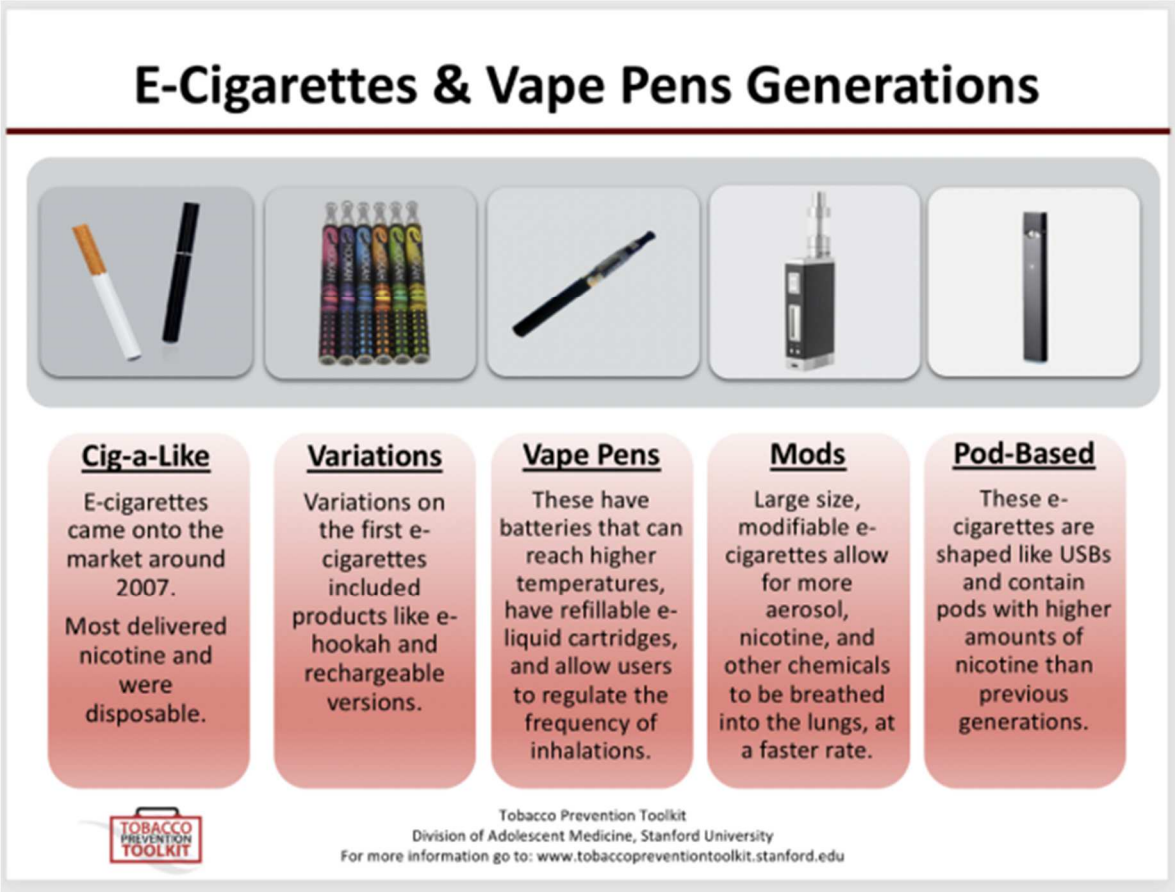
Note. From *Electronic Cigarette Fires and Explosions in the United States 2009-2016,* by the U.S. Fire Administration, 2017. (https://www.usfa.fema.gov/downloads/pdf/publications/electronic_cigarettes.pdf). Adapted with permission. See Appendix A.

Compared to traditional combustible tobacco, e-cigarettes have evolved over time from the visual cigarette to the sleeker mod-pod version as seen in Figure 3 below (See

Appendix A for permission/approval), adding to the visual appeal of the product. This newer version of the e-cigarette allows users to increase its power capacity to enhance the strength of its emissions and sensations (Myashita & Foley, 2020). Adversely, the ability to adjust the strength of the e-cigarettes also allows for weakening its effects, allowing new users to experiment with a lower strength (Jenssen & Boykan, 2019; Walley et al., 2020). Additionally, there are extra observations regarding the e-cigarette's form that display its evolution within the market to cater to the teenager/young person consumer, such as a smaller size to fit it in pockets that assist in concealing it or the ability to connect into USB ports for convenient re-charging and re-use (Stanford Medicine, 2021). As e-cigarette use among teenagers and young people continues to increase, more research was needed to understand why it was so common in this age group. With the possibility of such detrimental health outcomes such as nicotine addiction, there was a need to concentrate on what causes e-cigarette use concurrently among teenagers and young people.

Figure 3

E-Cigarettes and Vape Pens Generations



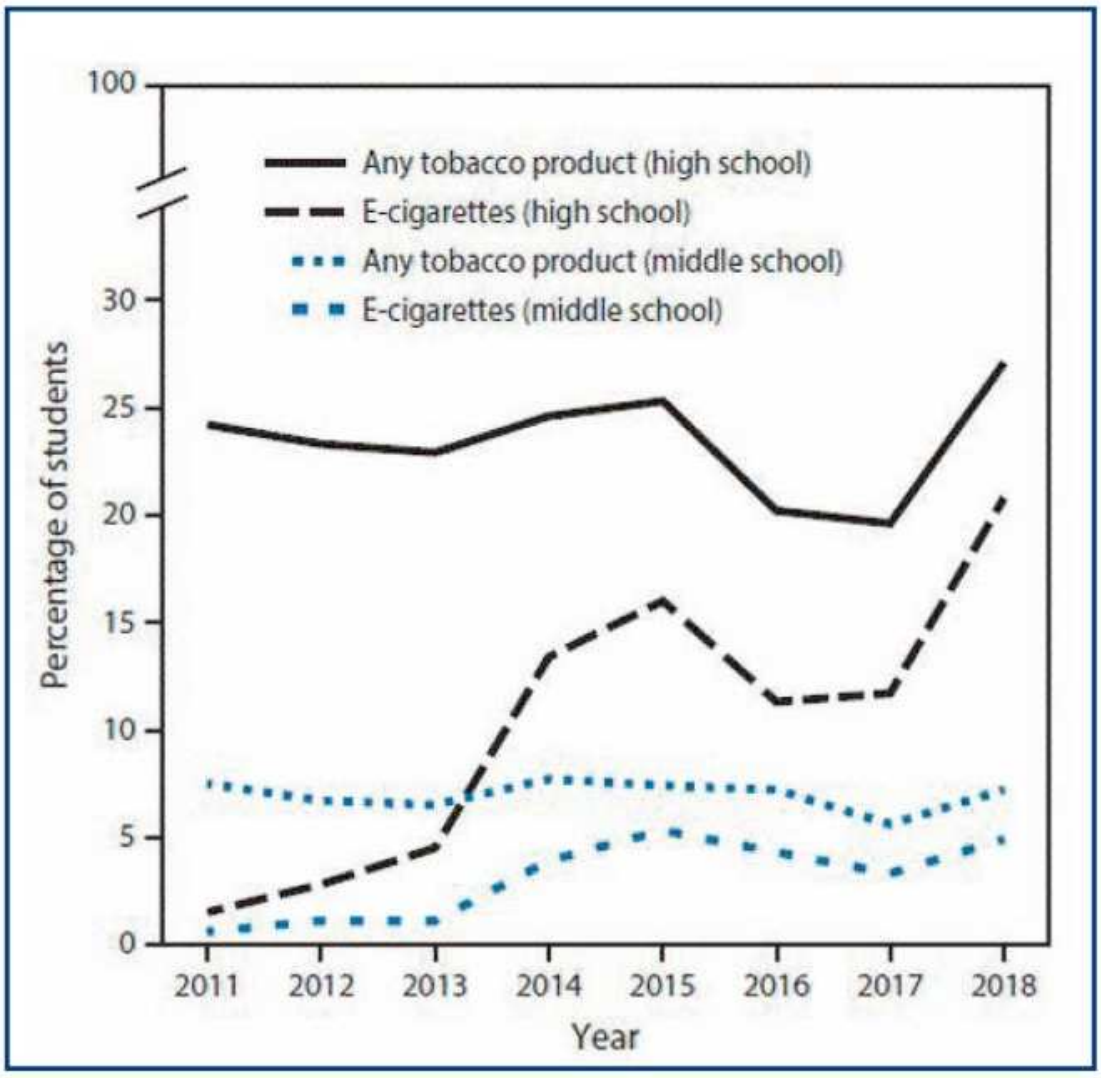
Note. From *E-Cigarettes and Vape Pen Modules,* by Stanford Medicine, 2017. (https://med.stanford.edu/tobaccopreventiontoolkit/curriculum-decision-maker/by-module/E-Cigs.html). Adapted with permission. See Appendix B.

Current E-Cigarette Use

Various sources have discovered that while the rate of traditional cigarettes has been decreasing in recent years, the rate of e-cigarette use has been increasing (see Evans-Polce et al., 2020; Jenssen & Boykan, 2019; Mibolouk et al., 2018; Sapru et al., 2020; Wang et al., 2019). This includes a surge of 8.8% in 2014 to 28.6% in 2018 with more individuals starting at early ages (Evans-Polce et al., 2020; Mibolouk et al., 2018) as shown in Figure 4 below (please see Appendix D for permission/approval). This substantial rise has undermined years of work targeting tobacco use that facilitated the cessation of smoking among users and the prevention of initiation of smoking behaviors among never-users (Sapru et al., 2020). Focus on teenagers and young people as the most common age demographic for e-cigarette use was relevant for the current study because the prevalence and incidence rates of e-cigarette use have increased over time. Additionally, most current traditional combustible tobacco users classified as adults were previously users of e-cigarettes as teenagers. Therefore, it was imperative to examine the possible predictors of e-cigarette use in teenagers and young people.

Figure 4

Increase of E-Cigarette use in the United States



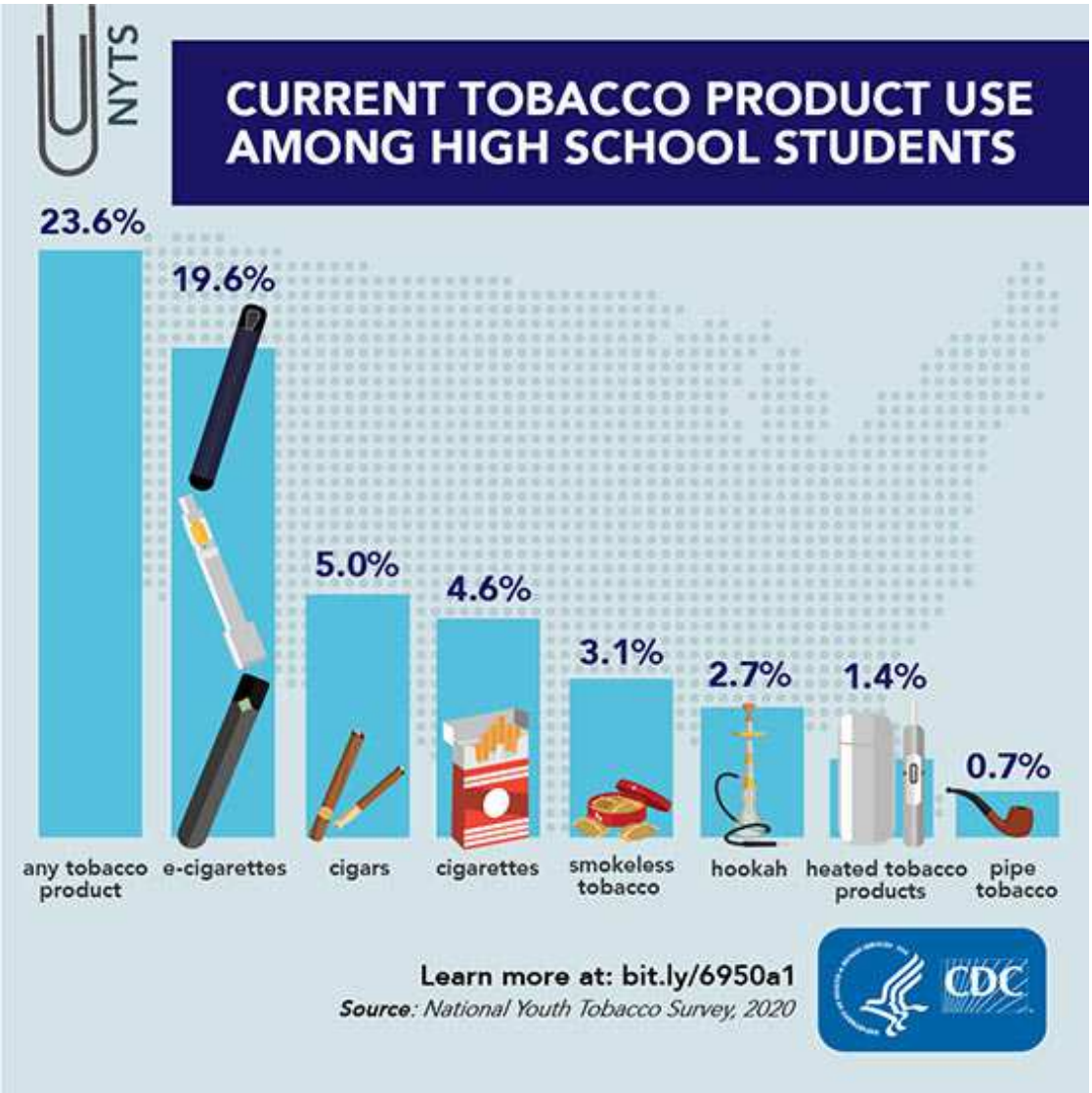
Note. From "Notes From the Field: Use of Electronic Cigarettes Any Tobacco Products Among Middle and High School Students – United States, 2011-2018" by K. A. Cullen, B. K. Ambrose, A. S. Gentzke, B. J. Apelberg., A. Jamal, & B. A. King, 2018, *Morbidity and Mortality Weekly Report, 67,* pp. 1276-1277 (https://doi.org/10.15585/mmwr.mm6745a5). Adapted with permission. See Appendix C.

E-Cigarette use Among Teenagers and Young People

Even though there are multiple variants of tobacco products available, e-cigarettes have been identified as the most used item among teenagers and young people, as seen below in Figure 5 (Cullen et al., 2018). E-cigarettes are popular among teenagers and young people because of their fashionable and discreet design and user-friendly functionality, but the availability to consume it in a variety of flavors was most common (Bhatt et al., 2020; Fadus et al., 2019). The variety of flavors that e-cigarettes come in encourages teenagers and young people to experiment with e-cigarettes and other flavored tobacco products (Shinbashi & Rubin, 2020). Many teenagers and young people do not enjoy traditional combustible tobacco products, preferring to consume products that are sweeter in nature such as chocolate, candy, and fruit-based flavors that add to the appeal of the product while enhancing the sensations affiliated with smoking, such as euphoria (Drazen et al., 2019; Soneji et al., 2019; Vallone et al, 2020). As of 2020, there were over 15,000 available flavors of e-cigarettes (Myashita & Foley, 2020). Moreover, the ability to mix flavors among e-cigarette users makes this product versatile among new users because the flavors and aromas make use more appealing and encourage experimentation, thereby increasing the likelihood, frequency, and persistence of use (Bhatt et al., 2020). As flavors increase, so does the appeal of e-cigarettes among teenagers and young people. However, flavors do not mask the possible diseases and negative outcomes associated with using e-cigarettes.

Figure 5

Current E-Cigarette use Among High School Students



Note. From "Notes From the Field: Use of Electronic Cigarettes Any Tobacco Products Among Middle and High School Students – United States, 2011-2018" by K. A. Cullen, B. K. Ambrose, A. S. Gentzke, B. J. Apelberg, A. Jamal, & B. A. King, 2018, *Morbidity and Mortality Weekly Report, 67,* pp. 1276-1277 (https://doi.org/10.15585/mmwr.mm6745a5). Adapted with permission. See Appendix D.

It was important to understand that early use of e-cigarette can cause negative health outcomes chronically. The age demographic of teenagers and young people was a critical area of focus in the war against tobacco smoking because e-cigarettes contain nicotine, a harmful substance that can adversely affect brain development during adolescence (HHS, 2021; Shinbashi & Rubin, 2020). Nicotine negatively affects memory in developing young people (ALA, 2020; Mooney-Leber & Gould, 2018). Preventing exposure to nicotine in teenagers and young people can help protect their health as they mature into adults. Those who become exposed within this time frame are more susceptible to developing habits and behaviors that will affect them for the rest of their lives.

E-cigarette use within this age demographic can instigate smoking habits and addictions that develop over time (Park et al., 2021; Sapru et al., 2020; Wang et al., 2021; Warner & Mendez, 2019). Multiple health authorities have determined that early exposure to e-cigarettes during teenage and adolescent life stages has strong associations to lifelong cigarette use (ALA, 2020; CDC, 2022; HHS, 2021; Jenssen & Boykan, 2019; Shinbashi & Rubin, 2020). Many individuals who initiated in e-cigarettes at younger ages have testified to becoming cigarette users or dual users of e-cigarettes and traditional combustible cigarettes (CDC, 2021b; HHS, 2021; Shinbashi & Rubin, 2020). Early users become susceptible to health effects related to smoking, such as lung injury and respiratory illness (Blagev et al., 2019; Layden et al., 2020). Therefore, identifying factors that lead to e-cigarette use in teenagers and young people may protect them from future health complications. Preventing use of e-cigarettes among teenagers and young

people may start with helping them understand the risks associated with e-cigarette use and what possible damage it may cause at early ages.

The incidence of e-cigarette use and smoking among teenagers and young people is increasing, and many who use these products are influenced by friends and family without understanding the risks associated with long-term tobacco use (ALA, 2020; Park et al., 2021; Sapru et al., 2020; Singh et al., 2020). Recent studies found that more than 90% of reported smokers initiated before the age of 18, and more than 60% of high school smokers maintained smoking habits by the time they reached adulthood (Gaiha et al., 2020; Jenssen & Boykan, 2019). Children as young as 7 have been found to initiate in e-cigarettes, compared to the national average of 14–15 years old (Gaiha et al., 2020). As the age of initiation in e-cigarettes becomes younger, the health effects can become potentially more dangerous.

Health Effects of E-Cigarettes

E-cigarettes differ from traditional combustible tobacco in many ways, but one notable distinction is its potency. E-cigarettes have the capability of delivering nicotine at a more powerful level than traditional combustible cigarettes, making the risk of becoming addicted to nicotine much higher (Jenssen & Boykan, 2019; Shinbashi & Rubin, 2020). E-cigarettes have a worse acute toxicity than tobacco (Bhatt et al., 2020). Additionally, e-cigarettes mimic the effects of nicotine by administering the chemicals into users in a “salt-like” form, allowing it to be absorbed into the bloodstream more efficiently than traditional tobacco products (Aaron, 2021). According to Levy et al. (2017), potential deaths related to tobacco use can be avoided. They (Levy et al, 2017)

determined that over a ten-year period, e-cigarette use can prevent over six million premature deaths and projected an increase of life by 15 years in comparison to traditional combustible tobacco. The number of potential life years that can be gained through e-cigarette cessation exceeds the number of life years lost for individuals who currently smoke (Warner & Mendez, 2019). However, current research posits that e-cigarettes should not be accessible by teenagers and young people for any reason, and they should not initiate in use due to its related health outcomes. Consequently, there was a new disease directly to related e-cigarettes that has been recently discovered.

In 2019, there was an increase in the rate of a condition known as e-cigarette or vaping use associated lung injury (EVALI; ALA, 2020; Overbeek et al., 2020; Park et al., 2021; Singh et al., 2020). Diagnosis of EVALI was associated with e-cigarette use within 90 days of onset of symptoms, the presence of pulmonary infiltrates on a chest computed tomography (CT) scan, lack of evidence of infection or that an infection was the main cause of lung injury, and there were no alternative diagnoses available (Shinbashi & Rubin, 2020). Patients who suffer from EVALI are more likely to develop lung abnormalities and expire with e-cigarette usage as a major contributing factor to their death (Blagev et al., 2019) as well as adverse cardiovascular, immunological, and neurodevelopmental effects (Overbeek et al., 2020; Park et al., 2021). According to the CDC (2021a), there are nearly 3,000 reported cases of EVALI among the United States, including Puerto Rico and the U.S. Virgin Islands since 2019, where the median age of patients was identified as 24 years of age, and over 50% of individuals diagnosed with EVALI are under the age of 24. Like traditional combustible tobacco, e-cigarette users

are susceptible to injuries and diseases related to the respiratory system (Jenssen & Boykan, 2019). Avoiding this product may prevent the onset of EVALI in individuals, but teenagers and young people would still be vulnerable to additional injuries and diseases.

Individuals who use e-cigarettes are more likely to report cases of lung injury, including respiratory, gastrointestinal, and constitutional symptoms (Blagev et al., 2019; Jenssen & Boykan, 2019; Layden et al., 2020). This includes symptoms such as abdominal pain, nausea, vomiting, and tremors when nicotine levels in teenagers and young people exceeds what they can tolerate (Singh et al., 2020). E-cigarette use affects individual health through elevated heart rate and blood pressure and exacerbates asthma in both users and those exposed to secondhand smoke (Walley et al., 2019). Evidence suggests that e-cigarette usage has a significant association with pulmonary toxicity, however more research was needed to understand the role of nicotine, flavorings, and the effects e-cigarette aerosols have on lungs through habitual usage (Chun et al., 2017). E-cigarettes also fail to have a noticeable 'end-point' where traditional combustible cigarettes shorten when their use is expired as opposed to e-cigarettes that allow users to continuously use their device (Singh et al., 2020). Consequently, this makes e-cigarettes more dangerous as they can endure over longer periods of time with repeated and frequent use (Singh et al., 2020). As e-cigarettes differ from traditional combustible tobacco in both form and components, one major difference between them is that e-cigarettes have the power to change certain elements during use.

E-cigarettes, unlike traditional combustible tobacco, can alter the amount of nicotine that is consumed during use (Bhatt et al., 2020). The level of nicotine that is absorbed in the blood can be adjusted based on the user's ability to change the duration of their puff, and the puffing topography (Bhatt et al., 2020; Walley et al., 2019). Such methods include increasing the voltage of the battery or "dripping", which involves pouring the e-liquid solutions onto the coils, which can make it easier for teenagers and young people as well as inexperienced users to inhale (Jenssen & Boykan, 2019; Walley et al., 2020). Higher levels of nicotine exposure encourage more frequent use and stronger likelihood of becoming addicted to tobacco (Gaiha et al., 2020). As e-cigarettes can introduce nicotine addictions to teenagers and young people, this can make them more susceptible to trying additional harmful substances.

Teenagers and young people who initiate in e-cigarette use are up to four times as likely to use regular cigarettes, cannabis, and other substances, as well as become poly substance users (Jenssen & Boykan, 2019; Walley et al., 2020) The guiding principle for e-cigarettes should be that they are harmful to the individual, in both short-term and long-term contexts (Walley et al., 2019). Furthermore, most teenagers and young people who initiate in e-cigarettes are classified as "never" or "non" users while still suffering from the negative consequences of e-cigarette use (Sapru et al., 2020). They (e-cigarettes) should be considered a new way to trap new users among teenagers and young people with a nicotine addiction (Bhatt et al., 2020). E-cigarettes should not be used by teenagers or young people by any means or context, as it increases their risk for additional substance abuse and possible life-long dependency on nicotine (ALA, 2020; CDC, 2022;

HHS, 2021; Jenssen & Boykan, 2019; Shinbashi & Rubin, 2020). Therefore, the prevention of use in e-cigarettes among teenagers and young people should be prioritized. Working with this age group could prevent future use of traditional tobacco products, as well as the experimentation of other harmful substances.

E-Cigarettes Misconstrued as a Healthy Alternative to Smoking

It is a common misconception that using e-cigarettes are considered healthier and safer than combustible tobacco products, however there was not enough research to support this claim. Morean et al (2019) determined that despite JUUL, a popular e-cigarette manufacturer, advertised that their products contain 5% nicotine, many teenagers and young people perceive themselves to be at lower to moderate risk of nicotine addiction compared to traditional cigarettes. E-cigarettes have been misconceived as healthy alternative to traditional cigarettes and the product is appealing to multiple populations, including current smokers, former smokers, and teenagers/young people (Gotts et al., 2019; Park et al., 2021; Ratajczak et al., 2018; Sapru et al., 2020). Due to its nature as a newly introduced product, it cannot be considered a healthy intervention or a safe alternative to cigarettes (Gotts et al., 2019; Park et al., 2021; Ratajczak et al., 2018; Sapru et al., 2020). Children, teenagers, and young people who believe that e-cigarettes are less harmful than traditional combustible tobacco products are more likely to experiment and initiate in e-cigarettes (Bhatt et al., 2020). The e-cigarette is still a relatively new product, and due to its constant evolving nature, it makes conducting consistent research difficult (Walley et al., 2019). As such e-cigarettes cannot be considered safe to consume by the human body for any reason.

The FDA does not approve the e-cigarette as a safe alternative and smoking cessation tool (Borrelli & Connor, 2019), even though e-cigarettes do not contain tar, and do not require a combustible element to ignite the product (Jenssen & Boykan, 2019). E-cigarettes are not recommended to be identified as a safe pharmacotherapy, nicotine replacement therapy, or clinical cessation intervention in place of traditional combustible tobacco by multiple health authorities, including the WHO, FDA, National Academies of Sciences, Engineering, and Medicine, and the American Academy of Pediatrics (Gaiha et al., 2020; Walley et al., 2019). It is the general conclusion of numerous health experts throughout the world: CDC, ALA, U.S. National Academies of Science, Engineering, and Medicine, Australian Commonwealth Scientific and Industrial Research Organization, Forum of International Respiratory Societies, the European Public Health Organization, the European Commission, and the WHO, that the e-cigarette will lead to a new generation of nicotine addicts (Bhatt et al., 2020). While the e-cigarette user is susceptible to various injuries and diseases caused by the chemicals/elements found in the e-liquid (ALA, 2020), they are not the only ones at risk to develop diseases. Those in the individual's general vicinity also become exposed and potentially susceptible to the negative effects of the secondhand smoke.

Many users of e-cigarettes believe that the secondhand aerosol they expel is considered steam and is harmless to inhale (Bhatt et al., 2020; Ratajczak et al., 2018), however that is not true. The aerosols that come from e-cigarettes are unhealthy and can cause negative health outcomes to others who are exposed to secondhand smoke formed from e-cigarette users (ALA, 2020; CDC, 2021b; National Institute on Drug Abuse

[NIDA], 2021), including impaired respiratory health (Ratajczak et al., 2018). The secondhand smoke from e-cigarettes contains toxicants and carcinogens that are harmful to small children (Jenssen & Boykan, 2019). Secondhand smoke exposure in all age demographics increases morbidity and mortality rates (Ling et al., 2020), however when teenagers, young people, and children are exposed they are more likely to initiate in smoking (HHS, 2021). Protecting teenagers and young people from e-cigarettes means restrictions that encompass both consumption and use by the individual, and ways to protect the people around individual's who use e-cigarettes from their secondhand smoke expulsions. Such laws and regulations within the United States have been able to enforce such protections, however the presence of e-cigarette use within the nation currently remains a topic of focus.

Smoking in the United States and the State of Nevada

The Tobacco Control Act of 2009 granted the FDA the authority to regulate the access of tobacco products to minors, however the statute also stated that the act applied only to certain products that did not originally include e-cigarettes, allowing additional products to come into the market (Aaron, 2021). It was not until 2016 when the Deeming Rule was formulated to expand the authority of the FDA over all products that met the official definition of a tobacco product: "Any product made or derived from tobacco that is intended for human consumption, including any component, part, or accessory of a tobacco product" (Aaron, 2021). In 2019 when former President Trump signed into legislation the Tobacco 21 Act, it raised the age for legally selling tobacco products to individuals over the age of 21, three years higher than what was stated in the FDA

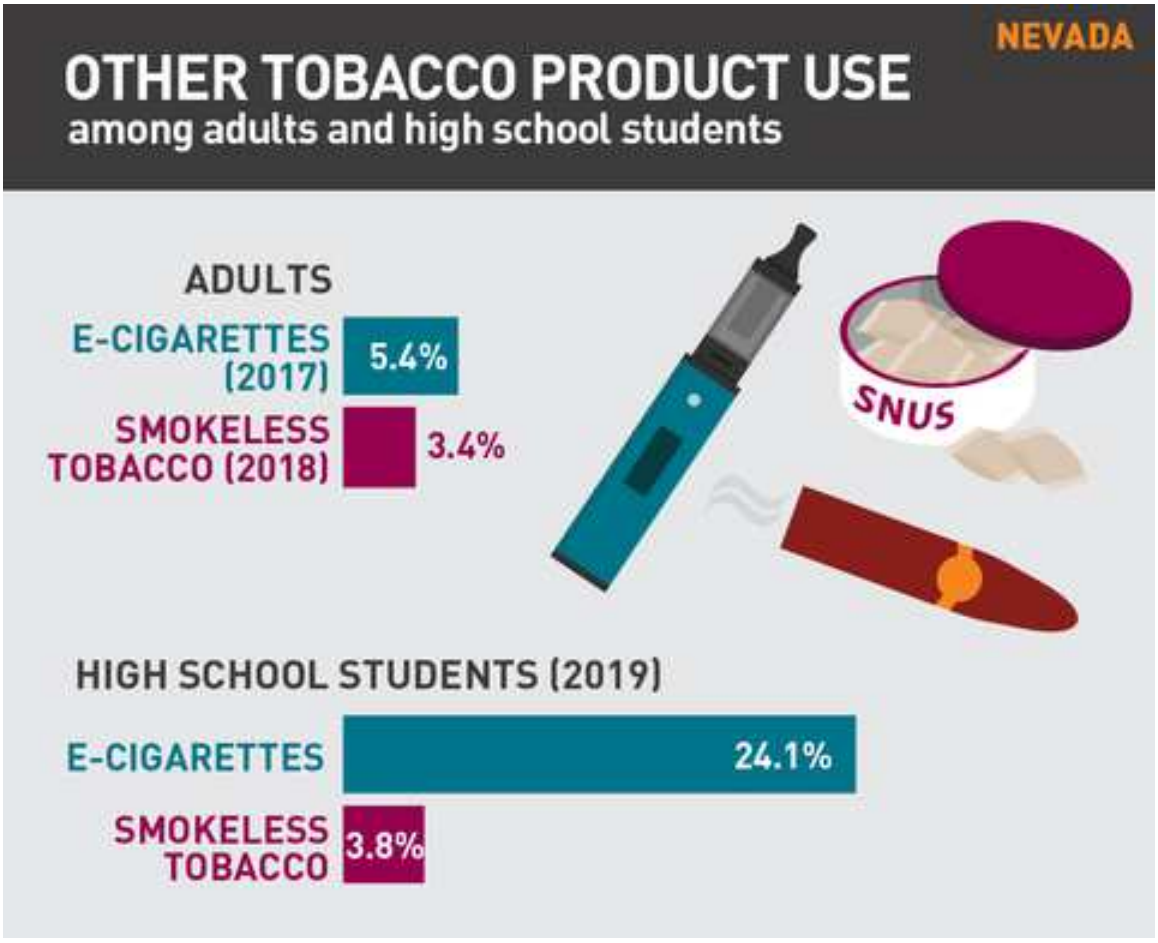
Cosmetic Act (FDA, 2021). While this act helped increased the number of protections for teenagers and young people from being able to purchase e-cigarettes and adopted universally for the entire country (FDA, 2021), e-cigarette initiation and use was still considered high (CDC, 2022). Although there have been amazing strides in promoting smoke-free areas and regulations (Campaign for Tobacco Free Kids, 2021; Jenssen & Boykan, 2019), the enforcement of comprehensive smoke-free laws is not universal within the United States. As it stands, not all states have enacted comprehensive smoke-free laws to protect individuals from the harmful effects of e-cigarettes and the secondhand aerosols.

Nevada has not enacted a comprehensive tobacco law and is the only state within the United States that does not have any local smoke-free workplace law (American Nonsmoker's Rights Foundation, 2022). E-cigarette smoking in Nevada is on the rise according to the Nevada Tobacco Prevention Coalition, with the state experiencing an increase of 45% within youth e-cigarette use from 2017 to 2019 (2021). In 2017, Nevada was identified as the state with the eighth highest youth e-cigarette use rate among all states in the country (CDC, 2021b). In one study conducted by Pearson et al. (2021), they determined that middle school and high school students in the state Nevada who used e-cigarettes were more likely to become poly-substance users. Also, in comparing age groups, high school students are more likely to use e-cigarettes than adults (see Figure 6 below). However, state legislation in Nevada does not allow for a ban of tobacco products, instead enforcing law that targets the restriction of exposure to secondhand smoke in various setting such as areas that allow minors and public buildings where

vulnerable populations like pregnant women or children may traverse under the Clean Indoor Air Act (Southern Nevada Health Department [SNHD], 2020). Comprehensive smoke-free laws and legislation have been considered one the grandest achievements in public health, protecting hundreds of millions of people from exposure to secondhand smoke (Jenssen & Boykan, 2019). The presence of strict comprehensive smoke-free laws is the only way to truly protect nonsmokers from being exposed to secondhand smoke in public capacities such as workplaces, as opposed to sectioned-off areas that allow smoking or ventilation systems meant for cleaning the air of smoke particles (CDC, 2021b). It has been previously stated that e-cigarettes differ from traditional combustible tobacco products, therefore such a distinction must be made clear. In the state of Nevada, such a definition helps clarify what classifies a vapor product as an e-cigarette against what is a considered a traditional combustible tobacco product.

Figure 6

E-Cigarette use Among Nevada Residents



Note. From the Truth Initiative, 2022. (https://truthinitiative.org/research-resources/smoking-region/tobacco-use-nevada-2021) In the Public Domain.

According to the Nevada Revised Statutes, e-cigarettes fall under the term vapor product, and is defined as follows:

> 1. Means any noncombustible product containing nicotine or any other substance that employs a heating element, power source, electronic circuit or other electronic, chemical, or mechanical means, regardless of the shape or size thereof, that can be used to produce vapor from nicotine or any other substance in a solution or other form, the use or inhalation of which simulates smoking.
>
> 2. Includes, without limitation:
>
> (a) An electronic cigarette, cigar, cigarillo, pipe, hookah, or vape pen, or a similar product or device; and
>
> (b) The components of such a product or device, whether or not sold separately, including, without limitation, vapor cartridges or other container of nicotine or any other substance in a solution or other form that is intended to be used with or in an electronic cigarette, cigar, cigarillo, pipe, hookah, or vape pen, or a similar product or device, atomizers, cartomizers, digital displays, clearomizers, tank systems, flavors, programmable software or other similar products or devices. As used in this paragraph, "component" means a product intended primarily or exclusively to be used with or in an electronic cigarette, cigar, cigarillo, pipe, hookah, or vape pen, or a similar product or device.
>
> 3. Does not include any product:

(a) Regulated by the United States Food and Drug Administration pursuant to subchapter V of the Federal Food, Drug, and Cosmetic Act, 21 U.S.C. §§ 351 et seq.

(b) Subject to the excise tax on cannabis or cannabis products pursuant to NRS 372A.200 to 372A.380, inclusive.

(c) Purchased by a person who holds a current, valid medical cannabis establishment license pursuant to chapter 678B of NRS.

(Added to NRS by 2015, 2496; A 2019, 3590, effective July 1, 2020)

To protect Nevada residents, the Clean Indoor Air Act was passed in 2006 and revised in 2019 to include "vapor products" such as e-cigarettes (SNHD, 2020). This law allows for the use of smoking products in specified locations that protects women and children and prohibits entry from minors including casinos, taverns, bars, saloons, retail tobacco stores, strip clubs, brothels, and tobacco conventions/trade shows (SNHD, 2020). According to the WHO at the Geneva Convention (2004), the only effective measure to prevent exposure to smoking and smoking byproducts is the complete elimination of smoking within indoor environments. Consequently, the state of Nevada is a prime location to explore how e-cigarette use affects teenagers and young people.

Impact of Parent Involvement With Developing Children

This study focuses on how teenagers and young people develop health-related behaviors and perceptions in relation to e-cigarettes, which was why focus was placed on key individuals that directly shape adoption of health-related behaviors. Parents and guardians play a critical role in a teenager and young person's life, as the

parent/guardian's attitudes directly affect their children (Brown et al., 2020; Trucco et al., 2020). There is a lower likelihood that teenagers and young people will participate in e-cigarette behaviors or initiate if the attitudes of their parents correlate smoking to negative outcomes (Brown et al., 2020). When parental perceptions of e-cigarette use, expectancies, intentions, and norms are negative, the child is more likely to avoid use (Trucco et al., 2020). If e-cigarettes and e-cigarette smoking are considered normal then the teenagers and young people will perceive it as normal and are more likely to stimulate experimentation with e-cigarettes (Fite et al., 2018; Trucco et al. 2020). Han & Son (2020) determined that teenagers/young people that initiate in e-cigarettes are more likely to come from a home where family members also smoke and have a greater risk of being exposed to secondhand smoke. Hence the parents, guardians, and family members who are in the teenager/young person's home can directly affect their perception on using an e-cigarette. With the parent/guardian's perceptions identified as a major predictor of e-cigarette initiation and use among teenagers and young people, they can also place additional stressors on their children that may push them into using e-cigarettes.

Parents and guardians play a direct role in the way that teenagers and young people perceive experiences and behaviors and can easily encourage risky behaviors that lead to poor health outcomes within the home environment. Evidence found multiple factors that associate to e-cigarette use such as flavors, advertisements, close friends who also smoke, poor relationships, and low socioeconomic status, parents and guardians who smoke tobacco products or who use e-cigarettes directly affects how teenagers and young people perceive the effects of tobacco (Ho et al., 2019). Parents, guardians, and

caregivers play a major role in shaping views and perceptions around e-cigarettes and smoking, despite accounting for the social norms that teenagers and young people face when they meet with their peers (Trucco et al., 2021). Parent/guardian/caregiver use of e-cigarettes greatly increases the risk of e-cigarette use among teenagers and young people (Bailey et al., 2022). Therefore, the way that parents and guardians approach and perceive such behaviors and attitudes related to e-cigarettes have a powerful impact on teenagers and young people.

Academic Performance and Achievement in Teenagers and Young People

According to Dearfield et al. (2021) and Doxbeck (2020), youth within the United States are more likely to perform lower in academic settings when they initiate in e-cigarette and cigarette smoking. McCabe et al. evaluated possible problem behaviors linked to e-cigarette use among high school students within the U.S. (2017), and they determined that seniors who were dual users were more likely to suffer lower academic performance and higher rates of truancy. This can be tied to the nicotine found in e-cigarettes, as nicotine affects restful sleep, which is directly linked to positive cognitive functioning within classroom settings (see Dearfield et al., 2021). Additionally, the development of smoking behaviors is directly related to absenteeism which is a common factor in lower academic performance (Garcia & Weiss, 2018). One such study conducted by Jenson (2018) to evaluate psychosocial and behavioral risk factors among adolescents in Minnesota identified similar findings regarding the association between poor academic performance and e-cigarette use. Students who reported mostly Bs were more than twice as likely to have used e-cigarettes than students who had reported mostly

A's, and students that reported mostly Fs were almost four times as likely to report e-cigarette use (Jenson, 2018). As students strive for their best academic performance in schools, the added pressure that comes from maintaining excellent scholastic standing can adversely affect the morality of teenagers and young people (Zhao et al., 2020). Observing the academic performance and achievement in teenagers and young people becomes an ideal way to predict e-cigarette use. However, not all students are truthful when reporting their academic performance.

As McCabe et al. (2017) recognizes academic performance as a critical component in examining possible correlations to e-cigarette use, I needed to consider that teenagers and young people can be dishonest when self-reporting their academic performance. Teenagers and young people are more likely to cheat or be dishonest about their academic performance when there is a greater yield for reward but can fill an individual with feeling of shame and regret (Azar & Applebaum, 2020). Moreover, parents may assist their children with academic issues at home as a method to succeed but can lead their child to believe that certain circumstances allow dishonesty (Azar & Applebaum, 2020). Concepts like praise for children then become a contradiction, where children then believe that their recognition for academic success becomes tied directly to their parents' approval.

Praising children for academic performance can move beyond what is considered positive encouragement and can influence a child to be dishonest in their scholastic accomplishments, thus shaping their morality (Zhao et al., 2020). This can lead children to believe that cheating and dishonesty is acceptable if it means garnering praise while

creating a fear of failing parental/familial values (Fletcher et al., 2017). Cheating is not considered an innate behavior, but rather a choice that is learned as young children mature (Amato et al., 2020; Azar & Applebaum, 2020) Older children are found to be more honest when reporting academic performance than younger children as they may be taught to be more independent at a later age (Amato et al., 2020; Azar & Applebaum, 2020). Still, parents and guardians should be mindful of how involved they become with their children's studies, as this can have both positive and negative outcomes.

Children are easily affected by their parent's involvement in their academic activities according to Brajsa-Zganec et al., who determined that a child's scholastic performance and achievement were directly correlated to their parent's involvement and supervision in school-related activities (2019). However, there are also negative consequences associated with parents who find themselves too involved in their child's success, which can lead to adverse psychological trauma through overparenting (Fletcher et al., 2017). Children who experience overparenting are more likely to experience negative psychological outcomes such as anxiety, depression, and an overwhelming fear of academic failure and poor scholastic performance (Fletcher et al, 2017). As a result, teenagers and young people may be more dishonest when it comes to self-reported academic performance and more likely to engage in unethical behaviors such as smoking (Fletcher et al, 2017; Isakov & Tripathy, 2017). Additionally, parents who attempt to help their child succeed may place incorrect moral values in the child, thereby teaching them that unique circumstances may allow them to be dishonest if certain rewards are available (Azar & Applebaum, 2020; Isakov & Tripathy, 2017). Therefore, it was crucial

to understand how powerful the influence of parents and guardians are on teenagers and young people. This calls for a need in evaluating the environments that teenagers and young people are immersed in as it relates to their ability to self-report their academic ability to their peers and family.

Ultimately, the academic performance and academic honesty of teenagers and young people are affected by the people around them and their perception of their environment. This evidence explains that the environment teenagers and young people are in was a critical element in determining academic dishonesty as well as the adoption of health-related behaviors. However, this also means that environments with negative circumstances can directly affect a teenager/young person's decision to initiate in e-cigarettes.

The Effects of ACEs

Teenagers and young people who suffer from ACEs are more likely to participate in cigarette/e-cigarette use (Martinasek et al., 2021). ACEs include physical, psychological, and sexual abuse (Martinasek et al., 2021; O'Neill et al., 2018), and are categorized into two main groups: child maltreatment and household challenges (Ofuchi et al., 2020). Per Williams et al. (2020), they reported the association between ACEs and electronic vapor product use among middle school students, one in five middle school students reported using an e-cigarette and 5% of the participants self-reported initiation before the age of eleven. Teenagers and young people who have suffered greater than four ACEs had a significantly higher risk of participating in e-cigarette use (Martinasek et al., 2021; Ofuchi et al., 2020), and those who have suffered from maltreatment from

their family were greatly associated with lifetime e-cigarette use (Shin et al., 2019). Middle school and high school students who suffered from ACEs like depression were more likely to suffer from poly-substance abuse, and the presence of family and friends had greater influence on whether students would initiate or continue substance abuse (Pearson et al., 2021). As such, analyzing the effects of ACEs on teenagers and young people becomes paramount in understanding e-cigarette use. While ACEs are common in the household with parents/guardians, one of the most common ACEs that occurs within this age demographic occurs within the school environment.

Cyberbullying

Many studies have shown another phenomenon associated with e-cigarette use by teenagers and young people: cyberbullying. Defined as an aggressive attack on others through electronic means and technologies (Guo et al., 2020), it is most common among teenagers and young people in middle school and high school (Larson et al., 2018; Pichel et al., 2022). While there are various roles in a cyberbullying event, it is the victim of cyberbullying that has the strongest association with e-cigarette use. However, additional research determined that all roles within a cyberbullying attack, victim, witness, or perpetrator, increases the risk of participating in e-cigarettes and future poly-substance abuse (Larson et al., 2018; Pichel et al., 2022; Yoon et al., 2019). Thus, all roles in cyberbullying must be taken into consideration when identifying associations to e-cigarette use. Whether an individual is the instigator or the victim, bullying as a physical confrontation or an electronic one can lead to negative emotional outcomes (Afifi et al.,

2020). Bullying should be prevented in all environments to prevent possible upsetting outcomes that can lead to possible initiation in reckless behavior like substance use.

Bullying, both in person and electronically, is a common experience among teenagers and young people, and can have traumatic effects (Afifi et al, 2020). According to Doxbeck (2020), bully victimization through physical and online environments was significantly related to e-cigarette use among high school students. Teenagers and young people who were subjected to being cyberbullied were more likely to initiate in and participate frequently in e-cigarettes (Doxbeck, 2020). Individuals who have been cyberbullied who partake in substance abuse was partially mediated by psychological distress (Cenat et al., 2018). Individuals who suffer from cyberbullying are 2.5 times more likely to partake in alcohol and substance abuse (Cenat et al., 2018), and females were more likely to initiate in e-cigarette use when victimized by bullying than men in high school (Azagba, 2020; Shah et al., 2019). Victims of cyberbullying seek solace in substance abuse and alcohol (Cenat et al, 2018), and students who suffer from cyberbullying are more likely to report risky behaviors such as substance abuse related to smoking behaviors (Long & Dowdell, 2021). To help protect and prevent possible future e-cigarette use, cyberbullying must be monitored or in more ideal circumstances prevented.

The Home Environment

Additionally, the home environment also plays a major role in the development and maintenance of behaviors among teenagers and young people and can lead to negative health outcomes. The presence of homelessness within this age range

exacerbates the development of negative health outcomes and increases the likelihood of poor health, reduced education, social isolation, lowered economic success, and psychological stress and trauma (Heerde et al., 2022; Labelle et al., 2022). Nearly all of teenagers and young people that suffer from homelessness suffer from some form of mental health disorder (Dzubur et al., 2022). The presence of homelessness among this age group increases their risk of initiating and maintaining negative health behaviors such as substance abuse (Glasser et al., 2022; Milburn et al., 2021; Rew et al., 2022). Multiple factors in the home environment directly affect the development of behaviors and habits in teenagers and young people due to trauma, poor family function and the presence of family conflict (Milburn et al., 2019). Individuals in this age group and who suffer from homelessness are more vulnerable to adverse health behaviors such as e-cigarette use, thus their health must be prioritized.

Prevention efforts related to e-cigarette use needs to focus on teenagers and young people who have suffered or may suffer from an ACE (Ofuchi et al., 2020). Prevention strategies can provide additional support for campaigns against the initiation of smoking habits (Martinasek et al., 2021; Williams et al., 2020). Protecting teenagers and young people from such adversities can prevent associated use with various substances such as e-cigarettes (Shin et al., 2019). Therefore, the presence of ACEs in a major predictor of e-cigarette use in both the home and school atmospheres. The analysis of specific ACEs such as cyberbullying in school and being homeless will help uncover additional ways to prevent e-cigarette use.

Definitions

Adverse childhood events/experiences: Potentially traumatic events that occurring within childhood and up to young adulthood, that can create long-term and negative effects on an individual's health, development, or well-being (O'Neill et al., 2018).

Cyberbullying: Aggressive and negative behaviors that target an individual or a group of individuals using electronic devices/means (Guo et al., 2021).

E-cigarette: Also known as an e-cig, cig-a-like, vape, vape pen, mod, tank system, or electronic nicotine delivery system, it is an electronic device that imitates the effects of cigarettes through a heating element applied to nicotine (Aaron, 2021; CDC, 2021b; Sapru et al., 2020).

E-cigarette use: The use of e-cigarettes, as many believe they inhale a vapor as opposed to an aerosol (ACA, 2022).

Homeless/homelessness: For the sake of this study, the situation presented to teenagers and young people who live independently from their parents/guardians/caregivers but lack the ability to maintain a safe or stable home/residence (Labelle et al., 2022).

Teenagers and young people: For the sake of this study, teenagers and young people are defined as individuals between the ages of 12-18 as provided by the NHSYBS (2018), as well as encompassing the age range set forth by the United Nations (2021).

Traditional combustible tobacco/traditional combustible cigarette: Tobacco products that require a combustible element to ignite it for use and consumption (Primack et al., 2015).

Assumptions

Multiple assumptions were considered appropriate in this study. First, the data used for this study was the 2019 National YRBS and as this study was a secondary analysis, it was assumed that the data came from an appropriate sample that represents the target population. This study assumed that all respondents who were categorized under Nevada answered this survey from Nevada are residents in the state of Nevada. The sample that came from this survey focused on the target population demographic of teenagers and young people within the state of Nevada in the United States, and provided the appropriate variables as sought out by this study for the exploration of possible associations. Therefore, this data was assumed to be suitable to examine the possible association between the IVs of academic performance and e-cigarette use among teenagers and young people with the MVs of ACEs in the school and home setting. Secondly, I assumed that these are students who have not initiated previously in e-cigarette use or in smoking-related health behaviors. Thirdly, I assumed that the academic performance reported by each individual within the study was considered an accurate depiction of their academic performance, despite studies that find students to be dishonest when self-reporting such information based on a variety of factors, including the perception of or lack thereof for an external reward, the lack of motivation to succeed, and/or if the skills learned within a classroom will create a sense of skill mastery that will be useful to them as individuals (Krou et al., 2020). These assumptions become essential when evaluating the secondary data provided by the 2019 National YRBS to complete the required analyses set forth by the research questions.

Scope and Delimitations

In this study, I assumed that the presence of both academic performance in conjunction with ACEs would associate with e-cigarette use among the target population of teenagers and young people within the state of Nevada. These variables were controlled to determine if such a relationship existed. As a quantitative study, the number of participants that met the criteria for inclusion was based upon secondary data that was collected within the 2019 National YRBS. Teenagers and young people that fell within the criteria for inclusion were evaluated and selected, following the age range defined by the United Nations (2021). Therefore, teenagers and young people below the age of 12 were excluded. High school students within the state of Nevada were targeted for the completion of this study. The focus on this group was defined by multiple authorities that identify individuals within the desired age range of individuals who frequently use e-cigarettes more than any other age group (CDC, 2022, FDA, 2021; WHO, 2021). Due to the varying laws regarding tobacco-free campaigns among the different states, this study could not be considered nation-wide. Thus, the study may not be generalizable to the United States, as it encompasses one state within the nation.

Limitations

There are various limitations to consider within this study. First, the data comes from secondary data that was recorded and made public from a previous study. Thus, the collection of data, chosen variables, and responses are based upon the previous researchers and their original study design. Second, was the presence of academic honesty and dishonesty among the self-reported academic performance among teenagers

and young people. There was a possibility that results are under or over reported based on what was recorded within the survey. Finally, this study was of quantitative design using binary logistic regression analysis with MVs, with the second and third research questions utilized mediation analysis with regression. As there was evidence that academic performance and the presence of ACEs associate positively with e-cigarette use, this study will explore how these two variables interact with each other through the presence of mediating circumstances, and if there are other potential relationships to be determined.

Significance

The results of this study may uncover additional associations that can predict e-cigarette use among teenagers and young people. As this study targeted individuals who have suffered from different ACEs, which have proven to positively associate with smoking-related behaviors and e-cigarette use, it has the potential to create social change by predicting e-cigarette use based on different measurable factors. The results of this study may improve the identification of experiences such as cyberbullying in school and emotional distress at home as predictors of e-cigarette use. Thus, this study has the capacity to create positive social change by increasing the current knowledge related to factors that can predict e-cigarette use among teenagers and young people.

Summary and Conclusions

This research targeted and examined if there was a possible association between self-reported academic performance and e-cigarette use among teenagers and young people within the state of Nevada. Additionally, this relationship will be evaluated further

if the presence of ACEs mediates this relationship. Evaluation of current research has determined that the academic performance and ACEs influence e-cigarettes behaviors independently but do not address how these two variables interact with each other when evaluating the presence of ACEs. This research will help facilitate the need to monitor behaviors in teenagers and young people while assisting in the creation of possible public health interventions to prevent cigarette smoking behaviors. This gap in the literature from current research within the last five years of study will be filled to help future research understand possible associations to predicting cigarette use in teenagers and young people. As this target population was focused on the state of Nevada within the United States, these results could lead to additional interventions applicable in other states of the nation.

The next section will focus on the research study design and the data collection used for this study. This will include the rationale for the study design, the methodology, size, sampling, threats to validity and a summary.

Section 2: Research Design and Data Collection

Introduction

The purpose of this retrospective quantitative study was to determine if there was an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada. The IV was academic performance, and the DV was e-cigarette use. Additionally, I determined if this association was mediated by the presence of ACEs through two MVs: cyberbullying in the school environment and the presence of homelessness in the home environment.

Section 2 of this study includes the research design and rationale, methodology (including population, sampling procedures, and operationalization of variables), the data analysis plan, threats to validity, and associated ethical procedures.

Research Design and Rationale

The goal of this study was to determine if there was an association between an individual's academic performance and e-cigarette use. Furthermore, I explored if the presence of different ACEs mediated this association. The IV was the individual's self-reported academic performance. The DV was e-cigarette use as reported by the individual. The MVs included the presence of ACEs in the form of cyberbullying and the presence of homelessness. Covariates included age, sex, race, and ethnicity. The target population was classified as individuals in the state of Nevada in the United States, with a focus on teenagers and young people between the ages of 12 and 18.

This study was retrospective and of quantitative design to determine if there was an association between academic performance and e-cigarette use in teenagers and young

people in the state of Nevada. To answer the research questions I used quantitative, secondary data provided by the 2019 National YRBS. This survey was of cross-sectional design and was administered to all high schools within the United States. The quantitative research design was deemed suitable for this study, as it allowed teenagers and young people to share and self-report their experiences with e-cigarettes, academic performance, and ACEs.

Out of all available research designs, binary logistic regression was the most optimal method to explore if there was a relationship between academic performance and e-cigarette use. This was determined after review of the secondary data summarized by the 2019 National YRBS and review of the variables of interest for this study. Binary logistic regression analysis explores the possible association between one or more IV and a DV using a linear prediction model (Frankfort-Nachmias et al., 2021). In binary logistic regression, the IV was identified as continuous, ordinal, or categorical (academic performance), and the DV was ordinal, categorized, and dichotomous (e-cigarette use). The 2019 National YRBS survey was used as the 2021 was not publicly released or accessible.

Upon review of the data, there were no noticeable time and/or resource constraints that hindered the collection of data from the 2019 National YRBS or in the design of this study. Utilization of secondary data reduced the amount of time needed to create survey instruments and collecting data from teenagers and young people within the state of Nevada. Use of this secondary data allowed for the scope of this study to encompass the state of Nevada.

Methodology

Population

For this research study, I focused on individuals between the ages of 12 and 18 within the state of Nevada. This age group was recognized as a focal point of this study as they use e-cigarettes the most of all age groups (see CDC, 2022; FDA, 2021; WHO, 2021). Additionally, the age range of 12 to 18 years old was determined by the United Nations in defining individuals who fell within this group designated as teenagers and young people; however, Nevada did not submit middle school data in 2019 (CDC, 2021). Also, Nevada has been recognized as the only state without a comprehensive tobacco law (American Nonsmoker's Rights Foundation, 2022). The resulting sample size for the 2019 National YRBS was approximately 1,400 students. For the first research question, the sample was evaluated to compare if there was an association between academic performance and e-cigarette use while controlling for age, sex, race, and ethnicity. If such a relationship existed, the second and third research questions were investigated. Both were evaluated by observing respondents who positively answered to suffering from ACEs in the form of cyberbullying and the presence of homelessness.

Sampling Procedure

The National YRBS was created to help monitor and observe causes of disease and health outcomes among youth, including sexual behaviors, smoking habits and behaviors, alcohol use, and physical activity (CDC, 2020a). It is a self-administered survey that is distributed on a bi-annual basis to students between ninth and twelfth grade during the spring term. The schools who participated encompassed both public and

private schools within the United States, which evaluated responses within each state. According to the CDC, since its initial administration in 1990, the National YRBS has had multiple studies conducted between 1992 and 2008 to improve the quality of the data content. Currently, the National YRBS is designed to observe changes in health behaviors among teenagers and young people over time in terms of prevalence, incidence, and recurrence while allowing researchers to compare between different areas on multiple jurisdictions including city, state, and national areas.

The National YRBS administered by the CDC is a national survey to youth and adults within the United States (CDC, 2020). Students may participate with the consent of their parents/guardians while their identities are kept anonymous. This survey monitors six main categories of health behaviors among both youth and adult demographics. This includes sexual behaviors, alcohol and other drug use, tobacco use, unhealthy dietary behaviors, and inadequate physical activity. Originating from a morbidity and mortality report with a focus on teenagers and young people in the United States, the CDC (2020) determined that many deaths (approximately 70%) are attributed to one of four major areas: car accidents, unintentional harm, homicide, and suicide, which led to these areas of focus. This survey has been revised to monitor for additional health conditions such as obesity and asthma. The National YRBS was considered the primary source of information regarding health behaviors of middle school and high school students in the country and is consistently referenced for the improvement of health policy and programs aimed at this age group.

Validity and reliability tests were conducted on the National YRBS in three different stages to help evaluate the development of the questionnaire (Brener et al, 2013). The first in 1989 was reviewed by different education agencies representing each state as well researchers and reviewers from the CDC's National Center for Health Statistics. The second evaluation occurred during the spring of 1990 to clarify nomenclature and responses. The third and final evaluation in October of 1990 combined revisions from the two previous evaluations and suggestions from the CDC's steering committee and methods for measuring progress towards nationally recognized objectives towards optimal health. Because of this, the National YRBS is conducted on a biannual basis during every odd year to accommodate for the gradual changes that take place with changes in behavior.

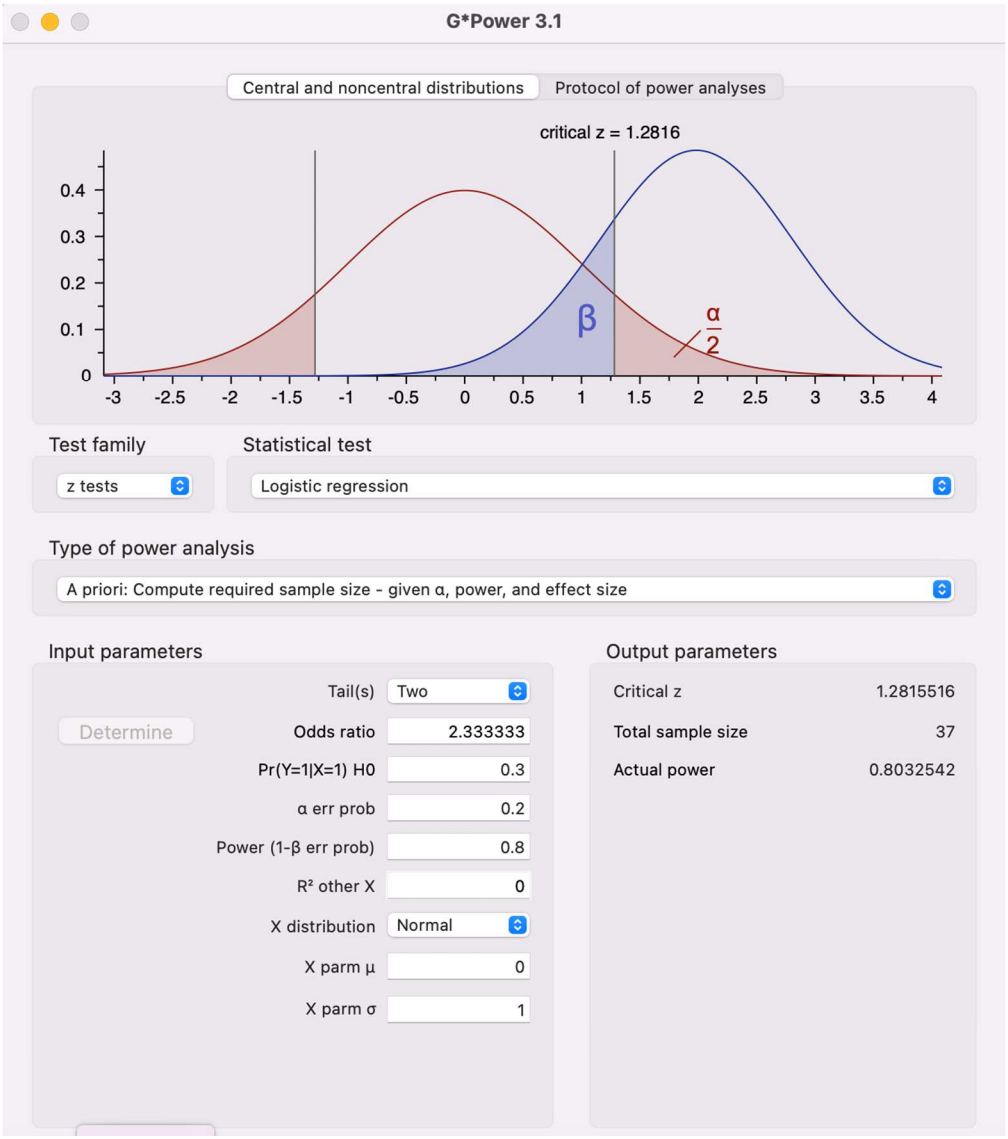
Furthermore, two test-retest reliability studies were conducted in a longitudinal study comparing the questionnaire in 1992 and 2000 by the CDC (Brener et al., 2013). Both tests were administered at two-week intervals, the first in 1999 to approximately 1,600 students, and the second in 2000 to 4,600 students. It was determined by the CDC (Brener et al., 2013) that despite this survey utilizing self-reported data, it does not significantly impact the reliability for cognitive and situational factors. Additionally, the CDC conducted a validity test in 2000 on the height and weight of students comparing their self-reported data to their actual measurements. Students overreported their height by three inches and underreported their weight by three pounds; however, the results remained substantially reliable.

The 2019 National YRBS was reviewed for this study, as the 2021 survey was not currently available. Reports and previously collected data was made publicly accessible by the CDC website under YRBSS Data and Documentation (see CDC, 2021). Data are electronically available in two formats: Access ® and ASCII.

A power analysis was completed to determine the sample size, effect size, alpha level, and power level appropriate for this study using the G*Power Software Version 3.1.9.7 (Kang, 2021). To complete an A priori power analysis, *z* tests were chosen for the test family, and logistic regression was chosen for the desired statistical test. Alpha level was defaulted to .05, as it is considered the most used alpha statistical evaluations, as power was defaulted to 0.8 (Frankfort-Nachmias et al., 2021). The estimated sample size required for this study was calculated to 37 (See Figure 7 below).

Figure 7

*Sample Size Calculation for one Predictor in G*Power 3.1*



Operationalization

The variables explored for this study were the IV, academic performance, and the DV, e-cigarette use. Academic performance was classified as an ordinal variable, measured by the following question: During the past 12 months, how would you describe your grades in school? This question was available as Question 89. Respondents could answer from mostly As, mostly Bs, mostly Cs, mostly Ds, mostly Fs, none of these grades, or not sure.

E-cigarette use, was classified as dichotomous, and was asked as the following: Have you ever used an electronic vapor product? This question was available as Question 34, and respondents could answer as either yes or no.

The second and third research questions asked if the presence of ACEs mediated the association between academic performance and e-cigarette use. The ACE in the form of cyberbullying was found in the following question: During the past 12 months, have you ever been electronically bullied? (Count texting, Instagram, Facebook, or other social media). This variable was nominal and dichotomous and was identified as Question 24. Respondents could answer either yes or no.

The ACE, the presence of homelessness, was found in the following question: During the past 30 days, where did you usually sleep? This question was classified as categorical, and respondents could choose from the following: in my parent's or guardian's home, in the home of a friend, family member, or other person because I had to leave my home or my parents or guardian cannot afford housing, in a shelter or

emergency housing, in a motel or hotel, in a car, park, campground, or other public place, I do not have a usual place to sleep, or somewhere else.

The covariate variables included the age, sex, race, and ethnicity. This was because age, sex, race, and ethnicity do not directly affect the possible association between academic performance and e-cigarette use, but they help assist explaining the variability of this possible outcome (Field-Fote, 2019). Age was classified a continuous interval variable, determined by Question 1: How old are you? Students could select 12 years old or younger, 13 years old, 14 years old, 15 years old, 16 years old, 17 years old, or 18 years old or older.

Sex was classified as a dichotomous nominal variable asked as follows: What is your sex? in Question 2. Respondents could answer with female or male.

Ethnicity was classified as a dichotomous nominal variable, asked as follows in Question 4: Are you Hispanic or Latino? Respondents could answer as yes or no. This question was followed up by asking the respondent of their race. Race was categorical and nominal, asked as Question 5: What race are you? Respondents could multiselect from American Indian, Asian, Black or African American, Native Hawaiian or Pacific Island, or White if applicable. Please see Table 1 below for the operationalization of variables for this study.

Table 1

Operationalization of Variables

Variable name	Type	Categorization	Level of measurement
Academic performance	Independent	During the past 12 months, how would you describe your grades in school? A. Mostly As B. Mostly Bs C. Mostly Cs D. Mostly Ds E. Mostly Fs F. None of these grades G. Not sure	Ordinal
E-cigarette use	Dependent	Have you ever used a vapor product? A. Yes B. No	Nominal
Presence of cyberbullying or electronically bullied	Mediating	During the past 12 months, have you ever been electronically bullied? A. Yes B. No	Nominal

Variable name	Type	Categorization	Level of measurement
Presence of homelessness	Mediating	During the past 30 days, where did you usually sleep? A. In my parent's or guardian's home B. In the home of a friend, family member, or other person because I had to leave my home, or my parents or guardian cannot afford housing C. In a shelter or emergency housing D. In a motel or hotel E. In a car, park, campground, or other public place F. I do not have a usual place to sleep G. Somewhere	Nominal
Ethnicity	Covariate	Are you Hispanic or Latino? A. Yes B. No	Nominal

Variable name	Type	Categorization	Level of measurement
Race	Covariate	What is your race? A. American Indian B. Asian C. Black or African American D. Native Hawaiian or Pacific Islander E. White	Nominal
Sex	Covariate	What is your sex? A. Female B. Male	Nominal
Age	Covariate	How old are you? A. 12 years old or younger B. 13 years old C. 14 years old D. 15 years old E. 16 years old F. 17 years old G. 18 years old or older	Ordinal

Data Analysis Plan

Data analysis of the 2019 National YRBS was completed using IBM SPSS Version 28. Once the data was downloaded, it was filtered and screened for accuracy in alignment with the research questions and all elements related to the inclusion criteria.

Multiple methods for addressing missing data and cleaning the available data were explored. The first method considered was case deletion where cases with missing values are removed from the data and the remaining data is analyzed as their inclusion would "reduce statistical power, the lost data can cause bias in the estimation of parameters, it can reduce the representativeness of the samples, and it can complicate the analysis of the study by threatening the validity and creating invalid conclusions" (Kang, 2013). The other method was imputation where the missing data values were replaced with an estimated value to preserve the sample size and the shape of the distribution of data. Once I can determine the number of missing observations, I could decide upon using case deletion, imputation, or multiple imputation. Imputation could be used when there is a small number of missing observations and will be replaced with the mean or median of existing observations that will retain data and avoids changing the shape of data distribution. Multiple imputation would be used if there were many missing observations, and the missing data would be replaced with a predicted value that would not violate the assumptions of the research design and created results reliable in small sample sizes or in data that missing a high number of observations.

Research Questions

Research Question 1: Is there an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, controlling for age, sex, race, and ethnicity?

$H_0$1: There is no association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, controlling for age, sex, race, and ethnicity.

H_a1: There is an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, controlling for age, sex, race, and ethnicity.

Research Question 2: Is there an association between academic performance and e-cigarette use if mediated by the ACE of cyberbullying among teenagers and young people in the state of Nevada, controlling for age, sex, and race, and ethnicity?

$H_0$2: There is no association between academic performance and e-cigarette use if mediated by the ACE of cyberbullying among teenagers and young people in the state of Nevada, controlling for age, sex, and race, and ethnicity.

H_a2: There is an association between academic performance and e-cigarette use if mediated by the ACE of cyberbullying among teenagers and young people in the state of Nevada, controlling for age, sex, and race, and ethnicity.

Research Question 3: Is there an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, if mediated by the ACE of experiencing homelessness, controlling for age, sex, race, and ethnicity?

$H_0$3: There is an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, if mediated by the ACE of experiencing homelessness, controlling for age, sex, race, and ethnicity.

H_a3: There is no association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, if mediated by the ACE of experiencing homelessness, controlling for age, sex, race, and ethnicity.

Statistical Test

I analyzed the data by using binary logistic regression analysis for the first research question. This because the data scale for the DV for using a vapor product was measured dichotomously (Yes or No) and the IV for academic performance was identified as ordinal and nominal (Mostly As, Mostly Bs, Mostly Cs, Mostly Ds, Mostly Fs, none of these grades, not sure). It does not require a linear relationship between the IV and DV, the IV does not need to be multivariate scale, it does not rely on homoscedasticity, and the IV can be ordinal or nominal (Walden University Academic Skills Center, 2019). Key assumptions of binary logistic regression include numerous elements (JMP Statistical Discovery, 2022; Statology.org., 2021). First, the DV must be binary. Second, the IV and DV must be independent of each other. Third, there should not be any or minimal presence of multicollinearity. Fourth, logistic regression assumes a linear relationship of the IV and log odds. Finally, a large sample size is required, with a minimum of at least 10 cases per IV.

The second and third research questions were explored using regression with mediation analysis. For this progress, four steps must be explored to determine mediation

(University of Virginia Library, 2022). First, bivariate regression analysis must be conducted to predict the relationship from the IV to the DV. Next, bivariate regression analysis must be conducted to determine if there is a relationship between the IV and MV. Thirdly, bivariate regression analysis must be completed to determine if there is a relationship between the MV and the DV. Finally, the multiple regression analysis can be done to determine if the IV and the MV predict the outcome of the DV.

A priori analysis was used for calculating the sample size before the planning stage of the study, the design, and before the study is conducted (Kang, 2021). It was used to calculate the sample size, which lead to the effect size, alpha level, and power level necessary to complete the study. As it controls type I and type II errors for the null and alternative hypothesis, a priori analysis is the most optimal power analysis for sample size and calculation.

The first two assumptions of binary logistic regression were met upon review of the IVs and DVs. The IV of academic performance was identified as categorial, and the DV of e-cigarette use was identified as dichotomous and ordinal. Next, the IV and DV were identified to be independent of each other. The remaining two assumptions were explored during data analysis within SPSS given IRB approval on 08/03/2022 (08-03-2022-1019296). Regarding a large sample size, there were over 1,400 respondents for the state of Nevada.

To test for the third assumption of multi-collinearity, a correlation plot was conducted between the IV and the DV (Statology.org, 2021). Additionally, there was a strong enough correlation coefficient, so a variance inflation factor test was performed to

check for multi-collinearity. Regarding the linear relationship between the variables, this was reviewed using a Box-Tidwell test. Finally for the large sample size, this was determined upon review of the data to observe how many outcomes are available based on the data required of this study, ergo all participants that answered within the state of Nevada between the ages of 12 and 18, which was approximately 1,400 participants.

As aforementioned, the covariates that were controlled were age, sex, race, and ethnicity. Because of the numerous variables that can affect e-cigarette use, these covariates assisted in explaining the variability in the data (Field-Fote, 2019), and were initially removed for the sake of the research questions. Current research has determined that certain demographics have a strong correlation to e-cigarette use. One such example was females are more likely to start e-cigarette use when victimized by bullying than men in high school (Azagba, 2020; Shah et al., 2019), or that certain males were more likely to use e-cigarettes than females (Azagba & Shan, 2021; Jacobs et al., 2021).

Inferential statistics were evaluated using a p-value of 0.05, which is considered customary regarding social statistics (Frankfort-Nachmias et al., 2021). If the p-value is found above 0.05, then the null hypothesis is considered true and if the p-value is below 0.05, then the alternative hypothesis is considered true. The confidence intervals were set to 95% which were also deemed standard in social statistics and will reinforce the generalizability of the outcome. Odds ratios will be used to help determine the association between an outcome and an exposure (Szumilas, 2010).

Threats to Validity

External Validity

Threats to external validity occur when inferences are made inaccurately from data and applied to other settings, individuals, and time frames including past and future encounters (Creswell & Creswell, 2018). Three types of threats to validity were explored and evaluated for this study. The first was the interaction of selection and treatment, the second was the interaction of setting and treatment, and the third was the interaction of history or treatment. This study was of adequate size and scale to apply to the state of Nevada, as defined by the boundaries of the National YRBS as only participants from Nevada will be selected. However, the results would not be generalizable to other states in the country and would only be applicable to Nevada. Lastly, external validity was addressed when drawing conclusions from the data analysis to mention that these outcomes will be specific to the study population (within the state of Nevada) rather than the general population of the nation.

Internal Validity

Threats to internal validity occur when the procedures, treatments, or experiences of the participants of a study threaten/interfere with the inferences of the data (Creswell & Creswell, 2018). First, the National YRBS is a cross-sectional study that was administered in a single time frame to all students that were randomly selected among all versions of schools within the United States addressing history, maturation, regression, selection, and mortality. Thus, there were no threats of external events to affect a change in response, maturation of participants between different time frames, selection bias as

participants were selected randomly within the United States, there was no comparison between a control and an experimental group, therefore there were no threats involving diffusion of treatment, compensatory/resentful demoralization, or compensatory rivalry among control and experimental groups. Second, selection bias was reduced, and internal validity was improved by using the entire sample population from all respondents within the state of Nevada, where this study was focused. Finally, one of the key assumptions mentioned in section one was that all students had answered this survey truthfully. Per the CDC during administration of this survey to students, students were informed that this survey was important, and their answers and identities are protected. All remaining assumptions were tested and evaluated during the data analysis phase.

Statistical Conclusion Validity

Statistical conclusion validity is defined as the inaccurate inferences when the data lacks statistical power or violates the assumptions of the test being used (Creswell & Creswell, 2018). For this study, variables were explored and identified as appropriate measures. Furthermore, I attempted to increase external and internal validity while validity concerns and limitations were be addressed in the limitations section of this research paper.

Ethical Procedures

The National YRBS was created to monitor the health behaviors of teenagers and young people while maintaining their anonymity. It is a representation of public-school students between ninth and twelfth grade in each state and territory within the United States. The data from the 2019 National YRBS was stored on my personal computer,

where the device is password protected. Additionally, the folder containing the data will also be password protected and secured for the duration of this study. This data was only used and explored for the study once IRB approval was granted. As the National YRBS explores various topics surrounding the health of teenagers and young people, including sexual identity/health, the utmost consideration and care was observed, including that students were informed prior to administration and answering of the survey their identities are protected and they shall remain anonymous. The National YRBS is a secondary survey and there were no mental or psychological repercussions affiliated with the collection of this data. Parents were made aware of the contents and purpose of the survey prior to administration, and those who administered this survey gained parental consent before student participation. Students were also informed that this survey was important and asked to answer truthfully before initiating in the survey, and were given the opportunity not to participate if they decided not to on the day of the survey. Finally, there were no ethical implications/issues to report that would cause a conflict of interest within this work environment.

Summary

In Section two, the methodology for this study was discussed, including the research design, the data chosen, the explanation of the chosen variables, the strategy for analysis, threats to validity, and the ethical implications. This study utilized binary logistic regression to answer the established research question: Is there an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, controlling for age, sex, race, and ethnicity? The sample population

included all respondents within the 2019 National YRBS who met the inclusion criteria: teenagers and young people aged between 12-18 within the state of Nevada. The IV was academic performance, and the DV was e-cigarette use. The second and third research questions involved respondents who answered positively to suffering from an ACE. These two ACEs were classified as being a victim of cyberbullying and the presence of homelessness. These research questions would be answered using mediation analysis with regression. Covariates for all three research questions included age, sex, race, and ethnicity. I discussed the operationalization of the variables, and the method used to analyze the variables as they related to the research question. Binary logistic regression and mediation analysis with regression were also discussed, along with associated assumptions for both methods. Finally, internal and external validity were examined, as well as the ethical procedures associated with this study. In section three, the statistical analyses of the study were addressed along with the research findings. Section four will conclude the study with implications for future research as well as for social change.

Section 3: Presentation of the Results and Findings

Introduction

The purpose of this study was to determine if there was an association between academic performance and e-cigarette use among teenagers and young people within the state of Nevada, controlling for age, sex, race, and ethnicity. This was done using binary logistic regression. Additionally, I explored if the presence of an ACE mediated this relationship, using mediation analysis with regression. The ACEs identified for this survey as the MVs were the form of cyberbullying or the presence of homelessness. Together, these two research analysis methods were used to answer the following research questions and their associated hypotheses:

Research Question 1: Is there an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, controlling for age, sex, race, and ethnicity?

$H_0$1: There is no association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, controlling for age, sex, race, and ethnicity.

H_a1: There is an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, controlling for age, sex, race, and ethnicity.

Research Question 2: Is there an association between academic performance and e-cigarette use if mediated by the ACE of cyberbullying among teenagers and young people in the state of Nevada, controlling for age, sex, and race, and ethnicity?

$H_0$2: There is no association between academic performance and e-cigarette use if mediated by the ACE of cyberbullying among teenagers and young people in the state of Nevada, controlling for age, sex, and race, and ethnicity.

H_a2: There is an association between academic performance and e-cigarette use if mediated by the ACE of cyberbullying among teenagers and young people in the state of Nevada, controlling for age, sex, and race, and ethnicity.

Research Question 3: Is there an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, if mediated by the ACE of experiencing homelessness, controlling for age, sex, race, and ethnicity?

$H_0$3: There is an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, if mediated by the ACE of experiencing homelessness, controlling for age, sex, race, and ethnicity.

H_a3: There is no association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, if mediated by the ACE of experiencing homelessness, controlling for age, sex, race, and ethnicity.

Section three outlines the outcomes of this study. This section includes how the data was accessed, baseline descriptive statistics and frequencies, discrepancies from the initial plan from in Section two, and a summary of my overall findings. This section concludes with the overall discussion regarding the results of the different analyses.

Accessing the Data for Secondary Analysis

Data Collection and Response Rates

In this study, I used the 2019 National YRBS, which was considered the most current data. This was available electronically on the CDC website (see CDC, 2020b). This data was a national representation of students who voluntarily answered questions regarding various health behaviors and attitudes that develop during teenager/young person time frames. The National YRBS displayed data in both demographic and health-related contexts and depicted a fair representation of the prevalence, growth, decline, and incidence of health behaviors on a national scale. The data for the 2019 National YRBS were made available by the CDC website under Data and Documentation, found in ASCII and Access formats (see CDC, 2020b). Reliability and validity of the National YRBS were assessed in a previous study and assessed the National YRBS in terms of under and over reporting of participants (see Brener et al., 2013). Evaluation of the study in terms of internal and external validity were verified. This study was of cross-sectional design, addressing internal validity in terms of history, maturation, regression, selection, and mortality as respondents were aged between 12 and 18 at the time of administration. Generalizability of the study was solely for the state of Nevada as the parameters encompassed the state of Nevada.

After an initial review of the descriptive variables and their related frequencies, there were a few discrepancies in the analysis that were different from the previous plan in section two. This included covariate variables regarding race and ethnicity were combined into a 7-level answer and not set as a dichotomous variable, the question

regarding homelessness was not answered by the state of Nevada, and there was a noticeable difference in the number of missing values between questions.

The first discrepancy was the question regarding the race and ethnicity. After initial review of the questionnaire for the 2019 National High School YRBS, the question was asked as, "Are you Hispanic/Latino?" with a dichotomous response of either Yes or No. However, after reviewing the CDC's 2019 Combined YRBS Datasets User's Guide (2020), the race variable was transformed into a 4-level question instead of two, with individuals able to answer as White, Black or African American, Hispanic/Latino, or All Other Races. This question led to the final 7-level question regarding race and ethnicity as a combined question for the 2019 National YRBS (CDC, 2020). According to the U.S. Census Bureau (2022), race and ethnicity are traditionally addressed as two separate concepts. Race allows respondents to self-identify themselves based on five typical group, per the Office of Management and Budget Standards: White, Black or African American, American Indian or Alaska Native, Asian, or Native Hawaiian or Other Pacific Islander (U.S. Census Bureau, 2022). Ethnicity refers to those who identify as either Hispanic or Latino or Not Hispanic or Latino (U.S. Census Bureau, 2022). After review of the descriptive statistics under race and ethnicity, the number of respondents under Hispanic/Latino remained the same at 577 responses. Per the manual, this question changed over time to be appropriate and be identified as a more accurate indicator for respondents; thus, race/ethnicity was categorized for this study instead of race and ethnicity, as it recorded answers for both simultaneously.

The next discrepancy came from the question regarding the presence of homelessness. This question was identified as a group of various questions regarded as "selected additional risk behavior variable" that were not part of the standardized YRBS (CDC, 2020). This group of questions, which included homelessness, was part of the combined data provided for this survey. However, the state of Nevada did not have any answers submitted. Therefore, Research Question 3 could not be answered.

The last discrepancy was the number of missing values. Among the covariates in terms of demographic data, there was a range of values missing: 3 missing values in age, 6 missing values in sex, and 44 missing values in race and ethnicity. After reviewing the data, along with the assumptions with logistic regression, I decided to use single imputation.

Single imputation was determined after performing a missing values analysis with Little's missing completely at random test (see Table 2 below). The resulting value was calculated at $\chi^2(24, N = 1{,}401) = 36.501$, $p = .054$. With the p value being above .05, it allowed me to reject my null hypothesis and determine that these values were missing completely at random. While removing cases with missing data would be the easiest method and not affect the last assumption of logistic regression, it was not recommended despite its simplicity (see Tsikriktsis, 2005); thus, single imputation was used. Figure 8 below shows the results of the missing values test to determine if the missing values were completely at random or not.

Figure 8

Missing Values Test

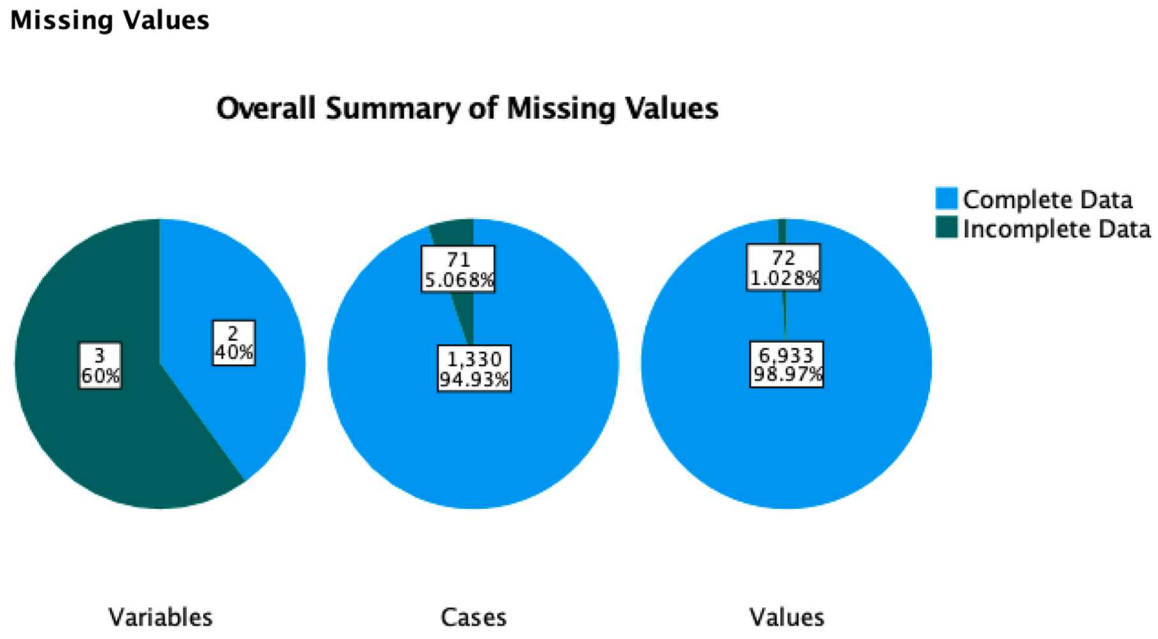


Table 2

Number of Missing Values Among Covariates

Variable	*N*	Percent	Valid *N*
Ethnicity 7 level	39	2.8%	1,362
E-cigarette use	32	2.3%	1,369
Age	1	0.1%	1,400

Sample Representativeness

The National YRBS created a national-level representation of students from ninth to twelfth grade who attended both private and public schools (as cited in Underwood et al., 2021). It is a 3-stage cluster sampling design, in which over 1,200 schools were separated into 16 categories based on urban or rural areas and the percentages of minorities among non-Hispanic black and Hispanic students. Schools were chosen that provided ninth to twelfth grade levels for students, and of those schools one or two classrooms were selected for those students to participate. All students in each class were eligible, and those who refused to participate were not placed or replaced for this design.

For this study, I used all respondents categorized in the state of Nevada who completed the 2019 National YRBS survey. The data displayed respondents who fell within the desired age range of my research questions as well as my desired variables. These steps limited the number of errors that may have been caused by external validity and provided a fair representation of the responses for teenagers and young people for the state of Nevada.

Univariate Analysis of IV, DV, and Covariates

IV

Table 3 below displays the frequency table for the IV, academic performance for all respondents within the state of Nevada for the 2019 National YRBS. Five-hundred twenty-five (39.7%) of respondents answered that they obtained mostly As, 432 (32.7%) respondents answered with mostly Bs, 216 (16.3%) answered with mostly Cs, 63 (4.8%)

answered with mostly Ds, 28 (2.1%) answered with mostly Fs, 28 (2.1%) answered with none of these grades, and 49 (3.7%) answered with not sure.

Table 3

Frequency Distribution for Grades in School

Grades	Frequency	Percent
Mostly As	525	39.7%
Mostly Bs	432	32.7%
Mostly Cs	216	16.3%
Mostly Ds	63	4.8%
Mostly Fs	28	2.1%
None of these grades	9	0.7%
Not sure	49	3.7%

Note. The question was as follows: During the past 12 months, how would you describe your grades in school?

DV

For the DV of, "Have you ever used a vapor product?", Table 4 below displays these results for all respondents in the state of Nevada for the 2019 National YRBS. Six-hundred seven (44.2%) answered with yes, and 767 (55.8) answered with no.

Table 4

Frequency Distribution of Have you Ever Used an E-Cigarette?

Yes or no	Frequency	Percent
Yes	607	44.2%
No	767	55.8%

Note. The question was as follows: Have you ever used a vapor product?

Covariates

Covariates were identified previously as possible influences on study outcomes (Field-Fote, 2019). Covariates for the purpose of this study regarding the association between academic performance and e-cigarette use included age, sex, and race/ethnicity.

Univariate analysis was completed for each covariate in terms of descriptive statistics and frequency. These preliminary analyses were reviewed and examined to observe possible relationships to the DV of e-cigarette use. Additionally, chi-square analyses were completed for each covariate to determine if there were statistically significant associations to the DV.

Sex

Table 5 below shows the number of valid cases categorized by males and females available within the data. Figure 9 below shows that 24.82% of females and 18.34% of males have attested to using an e-cigarette. There was an asymptotic significance value of .565 for the chi-square value, which was above the .05 threshold for a *p*-value (see Table 6 below). Therefore, I rejected the alternative hypothesis and accepted the null and found that there was no statistical significance between different sexes and e-cigarette use, and they are independent of each other. Additionally, the Phi and Cramer's V value was .016, which denoted a small effect size. Thus, the association between sex and e-cigarette use was small (see Table 7 below).

Figure 9

E-Cigarette use by sex

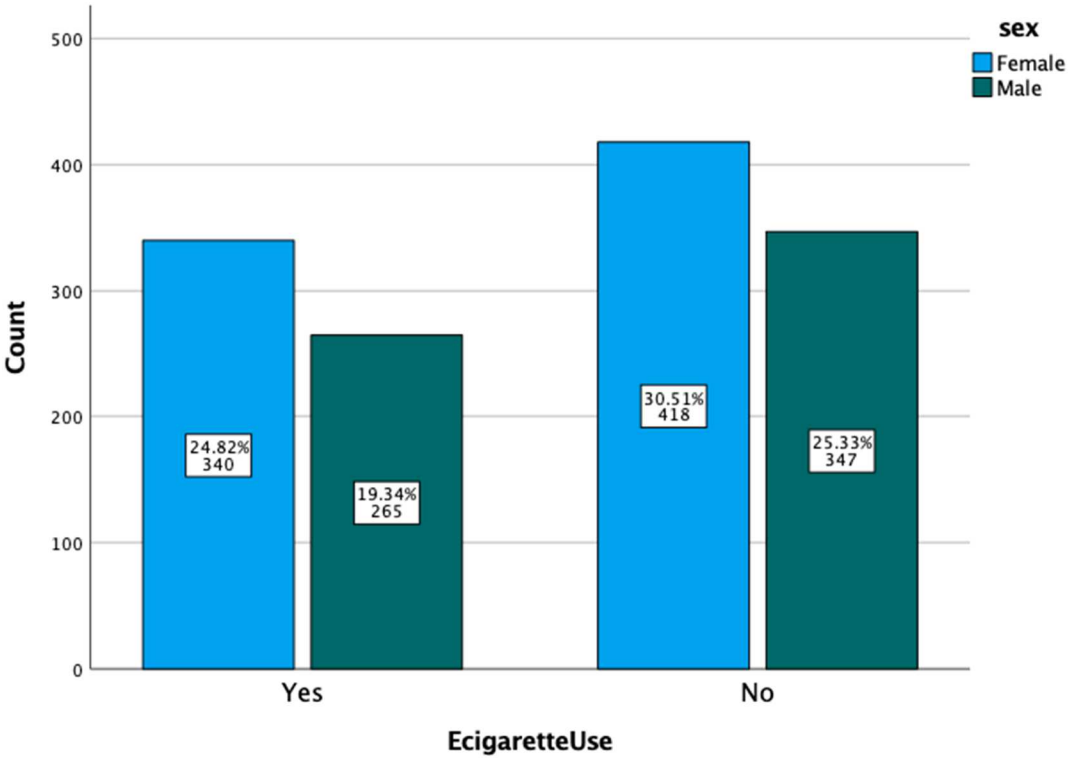


Table 5

Crosstabulation of Have you Ever Used an E-Cigarette by sex

	Have you ever used and e-cigarette?		
Sex	Yes	No	Total
Female	340	418	758
Male	265	347	612
Total	605	765	1,370

Table 6

Chi-Square Analysis of E-Cigarette Usage by sex

Chi-Square Test	Value	*df*	Asymptotic significance
Pearson Chi-square	.332	1	.565
Continuity correction	.272	1	.605
Likelihood ratio	.332	1	.565
Linear-by-linear association	.331	1	.565
N of valid cases	1,370		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 270.26.

b. Computed only for a 2x2 table

Table 7

Effect Size of E-Cigarette Usage by sex

Effect Size	Value	Approximate significance
Nominal by nominal		
Phi	.016	.565
Cramer's V	.016	.565
N of valid cases	1,370	

Age

Figure 10 and Table 8 below shows e-cigarette use by age. Among respondents who reported using an e-cigarette, there were 187 (13.64%) of 16-year-olds, 149 (10.87%) of 17-year-olds, 144 (10.5%) of 15-year-olds, 66 (4.81%) of 14-year-olds, 58 (4.23%) of 18-year-olds, and 1 (less than 1%) of the 13-year-olds. The individual who classified as 12 years old or younger did not answer this question. The chi-square analysis yielded an asymptotic value of .016, which was below the threshold of $p < .05$ (see Table 9 below). Thus, I rejected the null and accepted the alternative hypothesis that there was a statistically significant association between age and e-cigarette use. Additionally, the Phi and Cramer's V (see Table 10 below) yielded an effect size, denoting that the effect of this association was small.

Figure 10

E-Cigarette use by age

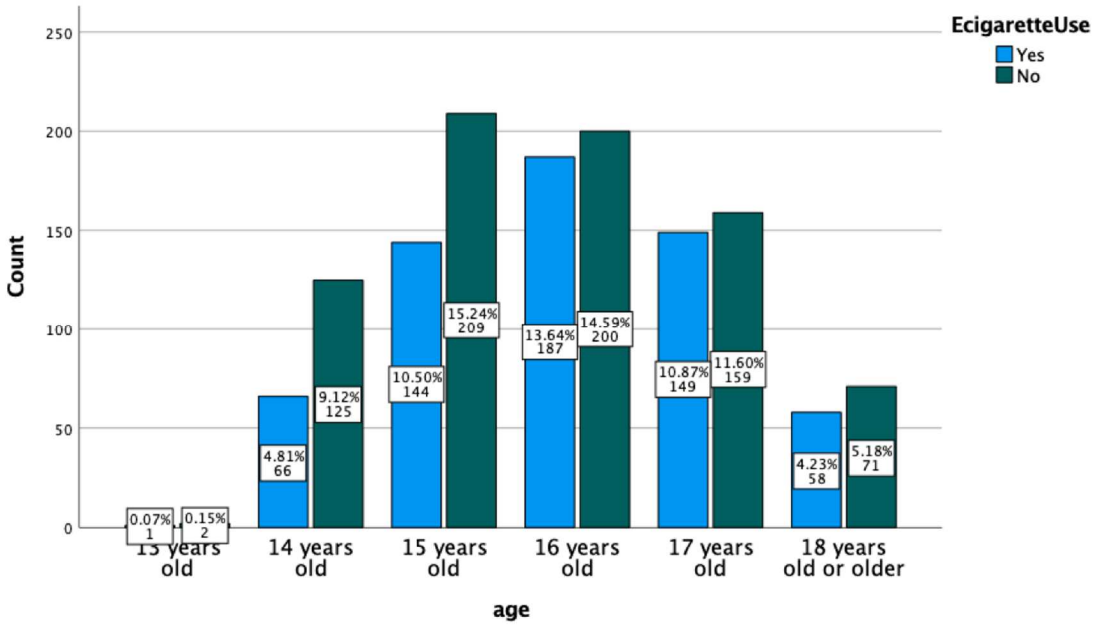


Table 8

Crosstabulation of Have you Ever used an E-Cigarette by age

	Have you ever Used an E-Cigarette?		
Age	Yes	No	Total
12 years old or younger	0	0	0
13 years old	1	2	3
14 years old	66	125	191
15 years old	144	209	353
16 years old	187	200	387
17 years old	149	159	308
18 years old or older	58	71	129
Total	605	766	1,381

Table 9

Chi-Square Analysis of E-Cigarette Usage by age

Chi-Square Test	Value	d*f*	Asymptotic significance
Pearson Chi-square	13.884	5	.016
Likelihood ratio	14.027	5	.015
Linear-by-linear association	8.683	1	.003
N of valid cases	1,371		

a. 2 cells (16.7%) have expected count less than 5. The minimum expected count is 1.32.

Table 10

Effect Size of E-Cigarette Usage by age

Effect Size	Value	Approximate significance
Nominal by nominal		
Phi	.101	.016
Cramer's V	.101	.016
N of valid cases	1,371	

Race/Ethnicity

Within this covariate, Figure 11 and Table 11 below shows that Hispanic/Latino respondents were found more likely to use an e-cigarette than any other ethnicity with 264 (19.8%) respondents saying they have tried an e-cigarette, followed by 194 (14.6%) White respondents, 45 (3.38%) respondents with Multiple Races, 38 (2.85) Black or African American respondents, 30 (2.25) Asian respondents, 12 (0.90%) Native Hawaiian/Other Pacific Islander respondents, then 1 (0.08%) American Indian/Alaska Native. The Chi-square analysis discovered a value of .005 (see Table 12 below), and so I rejected the null and accepted the alternative hypothesis that there was a statistically

significant association between ethnicity and e-cigarette use. The Phi and Cramer's V value was .007, which denoted a small effect size (see Table 13 below).

Figure 11

E-Cigarette use by Race/Ethnicity

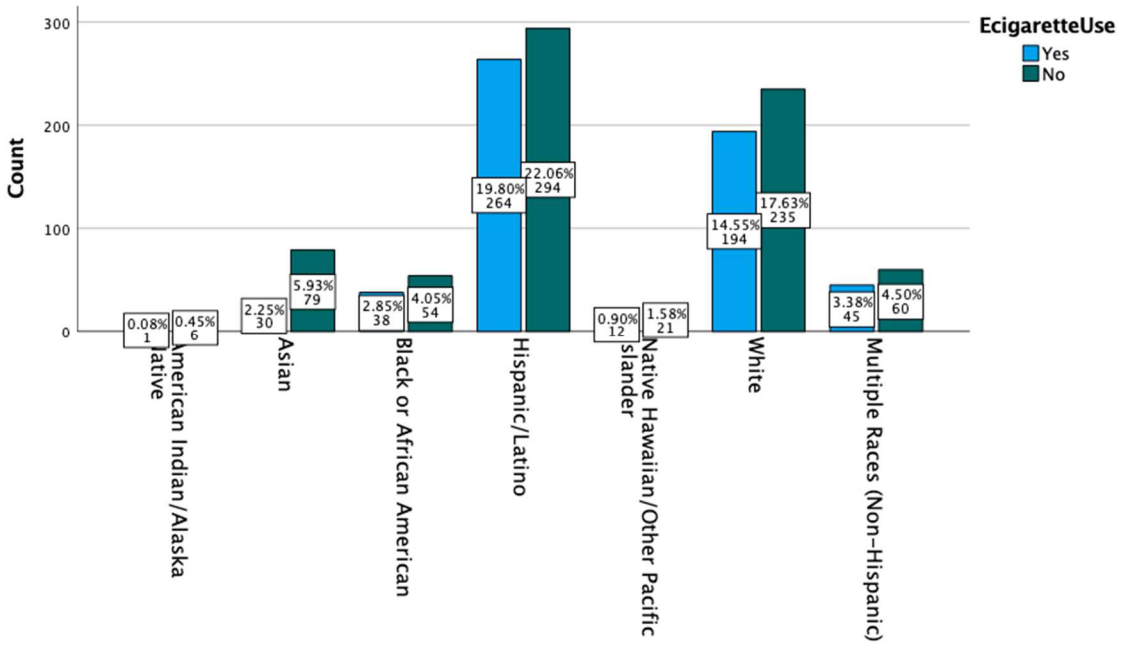


Table 11

Crosstabulation of E-Cigarette Usage by Race/Ethnicity

	Have you ever used an e-cigarette?		
Race/ethnicity	Yes	No	Total
American Indian/Alaska Native	1	6	7
Asian	30	79	109
Black or African American	38	54	92
Hispanic/Latino	264	294	558
Native Hawaiian/Other Pacific Islander	12	21	33
White	194	235	429
Multiple races (non-Hispanic)	45	60	105
Total	584	749	1,333

Table 12

Chi-Square Analysis of E-Cigarette Usage by Race/Ethnicity

Chi-Square Test	Value	*df*	Asymptotic significance
Pearson Chi-square	18.368	6	.005
Likelihood ratio	19.294	6	.005
Linear-by-linear association	3.842	1	.050
N of valid cases	1,333		

a. 2 cells (14.3%) have expected count less than 5. The minimum expected count is 3.07.

Table 13

Effect Size of E-Cigarette Usage by Race/Ethnicity

Effect Size	Value	Approximate significance
Nominal by nominal		
Phi	.095	.007
Cramer's V	.095	.007
N of valid cases	1,333	

The univariate analyses and chi-square tests determined that there was justification for the inclusion of each variable for the purpose of this study except for sex, which had no statistical significance. The variables that were statistically significant included age and race/ethnicity. Once these analyses were established, imputation was used to fill in the missing values to complete the descriptive statistics of this study.

Results

Descriptive Statistics

Table 14 below included the frequency for the IV, the DV, and the covariates as they related to this study. Imputation was used for all missing values within the IV, DV, and covariates. This allowed for a sample size of 1,401 respondents, fitting the logistic

regression model assumption of a large sample size. Descriptive statistics and frequency tables were used to define and identify the different classification of respondents within the state of Nevada. There were 770 (55%) female respondents and 631 (45%) male respondents. In terms of age, 4 (0.3%) at 13 years old, and 195 (13.9%) at 14 years old 365 (26.1%) at 15 years old, 395 (28.2%) at 16 years old, 311 (22.2%) at 17 years old, and 131 (9.4%) at 18 years or older. In terms of race/ethnicity, 22 (1.6%) were American Indian/Alaska Native, 114 (8.1%) were Asian, 99 (7.1%) were Black or African American, 588 (42%) were Hispanic/Latino, 35 (2.5) were Native Hawaiian/Other Pacific Islander, 436 (31.1%) were White, and 107 (7.6) were Multiple Races (Non-Hispanic. Please see the following figures below regarding visual sample distributions of respondents before removal by sex (Figure 12), age (Figure 13), and race/ethnicity (Figure 14).

Table 14

Baseline Descriptive Statistics/Frequencies for Respondents From Nevada

Variable name	Category	Number of responses	Percentage
Grades in school	Mostly As	550	39.3%
	Mostly Bs	452	32.3%
	Mostly Cs	224	16.0%
	Mostly Ds	65	4.6%
	Mostly Fs	31	2.2%
	None of these grades	27	1.9%
	Not sure	52	3.7%
Have you ever used a vapor product?	Yes	617	44.0%
	No	784	56.6%
Sex	Male	631	45.0%
	Female	770	55.0%
Age	13 years old	4	0.30%
	14 years old	195	13.9%
	15 years old	365	26.1%
	16 years old	395	28.2%
	17 years old	311	22.2%
	18 years old or older	131	9.4%
Race/Ethnicity	American Indian/Alaska Native	22	1.6%
	Asian	114	8.1%
	Black or African American	99	7.1%
	Hispanic/Latino	588	42.0%
	Native Hawaiian/Other Pacific Islander	35	2.5%
	White	436	31.1%
	Multiple races	107	7.6%

Figure 12

Sample Distribution by sex

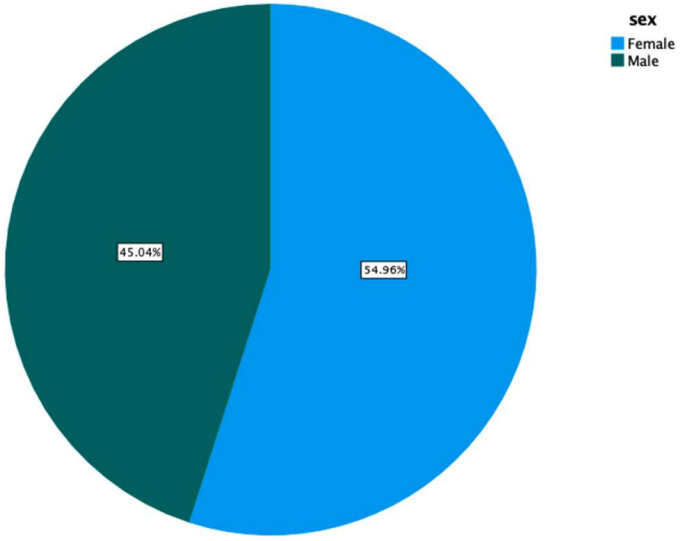


Figure 13

Sample Distribution by age

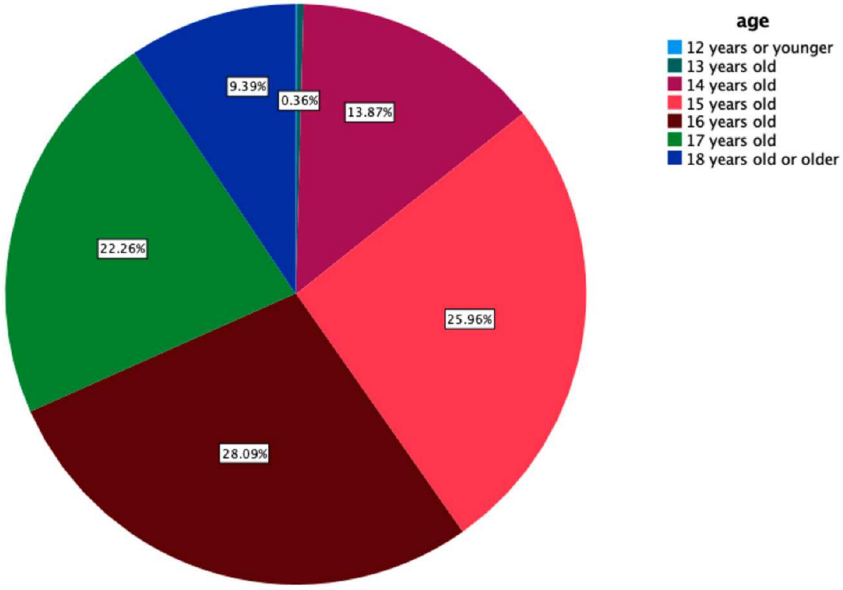
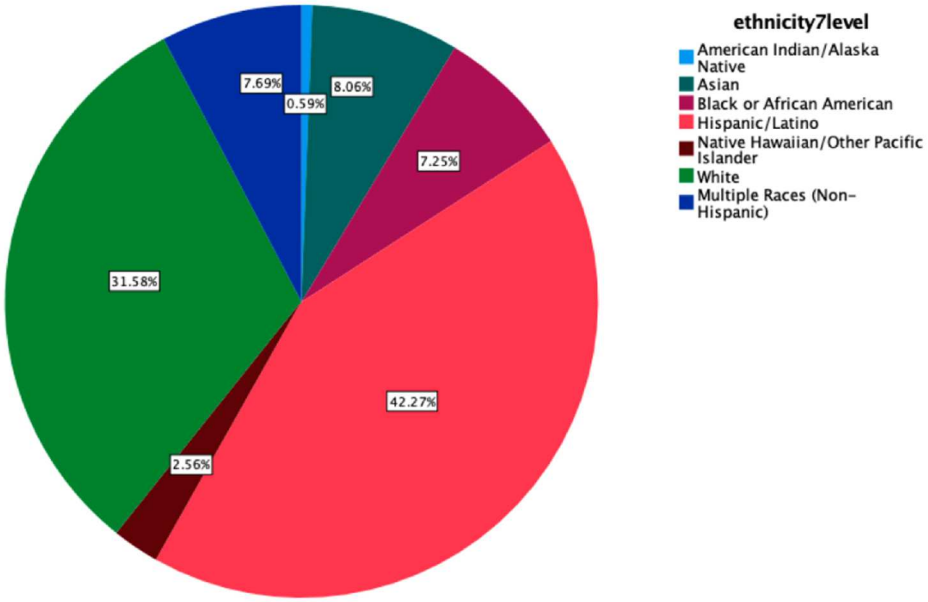


Figure 14

Sample Distribution by Race/Ethnicity



Statistical Assumptions of Logistic Regression

All six of the assumptions associated with logistic regression were tested for this study prior to evaluation. This included that the response variable is binary/dichotomous, the observations were independent of each other, there was no multicollinearity between the two variables, there were no extreme outliers, there was a linear relationship between the two variables, and the sample size was of adequate size and large in nature.

The first assumption that the response variable was binary was confirmed in section two upon review of the 2019 National YRBS Questionnaire. The DV, "Have you ever used an Electronic Vapor Product?", was identified with two answers of either 1 = yes or 2 = no and coded appropriately, fulfilling the first assumption.

The second assumption that the observations were independent of each other, was determined through revaluation of the variables and tested with a plot of the residuals (see Figure 16). Respondents who answered the question, “Have you ever used an e-cigarette product?” could not and cannot be included between both selections of “Yes” or “No”. Those who attested to their academic performance cannot be a part of multiple categories, fulfilling the second assumption. Additionally, this was tested by calculating the Durbin-Watson statistic value. Durbin-Watson values run from a range of 0-4, where the value of 2 means that the values are uncorrelated, and the values between 1.5 and 2.5 have been considered the most ideal and of normal range (StatisiticsHowTo.com, 2022). This value was determined to be 1.897 in SPSS (see Table 15 below) for the variables of interest, therefore it was safe to assume there was no noticeable level of correlation between the residuals.

Table 15

Durbin-Watson Calculation

Model	R	R square	Adjusted R Squared	Std. Error of the Estimate	Durbin-Watson
1	.080	.006	.006	.495	1.897

a. Predictors: (Constant), Grades in School

b. Dependent Variable: E-cigarette Use

The third assumption of logistic regression was that there was no multicollinearity between the two variables. This assumption was tested by calculating the variance inflation factor (VIF) and tolerance within SPSS. VIF is the reciprocal value of tolerance, and tolerance is the calculated percentage that there is a variance between the predictors

(Corporate Finance Institute, 2022). The rule for multicollinearity is that if the tolerance value is less than 0.1 or the VIF is greater than 10, then there is the presence of multicollinearity. In Table 16 below, the tolerance is above .10, and the VIF is under 10, for the DV as well as for all the covariates, therefore this assumption was met.

Table 16

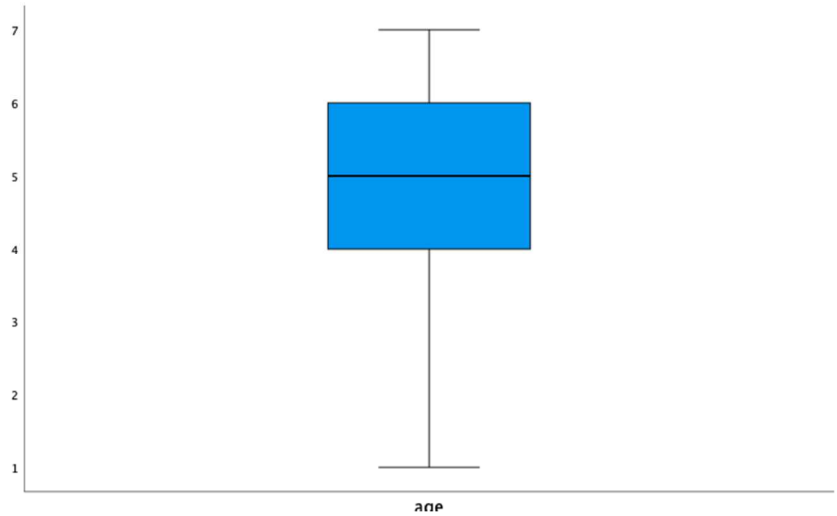
Calculation for Variance Inflation Factor and Tolerance

Model	*B*	Std. Error	Beta	*t*	Sig	Tolerance	VIF
Constant	1.785	.104		17.160	<.001		
Grades in school	-.030	.010	-.083	-2.940	.003	.991	1.009
Age	-.035	.012	-.083	-2.962	.003	.993	1.007
Sex	.027	.028	.027	.963	.336	.986	1.015
Race 4 Level	.015	.014	.034	1.057	.291	.755	1.324
Ethnicity 7 Level	-.013	.011	-.039	-1.197	.232	.755	1.324

The fourth assumption of logistic regression was that there are no extreme outliers within the data. This was explored for the continuous variable of age with a box and whisker plot (see Figure 15 below) and a plot of the residuals (see Figure 16 below). Upon review of both the box and whisker plot and the plot of residuals, there were no outliers identified. Since age was the only continuous variable identified, this assumption was met.

Figure 15

Box and Whisker Plot for age



The fifth assumption was that there was a linear relationship between both the variables and the logit of the DV. This was checked with a Box-Tidwell Test with all the with emphasis on the continuous IV of age. This was done with incorporating the continuous variable and its corresponding natural log. In Table 17 below, the significant value for the transformed age variable (TrnsfrmAge) was .051. As this value was above $p > .05$, it was not significant, thus this met the assumption regarding linearity.

Table 17

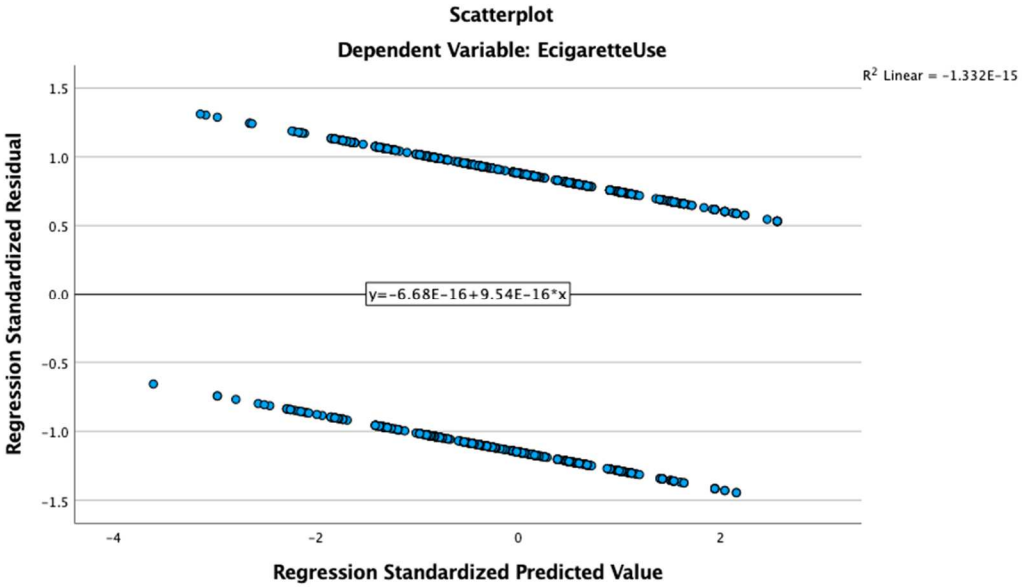
Box-Tidwell Test to Assess the Linearity to the Dependent Variable for age

Variable	*B*	S.E.	Wald	*df*	Sig.	Exp(B)	95% C.I. for Exp(B)	
							Lower	Upper
Grades in school	-.115	.042	7.643	1	.006	.891	.821	.967
Age	-2.026	.967	4.388	1	.036	.132	.020	.878
Sex	.105	.117	.802	1	.371	1.111	.883	1.397
Race 4 level	.063	.058	1.176	1	.278	1.065	.95	1.193
Ethnicity 7 level	-.062	.046	1.778	1	.182	.94	.858	1.030
Trnsfrm age	.731	.375	3.801	1	.051	2.077	.996	4.333
Constant	4.624	1.824	6.425	1	.011	101.902		

The sixth and final assumption was that the sample size was considered large enough to draw accurate conclusions. Depending on the number of variables to explore, this value should be multiplied by ten to produce an adequate sample size. Including covariates, there were eight total variables which means the study requires a minimum of 80 cases. Upon review of the descriptive statistics of respondents in the state of Nevada, there were over 1,400 cases this fulfilling the final assumption.

Figure 16

Plot of Residuals Between Academic Performance and E-Cigarette use



Statistical Findings and Analysis

The following subsection will contain the statistical findings associated with each of my research questions, with race/ethnicity classified as the new covariate in place of race and ethnicity. This will involve the following elements: the exact statistics, associated probability values, confidence intervals as appropriate, effect sizes, and associated statistical outputs.

Research Question 1

Binary logistic regression was used to determine if there was an association between academic performance and e-cigarette use among teenagers and young people within the state of Nevada controlling for age, sex, and race/ethnicity. SPSS v28 was used for this analysis, and single imputation was used to address the missing values among the IV and DV. This model was left with 1,401 valid cases (see Table 18 below),

and logistic regression was performed. The null and alternative hypotheses were as follows:

$H_0$1: There is no association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, controlling for age, sex, and race/ethnicity.

H_a2: There is an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, controlling for age, sex, and race/ethnicity.

Table 18

Case Processing Summary

Unweighted cases		*N*	Percent
Selected cases			
	Included in analysis	1,401	100%
	Missing cases	0	0%
	Total	1,401	100%
Unselected cases		0	0%
Total		1,401	100%

a. If weight is in effect, see classification table for the total number of cases

The data was fitted suitably for logistic regression. Table 18 below showed the model fit data, $\chi^2(18, N = 1{,}401) = 62.606$, $p < .001$. This model was demonstrated to be statistically significant ($p < 0.05$) and shows an increase in the ability to predict e-cigarette use by academic performance. The original percentage model was 55.5% and increased to 58.7% with this model. Thus, binary logistic regression was able to predict with more efficiency e-cigarette use than the intercept only (see Table 19 below)

Table 19

Model fit Information on E-Cigarette use and Covariates

Step	Chi-square	*df*	Sig.	% of correct fit
Intercept only				55.5%
model	62.606	18	<.001	58.7%

The Hosmer and Lemeshow Test value (see Table 20 below) suggested a poor fit, $\chi^2(8, N = 1{,}401) = 6.642$, $p = .576$. However, it was determined that this test may not be credible for large sample sizes (Wuensch, 2021).

Table 20

Hosmer and Lemeshow Test Goodness of fit Test

Step	Chi-square	*df*	Sig.
1	6.642	8	.576

Table 21 below explains the variance found in this model. The Cox and Snell R^2 shows that 4.6% of the variance regarding e-cigarette use was explained by this model. Additionally, based on Nagelkerke's R^2, 6.1% of the variance was explained by this model.

Table 21

Psuedo R-Square Cox and Snell and Nagelkerke

Step	-2 Log likelihood	Cox & Snell R^2	Nagelkerke R^2
1	1859.434	.046	.061

a. Estimation terminated as iteration number 4 because parameters estimates changed by less than .001

Table 22 below displays the coefficients and covariates of the model, along with the IV.

Table 22

Contribution of IVs to the Model by DV

Variables	B	S.E.	Wald	df	Sig	Exp(B)	95% CI for EXP(B) Lower	Upper
Grades in School			32.856	6	<.001			
Mostly As	.061	.315	.037	1	.847	1.063	.573	1.971
Mostly Bs	-.409	.314	1.690	1	.194	.664	.359	1.231
Mostly Cs	-.545	.327	2.773	1	.096	.580	.306	1.011
Mostly Ds	-.738	.382	3.725	1	.054	.478	.226	.595
Mostly Fs	-1.520	.510	8.872	1	.003	.219	.080	5.422
None of these grades	.374	.672	.310	1	.578	1.453	.389	
Age			9.833	5	.080			
12 years or younger	.543	1.270	1.83	1	.669	1.722	.143	20.753
13 years old	.413	.235	3.090	1	.079	1.512	.954	2.397
14 years old	.179	.210	.724	1	.395	1.195	.792	1.804
15 years old	-.061	.207	.089	1	.766	.940	.627	1.410
16 years old	-.093	.213	.188	1	.664	.912	.600	1.385
Female	-.096	.112	.731	1	.392	.908	.729	1.132
Ethnicity7Level			9.871	6	.130			
American Indian/Alaska Native	.811	.634	1.633	1	.201	2.249	.649	7.796
Asian	.444	.293	2.291	1	.130	1.559	.877	1.858
Black or African American	.054	.289	.035	1	.852	1.055	.599	1.360
Hispanic/Latino	-.118	.217	.294	1	.587	.889	.581	2.832
Native Hawaiian/Other Pacific Islander	.257	.400	.412	1	.521	1.293	.590	1.351
White	-.137	.223	.376	1	.540	.872	.563	1.351
Constant	.525	.298	1.745	1	.186	1.691		

a. Variables entered on step 1: Grades in School, Age, Sex, ethnicity 7 level

It should be noted first that not all the categories from IV and the covariates were displayed. SPSS automatically removed all variable categories that were evident of multicollinearity. The variables that were missing in this model included male sex, 17-year-olds, 18-year-olds, respondents that were Multiple Races (Non-Hispanic), and those unsure of their academic performance.

With respect to grades, respondents that reported from Mostly As (p = .847), Mostly Bs (p = .194), Mostly Cs (p = .096), Mostly Ds (p = .054), and None of these Grades (p = .578) did not have statistically significant values for e-cigarette use. However, respondents that attested to an academic performance of Mostly F's (p = .003) were found to be statistically significant of e-cigarette use.

Among age, there was no significance among the twelve-years-old or younger (p = .669), thirteen years old (p = .079), fourteen years old (p = .395), fifteen years old (p = .766), or sixteen years old (.664).

There was also no statistical significance among any of the races/ethnicities: American Indian/Alaska Native (p = .201), Asian (p = .130), Black or African American (p = .852), Hispanic/Latino (p = .587), Native Hawaiian/Other Pacific Islander (p = .521), or White (p = .540).

Logistic regression was completed to determine if there was an association between academic performance and e-cigarette use among teenagers and young people within the state of Nevada, controlling for age, sex, and ethnicity. The logistic regression model was statistically significant (χ^2 (18) = 62.606, $p < .001$), explained 6.1% of the variation (Nagelkerke's R^2) and correctly predicted 58.7% of the cases. Grades in school

($p < .001$) were considered statistically significant, but age ($p = .080$) and ethnicity ($p = .130$) were not. Thus, this allowed me to reject the null hypothesis and accept the alternative hypothesis: there is an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada when controlling for age, sex, and race/ethnicity.

Research Question 2

Mediation analysis with regression was used to determine if the association between academic performance and e-cigarette use among teenagers and young people was mediated by the presence of the ACE of cyberbullying within the state of Nevada controlling for age, sex, race, and ethnicity. Like the first research question, SPSS v 28 was used for this analysis, the covariate was changed to race/ethnicity, and single imputation was used to address the missing values among the IV and DV. This model was left with 1,401 valid cases (please see Table 19 above), and bivariate regression and logistic regression were performed. The null and alternative hypotheses were as follows:

$H_0$2: There is no association between academic performance and e-cigarette use if mediated by the ACE of cyberbullying among teenagers and young people in the state of Nevada, controlling for age, sex, and race/ethnicity.

H_a2: There is an association between academic performance and e-cigarette use if mediated by the ACE of cyberbullying among teenagers and young people in the state of Nevada, controlling for age, sex, and race/ethnicity.

Mediation analysis with regression was done using the Baron and Kenny's four step approach and completed with the Sobel test, which required the alpha value, beta value, and their associated standard error values.

For Step one, bivariate regression was used to determine the relationship between the IV of academic performance and e-cigarette use (see Table 23 below). There was a statistically significant relationship between grades in school and e-cigarette use (p = .002).

Table 23

Bivariate Regression Between the IV and the DV

						95% Confidence Interval	
Model	*B*	Std. Error	Beta	*t*	Sig.	Lower bound	Upper Bound
(Constant)	1.617	0.24		66.519	.000	1.569	1.665
Grades in School	-.028	.009	-.081	-3.030	.002	-.047	-.010

a. Dependent variable: E-Cigarette use

For Step two, bivariate regression was used to determine the relationship between IV and the MV of cyberbullying (see Table 24 below). It was determined that there was no statistically significant relationship between grades in school and cyberbullying (p = .449). This also provided me with a B value of - .005 and a std. error of .006, which provided the alpha value and the related standardized error value respectively.

Table 24

Bivariate Regression of IV on Mediating Variable of Cyberbullying

						95% Confidence Interval	
Model	*B*	Std. Error	Beta	*t*	Sig.	Lower bound	Upper bound
(Constant)	1.884	.016		115.666	.000	1.852	1.916
Grades in school	-.005	.006	-.020	-.758	.449	-.017	.008

a. Dependent variable: Cyberbullying

For Step three, multiple regression was used to determine the effect of the MV on the DV (see Table 25 below). The direct value of grades on e-cigarette use was -.027, with a std error of .009 ($p = .003$), giving me the c value. The direct value of cyberbullying on e-cigarette use was .283 with a std error of .039 ($p < .001$), giving me the beta value and its related standardized error value.

Table 25

Multiple Regression of IV and MV on DV

						95% Confidence Interval	
Model	*B*	Std. Error	Beta	*t*	Sig.	Lower Bound	Upper Bound
(Constant)	1.085	.078		13.956	<.001	.932	1.237
Grades in school	-.027	.009	-.077	-2.941	.003	-.045	-.009
Cyberbullied	.283	.039	.189	6.853	<.001	.206	.360

a. Dependent variable: E-cigarette use

For step four, the Sobel test (see Table 26 below) was completed using the Sobel Test Calculator (Preacher, 2022) to complete mediation analysis with regression. This required a calculated value for α, β, and their associated standard error coefficients, which were calculated from the previous bivariate and multiple regression models.

Table 26

Sobel Test Calculation

Input	Value	Test	Test statistic	Std. Error	*p*-value
α	-.005	Sobel	-0.82789191	0.00170916	0.407
β	.283	Aroian	-0.82024024	0.0017251	0.412
S_a	.006	Goodman	-0.83576179	0.00169307	0.403
S_b	.039				

The Sobel Test determined that there was no statistically significant association ($p = 0.407$) between academic performance and e-cigarette use when mediated by the presence of the childhood adverse event of cyberbullying.

Mediation analysis with regression was used to investigate if the presence of the ACE of cyberbullying mediated the association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada. Results indicated that academic performance was a significant predictor of e-cigarette use, B = -.028, SE = .009, 95% CI [-.047, -.020], β = -.081, $p = .002$, but academic performance was not a significant predictor of cyberbullying, B = -.005, SE = .006, 95% CI [-.017,.008], β = -.020, $p = .449$. Thus, combined they do not support the mediational hypothesis. However, upon using multiple regression, grades in school was still considered a predictor or e-cigarette use after controlling for the mediator of being cyberbullied, B =.027, SE = .009,

95% CI [-.045, -.009], β = -.077, *p* = .003. With a p = .407, this allowed me to reject my alternative hypothesis and accept the null: there is no association between academic performance and e-cigarette use if mediated by the ACE of cyberbullying among teenagers and young people in the state of Nevada, controlling for age, sex, and race/ethnicity.

Research Question 3

I was unable to complete the data analysis for research question 3, due to the lack of data submitted from the state of Nevada regarding homelessness. Mediation analysis with regression was planned to determine if the association between academic performance and e-cigarette use among teenagers and young people was mediated by the presence of the ACE of homelessness within the state of Nevada controlling for age, sex, race/ethnicity. However, this will be addressed in section 4.

Summary

Binary logistic regression was used to complete Research Question 1. The regression analysis showed that there was a statistically significant relationship between academic performance and e-cigarette use, when controlling for age, sex, and race/ethnicity for teenagers and young people within the state of Nevada. It was determined that there was no statistical significance with the relationship among the covariates of sex, or race/ethnicity. However, male sex, being 17 years old, being 18 years old, being of multiple races (non-Hispanic), and being unsure of your grades increased the odds of a teenager/young person of using an e-cigarette use.

Mediation analysis with regression was used to complete Research Question 2. The mediation analysis showed that despite there being a statistically significant association between grades in school with e-cigarette use, there was no statistically significant association between academic performance and the presence of cyberbullying, and the presence of cyberbullying did not mediate the relationship between academic performance and e-cigarette use.

Section four will outline these results and interpret the findings into meaningful conclusions. These findings related back to the literature review, the implications for social change, and possible future projects in public health practice.

Section 4: Application to Professional Practice and Implications for Social Change

Introduction

Smoking has been identified as one of the top global public health priorities, as its outcomes are considered preventable by multiple ranked authorities. As many adults who classify as current users attested to initiating as teenagers and young people (CDC, 2021b; Gaiha et al., 2020; HHS, 2021; Jenssen & Boykan, 2019; National Cancer Institute, 2020; Shinbashi & Rubin, 2020) this age group was prioritized as a focal point for analyzing and evaluating associations to use. In the United States, policy has been considered a ground-breaking intervention, especially in terms of comprehensive tobacco-free laws that protect vulnerable populations to tobacco exposure (Jenssen & Boykan, 2019), but the lack of universality among various jurisdictions among all states makes it difficult to assess when certain territories follow different regulations. The state of Nevada is one such example in which it does not follow the same guidelines as the rest of the country and has state specific protocols.

The purpose of this study was to determine if there was an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada while controlling for age, sex, and race/ethnicity. Moreover, this study explored if the presence of ACEs in the form of cyberbullying and homelessness mediated such a relationship. This study was quantitative in nature and used the 2019 National YRBS survey conducted by the CDC to assess the health risks and behaviors and teenagers and young people. The results of this study can help build upon current literature by identifying possible associations to e-cigarette use.

Summary of Key Findings

Binary logistic regression was used to answer the first research question to determine if there was an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada while controlling for age, sex, and race/ethnicity. Results of this analysis determined that teenagers and young people who attested to obtaining Mostly Fs had the only significant association to e-cigarette use. Among the covariates, I determined that there was a statistically significant relationship with respect to age, but not to sex and race/ethnicity. Further analysis determined that teenagers and young people who were 17-year-olds, 18-year-olds, male, being unsure of their grades, and those of multiple races (non-Hispanic) were more likely to have used an e-cigarette.

Mediation analysis with regression was used to answer the second research question, regarding if the presence of cyberbullying mediated the relationship between academic performance and e-cigarette use. There was a statistically significant relationship between academic performance and e-cigarette use, there was no statistically significant association between academic performance and cyberbullying, there was a statistically significant relationship between cyberbullying and e-cigarette use, and there was no statistically significant relationship on the indirect effect of academic performance and e-cigarette use. Results indicated that the presence of cyberbullying did not mediate the association between academic performance and e-cigarettes.

Interpretation of Findings

Research Question 1

Is there an association between academic performance and e-cigarette use among teenagers and young people in the state of Nevada, controlling for age, sex, race/ethnicity?

Binary logistic regression was used to evaluate Research Question 1, and single imputation was used to address missing values. The results showed that there was a statistically significant association between academic performance and e-cigarette use ($p < .001$). While controlling for different covariates, I determined that age ($p = .080$) and race/ethnicity (p= .130) were not statistically significant. However, when broken down into covariate categories, male sex, 17-year-olds, 18-year-olds, being multiple races (non-Hispanic), and being unsure of their grades were positively associated with e-cigarette use. This was determined when SPSS removed them from binary regression to indicate their multicollinearity. Therefore, I rejected the null hypothesis that there was no association between academic performance and e-cigarette use. Out of all the covariates, only respondents who attested to obtaining mostly Fs academically had a statistically significant output:

- Respondents who attested to grades that are mostly Fs were more likely to have used e-cigarettes, $p = .003$, *OR* .219, 95% CI [.080, 5.422]

Initial descriptive statistics of the covariates displayed various rates of e-cigarette use among each respective category, but none of the covariates were considered statistically significant. Among the covariates with univariate analysis, 16-year-olds,

Hispanic/Latino race/ethnicity, and females had the highest rates of e-cigarette use among their respective categories. However, this may also be a unique outcome to population with respect to the state of Nevada. Consequently, this research adds to the few articles that demonstrate trends in e-cigarette use among Nevada teenagers and young people.

This study yielded similar results to previous research within the United States. First, lower academic performance was found to be associated with higher likelihood of e-cigarette use (Chadi et al., 2020, Dearfield et al., 2021) Second, certain covariates positively associated to e-cigarette use, furthering certain demographic characteristics as subjects of interest. These previous studies determined that males were more likely to have participated in e-cigarette use than females (Azagba & Shan, 2021; Jacobs et al., 2021). Additionally, this confirmed that concurrent use was highest among the multiple races (non-Hispanic) race/ethnicity, as well as those who were 17 or 18 years of age (Jacobs et al., 2021).

These discoveries added to previous research (see Chadi et al., 2020; Doxbeck, 2020; Dearfield et al., 2021; Garcia & Weiss, 2018; Jenson, 2018; McCabe et al., 2017) that lower academic performance can lead to increased risk of e-cigarette use among teenagers and young people. Despite this, only teenagers and young people who were unsure of their grades were highly correlated to e-cigarette use through multicollinearity, and those who attested to mostly Fs were the only academic performance level that presented a statistically significant result ($p < .003$).

Research Question 2

Is there an association between academic performance and e-cigarette use if mediated by the ACE of cyberbullying among teenagers and young people in the state of Nevada, controlling for age, sex, and race/ethnicity?

For this analysis, the IV was academic performance, the DV was e-cigarette use, and the MV was the presence of cyberbullying. Following Baron and Kenny's 4-step process approach:

1. Academic performance significantly predicted e-cigarette use
   (B = -.028, p = .002, 95% CI [-.047, -.020])
2. Academic performance did not significantly predict the presence of cyberbullying
   (B = -.005, p = .449, 95% CI [-.017, .008])
3. The presence of cyberbullying significantly predicted e-cigarette use
   (B = .283, p <.001, 95% CI [.206, .360])
4. The total effect of the cyberbullying reduced the relationship from nonsignificant to significant
   (B =-.027, p = .003, 95% CI [-.045, -.009])

The Sobel Test was completed to determine if the presence of the MV (cyberbullying) had a statistically significant effect on the association between the IV (academic performance) and the DV (e-cigarette use). The indirect effect was z = -.083, p = .407; therefore, it was established that there was no statistically significant association on the effect cyberbullying has on the relationship between academic performance and e-cigarette use. Therefore, the alternative hypothesis was rejected, and the null hypothesis

was accepted that the association between academic performance and e-cigarette use was not mediated by the presence of the ACE of cyberbullying among teenagers and young people in the state of Nevada, controlling for age, sex, and race/ethnicity.

These findings yielded comparable results to previous studies that found a positive association between cyberbullying and e-cigarette use (see Azagba et al., 2020; Doxbeck, 2020; Ihongbe et al., 2021). However, it should be noted that this study did not determine the roles of respondents in the event of cyberbullying, which has shown to have different correlations and levels of association to e-cigarette use (Pichel et al., 2022; Yoon et al., 2019). This deeper level of analysis was discussed in greater detail later in the recommendation's subsection. While there was a statistically significant association on the direct effect of cyberbullying on academic performance as it related to e-cigarette use (p = .003), it was not statistically significant on the indirect effect (p = .407).

Research Question 3

There was no submission from the state of Nevada regarding the presence of homelessness for the 2019 National YRBS. However, the relationship of academic performance and e-cigarette use was still explored with the presence of an ACE in the form of cyberbullying with research question 2. This will be discussed in the recommendation's subsection.

Findings as They Relate to the SEM

There have been many reasons identified that associated with e-cigarette use among teenagers and young people. For the interest of this study, this research was based on Bronfenbrenner's (1977) SEM due to its approach that the influence of behavior was a

combination of multiple factors from different ecosystems. This included key individuals who influence health-related decision making in teenagers and young people, such as parents/guardians or close peers, and the influence of the environment at home or at school. Additionally, it included the presence of ACEs such as cyberbullying that could lead to the need to find coping mechanisms in the sight of trauma and stress. This study only strengthens the SEM in that smoking behaviors and outcomes are part of a complex and dynamic combination of factors and stimuli that can affect an individual's decision to initiate in smoking. ACEs that come from various sources were evidenced to associate to e-cigarette use, despite not mediating the relationship of academic performance. Within a grander context, smoking should be addressed as a public health policy that was unified so practices can simplify methods for prevention, education, and awareness. If multiple ecosystems within this context align in positive associations against e-cigarette use and in protecting teenagers and young people from exposure and experimentation, there was a greater likelihood that this age group will not participate in e-cigarette use and smoking-related behaviors.

Limitations of Study

There were several limitations for this study that should be acknowledged. First, this study cannot be considered universal within the United States, due to Nevada being the only state without a comprehensive tobacco-free law. However, the results of this study are generalizable to the state of Nevada. Also, this study used secondary data in the form of the National YRBS. Despite there being a local survey that mirrored the goals of the CDC's National YRBS in the form of the Nevada YRBS and had questions that were

more focused on the outcomes within Nevada, the National YRBS still maintained itself as a reliable and valid source of information for understanding health risks, behaviors, and attitudes among teenagers and young people. Additionally, the data used was from 2019. While a more recent dataset would have been more ideal, this was not possible as the 2021 data were not available at the time of this study's creation. However, the results of this study are still valid and build upon current literature that may help identify possible associations to e-cigarette use among teenagers and young people.

Recommendations

The purpose of this study was to fill in a gap in current literature regarding e-cigarette use among teenagers and young people within the state of Nevada. It was determined that there was a statistically significant relationship between academic performance and e-cigarette use. While controlling for covariates, there was no statistically significant relationship when accounting for age, sex, or race/ethnicity, although there were signs of high correlation among male sex, 17- and 18-year-olds, respondents unsure of their grades or who attested to mostly Fs, and those of multiple races (non-Hispanic) race/ethnicity. I have not found any previous research or studies that analyzed the association between academic performance and e-cigarette use among teenagers and young people within the state of Nevada.

With these results in mind, my recommendations for future research would include analyzing academic performance within greater paradigms as previous studies found e-cigarette use to be associated with lower academic performance (Dearfield et al., 2021). As the academic performance became lower, the likelihood of e-cigarette use

increased, leading to those attesting to Mostly Fs and those unsure of their grades to have positive significant associations. With regards to age, the restriction of Tobacco 21 (FDA, 2021) was implemented in September of 2021, which restricted the access of tobacco products to individuals over the age of 21. This may be why there was the presence of a multicollinear relationship within age groups to e-cigarette use as determined with the 17- and 18-year-old respondents.

These results also have the capacity to guide future campaigns that are targeted at the individuals who fall within these categories regarding academic performance that displayed the presence of high correlations to e-cigarette use. Those of the male sex, 17- and 18-year-old respondents, those unsure of their grades, and those of multiple races (non-Hispanic) revealed a positive association to e-cigarette use. These are individuals who may be preparing to go to college and university, where the risk of being exposed to e-cigarettes may increase. With the evidence discovered by this study, as academic performance gets lower, the greater the likelihood of e-cigarette use.

The second research question determined that the presence of cyberbullying did not have a statistically significant mediating effect on the association between academic performance and e-cigarette use. However, initial analyses found that academic performance had a statistically significant direct effect on the relationship on e-cigarette use and on cyberbullying. It may be of interest to breakdown the roles of respondents within cyberbullying. Between the bully, the victim and the bystander, previous research determined that participation in cyberbullying may be an influence, but being a victim greatly increased the chances of trying e-cigarettes (Azagba et al., 2020). Although

academic performance did not have a statistically significant relationship on the indirect effect of cyberbullying, it was still worth noting that there was a statistically significant relationship on the direct effect of cyberbullying.

Currently, there is a local state survey that has been made as a replica of the CDC's National YRBS, called the Nevada YBRS (University of Nevada, Reno, 2022). This survey also monitors teenagers and young people within the state of Nevada and is also administered on a biannual basis to students to identify trends regarding health-related behaviors and attitudes. As a study that previously identified the increased risk of e-cigarette use through the presence of multiple ACEs within Nevada through this survey (Williams et al., 2020), there may be additional research in the impact different ACEs have on teenagers and young people. Therefore, evaluating the effects of multiple ACEs on this relationship may be worth exploring. This includes the ACEs like the presence of homelessness or being verbally put down by the respondent's parent/guardian. Such critical individuals around a teenager/young person can have direct effects on the development and adoption of health-related behavior (Brown et al, 20202; Ho et al., 2019; Trucco et al., 2021). It may prove beneficial to evaluate if there are distinct effects on health behaviors that stem from different individuals or different events.

The presence of ACEs in the form of cyberbullying may not mediate the association between academic performance to e-cigarette use, but this study determined that cyberbullying positively associated to e-cigarette use directly. It may be of interest for future studies to determine if there are differences in associations to e-cigarette use based on the why someone was cyberbullied, such as if it was their appearance or some

other characteristic. If different roles in a cyberbullying attack have different impacts on the risks of e-cigarette use, there may be research that also indicates different reasons for being bulled to have different impacts on e-cigarette use. Furthermore, it may be worth evaluating being bullied for different reasons. As different levels of academic performance yielded different levels of association to e-cigarette use, it is plausible that being bullied for different reasons, such as different features or traits, may have distinctive effects on the likelihood e-cigarette use among this age group.

Furthermore, as this study examined if the presence of key figures in certain environments could affect the development of health-related behaviors in teenagers and young people, it may be worth considering the effect that originates from other important characters, such as the influence of siblings or teachers. This may uncover additional information on how behaviors and attitudes are created and adopted within the same settings as this study.

Implications for Professional Practice and Social Change

This research revealed significant data that was pertinent to determining associations to e-cigarette use among teenagers and young people in the state of Nevada. The outcomes from this study are crucial in determining factors that could reduce current e-cigarette use, and possibly prevent future e-cigarette use. In the following section, I discuss possible implications for professional practice and positive social change.

Professional Practice

The findings of this study revealed that academic performance was a significant factor in predicting e-cigarette use among teenagers and young people within the state of

Nevada. Male sex, 17- and 18-year-olds, those unsure of their grades, those who attested to obtaining mostly Fs, and those of multiple races (non-Hispanic) race/ethnicity were more likely to have used an e-cigarette. The literature review determined that Nevada was ranked in the higher echelons of e-cigarette use compared to other states, and that academic performance and the presence of an ACE would have an impact on e-cigarette usage. Based on these findings, public health professionals, educators, local policy makers, and local officials should update guidelines and procedures to anticipate the use of e-cigarettes in lieu of poor academic performance and the presence of cyberbullying in schools. As there was research that shows positive associations between negative health behaviors like e-cigarette use and homelessness (see Glasser et al., 2022; Heerde et al., 2022; Labelle et al., 2022; O'Brien et al., 2021; Milburn et al., 2021; Tucker et al., 2019; Rew et al., 2022) and a high rate of homelessness within Nevada (Security.org, 2021), additional measures to identity teenagers and young people in this population may be of interest to review. This research helps to fill a gap in understanding what associations may exist that could prevent or reduce the amount of current and future e-cigarette users as well as traditional tobacco users.

These results can affect current practice by improving screening tools that identify indicators of e-cigarette use through academic performance and cyberbullying within school environments. This includes the ability to identify key indicators of poor academic performance and the being mindful of trauma in the sight of cyberbullying among students. Teachers, parents/guardians, and public health professionals should evaluate these paradigms to provide more resources to improve academic performance and

provide protection against cyberbullying. Practical implications should also include updating awareness for students who struggle academically and improving electronic environments where students may be subject to cyberbullying.

One inference I've discovered from this study is that the presence of various ACE's can lead to the possible initiation and use of e-cigarettes among teenagers and young people. Previous research has concluded that as a teenagers/young people is exposed to more ACE's, the likelihood of their initiation in substance use increases (Pearson et al., 2021). I believe that these individuals are easily afflicted by various stressors which may open the opportunity to create education to invest in their mental health. Programs and education that focus on the importance of mental health and may provide resources that can reduce the pressure that comes from different ACE's and help them healthily cope with emotional distress related to stress and anxiety.

Social Change

E-cigarettes continues to be one of the most influential health behaviors in the world, and among those in the United States, the most used product among teenagers and young people compared to any age demographic (CDC, 2022). This study has revealed that the positive association between academic performance and e-cigarette use was a significant predictor within the state of Nevada. While the presence of cyberbullying does not mediate this relationship, I determined that academic performance had a statistically significant association to the presence of cyberbullying, which can lead to e-cigarette use. This section will discuss the results of this study and how it will lead to positive social change.

On the individual and family level, the results of this study will offer positive contributions to teenagers/young people by providing teachers, parents/guardians, and other important figures to the possible indicators and use of e-cigarettes. Detecting lower academic performance can help indicate possible initiation and use, allowing parents/guardians to become involved when these individuals are under signs of stress or anxiety caused by trying to achieve or maintain academic performance, or when they are subjected to harassment and criticism by their peers through electronic means. Early detection of low academic performance and cyberbullying can prevent/reduce stress in these individuals, which can decrease their chances of initiating or using e-cigarettes.

With regards to society and policy, policy makers and local health authorities may have additional leverage to improve current guidelines within Nevada. Policies may include additional avenues to improve or monitor academic performance and/or repercussions to inciting cyberbullying among teenagers and young people. As the state of Nevada does not offer a comprehensive tobacco free law and allows smoking by certain individuals and within certain environments (SNHD, 2021), abstinence from smoking for teenagers and young people may be difficult to achieve. However, additional protections in other environments such as in school and electronic forums may help prevent e-cigarette initiation and improve usage rates. Regardless it is not to say that Nevada is without its local protective guidance but could possibly be improved with this addition to current literature and research.

Such protections would improve the health outcomes of teenagers and young people within the state of Nevada, but complete restriction to access and usage through

policy and education may not be sufficient. Per Bronfenbrenner's (1977) model, the influence of health-related behavior is a complex and dynamic design, where multiple factors can contribute to an individual's choice to initiate in any behavior they desire. It is when these different ecosystems are unified that the message to avoid certain behaviors and adopt other attitudes is at its strongest. The lack of a united front between different systems against negative health behaviors opens possible opportunities for teenager and young people to initiate in poor health behaviors.

Conclusion

Smoking and all its associated diseases/conditions are preventable and should remain a public health priority among teenagers and young people, regardless of associations like age, sex, and race/ethnicity. Smoking increases the likelihood of an individual to become a habitual, lifelong smoker that can lead to addiction and dependency. Although initiation and experimentation can occur at any point, teenagers and young people are able to make decisions about their health based on their own experiences and those of others. This becomes a critical stage where individuals can be informed and educated about the possible risks associated with initiating in smoking behaviors such as with e-cigarettes.

E-cigarettes may be alluring because they are flavorful, cost-effective, and convenient, but these qualities should not mask the fact that e-cigarettes still contain addictive and toxic components such as nicotine that can adversely affect mental development in teenagers and young people. Moreover, early use in e-cigarettes increases the likelihood of never-users into traditional cigarette users and possibly dual-users of

both products. This exponentially increases an individual's chances of developing various pulmonary and cardiovascular diseases. E-cigarettes open possibilities and potential risks that should not be explored or tested considering the possible negative outcomes associated with smoking such as lung cancer and/or cardiopulmonary disease. Thus, preventing e-cigarette use and initiation among this age demographic and education is crucial.

There may be multiple tools available to convince individuals not to participate in smoking behaviors such as education, public policy, and awareness but prevention is not guaranteed. The chances that an individual refuses to participate in smoking practices can improve by keeping individuals informed and creating environments that protect against the tobacco exposure. Like many diseases, it is easier to prevent the negative effects associated with smoking than it is to manage them. The findings of this study may help identify patterns in teenagers and young people that can bolster prevention efforts.

Public health officials have the capability to inform and educate those who are curious about e-cigarette initiation and use, as well as all the associated outcomes. However, smoking and all its outcomes are the result of a choice. Everything must be done to dissuade individuals from a long-term, possible life-long dependency. In the end, one fact remains about smoking and its related outcomes. It is preventable.

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Appendix A: Permission to Use Parts of an Electronic Cigarette Image

Hello,

This image may be used as long as the content is not changed and credit is given to USFA/the document it is found in.

Thank you for your interest in our publications.

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Appendix B: Permission to Use Parts of E-Cigarettes and Vape Pens Generations Image

Hi Jeremy,

Thank you for your email. I am a professor at Stanford and the Founder and Executive Director of our 3 Toolkits: Tobacco Prevention Toolkit, Cannabis Awareness and Prevention Toolkit, and Vaping Information, Solutions, and Interventions Toolkit.

Absolutely! Anything on our Toolkits are available for you to use (and note we just revamped the website and our curriculums). Please keep checking back as we are adding more and more.

just please keep the logo on the image and reference the toolkit.

thank you!

Founder and Executive Director, Tobacco Prevention Toolkit, Cannabis Awareness and Prevention Toolkit, and Vaping Information, Solutions, and Interventions Toolkit.

Stanford Reach Lab | Division of Adolescent Medicine
Department of Pediatrics | Stanford University School of Medicine
Stanford Research Park
3145 Porter Drive, Wing A, Room A104, MC 5395
Palo Alto, CA 94304

Appendix C: Permission to Use Increase in E-cigarette Use in the United States Image

Hi Jeremy,

Please feel free to use it. I actually don't own the image. It's in the public domain since it was created by CDC using tax-payer funding.

Best,

Chief, Epidemiology Branch 2
Office of Science
Center for Tobacco Products
U.S. Food and Drug Administration

Appendix D: Permission to Use Other Tobacco Product Use Among Adults and High School Students in Nevada Image

Hi Jeremy,

Thanks for reaching out and your interest in our work.

You can feel free to use this resource and just credit Truth Initiative.

Best of luck on your project!

Senior Specialist, Communications

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