3-13-2025

Physical Activity, Smokeless Tobacco, Urban/Rural Status and E-Cigarette Use among African American Young Adults

Destiny Britt
Walden University

Walden University

College of Health Sciences & Public Policy

This is to certify that the doctoral study by

Destiny Britt

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Manoj Sharma, Committee Chairperson, Public Health Faculty
Dr. Claire Robb, Committee Member, Public Health Faculty

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

Walden University
2025

Abstract

Physical Activity, Smokeless Tobacco, Urban/Rural Status and E-Cigarette Use among

African American Young Adults

by

Destiny Britt

MA, South University, 2018

BS, East Carolina University, 2016

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Public Health

Walden University

March 2025

Abstract

The growing prevalence of e-cigarette use is fueled by the false belief that they are safer than traditional cigarettes. African American adults aged 18 and older are disproportionately impacted by tobacco products, including e-cigarettes.

Little research focuses specifically on e-cigarette use among young African Americans, examining how factors like physical activity, smokeless tobacco, and urban/rural status influence their usage. This study aimed to investigate these influences while considering gender, academic level, alcohol and marijuana use, cigarette smoking, and anxiety/depression as controlling factors. Using the social ecological model (SEM), the research sought to understand how environmental factors interact with individual behaviors, such as e-cigarette use. Conducted as a quantitative secondary data analysis of the 2021 Behavioral Risk Factor Surveillance Survey (BRFSS) data, the study employed univariate and multivariate analyses to identify significant variables and their impacts. The logistic regression model showed a significant association between physical activity, e-cigarette use ($p = .043$, $OR = 1.804$), and smokeless tobacco use and e-cigarette use ($p = .001$, $OR = 4.013$). Other significant predictors included gender ($p = .004$, $OR = .558$), alcohol use ($p = .011$, $OR = 1.048$), and anxiety/depression ($p < .001$, $OR = 1.041$). Findings suggest that this information can be used to inform tobacco control efforts for vulnerable populations of young adults, contributing to positive social change.

Physical Activity, Smokeless Tobacco, Urban/Rural Status and E-Cigarette Use Among

African American Young Adults

by

Destiny Britt

MA, South University, 2018

BS, East Carolina University, 2016

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Public Health

Walden University

March 2025

Acknowledgments

I want to extend my sincere thanks to my family for their steadfast love, encouragement, and support throughout my academic journey. Their faith in me has been a continuous source of strength and inspiration.

I am profoundly grateful to my committee chair, Dr. Manoj Sharma and Dr. Claire Robb, for their invaluable guidance, expertise, and constructive feedback throughout the development of this research proposal. Dr. Sharma's and Dr. Robb's insights have played a pivotal role in defining the direction and scope of this study.

I would also like to express my sincere appreciation to my academic advisor, Laura Brodkey, for her mentorship, patience, and unwavering dedication in supporting me through this process.

Special thanks to the Institutional Review Board (IRB) or ethics committee at Walden University for their diligent review and approval of the ethical considerations of this study.

Lastly, I acknowledge the Centers for Disease Control and Prevention (CDC) for providing access to the Behavioral Risk Factor Surveillance System (BRFSS) data used in this study.

Table of Contents

List of Tables

Section 1: Foundation of the Study and Literature Review

Introduction to the Study

The use of electronic cigarettes (e-cigarettes) continues to rise, driven mainly by the widespread belief that they are less harmful than traditional cigarettes. Additionally, some individuals who lead otherwise healthy lifestyles turn to e-cigarettes to satisfy their cravings for flavors or nicotine, influenced by the perception that e-cigarettes pose minimal health risks (Pokrhel et al., 2019). Young adults who use e-cigarettes not only experience adverse effects on their heart, lung, kidney, and oral health, but they are also at higher risk for engaging in other unhealthy behaviors (Han & Son, 2022). The increasing prevalence of e-cigarette use among young adults needs to be acknowledged as a major public health issue.

Background

African American (AA) young adults were more likely to have used e-cigarettes compared to those who had never used them (Gaiha et al., 2022). African Americans over the age of 18 had higher adverse health effects from tobacco use, including e-cigarettes when compared to Caucasian Americans (Adzrago et al., 2023). Research on the health effects of e-cigarette use among different racial and ethnic groups, including African Americans and Caucasian Americans, is ongoing. However, some studies have suggested that there may be disparities in the adverse health effects of e-cigarette use between these groups (Asarri et al., 2022).

Moreover, there could be disparities in the marketing and promotion of e-cigarettes targeted toward different racial and ethnic groups, which may influence patterns of use and subsequent health outcomes (Erhabor et al., 2023). For example, some research suggests that specific marketing tactics may disproportionately target African American communities, potentially leading to higher rates of e-cigarette use and related health consequences. According to Adzrago et al. (2023), African Americans' e-cigarette use habits are significantly influenced by where they live. Due to characteristics like socioeconomic position and exposure to tobacco marketing, people who live in rural areas have higher rates of tobacco product use (Erhabor et al., 2023) and are less likely to stop using them (Adzrago et al., 2023). Urban environments may offer more exposure to e-cigarette marketing and the availability of vaping products, potentially leading to higher e-cigarette use among African American young adults living in cities. Conversely, rural areas may have different social norms and resource access, which could influence e-cigarette use patterns. For instance, limited access to traditional tobacco products might drive some individuals to turn to e-cigarettes as an alternative.

Although some studies indicate a positive link between increased physical activity and e-cigarette use (Pokhrel et al., 2019), the evidence remains inconsistent, and multiple factors likely shape this relationship. Those who use smokeless tobacco products may be more inclined to use e-cigarettes. Coleman et al. (2015) found that young adults who experimented with smokeless tobacco or other tobacco products were more receptive to smoking. Both behaviors may stem from similar motivations, such as nicotine addiction or seeking alternative forms of tobacco consumption.

This study centers on e-cigarette use among African American young adults. To identify patterns of use within this vulnerable population, it will explore the relationship between physical activity, smokeless tobacco use, and urban/rural status concerning e-cigarette use. Currently, there is a lack of research examining these factors among African American young adults. I selected African Americans aged 18-24 as the focus of this research because tobacco use disproportionately impacts African Americans over the age of 18 (Adzrago et al., 2023).

Further research is necessary to investigate the relationship between physical activity, smokeless tobacco use, and urban versus rural residence on e-cigarette use, while adjusting for influential factors such as gender, academic level, alcohol use, and anxiety/depression. This study aims to fill this gap by conducting a quantitative analysis that provides statistical evidence on potential risk factors for e-cigarette use among African American young adults. Although previous studies have addressed related issues, there has been limited exploration of how physical activity, smokeless tobacco use, and urban/rural status impact e-cigarette use within this demographic when controlling for factors like gender, academic level, alcohol use, and anxiety/depression. This research has the potential to contribute to positive social change by helping to identify tobacco control needs for vulnerable populations, such as African American young adult e-cigarette users. Gaiha et al. (2022) reported that African American young adult e-cigarette users are more susceptible to using e-cigarettes compared to non-users. Such research can inform targeted African American young adult e-cigarette messaging and curriculum used to prevent use among those who are most susceptible.

Problem Statement

Since its introduction, e-cigarette use has rapidly increased, particularly among young adults between the ages of 18 and 24 (Han & Son, 2022; Boakye et al., 2022). The widespread belief among the public that e-cigarettes are safer than traditional cigarettes contributes to the rising rates of e-cigarettes. Moreover, e-cigarettes are used by some healthy individuals to satiate their taste or nicotine demands (Pokrhel et al., 2019). According to earlier research, young U.S. adults between the ages of 18 and 24 are using e-cigarettes at significantly higher rates than they were in the past (Boakye et al., 2022), with 71.5% reporting no prior usage (Erhabor et al., 2023). Compared to those who had never used e-cigarettes, African American young adults were more likely to have done so (Gaiha et al., 2022). African Americans over the age of 18 experienced greater negative health impacts from tobacco use, including e-cigarettes, when compared to Caucasian American e-cigarette users (Adzrago et al., 2023).

The use of e-cigarettes is influenced by several characteristics, including physical activity, smokeless tobacco use, urban/rural status, gender, academic level, alcohol use, and anxiety/depression (Coleman, 2015; Pokrhel, 2019; Al Rifai et al., 2020; Assari et al., 2020; Lanza et al., 2020; Uddin et al., 2020; Pericot-Valverde et al., 2021; Sung, 2021; Boake et al., 2022; Gaiha et al., 2022). According to recent research, higher education appears to have a greater impact on Caucasian Americans than African Americans in terms of reducing high-risk health behaviors (Asarri et al., 2020). Lanza et al. (2020) found that young adults who use e-cigarettes are more prone to marijuana use and binge drinking. Additionally, Uddin et al. (2020) reported that African Americans are more likely to engage in dual use of e-cigarettes containing both nicotine and marijuana. Erhabor et al. (2023) also highlighted that younger age groups exhibited the highest rates of dual use of e-cigarettes and traditional cigarettes. Adzrago et al. (2023) found a positive association between African Americans' current daily or future e-cigarette use and anxiety/depression, with women being more susceptible to depression (Sung, 2021). Pericot-Valverde et al. (2021) found that after being exposed to a stressor, the quantity of e-cigarettes bought and used increased.

The continued rise in e-cigarette use, coupled with the disproportionate impact on African Americans, underscores a significant health disparity that needs urgent attention. Addressing this gap in research is crucial for understanding the specific factors contributing to these disparities and developing targeted interventions to mitigate them.

Purpose of the Study

This quantitative study aimed to fill the research gap concerning e-cigarette use among African American young adults. It investigated e-cigarette use, physical activity, smokeless tobacco use, and urban/rural status within this target population. While existing research has explored e-cigarette use among African Americans and young adults, there is limited investigation into how factors such as physical activity, smokeless tobacco use, urban/rural status, gender, academic level, alcohol use, and anxiety/depression specifically affect e-cigarette use within this demographic (Adzrago et al., 2023; Al Rifai et al., 2020; Assari et al., 2020; Boakye et al., 2022; Erhabor et al., 2023; Gaiha et al., 2022; Lanza et al., 2020; Pericot-Valverde et al., 2021; Pokhrel et al., 2019; Sung, 2021; Uddin et al., 2020).

Research Questions and Hypotheses

The study addressed the following research questions and corresponding hypotheses:

RQ1: Is there an association between physical activity and e-cigarette use among African American young adults, when controlling for gender, academic level, alcohol use, and anxiety/depression?

$H_0$1: There is no statistically significant difference in physical activity and e-cigarette use among African American young adults when controlling for gender, academic level, alcohol use, and anxiety/depression.

H_A1: There is a statistically significant difference in physical activity and e-cigarette use among African American young adults when controlling for gender, academic level, alcohol use, and anxiety/depression.

RQ2: Is there an association between smokeless tobacco use and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression?

$H_0$2: There is no statistically significant difference in smokeless tobacco use and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression.

H_A2: There is a statistically significant difference in smokeless tobacco use and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression.

RQ3: Is there an association between urban/rural status and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression?

$H_0$3: There is no statistically significant difference in urban/rural status and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression.

H_A3: There is a statistically significant difference in urban/rural status and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression.

Theoretical Framework

Uri Bronfenbrenner's social ecological model (SEM) was used as the framework to explore the individual and interpersonal levels of influence on e-cigarette use among African American young adults (Bronfenbrenner, 1974). The SEM examines how various levels of influence interact between individuals and their environments to determine health behavior (Han and Son, 2022). The framework outlines five levels of influence: intrapersonal (e.g., individual factors), interpersonal (such as parents or peers), organizational (like community or school), environmental (cultural norms or physical surroundings), and policy (local, state, or federal regulations). At the individual level, factors such as demographic characteristics (age, race, education), health-related behaviors (including alcohol, smokeless tobacco use, as well as physical activity), and mental health issues (anxiety/depression) influence e-cigarette use. The common perception that e-cigarettes are less harmful than traditional cigarettes encourage young adults to engage in risky behaviors. Education level significantly affects e-cigarette use among African Americans compared to Caucasian Americans. For Caucasians, higher education levels are positively associated with e-cigarette use, suggesting that higher education may reduce the likelihood of engaging in risky behaviors. At the interpersonal level, factors such as urban versus rural residence also impact e-cigarette use. Overall, the impact of physical activity, smokeless tobacco use, and urban/rural status on e-cigarette use among African American young adults is likely complex and influenced by a combination of individual and interpersonal factors. Additional research is needed to thoroughly understand these relationships and to develop targeted interventions to reduce e-cigarette use within this population.

The Nature of the Study

To address the research questions in this quantitative study, a cross-sectional design was used with secondary data from the 2021 Behavioral Risk Factor Surveillance Survey. The study explored potential associations between physical activity, smokeless tobacco use, urban/rural status, and e-cigarette use among African American young adults. Gender, academic level, alcohol use, and anxiety/depression were controlled for in the analysis. Physical activity, smokeless tobacco use, and urban/rural status were the independent variables, while e-cigarette use was the dependent variable. The covariates will help account for potential confounding factors and provide a clearer understanding of the relationships being studied.

Data Collection

The BRFSS employed a stratified random sampling method to select participants, ensuring representation across various demographic groups. For this study, the sample specifically focused on African American young adults. Trained interviewers conducted telephone interviews with selected participants using standardized questionnaires. Participants responded to questions about physical activity, smokeless tobacco use, urban/rural status, e-cigarette use, and covariates such as gender, academic level, alcohol use, and anxiety/depression.

Data Analysis

Descriptive statistics were used to outline the characteristics of the study population, providing means, frequencies, and percentages for the main variables. Multiple regression analysis was applied to investigate the adjusted relationships between physical activity, smokeless tobacco use, urban/rural status, and e-cigarette use, while accounting for covariates like gender, academic level, alcohol use, and anxiety/depression. Overall, rigorous statistical analyses was conducted to explore possible associations between key variables and to elucidate the relationships between physical activity, smokeless tobacco use, urban/rural status, and e-cigarette use among African American young adults, while considering the influence of covariates.

Literature Search Strategy

The literature review offered a solid foundation for scientific exploration of e-cigarette use, employing a scholarly approach. The search focused on peer-reviewed research articles that examined the explanatory variables (physical activity, smokeless tobacco use, and urban/rural status), the criterion variable (e-cigarette use), and the confounding variables (gender, academic level, alcohol use, and anxiety/depression). Moreover, I searched databases on quantitative studies on the independent, dependent, and confounding variables. Studies conducted on African Americans, young adults, and e-cigarette users were reviewed because of the limited literature on African young adults.

Additionally, I thoroughly examined recent studies to identify gaps in the literature on e-cigarette use among African American young adults in the U.S. I conducted searches in online databases, accessing, reviewing, and evaluating literature related to the theoretical framework for my study. The searches included articles and journals from Walden Library via the Health Sciences database. Key databases such as MEDLINE, PubMed, and Google Scholar were also searched for up-to-date journals on e-cigarette use. The search terms I frequently used to access related studies were *e-cigarette use, vaping, vapor cigarettes, electronic cigarettes, electronic nicotine delivery systems, young adults, African Americans, physical activity, exercise, smokeless tobacco, urban/rural status, anxiety,* and *depression.*

Theoretical Framework

The study utilized the social ecological model as a theoretical framework to comprehensively understand how individuals interact with their environments in shaping health behaviors, such as e-cigarette use. This model helped recognize the multiple levels of influence that affect health behavior (Kilanowski, 2017). The SEM is a framework commonly used in public health and other disciplines to understand how different levels of influence interact to shape behaviors and health outcomes. The SEM posits that individual behavior is affected by multiple levels of factors, including intrapersonal (personal characteristics), interpersonal (relationships with others), institutional (organizations and institutions), community (local environments and social networks), and societal (wider cultural, economic, and policy contexts; Kilanowski, 2017). Overall, the SEM offers a thorough framework for comprehending the intricate interactions of factors that affect behavior and health outcomes, aiding researchers and practitioners in developing more effective interventions (Kilanowski, 2017). By utilizing the SEM, researchers can take a comprehensive approach to understanding e-cigarette use that goes beyond individual behaviors to consider the broader social, environmental, and policy contexts (Models and Frameworks for the Practice of Community Engagement, 2015).

Rationale for Theory

The potential risk factors for e-cigarette use among African American young adults were elucidated by using the constructs of the SEM to explore these risks factors within this population. This model is grounded in several fundamental principles. First, it acknowledges multilevel influences, positing that individual behaviors are shaped by factors spanning intrapersonal characteristics, interpersonal relationships, institutional settings, community environments, and broader societal contexts encompassing cultural, economic, and policy domains (Sallis et al., 2008). These levels interact dynamically, influencing each other in complex ways. Second, the SEM emphasizes interconnectedness, illustrating how changes at one level can propagate effects across others; for instance, shifts in societal policies can impact community norms and subsequently individual behaviors (Sallis et al., 2008). Third, it underscores the complexity and contextual nature of behaviors, recognizing that they are shaped not merely by individual choices but by social, cultural, economic, and environmental conditions (Sallis et al., 2008). Lastly, the SEM advocates for interventions that address multiple levels of influence concurrently. Strategies targeting only one level, such as individual education campaigns, may yield limited effectiveness compared to comprehensive approaches that integrate efforts across various levels, including community norms and policy changes (Sallis et al., 2008). Addressing the disproportionate impact of e-cigarette use on African American young adults requires a multi-faceted approach that involved research, policy, and community engagement (Centers for Disease Control and Prevention, 2020).

Strengths of Applying the SEM

Applying the SEM to research on e-cigarette use offers several strengths due to its comprehensive approach to understanding health behaviors within various contexts (Han & Son, 2022). The SEM allows researchers to examine e-cigarette use across multiple levels of influence, including individual (intrapersonal), interpersonal, community, and societal factors (Kilanowski, 2017). This approach helps in identifying how factors at each level contribute to e-cigarette use behaviors (McCausland et al., 2024). By considering the interactions between different levels (e.g., how community norms influence individual behaviors), the SEM provides a nuanced understanding of the complexities surrounding e-cigarette use.

Limitations of Applying the SEM

The SEM operates under the assumption that a change agent can exert influence across all levels of a system, such as enacting high-level policies to restrict smoking advertisements (Sansom, 2022). However, even with a comprehensive multi-level approach, there are often external factors beyond one's control, such as requirements imposed by accrediting organizations, which can influence behaviors within a setting (Sansom, 2022). While modifying an environment can facilitate behavioral changes, success is not always assured.

How the Constructs Align with the RQ

In the context of the research questions and hypotheses provided, the SEM aligns well with the examination of multiple levels of influence on e-cigarette use among African American young adults. RQ1 explores individual-level factors (physical activity) and their association with e-cigarette use. The SEM acknowledges the importance of individual characteristics and behaviors in shaping health outcomes, placing physical activity within the intrapersonal level of influence. RQ2 also addresses individual-level factors (smokeless tobacco use) and their association with e-cigarette use. Similarly to RQ1, it focuses on the individual behaviors. Lastly, RQ3 examines environmental-level factors (urban/rural status) and their associations with e-cigarette use. The SEM recognized the influence of environmental contexts, such as neighborhood characteristics, on health behaviors. Urban/rural status falls within the interpersonal level of influence.

Each hypothesis (H_0 and H_A) corresponds to the SEM by testing whether there is a statistically significant difference in e-cigarette use based on the individual (intrapersonal) and environmental (interpersonal) factors examined in the research questions. By controlling for other variables such as gender, academic level, alcohol use, and anxiety/depression, the study accounts for additional levels of influence within the SEM, such as interpersonal (social relationships) and organizational (institutional policies and practices) factors.

Literature Review Related to Key Variables and/or Concepts

Other Studies Using the SEM

Boakye et al. (2022) applied the SEM framework in studies evaluating the impact of e-cigarette use on health outcomes among young adults. This approach allowed researchers to examine e-cigarette use within the broader context of individual, interpersonal, community, and societal factors influences health behaviors and outcomes. By applying the SEM, Boakye et al. (2022) could identify multilevel influences, understand contextual factors, guide intervention development, inform policy and advocacy efforts, and enhance research rigor.

Another researcher, Erhabor et al. (2023), explored the prevalence of e-cigarette use among college students and its potential impact on outcomes of academic achievement and psychological well-being. The study aimed to shed light on the relationship between e-cigarette use and these important facets of student life. By incorporating SEM, Erhabor et al. (2023) could assess the direct effects of e-cigarette use on academic performance and mental health, as well as explore the indirect pathways through which e-cigarette use may influence these outcomes. Lastly, Han and Son (2022) used the SEM to examine the individual level, interpersonal level, community level, and societal level influences on e-cigarette use among young adults.

Rationale for Selection of Variables

There is a well-established association between cigarette use and physical activity, with lower physical activity being linked to higher smoking rates. On the other hand, certain studies suggest that higher physical activity levels may be linked to higher e-cigarette use (Pokrhel et al., 2019). While some studies have reported a positive association between physical activity and e-cigarette use, others have found no significant association or even an inverse relationship. This inconsistency in findings suggests that the relationship between physical activity and e-cigarette use may be influenced by various factors and may not be straightforward.

The findings from Coleman et al. (2015) suggest a potential "gateway effect" where experimentation with one form of tobacco or nicotine product, such as smokeless tobacco, may increase the likelihood of trying other forms, including e-cigarette use or traditional cigarettes. Individuals who experiment with smokeless tobacco or other tobacco products may share common risk factors or characteristics that predispose them to try different forms of tobacco (Coleman et al., 2015). The social and environmental context of residential area can shape attitudes, norms, and behaviors related to e-cigarette use among African Americans. Factors such as peer influences, community norms, and cultural practices may vary across different neighborhoods and influence individuals' decisions to use e-cigarettes (Adzrago et al., 2023). Asarri et al. (2020) found that higher education has a greater impact on reducing high-risk health behaviors among Caucasian

Americans compared to African Americans, which highlights the importance of considering sociodemographic factors, such as race, in understanding health disparities and the effectiveness of interventions.

The findings from Lanza et al. (2020) and Uddin et al. (2020) suggest that young adults who use e-cigarettes are more likely to engage in polysubstance use, including marijuana use, cigarette use, and binge drinking. Uddin et al. (2020) found that African Americans are more likely to engage in dual use of e-cigarettes containing both nicotine and marijuana. This pattern of dual use raises concerns about the potential health risks associated with concurrent use of multiple substances and highlights the need for targeted prevention and intervention efforts tailored to the needs of African American communities. Erhabor et al. (2023) reported that young age groups had the highest rates of dual use of e-cigarettes and traditional cigarettes. This finding suggests that dual use behaviors may be more prevalent among younger individuals, which could have implications for long-term tobacco-related health outcomes and addiction trajectories.

The findings from Adzrago et al. (2023), Sung (2021), and Pericot-Valverde et al. (2021) illuminate the intricate connection between e-cigarette use and mental health, along with the impact of stress on e-cigarette consumption. Individuals with symptoms of anxiety or depression may be more inclined to turn to e-cigarettes as a coping strategy, potentially leading to increased usage and dependence (Adzrago et al., 2023). Sung (2021) further emphasized the gender differences in susceptibility to depression among e-cigarette users, with women being more vulnerable. Pericot-Valverde et al. (2021) discovered that experiencing a stressor resulted in a rise in the number of e-cigarettes purchased and consumed. This suggests that stress may play a role in driving e-cigarette consumption behaviors, potentially as a means of self-medication or stress relief. The relationship between e-cigarette use and anxiety/depression is likely bidirectional, with each factor affecting and intensifying the other. Those with existing mental health conditions may be more prone to using e-cigarettes as a coping strategy, while e-cigarette use may, in turn, worsen mental health symptoms and elevate stress levels over time. Understanding these dynamics is crucial for developing effective interventions addressing substance use.

Definition of Variables

Electronic cigarette (e-cigarette): A portable electronic nicotine delivery device that emits vapors or aerosols to mimic the effects of smoking cigarettes while delivering nicotine (Sung, 2021; Uddin et al., 2020).

Physical Activity: According to the World Health Organization, physical activity is defined as any movement of the body caused by skeletal muscles that results in energy expenditure (WHO, 2022).

Smokeless Tobacco Use: A type of tobacco that is not smoked or burned; having used chewing tobacco, dip, or snuff (Coleman, 2015).

Urban/Rural Status: An urban community is referred to as towns, cities, and suburbs. A rural community is referred to as “the country” with a low population density. (Urban Area, n.d.).

Gender: Male or Female

Academic Level: Typically refers to a stage or level of education attained by an individual, such as undergraduate, graduate, or postgraduate level.

Alcohol Use: Refers to the consumption of alcoholic beverages by individuals. This can encompass a range of behaviors, from occasional or moderate consumption to heavy or problematic drinking patterns.

Anxiety/Depression: Anxiety is a psychological condition involving worry, fear, and physical symptoms like a fast heartbeat, sweating, and trembling, which can disrupt daily life. Depression is a mental health condition marked by ongoing feelings of sadness, hopelessness, and a lack of interest in activities.

This study examined e-cigarette use as the dependent variable, categorized as either users (coded as 1) or non-users (coded as 0), using multiple logistic regression analysis. The independent variables—physical activity, smokeless tobacco use, and urban/rural status—were measured numerically and analyzed through multiple logistic regression. Additionally, covariates such as gender, academic level, alcohol use, and anxiety/depression were included. Multiple logistic regression was employed to explore the relationship between e-cigarette use and these predictor variables while adjusting for the identified confounders.

Table 1

Variables, Type, and Measures

Variable Name	Variable Type	Levels of Measurement
Dependent Variable (E-Cigarette use)	Dichotomous	Categorical
Independent Variable (Physical Activity)	Dichotomous	Categorical
Independent Variable (Smokeless Tobacco Use)	Dichotomous	Categorical
Independent Variable (Urban/Rural Status)	Dichotomous	Categorical
Covariate (Gender)	Dichotomous	Categorical
Covariate (Academic Level)	Ordinal	Categorical
Covariate (Alcohol Use)	Ordinal	Categorical
Covariate (Anxiety/Depression)	Ordinal	Categorical

Definition of Terms

Social Ecological Model (SEM): The social ecological model is a theoretical framework that focuses on multiple levels of influence, highlighting how behaviors are both impacted by and impact various contexts (Scarneo et al., 2019).

Behavioral Risk Factor Surveillance System (BRFSS): A comprehensive, nationally representative survey carried out by the CDC in collaboration with all U.S. states and participating territories (Uddin et al., 2020).

Assumptions

In the study, there may be certain assumptions that are believed but cannot be demonstrated true. These assumptions are essential to the study's significance, as they support the rationale and hypotheses under investigation. Some of these assumptions include:

- Causality: Given the cross-sectional design of the study, definitive causal relationships cannot be established. While the study may suggest potential causal links based on statistical associations, alternative explanations and underlying mechanisms remain possible without longitudinal or experimental data.

- Validity of self-reported data**:** The study utilizes self-reported data from the 2021 Behavioral Risk Factor Surveillance Survey. An assumption critical to the study's meaningfulness is the validity of this self-reported data. However, self-reported data may be subject to recall bias, social desirability bias, and other inaccuracies. While efforts are made to mitigate these biases through standardized survey instruments and trained interviewers, the accuracy and reliability of self-reported data cannot be guaranteed.
- Representativeness of sample**:** The study assumes that the sample of African American young adults included in the analysis is representative of the broader population of African American young adults aged 18-24 in the United States. However, despite efforts to employ stratified random sampling in the BRFSS survey, there may be limitations to the representativeness of the sample. Factors such as non-response bias, undercoverage, and sampling error may affect the generalizability of the findings to the target population.
- Homogeneity of African American young adults**:** The study may assume homogeneity within the African American young adult population in terms of e-cigarette use behavior and its determinants. However, African American young adults constitute a diverse group with varying socio-demographic characteristics, cultural backgrounds, and health-related behaviors. The study may overlook potential heterogeneity within this population, which could

impact the generalizability of the findings and the relevance of the study's conclusions to subgroups within the population.

Addressing these assumptions and acknowledging their limitations is important for ensuring the transparency and validity of the study findings. While these assumptions are critical for framing the research questions and hypotheses, they should be interpreted with caution, and alternative explanations should be considered when interpreting the study results. The assumptions outlined in the study are necessary in the context of research for several reasons including, hypothesis foundation, study relevance, practical considerations, and interpretation of findings.

By assuming potential causal relationships between physical activity, smokeless tobacco use, urban/rural status, and e-cigarette use, the study can develop specific hypotheses to test these relationships. This is essential for guiding the direction of the research and framing the investigation. By making assumptions about the relationships between key variables, the study focuses on investigating factors that are believed to be meaningful and impactful in understanding e-cigarette use among African American young adults. This ensures that the study addresses pertinent issues and contributes to the existing body of knowledge in the field. Similarly, assuming the representativeness of the sample allows the study to draw inferences about the broader population of African American young adults, despite potential limitations in sample representativeness. By assuming potential causal relationships between variables, the study can interpret statistically significant associations as evidence of potential causal pathways. This enables the study to provide valuable insights into the factors influencing e-cigarette use among African American young adults and to guide future research and interventions in this area. While these assumptions may have limitations and should be interpreted with caution, they are essential for framing the research within a meaningful theoretical and empirical context and advancing knowledge in the field of e-cigarette use among African American young adults.

Scope and Delimitations

Internal Validity

The study addresses several aspects of the research problem, including controlling for confounding variables, considering environmental factors, minimizing measurement bias, and filling research gaps. The study investigates how various health behaviors, namely physical activity, smokeless tobacco use, and e-cigarette use, are interrelated among African American young adults. By considering urban/rural status as a factor, the study explores how environmental factors may influence e-cigarette use among this population. Urban and rural environments may differ in terms of social norms, access to resources, and exposure to marketing, which impacts e-cigarette use patterns. The study will adjust for covariates such as gender, academic level, alcohol use, and anxiety/depression. By adjusting for multiple covariates known to influence e-cigarette use, this study aims to control for potential confounders. This enhances the internal validity of the findings by minimizing the influence of extraneous variables on the relationship between the independent variables (physical activity, smokeless tobacco use, urban/rural status) and the dependent variable (e-cigarette use). The study will address a gap in the literature by focusing specifically on e-cigarette use among African American young adults. By examining the specific population group and considering multiple factors that may influence e-cigarette use, the study aims to provide more accurate and internally valid insights into the determinants of e-cigarettes in this demographic.

External Validity

The scope of the study is determined by the population that is included or excluded and the theories relevant to the research area that were not explored. This consideration addresses issues of external validity, which relates to how well the study's findings can be applied to different populations and contexts. The populations included African American young adults aged 18-24 years and individuals who provided data for the 2021 Behavioral Risk Factor Surveillance Survey (BRFSS), a national survey managed by the Centers for Disease Control and Prevention (CDC) in the United States. This study does not include individuals outside the age range of 18-24 years. Individuals who did not participate in the BRFSS survey or did not provide data on the relevant variables are excluded from the study. The study does not specifically examine other racial or ethnic groups aside from African American young adults.

By outlining the study's boundaries and specifying which populations are included or excluded, the study recognizes its limitations regarding external validity. Although the results may be applicable to African American young adults aged 18-24 in the United States, they might not be relevant to other populations or settings. Additionally, exploring alternative theoretical frameworks could offer valuable insights into the underlying mechanisms driving e-cigarette use behavior among this demographic group.

Limitations

A potential challenge in using secondary data from the Behavioral Risk Factor Surveillance System (BRFSS) is recall bias. This occurs when respondents inaccurately remember events or omit details, which is common in self-reported studies (Recall Bias, 2017). The BRFSS collects data on health behaviors, chronic conditions, and preventive service use through telephone surveys. Secondary data limitations include potential issues with reliability, incomplete data, and lack of direct relevance to the research; additionally, researchers have no control over the accuracy or methods used in data collection (Bhandari, 2021). Additionally, this study may be limited by assessing physical activity in terms of exercise rather than specific activities.

This study has significant potential to contribute to the existing literature on health behaviors among African American young adults and to deepen our understanding of the complex interplay between various factors, including physical activity, smokeless tobacco use, urban/rural status, and e-cigarette use. However, it's essential to consider potential biases that could influence study outcomes, including selection bias, measurement bias, confounding bias, reporting bias, and sampling bias. If the study sample is not representative of the target population or if certain groups are systematically excluded, selection bias may occur, leading to results that are not generalizable to the broader population of African American young adults. Biases in the measurement of key variables, such as self-reported physical activity, smokeless tobacco use, and e-cigarette use, could impact study outcomes. Differences in how these behaviors are assessed, as well as variations in reporting accuracy across individuals, may introduce measurement bias. Confounding variables that are not adequately controlled for in the analysis could influence the observed associations between the variables of interest. For example, if socioeconomic status is not accounted for, it could confound the relationship between urban/rural status and health behaviors. Participants may provide biased or inaccurate responses, particularly when reporting sensitive information such as substance use or mental health symptoms. Social desirability bias may lead to underreporting of certain behaviors, while recall bias could affect the accuracy of self-reported data. If certain groups within the target population are disproportionately represented in the sample, sampling bias may occur. For example, if the study primarily recruits participants from urban areas, the findings may not be generalizable to rural African American young adults.

To mitigate these biases, researchers can use rigorous study designs, including random sampling techniques, standardized measurement tools, and suitable statistical analyses to account for confounding variables. Sensitivity analyses and validation studies can further evaluate the reliability of the findings. Additionally, clear and transparent reporting of study methods and limitations is essential for accurate interpretation and valid conclusions.

Significance

The study holds significance as it builds upon existing research that illustrates the relationship between physical activity, smokeless tobacco use, urban/rural status, and e-cigarette use, particularly among African American young adults, while controlling for age, gender, academic level, alcohol use, and anxiety/depression. The rising prevalence of e-cigarette use among young adults, including those with no history of traditional cigarette use, raises concerns about nicotine addiction and potential long-term health consequences. The results of this study will improve understanding among public health organizations, practitioners, policymakers, and the general public about effective strategies, programs, and policies for smoking cessation. This research has the potential to drive positive social change by aiding in the monitoring of e-cigarette usage among healthy young adults, addressing health disparities, elucidating the impact of targeted marketing, identifying specific risk factors, and facilitating the development of comprehensive public health interventions to mitigate tobacco-related harm in this demographic.

Summary and Conclusions

Firstly, studies indicate higher rates of e-cigarette use among African American young adults compared to their Caucasian counterparts. Additionally, African Americans experience more adverse health effects from tobacco use, including e-cigarettes, compared to Caucasian Americans. The disparities in e-cigarette use may be influenced by factors such as differences in urban/rural environments. Physical activity and smokeless tobacco also influence e-cigarette use, with some research suggesting a positive association. However, the evidence is not consistent, and the relationship may be influenced by various factors. To address gaps in understanding, the proposed study focused on examining the association between physical activity, smokeless tobacco use, urban/rural status, and e-cigarette use among African American young adults. It aimed to fill a research gap by exploring these associations while adjusting for influential factors such as gender, academic level, alcohol use, and anxiety/depression. This study has the potential to lead to positive social change by identifying tobacco control needs for vulnerable populations and informing targeted messaging and interventions aimed at preventing e-cigarette use among African American young adults. By addressing these gaps in knowledge, the study can contribute to efforts to reduce health disparities and improve public health outcomes among African American communities.

Section 2: Research Design and Data Collection

Introduction

Section 1 included a review of relevant literature, offering background on previous research related to risk factors affecting e-cigarette use. This quantitative study aimed to address a research gap regarding e-cigarette use among African American young adults by examining how factors such as physical activity, smokeless tobacco use, and urban/rural status influence e-cigarette use within this group. Although previous studies have explored e-cigarette use among African Americans and young adults, they have not specifically investigated the impacts of various factors—such as physical activity, smokeless tobacco use, urban/rural status, gender, academic level, alcohol use, and anxiety/depression—within this demographic. This section outlines the study's methodology, including the research design, its alignment with the research questions, and the design's limitations.

Research Design and Rationale

Study Variables

The dependent variable is e-cigarette use. The independent variables are physical activity, smokeless tobacco, and urban/rural status. Lastly, the confounding variables are gender, academic level, alcohol use, and anxiety/depression.

Research Design and Connection to RQs

The research design directed the methodologies employed in a social science study, which primarily addressed research inquiries and acquired relevant data to tackle the research issue. I utilized a quantitative design, which facilitated procedural guidance throughout the investigation. This involved utilizing correlational and descriptive statistics derived from the 2021 BRFSS data concerning African American young adults aged 18 to 24 in the US. Pearson's correlation was employed to elucidate and gauge the strength of associations and connections between variables. This method proved effective in identifying linear relationships among continuous, nominal, and dichotomous variables. Multiple logistic regression was employed to predict dependent variables based on the impact of one or more independent variables. This model helped evaluate the statistical significance of independent variables on the dependent variable and the outcome, allowing for the identification of which factors contribute to the likelihood of e-cigarette use within this demographic.

Time and Resource Constraints

The chosen quantitative research design, while offering structured methodologies for data analysis, may impose certain time and resource constraints. Gathering and analyzing quantitative data, particularly from a large sample like the 2021 BRFSS can be time-consuming (Dietz, et al., 2020). Additionally, ensuring the accuracy and reliability of the data collected necessitates careful attention to detail and rigorous quality control measure, further adding the time and resource requirements. These constraints may influence the timeline of the study and necessitate efficient allocation of resources to ensure the research objectives are met within the designated timeframe.

How the Design Choice is Consistent with Research Designs Needed to Advance Knowledge in this Discipline

Quantitative research offers a methodical and organized approach to gathering, analyzing, and interpreting data (Smith & Johnson, 2020). This objectivity and precision are crucial in public health research, where accurate measurement and analysis of health-related problems are essential for informing policies and interventions. Quantitative methods, such as Pearson's correlation and logistic regression, allow for rigorous statistical analysis to examine these relationships, identify patterns, and make evidence-based conclusions (Smith & Johnson, 2020). The use of quantitative data enables researchers and policymakers to make data-driven decisions. Lastly, many public health issues, such as the use of e-cigarettes among African American young adults, require epidemiological investigations to understand prevalence, trends, and risk factors. Overall, the choice of a quantitative research design is consistent with the rigorous methodology needed to advance knowledge in the public health discipline, enabling researchers to address complex health issues, inform evidence-based practices, and contribute to the improvement of population health outcomes.

Methodology

Target Population

The aggregated BRFSS dataset includes data from landline and cell phone surveys conducted in 2021, covering 49 states, the District of Columbia, Guam, Puerto Rico, and the US Virgin Islands (CDC, 2021).

Sampling Strategy

The 2021 BRFSS survey used a Disproportionate Stratified Sampling (DSS) technique for landline telephone samples and a random sampling method for cellular telephone surveys (Behavioral Risk Factor Surveillance System, 2022). To weight the data, the survey applied Iterative Proportional Fitting (IPF), also known as raking. This process involved adjusting responses across various demographic categories, including age, gender, race and ethnicity, education, marital status, geographic regions, telephone type, housing status, and specific age groups within racial and ethnic categories (Behavioral Risk Factor Surveillance System, 2022). The survey was conducted throughout 2021 in all 50 states, the District of Columbia, Guam, Puerto Rico, and the US Virgin Islands, with interviews conducted via both landline and cellular phones (Behavioral Risk Factor Surveillance System, 2022).

How Data Were Generated

In 2021, 54 states and territories implemented Computer-Assisted Telephone Interview (CATI) systems, with the CDC providing support via the Ci3 WinCATI software package. This support involved programming core and module questions for data collection, scripting additional state-specific questions upon request, and offering Ci3 consultant assistance as needed (Behavioral Risk Factor Surveillance System, 2022). The CDC begins data processing once states or their contractors submit data to the data management mailbox, continuing this process throughout the survey year. Monthly data submissions are received and monitored, with CDC staff running editing programs and performing cumulative data quality checks. Any issues identified are addressed in collaboration with state programmers (Behavioral Risk Factor Surveillance System, 2022). Following these steps, data are prepared for weighting and the addition of calculated variables, identified by leading underscores in variable names (Behavioral Risk Factor Surveillance System, 2022).

Inclusion and Exclusion Criteria

The BRFSS e-cigarette use data for 2020-2021 was appropriate for this study because the respondent inclusion and exclusion criteria complied with the Institutional Review Board (IRB) requirements. Including human subjects in public health research must adhere to the ethical standards set by the IRB. The inclusion criteria of the 2021 BRFSS data included data from 49 states, the District of Columbia, Guam, Puerto Rico, and the US Virgin Islands; adults aged 18 years and older who participated in the survey; and responses gathered from both landline and cell phone surveys conducted throughout the year (CDC, 2021). The study excluded individuals under 18 years old, those who did not participate in the BRFSS survey, and any responses that were incomplete or deemed unreliable. Additionally, Florida did not collect BRFSS data for a sufficient number of months to meet the minimum requirements for inclusion in the 2021 annual aggregate data set (CDC, 2021).

Gaining Access to the Data Set

BRFSS data on e-cigarette use is publicly accessible online through the Centers for Disease Control (CDC, 2021). I accessed the secondary data set from the CDC following research ethics clearance and approval by the Institutional Review Board (IRB). I used the 2021 BRFSS data set on e-cigarette use and collected data on respondents' demographics related to age, race, gender, and academic level. The dataset was examined for the possible risk factors of e-cigarette use in the population of African American young adults 18–24 years' old in the U.S.

Describe Necessary Permissions to Gain Access to the Data

After obtaining IRB approval to access the data, I downloaded the 2021 BRFSS dataset into Microsoft Excel. I meticulously reviewed the data to confirm consistency between the Excel records. Additionally, I updated the codebook to include new variables generated from the dataset. To maintain confidentiality, access to the data will be restricted to my committee chair and committee member only.

Reputability and Quality of the Data Set Source

The Behavioral Risk Factor Surveillance System (BRFSS) is recognized for its stringent sampling methods and comprehensive data collection procedures. Government agencies, such as the CDC, or well-regarded research institutions are often viewed as authoritative sources because of their expertise, resources, and dedication to data quality (CDC, 2021). Consequently, the data used in this study is reliable and aligns with the research's purpose and objectives. For instance, BRFSS data are comprehensive and include variables relevant to health behaviors, making it suitable for studying e-cigarette use among specific demographic groups like African American young adults.

Power Analysis

Effect Size

The effect size denotes the magnitude of the relationship or difference anticipated between the variables under investigation. Typically, effect sizes are quantified using correlation coefficients for continuous variables or odds ratios for binary outcomes such as e-cigarette use. In my study, I utilized logistic regression to explore this relationship, with a common strategy involving the estimation of expected odds ratios as the effect size. For example, if prior research or preliminary data indicates that smokeless tobacco use among African American young adults is associated with an odds ratio of 1.2 for e-cigarette use, this figure can serve as the anticipated effect size. This choice is grounded in existing literature or preliminary findings suggesting a plausible connection between smokeless tobacco use and e-cigarette use among African American young adults.

Alpha Level

The alpha level represents the probability of incorrectly rejecting the null hypothesis when it is actually true, known as the Type I error rate. The alpha level is conventionally set at 0.05 to control the Type I error rate. This standard significance level in statistical testing signifies a 5% likelihood of concluding there is an effect when none exists. In practice, the alpha level determines the threshold at which the null hypothesis is rejected, typically at levels of 0.05, 0.01, or 0.001 (Frankfort-Nachmias & Leon-Guerrero, 2015).

Power Level

A power analysis was conducted to evaluate the probability of rejecting the null hypothesis, which suggests no difference, in contrast to the research hypothesis when the null is proven false. Accepting the alternative hypothesis when it is true results in a Type II error (β), as outlined by Creswell (2014) and Frankfort-Nachmias & Leon-Guerrero (2015). The null hypothesis served as the basis for making statistical inferences about the target population. Conventionally, a power level of .80 (or 80%) is often used, meaning you have an 80% chance of detecting an effect if it truly exists.

In this study, I utilized *GPower 3.1.9.2,* a freely available software tool widely employed in the social sciences for conducting power analysis. As described by Hertzog (2017), *G*Power aids in determining the necessary sample size, effect size, and relationships with predictor variables in quantitative and cross-sectional research. Using G*Power, I calculated the sample size for a logistic regression of each research question. The OR was set to 1.3, the p-value was set to .05, and error of 0.80, which created a sample size of 477 (Faul et al., 2007).

Operationalization for Variables

Dependent Variable

The dependent variable in this study is the presence of e-cigarette use, also known as the outcome or criterion variable. This variable was measured by categorizing responses as either 'every day' or 'some days' use. Therefore, the outcome assessment consists of two categories: users and non-users. According to Gertsman (2015), an outcome variable that is nominal or categorical can be numerically represented in the data. In this study, 'every day' e-cigarette use and 'some days' e-cigarette use was coded as 1 (e-cigarette use), and no e-cigarette use was coded as 0.

Independent Variable

Independent variables, also known as explanatory, predictor, or regressor variables (Gerstman, 2015; Laerd, 2020), in this study include physical activity, smokeless tobacco use, and urban/rural status, which may potentially influence the outcome variable, e-cigarette use. Other contributing factors considered are gender, academic level, alcohol use, marijuana use, cigarette use, and anxiety/depression. Physical activity was assigned in two items: 1 = physical activity and 0 = no physical activity. Smokeless tobacco use included responses of 'every day' or 'some days' use and was assigned in two items: 1 = smokeless tobacco use (every day or some days use) and 0 = no smokeless tobacco use. Lastly, urban/rural status was a dichotomous variable assigned in two items: 1 = urban counties and 2 = rural counties.

Covariates

The primary covariates in this study were gender, academic level, alcohol use, marijuana use, cigarette use, and anxiety/depression. Creswell (2014) suggests that researchers should discuss covariates, even if they are not the main focus of the study, due to their potential impact on the outcome variable. Gender, academic level, alcohol use, and anxiety/depression are confounding, or spurious variables and likely predictors e-cigarette use among this population (Adzrago et al., 2023; Gaiha et al., 2022; Pericot-Valverde et al., 2021; Sung, 2021; Uddin et al., 2020) in this investigation. Academic level was grouped in 4 categories including: 1 = did not graduate high school; 2 = graduated high school; 3 = attended college or technical school; and 4 = graduated from college or technical school.

Table 2

Variables, Type, and Measures

Variable	Variable type	How the Variable is Measured
E-cigarette use	Dependent/outcome	1 = e-cigarette use or 0 = no e-cigarette use
Physical activity	Independent/predictor	1= physical activity or 0 = no physical activity
Smokeless tobacco use	Independent/predictor	1 = smokeless tobacco use or 0 = no smokeless tobacco use
Urban/rural status	Independent/predictor	1 = urban counties or 2 = rural counties
Gender	Covariate	1 = male or 2 = female
Academic level	Covariate	1= did not graduate high school, 2= graduated high school, 3 = attended college or technical school, 4 = graduated from college or technical school
Alcohol use	Covariate	0=None, 1=Mild, 2=Moderate, 3=Severe, 4=Very Severe
Anxiety/depression	Covariate	0 = None, 1 = Mild, 2 = Moderate, 3=Severe

Data Analysis Plan

Software

I used IBM SPSS version 29 software for an in-depth data analysis, which included running frequency distributions, creating graphs and charts, and conducting descriptive analyses. This allowed me to describe the target population and utilize logistic regression and bivariate analyses to explore the relationships between the outcome variables and predictor variables. Additionally, I used SPSS's logistic regression model, which automatically excluded any missing data.

Data Cleaning and Screening

Data cleaning is a crucial process in preparing a dataset for analysis, involving the identification and correction of errors or inconsistencies (Field et al., 2012). Key steps include handling missing data by assessing its extent per variable and deciding on appropriate strategies such as deletion, imputation, or utilizing models like SPSS that can manage missing data effectively (Field et al., 2012). Addressing outliers is also essential to mitigate their potential impact on statistical analyses, either through removal or data transformation. Consistency checks were conducted to review each variable for unexpected values that could compromise data integrity. Data screening ensures that the dataset meets the assumptions required for statistical analyses, including checks for normality using methods like histograms and tests for skewness and kurtosis (Field et al., 2012). Assessment for multicollinearity among predictor variables is crucial and can be achieved through correlation matrices or variance inflation factor analysis in regression models. Specific assumption tests, particularly for regression analyses like logistic regression, will be performed to validate the appropriateness of the chosen statistical models. Lastly, ensuring an adequate sample size is essential, particularly for logistic regression, which typically demands larger samples compared to linear regression to achieve reliable results (Field et al., 2012).

How Missing Data will be Addressed

Additionally, I used a logistic regression model in SPSS that automatically handles missing data by applying listwise deletion (Smith et al., 2022). This method improved the validity of the data and the conclusions derived from the analysis. Addressing missing data will help ensure that the assumptions of normality required for SPSS multiple imputations are satisfied (Smith et al., 2022).

Research Questions and Hypothesis

The study addressed the following research questions and corresponding hypotheses:

RQ1: Is there an association between physical activity and e-cigarette use among African American young adults, when controlling for gender, academic level, alcohol use, marijuana use, cigarette use, and anxiety/depression?

$H_0$1: There is no statistically significant difference in physical activity and e-cigarette use among African American young adults when controlling for gender, academic level, alcohol use, marijuana use, cigarette use, and anxiety/depression.

H_A1: There is a statistically significant difference in physical activity and e-cigarette use among African American young adults when controlling for gender, academic level, alcohol use, marijuana use, cigarette use, and anxiety/depression.

RQ2: Is there an association between smokeless tobacco use and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, marijuana use, cigarette use, and anxiety/depression?

$H_0$2: There is no statistically significant difference in smokeless tobacco use and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, marijuana use, cigarette use, and anxiety/depression.

H_A2: There is a statistically significant difference in smokeless tobacco use and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, marijuana use, cigarette use, and anxiety/depression.

RQ3: Is there an association between urban/rural status and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, marijuana use, cigarette use, and anxiety/depression?

$H_0 3$: There is no statistically significant difference in urban/rural status and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, marijuana use, cigarette use, and anxiety/depression.

$H_A 3$: There is a statistically significant difference in urban/rural status and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, marijuana use, cigarette use, and anxiety/depression.

Analysis Plan

Statistical Tests

Variables identified as significant in univariate analysis were further investigated through multivariate analysis. Statistical significance was assessed using a threshold of $P < 0.05$. These P values will guide whether to reject the null hypothesis or accept the alternative hypothesis. A significance level of $P < 0.05$ will indicate whether the relative risk factors align with the study's results and provide stronger statistical evidence. A lower P-value will support rejecting the null hypothesis in favor of the alternative hypothesis (Aschengrau & Seage III, 2014; Gertsman, 2015; Frankfort-Nachmias & Leon-Guerrero, 2015).

The multiple logistic regression model was chosen as the appropriate statistical approach for this study due to its suitability for analyzing one dichotomous outcome variable (e-cigarette use) and multiple predictor variables (physical activity, smokeless tobacco use, urban/rural status, gender, academic level, alcohol use, anxiety/depression) (Gerstman, 2015; Laerd, 2020). Furthermore, multiple logistic regression models were used to address each of the three research questions. This approach is suitable for analyzing the relationship between one dichotomous outcome variable (e-cigarette use) and multiple predictor variables (such as physical activity, smokeless tobacco use, and urban/rural status), while adjusting for potential confounders (gender, academic level, alcohol use, and anxiety/depression) (Gerstman, 2015; Laerd, 2020). The models helped elucidate the impact of predictor variables such as physical activity and smokeless tobacco use on e-cigarette use. Additionally, 95% confidence intervals were computed to improve the applicability of the findings to the larger population. The covariates of the study (gender, academic level, alcohol use, and anxiety/depression) were also analyzed. These covariates or confounders were chosen for this study due to their impact on both the outcome and predictor variables. To evaluate these associations, the analysis considered the sample size (n) and P-value ≤ 0.05.

Assumptions

Assumptions underlying Multiple Regression Analysis are critical to ensuring the reliability of statistical findings. For Multiple Regression Analysis, these assumptions include verifying the linearity of each predictor's relationship with the outcome variable, independence and normal distribution of model residuals, homoscedasticity (constant variance of residuals across predictor levels), and absence of significant multicollinearity among predictors, which can distort estimates (Hair et al., 2019). Techniques such as formal statistical tests (e.g., Shapiro-Wilk for normality, Levene's for variance), transformations of variables, or alternative robust methods (e.g., non-parametric tests) can address specific violations. Sensitivity analyses are also crucial, assessing the impact of assumption deviations on study conclusions and ensuring transparency in reporting limitations (Hair et al., 2019; Agresti, 2018).

Rationale for Covariates

Furthermore, the covariates of the study (gender, academic level, alcohol use, and anxiety/depression) were analyzed. These covariates or confounders were selected for this study because of the influence each has on the outcome and predictor variables (Adzrago et al., 2023; Al Rifai et la., 2020; Assari et al., 2020; Gaiha et al., 2022; Pokhrel et al., 2019; Sung, 2021; Uddin et al., 2020). Multiple logistic regression was used for the confounders by using odds ratios (ORs) for the association between the study variables (physical activity, smokeless tobacco use, urban/rural status, e-cigarette use) while controlling for the covariates (gender, academic level, alcohol use, and anxiety/depression).

Interpretation of Results

The univariate analysis and multivariate analysis (multiple logistic regression) provided different insights into the relationships to the variables. I identified variables that were found to be statistically significant ($P < 0.05$) in the analyses. For instance, in the multiple logistic regression, significant predictor variables indicated a statistically significant association with e-cigarette use after adjusting for other variables. I then assessed the effect size of these associations by examining ORs to understand the magnitude of the association between predictor variables and e-cigarette use.

External Validity

Creswell (2014) emphasized the importance of identifying and mitigating external threats in study design to ensure accurate conclusions and valid inferences from the data. Several measures will be implemented to safeguard external validity. Firstly, the study's conclusions were restricted to African American young adults in the U.S., specifically concerning their physical activity, smokeless tobacco use, urban/rural status, gender, academic level, alcohol use, and anxiety/depression. Secondly, the variables related to e-cigarette use among African American young adults were exclusively studied within the specific geographic and temporal context of the U.S. Extrapolating statistical inferences to other populations or settings, as noted by Creswell (2014) and Frankfort-Nachmias & Leon-Guerrero (2015), can jeopardize external validity. To address this, a systematic random sampling procedure was used to select participants who have confirmed e-cigarette use, thereby reducing threats to external validity. Additionally, a comprehensive review of relevant literature and constructs was conducted to further enhance the protection of external validity.

Internal Validity

During data collection, internal validity was rigorously checked, adhering to components such as history, maturation, regression, selection, mortality, and instrumentation, as outlined by Babbie (2014) and Creswell (2014). For instance, respondents were selected based on historical factors to ensure uniform exposure to external events during the BRFSS 2021 survey (CDC, 2021). Maturation was considered to select participants who exhibited similar rates of change, such as age (CDC, 2021). Regression analysis ensured that participants did not exhibit extreme or divergent characteristics (CDC, 2021). Additionally, random selection was employed to ensure a fair distribution of participants, and the impact of participant dropout was minimized through a large sample size (CDC, 2021). Furthermore, the consistency of instrumentation throughout the research process was maintained to ensure validity.

Ethical Procedures

Agreements to Gain Access to Data

After my proposal was approved by the University Research Review (URR) and with the guidance of my academic chair, I submitted an application to the Walden University Ethics Committee or Institutional Review Board (IRB) for permission to conduct data collection. Obtaining IRB approval is essential for addressing the ethical considerations associated with involving human subjects in the research. Despite using secondary data, every precaution will be taken to ensure that study participants will be safeguarded against physical, psychological, social, economic, or legal harm. Following IRB approval and upon receiving permission from the CDC to access the data, I downloaded and securely stored the data on a computer hard drive protected by password security measures.

Anonymity and Security of the Dataset

The dataset used in this study ensures anonymity and security through rigorous procedures. Identifiers will either never be included in the dataset or will be removed prior to its use for research purposes. Data was securely stored on a password-protected, encrypted computer hard drive to prevent unauthorized access. Access to the dataset was limited to authorized researchers who have obtained IRB approval, ensuring confidentiality. Data dissemination was limited to approved personnel only, adhering strictly to confidentiality agreements. Upon completion of the study, the dataset will be securely destroyed in compliance with data retention policies and ethical guidelines. This approach ensures that the dataset remains protected throughout its use, adhering to ethical standards and safeguarding the privacy of study participants

Ethical Issues

Ensuring the security and confidentiality of participant data is paramount to protect against unauthorized access and breaches, especially when dealing with sensitive information like health data (Tripathy, 2013). To address this issue effectively, several key measures were taken. Firstly, data was securely stored on encrypted devices or servers that restrict access to authorized personnel only. Lastly, a systematic approach to data destruction was implemented. This involved establishing clear protocols for securely deleting or destroying data once it is no longer required, in adherence to data retention policies and ethical guidelines. The CDC ensured that participants were fully informed about the survey's purpose, the nature of their involvement, and any potential risks or benefits. Participation was entirely voluntary (CDC, 2021).

Summary and Transition

In the study, I employed a quantitative research method and a descriptive design to investigate the factors contributing to e-cigarette use among African American young adults in the U.S. The investigation involved a cross-sectional study of a sample of African American young adults in the U.S. who participated in the Behavioral Risk Factor Surveillance Survey in 2021. The SEM was used in the study as a guiding theoretical framework. This public health issue continues to rise among African Americans and young adults (Adzrago et al., 2023; Al Rifai et al., 2020; Assari et al., 2020; Boakye et al., 2022; Erhabor et al., 2023; Gaiha et al., 2022; Pericot-Valverde et al., 2021; Pokhrel et al., 2019; Lanza et al., 2020; Sung, 2021; and Uddin et al., 2020). The data analysis involved multiple logistic regression, as well as univariate and multivariate analyses, along with p-values to determine statistical significance. Key variables in the study included e-cigarette use, physical activity, smokeless tobacco use, and urban/rural status. Additionally, multiple regression was utilized to elucidate the linear relationships between these variables, address research questions and hypotheses, and make inferences about the risk factors for e-cigarette use among African American young adults in the U.S.

Section 3: Presentation of Results and Findings Section

Introduction

This section presents the results and findings of the study, focusing on the associations between e-cigarette use and key predictor variables—physical activity, smokeless tobacco use, and urban/rural status—among African American young adults. The analysis includes descriptive statistics, univariate and multivariate analyses, and logistic regression models to evaluate the significance of these relationships while controlling for covariates such as gender, academic level, alcohol use, and anxiety/depression. Findings from these analyses provide insight into patterns of e-cigarette use within this population and contribute to the broader understanding of tobacco control efforts targeting African American young adults. The results are interpreted in the context of the research questions and hypotheses, offering a foundation for discussions on public health interventions and policy implications.

The purpose of this research study was to explore the risk factors influencing e-cigarette use as it relates to physical activity, smokeless tobacco use, and urban/rural status among African American young adults in the US after adjusting for gender, academic level, alcohol use, and anxiety/depression. The study aims at making contributions to the field of public health by improving the understanding among public health organizations, practitioners, policymakers, and the general public about effective strategies, programs, and policies for smoking cessation.

RQs and Hypothesis

This investigation addresses three research questions and associated hypotheses:

RQ1: Is there an association between physical activity and e-cigarette use among African American young adults, when controlling for gender, academic level, alcohol use, and anxiety/depression?

$H_0$1: There is no statistically significant difference in physical activity and e-cigarette use among African American young adults when controlling for gender, academic level, alcohol use, and anxiety/depression.

H_A1: There is a statistically significant difference in physical activity and e-cigarette use among African American young adults when controlling for gender, academic level, alcohol use, and anxiety/depression.

RQ2: Is there an association between smokeless tobacco use and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression?

$H_0$2: There is no statistically significant difference in smokeless tobacco use and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression.

H_A2: There is a statistically significant difference in smokeless tobacco use and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression.

RQ3: Is there an association between urban/rural status and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression?

$H_0$3: There is no statistically significant difference in urban/rural status and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression.

H_A3: There is a statistically significant difference in urban/rural status and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression.

Accessing the Data for Secondary Analysis

Timeframe of Data Collection

The 2021 Behavioral Risk Factor Surveillance System (BRFSS) data were collected throughout the year, primarily from January to December 2021. The BRFSS is a state-based telephone survey conducted annually to gather information on health-related risk behaviors, chronic health conditions, and use of preventive services. The survey typically includes both landline and cell phone interviews, allowing for a representative sample of the adult population (CDC, 2021).

Discrepancies in Secondary Dataset

The analysis used listwise deletion within the logistic regression model in SPSS, which automatically excluded cases with missing data from analysis (Smith et al., 2022). While this approach is valid for certain scenarios, it can lead to a reduced sample size, potentially decreasing statistical power and introducing bias if the missing data are not randomly distributed.

Missing Data

I utilized SPSS to remove cases that contained missing values by using the number of missing value function via filter unselected cases (CDC, 2020; Wagner III, 2016) to get the new data set. Then I conducted all statistical analysis on this new data set.

Descriptive and Demographic Characteristics of the Sample

Using the statistical package for social sciences (SPSS) version 29, I ran descriptive statistics (univariate analysis) for a synopsis of baseline and demographic characteristics of the sample representing the target population (African American young adults). The next level of statistical test included inferential statistics, multivariate regressions, to identify any relationships or associations between the predictor variables (physical activity, smokeless tobacco use, and urban/rural status) and the outcome variable (e-cigarette use), while controlling for gender, academic level, alcohol use, and anxiety/depression. The binary logistic regression model was utilized as the specific multivariate regression for analyses relating to testing my research hypotheses.

External Validity

When using the 2021 Behavioral Risk Factor Surveillance System (BRFSS) data for my research, the representativeness of the sample can be assessed based on the sampling design and the population it aims to reflect. The BRFSS is a probability-based survey, meaning that it uses a random sampling technique to select participants, which enhances its external validity and generalizability to the broader population. The sample is weighted to adjust for unequal probabilities of selection, nonresponse, and demographic discrepancies between the sample and the overall population. This ensures that the results are proportional to the actual U.S. population in terms of key characteristics, like age, sex, and race. However, non-probability sampling (e.g., convenience sampling or self-selection) was not used in this case, meaning the BRFSS data maintains strong external validity and is generally representative of the larger U.S. population.

Descriptive Statistics

Sample: African American Young Adults

Table 3

Frequencies of Age 1

N	Valid	2070
	Missing	0
	Median	0
	Mode	1

Table 4

Frequences of Age 2

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1	2070	100.0	100.0	100.0

Table 5

Frequencies of Race 1

N	Valid	2070
	Missing	0
	Median	2
	Mode	2

Table 6

Frequencies of Race 2

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1	2070	100.0	100.0	100.0

Based on my target population of African American young adults, I assessed the respondent's age and race/ethnicity that were grouped in six categories. I used the select cases option in SPSS to filter out the age variable to only include data from respondents between 18-24, as well as the race variable to include only African American respondents. From the crosstabulation, 2,070 participants were African American young adults (Tables 3-6).

Predictor Variable: Physical Activity

Table 7

Frequency of Physical Activity 1

N	Valid	2068
	Missing	2
	Median	1
	Mode	1

Table 8

Frequency of Physical Activity 2

Valid		Frequency	Percent	Valid Percent	Cumulative Percent
	No Physical Activity	482	23.3	23.3	23.3
	Physical Activity	1586	76.6	76.7	100.0
	Total	2068	99.9	100.0	
Missing	System	2	.1		
	Total	2070	100.0		

Physical activity was assessed by four categories, including Yes, No, Don't know/Not sure, and Refused. I recoded the physical activity variable into two new groups (nEXERANY2) for the purpose of running a bivariate analysis and only focusing on the respondents that are physically active. The nEXERANY2 group included 1= physical activity and 0 = no physical activity (Table 8). The data from the univariate analysis indicate that there are a total of 2068 respondents, with two missing. with a median and mode exercise value of one (Table 7). This indicates that most respondents are physically active, with 76.6% (1586) of the sample engaging in physical activity (Table 8).

Predictor Variable: Smokeless Tobacco Use

Table 9

Frequency of Smokeless Tobacco Use 1

N	Valid	1928
	Missing	142
	Median	.00
	Mode	.00

Table 10

Frequency of Smokeless Tobacco Use 2

Valid		Frequency	Percent	Valid Percent	Cumulative Percent
	No Smokeless Tobacco use	1887	91.2	97.9	97.9
	Smokeless Tobacco Use	41	2	2.1	100
	Total	1928	93.1	100.0	
Missing	System	142	6.9		
	Total	2070	100.0		

Smokeless tobacco use was assessed in the dataset in five categories, as follows: Every day, Some days, Not at all, Don't know/Not sure, and Refused (Table 10). The variable was recoded (nUSENOW3), with 1 being smokeless tobacco use every day or some days and 0 being no smokeless tobacco use (Table 10). The data from the new variable show that 91.2% (1,887) of the sample do not use smokeless tobacco (Table 10). The frequency distribution table shows a mode of zero (Table 9) indicating, again, that majority of the sample does not use smokeless tobacco. SPSS automatically excluded missing data (142), so there were only 1928 responses to this question in the dataset (Table 9).

Predictor Variable: Urban/Rural Status

Table 11

Frequency of Urban/Rural Status 1

N	Valid	2014
	Missing	56
	Median	1
	Mode	1

Valid		Frequency	Percent	Valid Percent	Cumulative Percent
	Urban Counties	1920	92.8	95.3	95.3
	Rural Counties	94	4.5	4.7	100
	Total	2014	97.3	100.0	
Missing	System	56	2.7		
	Total	2070	100.0		

Urban or rural status was assessed in the dataset by two categories: Urban counties and Rural counties. The data show that 92.8% (1920) of the sample are in an urban area (Table 11). SPSS automatically excluded missing data (56), so only 2014 responses to this question were from the sample (Table 11).

Outcome Variable: E-Cigarette Use

Table 12

Frequency of E-Cigarette Use 1

N	Valid	2014
	Missing	56
	Median	1
	Mode	1

Table 13

Frequency of E-Cigarette Use 2

Valid		Frequency	Percent	Valid Percent	Cumulative Percent
	No e-cigarette use	1679	81.1	87.3	87.3
	E-cigarette use	244	11.8	12.7	100.0
	Total	1923	92.9	100.0	
Missing	System	147	7.1		
	Total	2070	100.0		

E-cigarette use was assessed in five categories, as follows: 1=every day, 2=some days, 3=not at all, 4=never used e-cigs, 7=don't know/not sure, and 9=refused (ECIGNOW1). The variable was recoded (nECIGNOW1) to 1=e-cigarette use (every day, some days) and 0 = no e-cigarette use. There were 1923 responses to this question, with 147 responses that were missing or were coded as "don't know/not sure" or "refused" in the original data (Table 12). The mode is zero, suggesting that the most frequent response is "no e-cigarette use" (i.e., 0 = no e-cigarette use) (Table 12). The data shows that only 11.8% (244) use e-cigarettes every day or some days, while 81.4% (1684) of the sample do not use e-cigarettes (Table 13).

Covariate: Gender

Table 14

Frequency of Gender 1

N	Valid	2070
	Missing	0
	Median	2
	Mode	2

Table 15

Frequency of Gender 2

Valid		Frequency	Percent	Valid Percent	Cumulative Percent
	Male	1001	48.4	48.4	48.4
	Female	1069	51.6	51.6	100.0
	Total	2070	100.0	100.0	

Gender was assessed by the sex of the respondent; 1=male and 2=female. The data indicates that there are a total of 2070 respondents (Table 14), with 48.4% (1001) being male and 51.6% (1069) being female (Table 15). Overall, the distribution shows that the sample is predominately female.

Covariate: Academic Level

Table 16

Frequency of Academic Level 1

N	Valid	2067
	Missing	3
	Median	2
	Mode	2

Table 17

Frequency of Academic Level 2

Valid		Frequency	Percent	Valid Percent	Cumulative Percent
	Did not graduate high school	98	4.7	4.7	4.7
	Graduated high school	969	46.8	46.9	51.6
	Attended college or technical school	662	32.0	32.0	83.6
	Graduated from college or technical school	338	16.3	16.4	100.0
	Total	2067	99.9	100.0	
Missing	System	3	.1		
	Total	2070	100.0		

I assessed the respondents' level of education by five different categories: Did not graduate high school; graduated high school; attended college or technical school; graduated from college or technical school; and don't know. The variable was recoded (nEDUCAG) to filter out missing cases. The number of respondents with valid responses to this question is 2067 (as there are three missing) (Table 16). The data shows that 46.8% (969) of the sample graduated from high school, 32% (662) attended college or technical school, 16.3% (338) graduated from a college or technical school, and 4.7% (98) did not graduate high school (Table 17). Since both the median and mode are two (Graduated high school), it can be concluded that the "Graduated high school" category is the most typical education level in this dataset (Table 17).

Covariate: Alcohol Use

Table 18

Frequency of Alcohol Use 1

N	Valid	792
	Missing	1278
	Median	.00
	Mode	.00

Table 19

Frequency of Alcohol Use 2

Valid		Frequency	Percent	Valid Percent	Cumulative Percent
	No Alcohol Use	517	25.0	65.3	65.3
	Mild Alcohol Use	245	11.8	30.9	96.2
	Moderate Alcohol Use	11	.5	1.4	97.6
	Severe Alcohol Use	19	.9	2.4	100.0
	Total	792	38.3	100.0	
Missing	System	1278	61.7		
	Total	2070	100.0		

Alcohol use was assessed in the dataset by how many times did the respondent have five or more drinks within a 30-day period. The variable was recoded (nDRNKG3) into a categorical variable with 0=no alcohol use, 1=mild alcohol use, 2=moderate alcohol use, and 3=severe alcohol use. The mode number is zero (Table 18), which indicates that majority of the sample (25%) does not use alcohol (Table 19).

Covariate: Anxiety/Depression

Table 20

Frequency of Anxiety/Depression 1

N	Valid	2020
	Missing	50
	Median	1
	Mode	.00

Table 21

Frequency of Anxiety/Depression 2

Valid		Frequency	Percent	Valid Percent	Cumulative Percent
	None	859	41.5	42.5	42.5
	Mild	729	35.2	36.1	78.6
	Moderate	235	11.4	11.6	90.2
	Severe	197	9.5	9.8	100.0
	Total	2020	97.6	100.0	
Missing	System	50	2.4		
	Total	2070	100.0		

This dataset provides information about how many days respondents reported their mental health as being “not good” over a specified period. The values range from 1 to 30 days, with some special codes for missing or unclear responses. The variable was recoded (nMENTHLT) to a categorical variable with 0=none, 1=mild, 2=moderate, and 3=severe (Table 21). There were 2020 (N) respondents that provided responses to this question, with 50 missing data points (Table 20). The mode is zero (none), which suggests that, on average, the majority of the sample (41.5%) does not have issues with mental health (Table 21).

Statistical Assumptions

In this study, I used multiple logistic regression to examine how predictor variables—such as physical activity, smokeless tobacco use, and urban/rural status—affect the likelihood of e-cigarette use. Multiple logistic regression was an appropriate choice for this analysis because the independent variables are categorical. Preliminary analyses were conducted to assess the assumptions of outliers, multicollinearity, and linearity. One key assumption of this model is that the outcome variable (e-cigarette use) is measured at a binary level, which aligns with the structure of the data. The variables were tested for multicollinearity (Table 22), indicating no multicollinearity in the model (all variables had a VIF value less than 10).

Table 22

Test for Multicollinearity

	Model	B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	VIF
1	(Constant)	.248	.451		.551	.589		
	Physical Activity	.406	.263	.334	1.544	.142	.880	1.136
	Smokeless Tobacco Use	-.058	.211	-.058	-.273	.788	.906	1.103
	Academic Level	-.102	.143	-.172	-.715	.485	.711	1.407
	Marijuana Use	.017	.095	.048	.183	.857	.593	1.587
	Alcohol Use	-.194	.243	-.196	-.799	.436	.685	1.460
	Model	B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	VIF
	Anxiety/Depression	.168	.101	.401	1.664	.116	.710	1.409
	Gender	-.015	.231	-.015	-.063	.951	.774	1.292

Multivariate Analysis and Hypothesis Testing

RQ1

The following research question and hypotheses was addressed:

RQ1: Is there an association between physical activity and e-cigarette use among African American young adults, when controlling for gender, academic level, alcohol use, and anxiety/depression?

$H_0$1: There is no statistically significant difference in physical activity and e-cigarette use among African American young adults when controlling for gender, academic level, alcohol use, and anxiety/depression.

H_A1: There is a statistically significant difference in physical activity and e-cigarette use among African American young adults when controlling for gender, academic level, alcohol use, and anxiety/depression.

Table 23

Case Processing Summary/Omnibus Tests – RQ1

Unweighted Cases		N	Percent
Selected Cases	Included in Analysis	754	36.4
	Missing Cases	1316	63.6
	Total	2070	100.0
Unselected Cases		0	.0
Total		2070	100.0

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

Table 24

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	45.654	7	<.001
	Block	45.654	7	<.001
	Model	45.654	7	<.001

Table 25

Model Summary/Classification Table – RQ1

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	66.075[a]	.059	.096

Note: a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Table 26

Classification Table

			Predicted E-Cigarette Use		
Observed			No e-cigarette use	E-cigarette use	Percentage Correct
Step 1	E-Cigarette Use	No e-cigarette use	610	7	98.9
		E-cigarette use	133	4	2.9
	Overall Percentage				81.4

Table 27

Tables in the Equation – RQ1

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	Academic Level			3.362	3	.339	
	Academic Level (1)	.459	.567	.657	1	.418	1.583
	Academic Level (2)	.125	.568	.048	1	.826	1.133
	Academic Level (3)	.061	.586	.011	1	.917	1.063
		B	S.E.	Wald	df	Sig.	Exp(B)
	Alcohol Use	.053	.018	8.837	1	.003	1.055
	Anxiety/Depression	.040	.009	17.984	1	<.001	1.041
	Gender	-.571	.201	8.044	1	.005	.565
	Physical Activity	.590	.291	4.102	1	.043	1.804
	Constant	-1.848	.641	8.302	1	.004	.158

Note. a. Variable(s) entered on step 1: nEDUCAG, nDRNK3GE5, nMENTHLTH, SEX OF RESPONDENT, nEXERANY2.

The logistic regression results were significant, X2(6, N=754) = 45.654, p=<.001, indicating the model could distinguish between respondents who reported and did not report e-cigarette use (Tables 23 and 24). The model explained between 5% (Cox and Snell R2) and 9% (Nagelkerke R2) of the variance in e-cigarette use and correctly classified 81.4% of the cases (Tables 25 and 26). Physical activity (p=.043; OR=1.804), gender (p=.005; OR=.565), alcohol use (p=.003; OR=1.055), and anxiety/depression (p=<.001; OR=1.041) were significant predictors (Table 27). This indicated that a one unit increase in physical activity respondents were 1.804 times more likely to report e-cigarette use; a one unity increase in alcohol use respondents were 1.055 times more likely to report e-cigarette use; and a one unity increase in anxiety/depression resulted in respondents being 1.041 times more likely to report e-cigarette use (Table 27). An odds ratio of 0.565 for gender means that the group coded as 1 (male) has higher odds of e-cigarette use compared to the group coded as 2 (female). The results of the binomial logistic regression cause me to reject the null hypothesis that there is no statistically significant association between physical activity and e-cigarette use among African American young adults in the U.S.

RQ2

The following research question and hypotheses was addressed:

RQ2: Is there an association between smokeless tobacco use and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression?

$H_0 2$: There is no statistically significant difference in smokeless tobacco use and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression.

$H_A 2$: There is a statistically significant difference in smokeless tobacco use and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression.

Table 28

Case Processing Summary/Ominbus Tests – RQ2

Unweighted Cases		N	Percent
Selected Cases	Included in Analysis	754	36.4
	Missing Cases	1316	63.6
	Total	2070	100.0
Unselected Cases		0	.0
Total		2070	100.0

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

Table 29

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	51.052	7	<.001
	Block	51.052	7	<.001
	Model	51.052	7	<.001

Table 30

Model Summary/Classification Table – RQ2

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	663.676[a]	.065	.107

Note. a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Table 31

Classification Table

	Observed		Predicted E-Cigarette Use No e-cigarette use	E-cigarette use	Percentage Correct
Step 1	E-Cigarette Use	No e-cigarette use	609	8	98.7
		E-cigarette use	131	6	4.4
	Overall Percentage				81.6

Table 32

Variables in the Equation – RQ2

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	Academic Level			3.194	3	.363	
	Academic Level (1)	.647	.559	1.339	1	.247	1.909
	Academic Level (2)	.331	.560	.349	1	.555	1.392
	Academic Level (3)	.309	.575	.288	1	.591	1.362
	Alcohol Use	.047	.018	18.232	1	<.001	1.048
	Anxiety/Depression	.040	.009	6.387	1	.011	1.048
	Gender	-.584	.202	8.468	1	.004	.558
	Smokeless Tobacco Use	1.289	.427	10.569	1	.004	.558
	Constant	-1.595	.606	6.931	1	.008	.203

Note. a. Variable(s) entered on step 1: nEDUCAG, nDRNK3GE5, nMENTHLTH, SEX OF RESPONDENT, nUSENOW3.

The logistic regression results were significant, X2(6, N=754) = 51.052, p=<.001, indicating the model could distinguish between respondents who reported and did not report e-cigarette use (Tables 28 and 29). The model explained between 6% (Cox and Snell R2) and 10% (Nagelkerke R2) of the variance in e-cigarette use and correctly classified 81.6% of the cases (Tables 30 and 31). Smokeless tobacco use (p=.001, OR=4.013), gender (p=.004; OR=.558), alcohol use (p=.011; OR=1.048), and anxiety/depression (p=<.001; OR=1.041) were significant predictors (Table 32). This indicated that a one unit increase in smokeless tobacco use resulted in respondents being 4.013 times more likely to report e-cigarette use; a one unit increase in alcohol use resulted in respondents being 1.048 times more likely to report e-cigarette use; and a one unit increase in anxiety/depression resulted in respondents being 1.041 times more likely to report e-cigarette use. An odds ratio of 0.558 for gender means that the group coded as 1 (male) has higher odds of e-cigarette use compared to the group coded as 2 (female). The results of the binomial logistic regression cause me to reject the null hypothesis that there is no statistically significant association between smokeless tobacco use and e-cigarette use among African American young adults in the U.S.

RQ3

The following research question and hypotheses was addressed:

RQ3: Is there an association between urban/rural status and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression?

$H_0$3: There is no statistically significant difference in urban/rural status and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression.

H_A3: There is a statistically significant difference in urban/rural status and e-cigarette use among African American young adults when controlling for physical activity, gender, academic level, alcohol use, and anxiety/depression.

Table 33

Case Processing Summary/Omnibus Tests – RQ3

Unweighted Cases		N	Percent
Selected Cases	Included in Analysis	729	35.2
	Missing Cases	1341	64.8
	Total	2070	100.0
Unselected Cases		0	.0
Total		2070	100.0

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

Table 34

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	41.541	7	<.001
	Block	41.541	7	<.001
	Model	41.541	7	<.001

Table 35

Model Summary/Classification Table – RQ3

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	654.111[a]	.055	.090

Note. a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Table 36

Classification Table

Observed			Predicted E-Cigarette Use		
			No e-cigarette use	E-cigarette use	Percentage Correct
Step 1	E-Cigarette Use	No e-cigarette use	589	6	99.0
		E-cigarette use	129	5	3.7
	Overall Percentage				81.5

Table 37

Variables in the Equation – RQ3

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	Academic Level			2.265	3	.519	
	Academic Level (1)	.545	.567	.924	1	.336	1.725
	Academic Level (2)	.289	.568	.260	1	.610	1.336
	Academic Level (3)	.241	.581	.171	1	.679	1.272
	Alcohol Use	.050	.018	7.799	1	.005	1.052
	Anxiety/Depression	.040	.009	18.463	1	<.001	1.041
	Gender	-.622	.203	9.448	1	.002	.537
	Urban/Rural Status	.523	.477	1.201	1	.273	1.687
	Constant	-1.421	.616	5.320	1	.021	.242

Note. a. Variable(s) entered on step 1: nEDUCAG, nDRNK3GE5, nMENTHLTH, SEX OF RESPONDENT, nURBSTAT.

The logistic regression results were significant, X2(6, N=729) = 41.541, p=<.001, indicating the model could distinguish between respondents who reported and did not report e-cigarette use (Tables 33 and 34). The model explained between 5% (Cox and Snell R2) and 9% (Nagelkerke R2) of the variance in e-cigarette use and correctly classified 81.5% of the cases (Tables 34 and 35). Gender (p=.002; OR=.537), alcohol use (p=.005; OR=1.052), and anxiety/depression (p=<.001; OR=1.041) were significant predictors (Table 36). This indicated that a one unit increase in alcohol use resulted in respondents being 1.052 times more likely to report e-cigarette use; and a one unity increase in anxiety/depression resulted in respondents being 1.041 times more likely to report e-cigarette use. An odds ratio of 0.537 for gender means that the group coded as 1 (male) has higher odds of e-cigarette use compared to the group coded as 2 (female). The results of the binomial logistic regression cause me to accept the null hypothesis that there is no statistically significant association between urban/rural status and e-cigarette use among African American young adults in the U.S.

Summary

In this cross-sectional quantitative study, I investigated the potential influences of physical activity, smokeless tobacco use, and urban/rural status on e-cigarette use among African American young adults in the U.S., utilizing data from the 2021 Behavioral Risk Factor Surveillance Survey (BRFSS). Covariates considered in the analysis included gender, academic level, alcohol use, and anxiety/depression, based on findings from the literature review and the study's grounding theory (SEM) (Adzrago et al., 2023; Al Rifai et al., 2020; Assari et al., 2020; Boakye et al., 2022; Erhabor et al., 2023; Gaiha et al., 2022; Lanza et al., 2020; Pericot-Valverde et al., 2021; Pokhrel et al., 2019; Sung, 2021; Uddin et al., 2020). I conducted a univariate analysis and frequency distribution of the variables, followed by a multiple (binary) logistic regression model to predict the potential contributions of the predictor variables to e-cigarette use, while controlling for the covariates. The results of this analysis are detailed in the following section.

In section 4, I present interpretations and findings of the study. I also discuss conclusions, implications, positive social changes, and limitations of the study. Lastly, I make recommendations for further research.

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

Introduction

The purpose of this quantitative study was to explore potential relationships between physical activity, smokeless tobacco use, and urban/rural status with e-cigarette use among African American young adults in the United States. Research questions were designed to assess the relative impact of physical activity, smokeless tobacco use, and urban/rural status on the prevalence of e-cigarette use in this population. This section presents an interpretation of the data analysis results, discusses study limitations, and offers recommendations for future research.

Interpretation of Findings

The results of the logistic regression analyses suggest that physical activity, smokeless tobacco use, alcohol use, gender, and anxiety/depression are significant predictors of e-cigarette use among African American young adults, while urban/rural status does not appear to have a statistically significant association with e-cigarette use. In RQ1, a higher level of physical activity, alcohol use, and anxiety/depression were associated with increased odds of reporting e-cigarette use. Additionally, males (coded as 1) had higher odds of e-cigarette use than females (coded as 2). The OR for gender (0.565) suggests that males were less likely to report e-cigarette use than females, although this result might be counterintuitive considering other findings. RQ2 further demonstrated that smokeless tobacco use (OR = 4.013) was the strongest predictor, with higher levels of smokeless tobacco use associated with significantly greater odds of e-cigarette use. Again, males had higher odds of e-cigarette use than females (OR = 0.558).

In RQ3, gender, alcohol use and anxiety/depression remained significant predictors, but urban/rural status was not a significant factor in predicting e-cigarette use.

These findings collectively indicate that, for this sample of African American young adults, behavioral factors such as smokeless tobacco use, alcohol use, and anxiety/depression are more strongly associated with e-cigarette use than demographic factors like urban/rural status and gender.w34 The results of the logistic regressions reject the null hypotheses for physical activity (RQ1) and smokeless tobacco use (RQ2) as predictors while failing to find a significant relationship between urban/rural status and e-cigarette use (RQ3).

Comparison of Findings

The findings of this study contribute to the existing literature by both confirming and challenging previous research on the associations between physical activity, smokeless tobacco use, alcohol use, anxiety/depression, and urban/rural status with e-cigarette use among African American young adults.

Physical Activity

The positive association between physical activity and e-cigarette use found in this study (OR = 1.804) extends the findings of Pokhrel et al. (2019), who suggested a possible link between increased physical activity and e-cigarette use. While some research has shown an inconsistent relationship between these two variables, this study's significant finding suggests that higher levels of physical activity may be a predictor of e-cigarette use among African American young adults. This could reflect complex behavioral patterns, where physical activity might be linked to other factors, such as stress reduction or social activities that may also promote e-cigarette use, but further research is needed to understand this relationship fully.

Smokeless Tobacco Use

The study's finding that smokeless tobacco use is a strong predictor of e-cigarette use (OR = 4.013) aligns with the work of Coleman et al. (2015), which showed that young adults who experimented with smokeless tobacco products are more likely to experiment with e-cigarettes. This result is consistent with the concept of "dual use" of tobacco products, highlighted by Erhabor et al. (2023), where younger populations are more likely to use both smokeless tobacco and e-cigarettes simultaneously. This study's significant association supports the idea that smokeless tobacco use may act as a gateway to e-cigarette use among African American young adults, contributing to the broader pattern of tobacco product experimentation in this age group.

Urban/Rural Status

Contrary to findings in previous studies (Adzrago et al., 2023; Erhabor et al., 2023), this study did not find a significant association between urban/rural status and e-cigarette use. Adzrago et al. (2023) suggested that e-cigarette use is influenced by geographic location, with rural areas showing higher use due to factors like socioeconomic disadvantage and exposure to tobacco marketing. On the other hand, Erhabor et al. (2023) noted that rural areas tend to have higher rates of tobacco product use, possibly due to lower cessation rates and greater access to tobacco marketing. In urban areas, the availability of e-cigarettes and exposure to marketing were thought to increase usage among African American young adults. However, the results of this study failed to find a statistically significant relationship between urban/rural status and e-cigarette use, indicating that factors other than geographic location, such as social or behavioral influences, may be more crucial for this population.

Alcohol Use

The association between alcohol use and e-cigarette use (OR = 1.055) found in this study is consistent with the findings of Lanza et al. (2020), who reported that young adults who use e-cigarettes are more prone to binge drinking and marijuana use. This suggests that e-cigarette use may be part of a broader set of risky behaviors in young adulthood, including alcohol consumption. The results here confirm that alcohol use is positively correlated with e-cigarette use in this population, extending previous findings by emphasizing the need to consider co-occurring risk behaviors in health interventions.

Anxiety/Depression

This study's finding that anxiety/depression is a significant predictor of e-cigarette use (OR = 1.041) corroborates the results of Adzrago et al. (2023) and Sung (2021), who found that African American young adults with anxiety and depression are more likely to use e-cigarettes. This is further supported by Pericot-Valverde et al. (2021), who observed an increase in e-cigarette use following exposure to stressors. The findings of this study contribute to the literature by confirming the role of mental health issues as a predictor of e-cigarette use and highlighting the vulnerability of this population to using e-cigarettes as a coping mechanism for anxiety and depression.

Theoretical Applications

The findings of this study can be interpreted through the lens of the SEM, which emphasizes the multi-level influences on behavior, including individual, interpersonal, community, and broader societal factors. By analyzing the results within this framework, we can gain a deeper understanding of how various factors, ranging from personal behaviors to environmental contexts, interact to influence e-cigarette use among African American young adults.

Individual Level

At the individual level, the results of this study point to several key factors that influence e-cigarette use. For example, physical activity (OR = 1.804) and anxiety/depression (OR = 1.041) were found to significantly predict e-cigarette use, which aligns with SEM's emphasis on individual characteristics such as behaviors and mental health. The positive association between physical activity and e-cigarette use is noteworthy, suggesting that individual health behaviors may not always align with overall wellness goals. In this case, physical activity may be linked to other behaviors (e.g., social environments or stress) that influence the likelihood of e-cigarette use, highlighting the complex interactions within an individual's behavior patterns. Similarly, the finding that anxiety and depression are associated with higher odds of e-cigarette use reflects SEM's focus on mental health as a critical individual factor. Individuals facing mental health challenges may turn to e-cigarettes as a coping mechanism, reinforcing the need for addressing emotional well-being in tobacco prevention efforts.

Interpersonal Level

At the interpersonal level, the study found gender to be a significant predictor of e-cigarette use, with males (coded as 1) having higher odds of using e-cigarettes compared to females (coded as 2) in both RQ1 (OR = 0.565) and RQ2 (OR = 0.558). This suggests that gender dynamics, which are often shaped by social norms, peer influences, and gender roles can play a role in shaping e-cigarette use. SEM posits that interpersonal relationships, including family and peer networks, influence health behaviors. Gender-based differences in e-cigarette use can also reflect societal and cultural influences, underscoring the need for targeted interventions that consider the social context in which these behaviors occur.

Community Level

At the community level, factors such as smokeless tobacco use (OR = 4.013) emerge as significant predictors of e-cigarette use, reflecting the influence of shared community norms and behaviors. Smokeless tobacco use, particularly among young adults, may be more common in certain communities where tobacco use is normalized, and these behaviors are transmitted through social networks.

Limitations of the Study

The analysis was limited by the exclusion of two covariates, marijuana use and cigarette use, due to a significant amount of missing data, which reduced the sample size and potentially compromised the statistical power and generalizability of the results. While this decision helped retain a larger, more representative sample and ensured more reliable findings, it also introduced concerns about validity. Missing data could lead to biased estimates, especially if the missing values are not randomly distributed, potentially affecting the accuracy of the relationships between predictors and e-cigarette use. Additionally, the variables used to measure constructs like physical activity, smokeless tobacco use, and anxiety/depression may not have perfectly captured the intended behaviors or mental health conditions, raising concerns about construct validity. Finally, although excluding these covariates helped address statistical power, it also increased the risk of Type II errors (failing to detect true effects), which could undermine the overall reliability of the findings.

Recommendations

Building on the strengths and limitations of this study, future research should focus on several key areas to deepen our understanding of e-cigarette use among African American young adults. First, advanced imputation methods should be employed to address missing data, particularly for covariates like marijuana and cigarette use, which were excluded in this study. By doing so, statistical power could be enhanced and a more complete set of variables retained. Additionally, research should explore poly-substance use, examining the combined effects of e-cigarettes, cigarettes, and marijuana, as dual and multiple use behaviors are common among young adults.

To improve construct validity, more precise and comprehensive measures of anxiety/depression, such as clinical assessments or diagnostic interviews, should be used. Expanding the social-ecological context of the study by including factors like neighborhood tobacco norms and marketing exposure would provide a more nuanced understanding of how environmental influences shape e-cigarette use. Finally, studies should aim to include a more diverse sample, encompassing both urban and rural areas and a range of socioeconomic backgrounds. This would help enhance the generalizability of the findings and inform more targeted, effective interventions.

Implications for Professional Practice and Social Change

Overall, the results of this study confirm several key relationships found in previous research, particularly the links between physical activity, smokeless tobacco use, alcohol use, and anxiety/depression with e-cigarette use. However, the absence of a significant relationship between urban/rural status and e-cigarette use challenges some prior assumptions in the literature, indicating that other factors, perhaps individual behaviors or access to resources, may be more influential in predicting e-cigarette use among African American young adults. The study's findings contribute to the understanding of the multifaceted nature of e-cigarette use in this population and underscore the importance of considering a wide range of social, behavioral, and psychological factors when addressing e-cigarette use among young adults.

The study's findings suggest that positive social change can be achieved through multi-level interventions that address individual behaviors, family dynamics, organizational support, and societal policies. At the individual level, the results emphasize the importance of addressing mental health and substance use behaviors to prevent and intervene in e-cigarette use among African American young adults. By recognizing the significant links between anxiety, depression, and e-cigarette use, interventions can be tailored to help individuals manage mental health issues, potentially reducing their reliance on substances like e-cigarettes. At the family level, the findings highlight the crucial role families play in fostering healthy behaviors and mental well-being. Families can create supportive environments that prioritize mental health, potentially reducing the risk of e-cigarette use. On the organizational level, schools, universities, and community organizations can integrate these findings into targeted health promotion programs. For example, colleges could develop mental health resources, substance abuse counseling, and wellness initiatives focused on reducing e-cigarette use and promoting overall well-being. At the societal and policy level, the study calls for policy interventions that address the intersection of mental health, substance use, and tobacco product use. Public health policies and tobacco control efforts could be adapted to incorporate mental health screenings and support services, offering a more holistic approach to reducing e-cigarette use.

Conclusion

This study addresses a critical public health issue by exploring the factors influencing e-cigarette use among African American young adults. Through a rigorous quantitative approach and application of public health models, the research identifies key predictors of e-cigarette use, including mental health, substance use, and social factors. The findings underscore the need for targeted, evidence-based interventions that address these interconnected behaviors, contributing to positive social change and improved health outcomes. By integrating methodological rigor with ethical considerations, this study aims to inform public health practice and policy, promoting equitable health solutions for diverse populations and helping to reduce the burden of e-cigarette use among vulnerable groups.

Synthesis of DrPH Foundational and Program-Specific Competencies

I designed a quantitative research study using the 2021 BRFSS data, which allowed for a comprehensive analysis of key health behaviors and determinants in a large, representative population. The project was built around a robust research question, using a logistic regression model to identify predictors of e-cigarette use, demonstrating my ability to design and conduct rigorous public health research.

The study applied the SEM to frame the analysis of health behaviors. I critically evaluated the strengths of applying these models in explaining health behaviors, while acknowledging their limitations, such as the lack of consideration for cultural and contextual factors or the simplification of complex behaviors. This demonstrated my capacity to apply theoretical frameworks to public health research while being aware of their limitations in real-world settings.

Ethical considerations were paramount throughout the study. I ensured informed consent and confidentiality for all participants involved in the BRFSS data collection process, acknowledging the ethical principles of respect for persons, beneficence, and justice. Additionally, I addressed potential conflicts of interest and bias in data interpretation, ensuring the integrity of the study's findings. This aligns with ethical standards in public health research and reinforces my commitment to conducting responsible, transparent research.

I communicated the study findings to diverse stakeholders, including community health organizations, policymakers, and public health practitioners, ensuring that the results were presented in clear, accessible language. I tailored communication to various health literacy levels, using visual aids, summaries, and recommendations to facilitate understanding and influence behavior. My approach demonstrated effective science communication's importance in driving policy change and promoting public health actions.

In my work, I synthesized foundational and program-specific competencies by utilizing evidence-based approaches to address tobacco use disparities among African American young adults. Through the SEM, I identified individual, interpersonal, community, and policy-level factors contributing to e-cigarette and smokeless tobacco use. Leveraging these insights, I proposed public health policies to influence positive social change within affected communities.

First, I advocated for policies that restrict tobacco marketing targeted at African American communities**,** addressing the disproportionate exposure to predatory marketing practices. Second, I emphasized the need for funding safe and accessible recreational spaces in underserved rural and urban areas. Lastly, I proposed the expansion of services to support mental health and smoking cessation efforts to address co-occurring factors like anxiety, depression, and substance use.

References

Adzrago, D., Fujimoto, K., Harrell, M. B., Jones, A., & Wilkerson, M. J. (2023). Association between e-cigarette use behaviors and perceived harmfulness of e-cigarettes and anxiety/depression symptoms among Black/African American adults. *Preventive Medicine Report, 102080*. https://doi.org/10.1016/j.pmedr.2022.102080

Agresti, A. (2018). *Foundations of linear and generalized linear models*. John Wiley & Sons.

Al Rifai, M., Mirbolouk, M., Obisesan, O. H., Jia, X., Nasir, K., Merchant, A. T., Virani, S. (2020). The association of electronic cigarette use and the subjective domains of physical and mental health: The Behavioral Risk Factor Surveillance System Survey. *Cureus*, *12*(2), e7088. https://doi.org/10.7759/cureus.7088

Aschengrau, A., & Seage III, G. R. (2014). *Essentials of epidemiology in public health* (3rd ed.). Jones & Bartlett Learning.

Assari, S., Mistry, R., & Bazargan, M. (2020). Race, educational attainment, and e-cigarette use. *Journal of Medical Research and Innovation, 4*(1), e000185. https://doi.org/10.32892/jmri.185

Babbie, E. (2014). *The basics of social research* (6th ed.). Cengage Learning.

Behavioral Risk Factor Surveillance System. (2022). Overview: BRFSS 2021. Retrieved from Centers for Disease Control and Prevention: https://www.cdc.gov/brfss/annual_data/2021/pdf/Overview_2021-508.pdf

Behavioral Risk Factor Surveillance System. (2022). Comparability of Data BRFSS

2021. Retrieved from Centers for Disease Control and Prevention: https://www.cdc.gov/brfss/annual_data/2021/pdf/compare_2021-508.pdf

Bhandari, P. (2021). Secondary data analysis: Advantages and disadvantages. *Journal of Education and Social Sciences*, *12*(3), 45–56.

Boakye, E., Osuji, N., Erhabor, J., Obisesan, O., Osei, A. D., Mirbolouk, M., Bhatnag. (2022). Assessment of patterns in e-cigarette use among adults in the US, 2017-2020. *JAMA Netw Open, 5*(7). https://doi.org/10.1001/jamanetworkopen.2022.23266.

Center for Disease Control and Prevention. (2021). Retrieved from 2021 BRFSS Survey Documentation: https://www.cdc.gov/brfss/annual_data/annual_2021.html

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Thousand Oaks, California: SAGE Publications, Inc.

Coleman, B. N., Apelberg, B. J., Ambrose, B. K., Green, K. M., Choiniere, C. J., Bunnell, R., & King, B. A. (2015). Association between electronic cigarette use and openness to cigarette smoking among US young adults. *Nicotine and Tobacco Research, 17*(2), 212–218. https://doi.org/10.1093/ntr/ntu211

Dietz, P., Raddatz, C., Schäfer, K., & Wiegand, M. (2020). Challenges of large-scale quantitative data collection and analysis in social sciences: Lessons learned from an international survey project. *Survey Research Methods, 14*(2), 145–162. https://doi.org/10.18148/srm/2020.v14i2.7724

Erhabor, J., Boakye, E., Obisesan, O., Osei, A. D., Tasdighi, E., Mirbolouk, H., Bhat. (2023). E-cigarette use among US adults in the 2021 Behavioral Risk Factor

Surveillance System Survey. *JAMA Netw Open, 6*(11), e2340859. https://doi.org/10.1001/jamanetworkopen.2023.40859.

Field, A., Miles, J., & Field, Z. (2012). *Discovering statistics using R*. SAGE Publications Ltd.

Frankfort-Nachmias, C., & Leon-Guerrero, A. (2015). *Social statistics for a diverse society* (7th ed.). SAGE Publications.

Gaiha, S. M., Rao, P., & Halpern-Felsher, B. (2022). Sociodemographic factors associated with adolescents' and young adults' susceptibility, use, and intended future use of different e-cigarette devices. *International Journal of Environmental Research and Public Health, 19*(4), 1941. https://doi.org/10.3390/ijerph19041941.

Gertsman, B. B. (2015). Basic Biostatistics: Statistics for Public Health Practice (2nd ed.). Burlington, MA: Jones & Bartlet Learning, LLC, an Ascend Learning Company.

Han, G., & Son, H. (2022). A systematic review of socio-ecological factors influencing current e-cigarette use among adolescents and young adults. *Addictive Behaviors, 135*, 107425. https://doi.org/10.1016/j.addbeh.2022.107425

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate Data Analysis* (8th ed.). Cengage Learning. Chapter 7 discusses regression analysis assumptions including linearity, independence of errors, normality of residuals, homoscedasticity, and multicollinearity.

Hertzog, M. A. (2017). Using G*Power 3.1.9.2 for power analysis in research. *Behavior Research Methods*, *49*(4), 1608–1619. https://doi.org/10.3758/s13428-016-0775-3

Kegler, M. C., Escoffery, C., Groff, A., Butler, S., & Foreman, A. (2017). A qualitative study of how families decide to adopt household smoking restrictions. *Family & Community Health, 40*(1), 31--39. https://doi:10.1097/FCH.0000000000000128

Kilanowski, J. F. (2017). Breadth of the Socio-Ecological Model. *Journal of Agromedicine, 22*, 295-297. https://doi.org/10.1080/1059924X.2017.1358971

Laerd Statistics. (Pearson's Product-Moment Correlation SPSS Statistics). Assumptions. Retrieved November 27, 2020, from https://statistics.laerd.com/premium/spss/pc/pearson-correlation-in-spss-7.php

Lanza, I. H., Motlagh, G., & Orozco, M. (2020). E-cigarette use among young adults: A latent class analysis examining co-use and correlates of nicotine vaping. *Addictive Behaviors*, *110,* 106528. https://doi.org/10.1016/j.addbeh.2020.106528

McCausland, K., Booth, S., Leavers, F., Freeman, B., Wolf, K., Leaver, T., & Jancey, J. (2024). Socio-ecological factors that influence youth vaping: perspectives from Western Australian school professionals, parents and young people. *International Journal of Qualitative Studies in Health and Well-being, 19*(1), 2322753. doi: 10.1080/17482631.2024.2322753

Pericot-Valverde, I., Heo, M., Litwin, A. H., Niu, J., & Gaalema, D. E. (2021). Modeling the effect of stress on vaping behavior among young adults: A randomize cross-over pilot study. *Drug Alcohol Depend, 225*(1), 108798. https://doi.org/10.1016/j.drugalcdep.2021.108798

Pokhrel, P., Schmid, S., & Pagano, I. (2019). Physical activity and use of cigarettes and e-cigarettes among young adults. *American Journal of Preventative Medicine,* *58*(4), 580--583. https://doi.org/10.1016/j.amepre.2019.10.015.

Sallis, J. F., Owen, N., & Fisher, E. B. (2008). Ecological models of health behavior. In K. Glanz, B. K. Rimer, & K. Viswanath (Eds.), *Health behavior and health education: Theory, research, and practice* (4th ed., pp. 465--485). Jossey-Bass.

Sansom, R. (2022). *Ecological models of behavior change*. Retrieved from Accelerating Systemic Change Network: https://ascnhighered.org/ASCN/change_theories/collection/ecological_models.html

Scarneo, S., Traeder, T., & Baker, E. (2019). Applying the Social Ecological Model: A comprehensive approach to preventing childhood obesity. *Journal of Public Health Management and Practice*, *25*(1), 30--39. https://doi.org/10.1097/PHH.0000000000000912

Smith, J. K., & Johnson, L. M. (2020). Quantitative Methods in Public Health: The Role in Understanding and Addressing Health Disparities. *Journal of Public Health Management & Practice*, *26*(4), 123--135.

Smith, M. J., Quartagno, M., & Njagi, E. N. (2022). *Multiple imputation for logistic regression models: Incorporating an interaction*. Retrieved from Arxiv: https://arxiv.org/pdf/2211.14556

Sung, B. (2021). Gender differences in the association between e-cigarette use and depression among US adults. *Osong Public Health and Research Perspectives, 12*(1), 13--19. https://doi.org/10.24171/j.phrp.2021.12.1.03.

Behavioral Risk Factor Surveillance System. (2022, July). Retrieved from Centers for

Disease Control and Prevention: https://www.cdc.gov/brfss/annual_data/2021/pdf/Overview_2021-508.pdf

Tripathy, J. P. (2013). Secondary Data Analysis: Ethical Issues and Challenges. *Iran Journal of Public Health, 42*(12), 1478--1479.

Uddin, I. S., Osei, A. D., Obisesan, O. H., El-Shahawy, O., Dzaye, O., Cainzos-Achirica, M., Henr. (2020). Prevalence, trends, and distribution of nicotine and marijuana use in e-cigarettes among US adults. The Behavioral Risk Factor Surveillance System 2016-2018. *Preventative Medicine, 139,* 106175. https://doi.org/10.1016/j.ypmed.2020.106175

Urban Area. (n.d.). Retrieved from National Geographic: https://education.nationalgeographic.org/resource/urban-area/

Appendix A: Community Health Intervention Plan

Title: "Breaking Barriers: Promoting Healthy Behaviors Among African American Young Adults"

Public Health Problem: African American young adults in the United States face disproportionately high rates of tobacco use, including smokeless tobacco and e-cigarettes. Additionally, physical inactivity and environmental disparities between urban and rural areas contribute to adverse health outcomes, including chronic diseases such as cardiovascular disease and cancer. Addressing these interconnected behaviors and social determinants of health is crucial to improving health equity in this population.

Summary of Findings

The findings indicate that higher levels of physical activity, alcohol use, and anxiety/depression are associated with increased odds of e-cigarette use. Smokeless tobacco use emerged as the strongest predictor, with significantly greater odds of e-cigarette use (OR = 4.013). Interestingly, while males consistently demonstrated higher odds of e-cigarette use than females, the odds ratios (0.565 in RQ1 and 0.558 in RQ2) suggest males were less likely to report e-cigarette use compared to females, which appears counterintuitive. Additionally, while alcohol use and anxiety/depression remained significant predictors across analyses, urban/rural status was not found to significantly impact e-cigarette use. These findings highlight key behavioral and demographic factors influencing e-cigarette use among African American young adults.

How Findings Inform the Intervention

The association between physical activity and increased odds of e-cigarette use suggests the need for integrating tobacco education into fitness programs. Interventions can leverage physical activity initiatives as an opportunity to raise awareness about the risks of e-cigarette use, particularly among individuals already engaging in health-related behaviors.

The significant associations between alcohol use, anxiety, depression, and e-cigarette use underscore the importance of addressing co-occurring risk factors. Community health interventions should include mental health support and substance use education, with accessible counseling and peer-support groups to address anxiety and depression.

The strong relationship between smokeless tobacco and e-cigarette use highlights the need to prioritize dual-use prevention efforts. Community programs should focus on educating young adults about the risks of smokeless tobacco and its role in escalating e-cigarette use. Tailored messaging, particularly in rural areas where smokeless tobacco use is higher, could significantly reduce dual use.

Target Population: African American young adults (ages 18–25) in both urban and rural settings across the U.S., with a focus on those at higher risk of tobacco use.

Visual representation of Community Health Intervention Plan using the Social Ecological Model

Levels	Intervention	Rationale
Individual Level: **Enhancing Knowledge and Self-Efficacy**	Culturally tailored health education programs to increase awareness Incorporate digital tools (e.g. mobile apps) to track physical activity	Educating individuals about risks and benefits empowers behavior change and builds self-efficacy
Interpersonal Level: **Leveraging Social Support**	Establish peer-led support groups by African American young adults to encourage tobacco cessation and promote active lifestyles Train mentors to provide guidance and accountability	Social support networks reinforce positive behaviors and create safe spaces for discussing challenges
Community Level: **Creating Supportive Environments**	Partner with community organizations, such as churches, recreational centers, and Historically Black Colleges (HBCU's) to host tobacco-free community events and fitness programs	Community-based interventions build trust and increase accessibility to resources in culturally relevant ways
Policy Level: **Advocating for Environmental and Structural Change**	Policies that restrict tobacco marketing targeted at African American communities Funding for safe and accessible recreational spaces in underserved rural and urban areas Expansion of telehealth services to support mental health and smoking cessation efforts	Structural changes address systemic inequities that contribute to health disparities

Appendix B: Information Sheet

Breaking Barriers: Promoting Healthy Behaviors Among African

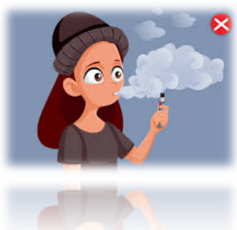
Who's at Risk

African American young adults (18-25)

Physically active individuals

Dual users of other tobacco products and alcohol

Individuals suffering with mental health, such as anxiety/depression



What You Need to Know

- **E-cigarettes and Smokeless Tobacco Use:** E-cigarette use is on the rise among African American young adults, often linked to smokeless tobacco use, alcohol consumption, and mental health challenges like anxiety/depression.
- **E-cigarettes and Physical Activity:** staying active is great for your health, but studies show that even physically active individuals may be at risk of using e-cigarettes.
- **Mental Health Matters:** Anxiety and depression can increase the likelihood of e-cigarette use. Addressing mental health is crucial for making healthier choices

Why It Matters

Tobacco use is a leading cause of preventable illness and death, and e-cigarette use is a growing concern. Together, we can:

- Reduce tobacco use and improve overall health
- Create safe spaces for physical activity and social support

Did You Know?

Higher Susceptibility: African American young adults are more likely to use e-cigarettes compared to those who have never used them, highlighting a significant public health concern

While physical activity is generally considered a positive health behavior, higher levels of physical activity were unexpectedly associated with increased odds of e-cigarette use in this population.

Get Involved

Want to learn more or get involved?

- Join a program near you
- Access free resources and tools
- Advocate for healthier communities