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The Impact of Electronic Cigarettes Use on Traditional Cigarette Uses Among U.S. Adolescents

Ismail Mensah Dwumfour-Poku
Walden University

Walden University

College of Health Professions

This is to certify that the doctoral dissertation by

Ismail Dwumfour-Poku

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Review Committee
Dr. Nicoletta Alexander, Committee Chairperson, Public Health Faculty
Dr. Xianbin Li, Committee Member, Public Health Faculty
Dr. Jamuir Robinson, University Reviewer, Public Health Faculty

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Walden University
August 2022

Abstract

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Adolescents

by

Ismail Dwumfour-Poku

MPH, Walden University, 2014

BS, Shenandoah University, 2010

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health-Epidemiology

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Abstract

The increased usage of e-cigarettes among adolescents in the United States (U.S.) is a major public health concern. According to the Centers for Disease Control and Prevention (CDC), nicotine, an active ingredient in e-cigarettes, is the most addictive drug in use today. The purpose of the current study was to explore the relationship between smoking of e-cigarettes and the risk of smoking traditional cigarettes among middle and high school students in Grades 6 through 12 in the U.S., and to determine if demographic factors contribute to this predisposition. This, quantitative cross-sectional study used the social ecological model as the framework to guide the design. The study used secondary datasets from the 2011 National Youth Tobacco Survey with a sample size of 15,801 of U.S. middle and high school students. Chi-square and logistic regression analysis were used to determine if there was a relationship between e-cigarettes use and traditional cigarettes use. Results indicated a statistically significant relationship between e-cigarettes use and traditional cigarettes ($p = .0001$), and the odds of smoking traditional cigarettes is 13 times higher for those who smoke e-cigarettes (AOR = 13.384; CI = 11.04-16.263; $p = .0001$). The potential positive social change impact of this study is a better understanding of youth smoking behavior. This information provides further evidence that can be used towards the development of more effective intervention programs that focus specifically on middle and high school students who smoke e-cigarettes. The results of this study will help stakeholders such as local municipalities and community leaders focus more resources on low socioeconomic and at-risk neighborhoods where improvement is much needed.

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Dedication

This dissertation is in loving memories of my grandmother and father who made high school education possible at a time when high school was only for the elite and the rich. It was so expensive the poor could not afford it at the time, but my grandmother was so hopeful and always said "God will make a way where there is no way. He makes the impossible possible." These words continue to echo in my ears and memory. Their dedication to education laid the foundation for me to be where I am today. Grandma and Pap, I still love you and always will. RIP! To my lovely, widowed mother who carried the burden and the torch that kept my early educational fire burning; you are my hero. Mom, thank you for your unconditional love and for pushing me to press on because as you will always say "nothing that is worthwhile ever comes easy."

Acknowledgments

To God be the glory. Thank you, Father, for guiding me through this journey. First and foremost, my warmest and sincere gratitude goes to my wonderful and impeccable Chair, Dr. Nicoletta Alexander, whose dedication, perseverance, persistence, guidance, and numerous corrections after corrections to my dissertation made this accomplishment possible. I also thank my committee member and Methods professor, Dr. Daniel Xianbin Li, who has been just as great for his knowledge, time, and support in creating this document; and to Dr. JaMuir M. Robinson, University Research Reviewer (URR)–your guidance and revisions in writing this dissertation and your eye for detail are very much appreciated. To Form & Style Editor, Jenny Martel, thanks for your contribution in making this manuscript better. Many thanks go to my wife and beautiful children who fed me and gave me hope and the motivation not to give up. Thanks to my friends and course mates for their support throughout this arduous journey. Finally, I will be remiss if I did not mention the Walden faculty and academic community for their support throughout my academic journey here at Walden, especially my advisor Jennifer Rothamel, who constantly kept up with my progress and always asked if I needed anything. Thank you, Jen.

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Chapter 1: Introduction to the Study

Introduction

Electronic cigarettes, popularly known as e-cigarettes or vapor cigarettes are

concerning to health professionals and public health agencies that have fought for

decades to ban smoking, a cause of preventable diseases, disability, and premature

deaths. Most experts and healthcare professionals agree that nicotine is unquestionably

the most addictive drug in use today (Centers for Disease Control and Prevention

([CDC], 2016; Jenssen & Boykan, 2019). Much of the suffering and death from cancer

could be prevented by more systematic efforts to reduce tobacco use (Jenssen & Boykan,

2019). This is the reason I am embarking on a journey to find the truth about e-cigarettes.

The deleterious effects of smoking on social and physical health continue despite

the ongoing attempts to combat tobacco use among youth and adolescents over the last

few decades. Death and disabilities associated with tobacco use among youth are

premature and preventable (CDC, 2018). Diseases such as asthma, lung cancer, diabetes,

stroke and coronary artery disease, and other chronic diseases are all related to smoking

(CDC, 2018). Public health organizations have consistently attempted to combat this

growing trend with the hope of improving the health and welfare of every community.

Many schools of thought contend that curiosity is what motivates young people to start

smoking e-cigarettes, fueled by peer pressure (Chao et al., 2019). Researchers' efforts to

continue to analyze the behavioral and smoking patterns of adolescents are ongoing to

find ways to protect youth from the dangers of nicotine and other tobacco products (Chao

et al., 2019). Among those younger than18, cigarette smoking has fallen; however, e-

cigarettes use has increased sharply, thus putting at risk a new generation of young

Americans for nicotine addiction (U.S. Department of Health and Human Services

([HHS], 2016).

This study, in terms of social change implications, will be instrumental in creating

awareness about the hazards of electronic cigarettes, further developing the necessary

tools and measures to slow down this growing trend. While there is evidence about the

dangers and addictive nature of nicotine, not much is known about the dangers of e-

cigarettes. As a result, manufacturers of this product continue to advertise them as safe.

This could be the reason the U.S. Food & Drug Administration (FDA) is slow in

implementing measures to slow down the increasing use of e-cigarettes among youth and

adolescents (American Lung Association, 2020a; Scottera, 2014). The major sections of

this chapter include background of the study, problem statement, purpose of the study,

research questions and hypotheses, nature of the study, the conceptual model, study

assumptions and limitations, delimitations, and significance of the study, followed by the

chapter summary and transition to next chapter.

Background

In the 1950s and 1960s, smoking was glamorized all over the world. It was accepted

in any indoor environment, on airplanes, and in elevators, in the movies, and even

glamorized on Saturday morning cartoon shows (CDC, 2013). During this period, over 50%

of U.S. adult males smoked tobacco (CDC, 2013). CDC and other public health agencies

fought a hard, long battle to raise awareness of the health risks of smoking – and this has

been successful in some countries – but smoking rates are rising in the U.S. in the alternative form of electronic cigarettes or e-cigarettes.

Electronic cigarettes, popularly known as e-cigarettes or vapor cigarettes have been around since 2007 (Jenssen & Boykan, 2019). Since then, they have become increasingly popular among smokers who are concerned about their health and want to quit; and the youth, who have been led to believe that it is harmless (Jenssen & Boykan, 2019). They are battery-operated devices with cartridges designed to deliver doses of highly addictive nicotine and other chemicals to the user in the form of aerosol such as propylene glycol or glycerol with fruit, mint, or chocolate flavorings (CDC, 2013, FDA, 2011, Jenssen & Boykan, 2019). Electronic cigarettes have a rechargeable, battery-operated heating element, a replaceable cartridge that may contain nicotine or other chemicals, and an atomizer (heating element) that, when heated, converts the contents of the cartridge into a vapor. This vapor can then be inhaled by the user (FDA, 2011, Jenssen & Boykan, 2019). There are many different brands; most of them manufactured to look like conventional cigarettes, cigars, and pipes. They are also sometimes made to look like everyday items such as pens and USB memory sticks, with names such as Atomizer, V-hit, Tornado e-cigarettes (CDC, 2013; FDA, 2011). This study will seek to determine the association of e-cigarettes smoking among adolescents in the United States and the risk of their predisposition or initiation to smoking traditional cigarettes with the hope of finding ways to mitigate and/or eradicate this growing trend.

Problem Statement

The use of e-cigarettes continues to gain popularity among young people. As a result, there is an increasing number of middle and high school students who are smoking e-cigarettes, according to a study conducted by the National Youth Tobacco Survey (NYTS), the FDA, and the CDC. According to 2018 NYTS data, between 2017 and 2018, current use of e-cigarette, otherwise known as "vaping," increased at an alarming rate among middle school and high school students in the United States, with more than 3.6 million children vaping in 2018 (NYTS, 2020). If smoking among the youth continues at the current rate in the United States, 5.6 million of U.S. teenagers younger than 18 years will die prematurely from illness related to smoking. That translates to approximately 1 out of every 13 young Americans 17 years of age or younger living today (CDC, 2019a). The extent to which e-cigarettes are addictive and harmful in relation to conventional cigarettes remains unknown (Amrock et al., 2016). Researchers have noted that the primary ingredient in e-cigarettes is nicotine just as it is in traditional cigarettes (University of California San Francisco ([UCSF], 2014). Public health professionals and healthcare experts such as epidemiologists, public health research scientists, physicians, medical scientists, and clinical researchers, among others all agree that nicotine is unquestionably the most addictive drug in use today (CDC, 2014; Jenssen & Boykan, 2019).

There is a major concern among public health officials about the correlation between the use of e-cigarettes and conventional cigarettes smoking and the fact that demographics and socioeconomic factors may play a key role (Amrock et al., 2016). The

problem, however, is that while we know the potential dangers of smoking such as addiction and later lung cancer, it is unclear how many e-cigarette users will end up smoking traditional cigarettes (CDC, 2014). It is imperative to discover in my study what percentage of youth e-cigarette smokers go on to smoke traditional cigarettes and the role demographics and socioeconomic status play in this transition, along with estimating the current prevalence of smoking of electronic cigarettes among the youth. Furthermore, while few studies have investigated the mechanisms regarding the association between conventional cigarettes and e-cigarettes use among the youth, it will be prudent to determine whether the use of e-cigarettes will ultimately, in the long run, replace smoking of traditional cigarettes, which is a major public health concern. This mechanism may be attributed to the social network of peer influence on adolescents' penchant for electronic cigarettes and their predisposition to smoking conventional cigarettes in general (Chao et al., 2019). This was the focus of the study and the knowledge gap desired to be explored. The social significance of this study, therefore, cannot be overemphasized.

Purpose of the Study

The purpose of my dissertation was to explore the relationship between smoking of e-cigarettes and their effect on smoking traditional cigarettes among students in Grades 6 through 12; between 12-18 years of age in the United States and to determine the role demographics and socioeconomic status play in this predisposition. I chose this age group because this population was the most vulnerable and comprises a new generation of smokers and teen vaping that is threatening to reverse the progress made over the years in

the fight and reduction of tobacco. For teens who have never smoked or used any other tobacco products, e-cigarettes experimentation may be a gateway to nicotine addiction (University of Southern California ([USC], 2015).

The independent variables were electronic cigarettes, allowance, age, gender, and the dependent variable was traditional cigarettes use. Socioeconomic status, race/ethnicity, age, and gender were confounding variables in the study. The target population for this study was middle and high school students across the United States. For the purpose of this study, I used the 2011 NYTS dataset, which was the most current dataset available that contained all the variables at the beginning of the study.

Research Questions and Hypotheses

This study comprised of four main research questions (RQs), along with hypothesis generated for each one of them. The RQs and hypotheses are shown below.

RQ 1: Among U.S. middle and high school students, Grades 6-12, does e-cigarettes use play a significant role in smoking traditional cigarettes when controlling for age, gender, race, and allowance?

$H1_0$: Among U.S. middle and high school students, Grades 6-12, e-cigarettes use does not play a significant role in smoking traditional cigarettes when controlling for age, gender, race, and allowance.

$H1_a$: Among U.S. middle and high school students, Grades 6-12, e-cigarettes use plays a significant role in smoking traditional cigarettes when controlling for age, gender, race, and allowance.

RQ 2: Among US middle and high school students, Grades 6-12, does allowance play a significant role in smoking traditional cigarettes when controlling for age, gender, race, and e-cigarettes?

$H2_0$: Among U.S. middle and high school students, Grades 6-12, allowance does not play a significant role in smoking traditional cigarettes when controlling for age, gender, race, and e-cigarettes.

$H2_a$: Among U.S. middle and high school students, Grades 6-12, allowance plays a significant role in smoking traditional cigarettes when controlling for age, gender, race, and e-cigarettes.

RQ 3: Among U.S. middle and high school students, Grades 6-12, does age play a significant role in smoking traditional cigarettes when controlling for gender, race, allowance, and e-cigarettes?

$H3_0$: Among U.S. middle and high school students, Grades 6-12, age does not play a significant role in smoking traditional cigarettes when controlling for gender, race, allowance, and e-cigarettes.

$H3_a$: Among U.S. middle and high school students, Grades 6-12, age plays a significant role in smoking traditional cigarettes when controlling for gender, race, allowance, and e-cigarettes.

RQ 4: Among U.S. middle and high school students, Grades 6-12, does gender play a significant role in smoking traditional cigarettes when controlling for age, race, allowance, and e-cigarettes?

$H4_0$: Among U.S. middle and high school students, Grades 6-12, gender does not

play a significant role in smoking traditional cigarettes when controlling for age,

race, allowance, and e-cigarettes?

$H4a$: Among U.S. middle and high school students, Grades 6-12, gender plays a

significant role in smoking traditional cigarettes when controlling for age, race,

allowance, and e-cigarettes?

Theoretical Foundation

The study employed quantitative methodology along with the social ecological

model (SEM), otherwise known as the ecological model (EM), as the framework to guide

the design. McLeroy et al. (1988) proposed the ecological model of health behavior. At

its core, the concept of ecological models is that behavior comprises several levels of

influences that usually include interpersonal, intrapersonal, community, policy, physical,

environmental, and organizational phenomenon (McLeroy et al., 1988). These SEMs are

believed to provide frameworks that are comprehensive for understanding the interacting

and multi-level determinants of the behaviors of health (Glanz & Bishop, 2010). EMs

have been in the center of health promotion for many decades now. Over the last two

decades, there has been a dramatic increase in interest in the use of ecological models and

its applications in practice and research, partly because of the promise they have shown

in guiding population-wide, comprehensive approaches to changing certain behaviors

such as smoking that will ultimately mitigate prevalent and serious health problems

(Sallis et al., 2015). Since the 1960s in the United States, policy, combined with

individual, social, and environmental strategies have been credited with unprecedented reductions in tobacco use and smoking (Sallis et al., 2015).

Socioeconomic status and a wide array of sociodemographic characteristics including race, age, gender, income, and employment, among others have been linked to the health behavior and health status of people, rich and poor, in recognizing differences in diseases and rates of mortality associated with smoking and tobacco use (Smedley et al., 2003; World Health Organization, 2007). Health policy makers have high expectations on the use of these models and increasingly rely on multilevel interventions in solving the most pressing and serious health problems; one of which is partly the success in reversing and mitigating the epidemic of smoking and tobacco use. The expectations are even higher in the sense that the obesity epidemic can also be reversed, utilizing interventions that are based on SEMs, by way of improving policies and environments that are drivers for change in nutrition behaviors and physical activity. The WHO (2004), the Institute of Medicine (IOM) (2007), Koplan et al., (2005), have proposed solutions to the obesity epidemic that will require environmental and policy change.

Smoking and tobacco use are not only an individual behavioral problem but recognized widely as a public health and a social problem. An ecological perspective was required to explain the changes in population in regard to smoking. There is increasing evidence that suggests that public health, along with interventions of health promotion that are driven by behavioral and social science theories, tend to be more effective, compared to those that lack a theoretical base (Glanz & Bishop, 2010). To this end, the

SEM was instrumental in identifying the sociodemographic factors of race, age, gender, income, education, and employment in its application to smoking among middle and high school students.

Nature of the Study

The research method of choice was quantitative with retrospective cohort using secondary data from the NYTS. Differences between subjects were determined using this approach, placing emphasis on accurate measurements, and controlling for sources of error, if any (Rudestam & Newton, 2015). Important facts from the data in this study were statistically analyzed using demographics, differences between groups, and socioeconomic status, among others (Creswell, 2012). Since there were several independent variables including gender, age, race/ethnicity, socioeconomic status such as allowance, among others, a multiple logistic regression analysis was utilized in this study (Rudestam & Newton, 2015). To be effective predictors, independent variables need to have strong correlations with the dependent variable (Grove, 2007; Sullivan, 2012). The dependent variable was traditional cigarettes use, while the independent variables were electronic cigarette use, allowance, age, and gender. Covariates in the study included race/ethnicity, education, employment, among others.

A quantitative, cross-sectional methodology was employed in this study, which involved secondary data collection, and information obtained was quantified and subjected to statistical analysis. Multiple logistic regression analysis was performed to explore the extent to which the chosen constructs will predict past behaviors and current behaviors (Creswell, 2009). The target population for this study was middle and high

school students across the United States, Grades 6-12. I obtained the 2011 NYTS datasets from CDC with no special permissions required (Hooper et al., 2016; NYTS, 2020).

Definitions

*e-cigarettes***:** Also known as electronic cigarettes. They are battery-operated devices with cartridges designed to deliver doses of highly addictive nicotine and other chemicals to the user in the form of aerosol such as propylene glycol or glycerol with fruit, mint, or chocolate flavorings. The device has a rechargeable, battery-operated heating element, a replaceable cartridge that may contain nicotine or other chemicals, and an atomizer (heating element) that, when heated, converts the contents of the cartridge into a vapor (Jenssen & Boykan, 2019).

*Healthcare professional***:** A person who has direct patient contact and also qualified to evaluate and assess the patient and provide care, treatment, medication, such as a nurse, physician, dieticians, clinical psychologists, among others (WHO, 2013).

National Youth Tobacco Survey (NYTS): This is a school-based survey conducted by the CDC that annually collects information on tobacco use among middle and high school students. from Grades 6 through 8 and 9 through 12 (CDC, 2004).

*Nicotine***:** A poisonous chemical found in tobacco products as the main active ingredient (CDC, 2016; Jenssen & Boykan, 2019).

Socioeconomic status: Low income, lower level of education attainment, underemployment/low employment, substandard housing, and low academic achievement (Oxford Reference, 2020).

Sociodemographic variables: Age, gender, education attainment, and employment status. Age was coded as a categorical variable. Gender is a categorical variable based on self-reported affiliation and recorded as male or female.

Traditional cigarettes: Are tube-shaped tobacco products that are made of finely cut; cured tobacco leaves wrapped in thin paper. They may also have other ingredients, including substances to add different flavors. A cigarette is lit on one end and smoked, and the smoke is usually inhaled into the lungs (National Cancer Institute, 2020).

Combustible tobacco: Tobacco products other than cigarettes designed to be smoked such as cigars, cigarillos, little cigars, and bidis or beedis (small, flavored filter-less Indian cigarettes) (Leventhal et al., 2015).

Assumptions

There is no denying the fact that assumptions play a pivotal role in any study. These assumptions are necessary because without assumptions, the research question cannot be answered; neither would there be a research problem (Leedy & Ormrod, 2010). In this study, it was assumed that survey questionnaire was answered truthfully and honestly by the respondents. It was also assumed that the research questions in this study was answered by the information obtained from the dataset. I also assumed that the sample chosen was a true representative of the population in question from which inferences were drawn. Further assumption was that the observations of each group were independent. Though the proposed study sample was quite diverse, however, the fact remains that some segments of the student population were not included (Hooper et al., 2016).

Scope and Delimitations

The research problem addressed was the lack of data among public health officials about the correlation between the use of e-cigarettes and traditional cigarettes smoking and the fact that demographics and socioeconomic factors played a key role (Amrock et al., 2016). The problem, however, was that while we know the potential dangers of smoking such as addiction and later lung cancer, it was unclear how many e-cigarette users would end up smoking traditional cigarettes (CDC, 2014). The extent to which e-cigarettes are addictive and harmful in relation to traditional cigarettes remains unknown (Amrock et al., 2016). Though this study was based on a large, nationally representative samples of middle and high school students between the ages of 12-18; Grades 6 through 12 in the United States, students who were schooled at home, institutionalized, or those who were habitual truants were not included. As a result, the rates of smoking prevalence reported were probably underestimated compared to the actual smoking prevalence of the total student population (Hooper et al., 2016). Furthermore, about 40 high schools, all public, in the Los Angeles, metropolitan area were asked to participate in a study. The reason for choosing these schools was because of the demographics and the diversity of the student population. Parental consent was provided to participants before completing the questionnaire. Ten of the schools agreed to take part in the study (Leventhal et al., 2015). In terms of the study's generalizability, it was limited to the total student teenage population.

Limitations

A limitation of the study was that of the dependent and independent variables, which measured the perceptions of the subjects, but not the actual behaviors (caught in action) (Leventhal et al., 2015). The characteristics of the product such as flavor and the strength of nicotine were never assessed. As a result, the study was not able to determine the association with combustible tobacco initiation to the type of electronic cigarette use or specific frequency (Leventhal et al., 2015). The study focused primarily on initiation outcomes. Further study is needed in the future to evaluate if the use of e-cigarettes is associated with increasing risk to escalate to traditional and frequent combustible use of tobacco. Also, selection bias can influence study outcome, and this can be avoided through random sampling (Creswell, 2012). Lastly, anytime an instrument is used, the results of the study are subject to the known validity and reliability of that particular instrument (Creswell, 2012). Additionally, a major threat to internal validity was the selection of subjects or participants and associated characteristics (Polit & Beck, 2012). In terms of external validity, the question was asked whether the participants sampled were true representatives of the population (UCF, 2013). The survey was only limited to participants who go to public school. Another limitation was participants' admission of SES, which may be inaccurate. This may be considered self-admission bias (Creswell, 2012). No potential bias can be predicted due to the nature of the study. It could not be determined if participants under reported or over reported e-cigarettes smoking behaviors since data were self-reported (Creswell, 2012).

Significance

The majority of healthcare experts agree that the most addictive drug being used today unquestionably is nicotine (CDC, 2010). Public health educators and researchers have been raising awareness about smoking and the use of tobacco products ever since the Surgeon General declared in 1964 that smoking causes lung cancer (CDC, 2014; Jenssen & Boykan, 2019). It was therefore imperative to discover what percentage of youth e-cigarette smokers go on to smoke traditional cigarettes as well as any relationships associated with the transition including demographics and socioeconomic status (SES). Low SES has been found to play a key role in teenagers' penchant for smoking (CDC, 2014). According to the CDC, in the U.S., teens that live below the poverty level have higher rates of smoking compared to the general population (CDC, 2019). SES factors such as low income, lower level of education attainment, underemployment or low employment, substandard housing, and low academic achievement influence teenagers' behavior towards smoking (CDC, 2019b; Koh & Sebelius, 2012). While youth awareness and use of e-cigarettes are high and increasing rapidly, current data are limited on how many will end up smoking traditional cigarettes (CDC, 2013). This was the impetus of the study as this was critical information in developing interventions to combat the growing trend and /or mitigate the number of adolescents who may try e-cigarettes for the first time. Notwithstanding, while e-cigarettes use has become popular in recent years among young people as the most common tobacco product; in general, there was a decrease in the rate of use between 2015 and 2017. However, it is rather unfortunate this decline did not last long as a 2018

NYTS data revealed a startling and sharp reversal of overall rate of use decreases in years past (NYTS, 2019).

The long-term deleterious effects of tobacco use among the youth must be drivers for change and given the enormity and the nature of the epidemic the public is facing, a collective effort is needed to address this problem immediately at all levels- media, families and individuals, communities, schools, and industry to combat smoking prevalence. Nonetheless, positive social change implications from this study will include primary prevention programs that will target the youth to augment awareness through health communication campaigns that are designed to discourage risky behaviors and promote healthy habits (Bayer, et al., 2013; Walden University, 2020). Additionally, to improve the health of the community requires smoking cessation prevention and intervention strategies to promote a healthy environment. This will be done through assessments, evaluations, community education, monitoring and surveillance of disease, and disease control through health services. Positive social change implications through the results of this study will help stakeholders such as local municipalities and community leaders focus more resources on low socioeconomic and at-risk neighborhoods where improvement is much needed. Making cigarettes inaccessible to minors and a heavy levy on the price have proven effective in the past and public health must continue these efforts (Thompson, 2013). The impact on future health is a major priority and requires immediate intervention, considering the prevalence of chronic diseases arising from smoking and the burden it imposes on the health care system. The process of change is one that involves careful planning, execution,

and surveillance to ensure that implementation is both beneficial and sustainable (Novick et al., 2008).

The astonishing results of the NYTS study, with many young people taking up smoking considering the several warnings about the dangers of cigarette smoking is troubling (NYTS, 2019). It comes as no surprise that the Surgeon General calls it public enemy #1 (Jenssen & Boykan, 2019). The obligation to preserve one's health should be a public duty. Therefore, intervention by the government and/or public health is justified to prevent bad health choices. This will reduce healthcare costs and perhaps the national debt, and ultimately decrease mortality on a system that is overburdened with chronic diseases. Seipel and Shafer (2013) promote the use of public health campaigns and advocacy work as a means for social workers to reach out in the community and promote the process of change (Seipel & Shafer, 2013). With a more systematic effort to reduce or combat smoking and tobacco use, death and much of the suffering from cancer and chronic diseases could be prevented (CDC, 2013). Additionally, this study's results will contribute to positive social change by way of mitigating the number of first-time adolescent e-cigarettes smokers and those who may transition to smoking traditional cigarettes.

Summary

I started chapter one with an in-depth discussion of the advent of e-cigarettes and tobacco use among the youth, followed by the background and problem statement. I discussed the purpose of the study and enumerated the research questions and their related hypothesis, followed by a discussion of the theoretical foundation and the nature of the study. I then gave an overview of the assumptions, limitations and delimitations,

followed by a discussion of the significance of the problem and social change

implications. In Chapter 2, I presented the literature search strategy and a discussion of

the theoretical foundation and its related social ecological model, a comprehensive

review of the literature. The literature review discussed the impact of e-cigarettes,

strengths and limitations of the study and study variables.

Chapter 2: Literature Review

Introduction

The purpose of my dissertation was to explore the relationship between smoking of e-cigarettes and their effect on smoking traditional cigarettes among students in Grades 6 through 12; between 12-18 years of age in the United States. The intent of this proposed study sought to determine whether smoking of electronic cigarettes predisposed adolescents to smoking traditional cigarettes, while also determining if factors such as demographics and socioeconomic status played a role in this predisposition. This age group was chosen because this population was the most vulnerable and comprises a new generation of smokers and teen vaping that is threatening to reverse the progress made over the years in the fight to reduce tobacco use. For teens who have never smoked or used any other tobacco products, e-cigarettes experimentation may be a gateway to nicotine addiction (USC, 2015). Determining the significance and magnitude of the association between smoking of e-cigarettes and its impact on traditional cigarettes and the role allowance, age, and gender play in this association was an important first step to develop the necessary interventions. The independent variables were electronic cigarettes, allowance, age, and gender and the dependent variable was traditional cigarettes use. Race/ethnicity, education and employment were confounding variables in the study. The target population for this study was middle and high school students across the United States.

E-cigarette use (vaping) is rapidly gaining popularity, especially among the youth. As a result, there is an increasing number of middle and high school students who are

smoking e-cigarettes, according to a study conducted by the NYTS and the CDC (2014).

There is increasing evidence that vaping is associated with initiation of future smoking

(NYTS, 2019). The major sections of Chapter 2 included literature search strategy,

theoretical foundation, literature review related to key variables and/or concepts, smoking

of electronic cigarettes by adolescents, and their predisposition to smoking traditional

cigarettes, along with the risk factors and adverse effects associated with the use of

nicotine. The chapter also includes an overview of the increasing trend of the use of

electronic cigarettes among middle and high school students in the United States. and

possible prevention and intervention strategies, followed by the summary, conclusion,

and transition to the next chapter.

Literature Search Strategy

The Walden Library was a great source of literature search for my dissertation.

The Google Scholar, Walden Webinars, videos, and the rubric were instrumental in

helping shape my dissertation. The Webinars provided coaching to help develop the

dissertation on how to select and understand which research was more suitable for the

study. They also explained the literature review process through the construction of the

literature review matrix to maintain and organize articles selected. Most of the

information obtained was through electronic databases such as the Cochrane Database of

Systematic Reviews (CDSR), websites of journals, CINAHL, the Academic Search

Premier, MEDLINE, Education Resource Information Center (ERIC), Journals at Ovid,

ProQuest, and databases of publishers. The database search began in 2015 through 2017

so that citations relevant to the literature can be identified. Key search terms/words

included *e-cigarettes, cigarettes, smoking, smoking cessation, prevention and intervention, youth and adolescent smoking, smoking regulation, nicotine,* and *tobacco use among the youth*. Only articles published in the English language were searched. After conducting a literature review, a theoretical framework appropriate for this study was determined. I described this in the following section.

Theoretical Foundation

The study employed quantitative methodology along with the SEM, otherwise known as the EM, as the framework to guide the design. McLeroy et al., (1988) proposed the ecological model of health behavior. At its core, the concept of ecological models is that behavior comprises several levels of influences that usually include interpersonal, intrapersonal, community, policy, physical, environmental, and organizational phenomenon (McLeroy et al., 1988). These SEMs are believed to provide frameworks that are comprehensive for understanding the interacting and multilevel determinants of the behaviors of health (Glanz & Bishop, 2010). EMs have been in the center of health promotion for many decades now. Over the last two decades, there has been a dramatic increase in interest in the use of ecological models and its applications in practice and research, partly because of the promise they have shown in guiding population-wide, comprehensive approaches to changing certain behaviors such as smoking that will ultimately mitigate prevalent and serious health problems (Sallis et al., 2015). Since the 1960s in the United States, policy combined with individual, social, and environmental strategies have been credited with unprecedented reductions in tobacco use and smoking (Sallis et al., 2015).

Socioeconomic status and a wide array of sociodemographic characteristics including race, age, gender, income, education, and employment, among others have been linked to the health behavior and health status of people, rich and poor, in recognizing differences in diseases and rates of mortality associated with smoking and tobacco use (Smedley et al., 2003; WHO, 2007). Health policy makers have high expectations on the use of these models and increasingly rely on multilevel interventions in solving the most pressing and serious health problems; one of which is partly the success in reversing and mitigating the epidemic of smoking and tobacco use. The expectations are even higher in the sense that the obesity epidemic can also be reversed, utilizing interventions that are based on SEMs, by way of improving policies and environments that are drivers for change in nutrition behaviors and physical activity. WHO (2004), the Institute of Medicine (IOM) (2007); and Koplan et al., (2005) have proposed solutions to the obesity epidemic that will require environmental and policy change.

Smoking and tobacco use are not only an individual behavioral problem but recognized widely as a public health and a social problem. An ecological perspective is required to explain the changes in population with regard to smoking. There is increasing evidence that suggests that public health, along with interventions of health promotion that are driven by behavioral and social science theories, tend to be more effective, compared to those that lack a theoretical base (Glanz & Bishop, 2010). To this end, the SEM will be instrumental in identifying the sociodemographic factors of race, age,

gender, income, education, and employment in its application to smoking among middle and high school students.

<div align="center">**Literature Review Related to Key Variables and/or Concepts**</div>

Impact of E-cigarettes

A new generation of teenagers are being drawn by e-cigarettes into the use of recreational nicotine because of their high-tech attraction, their enticing flavors, the ease of purchase, and somehow, they believe that they are harmless (Leventhal et al., 2015). Many adolescents are open to trying other nicotine products such as cigars, hookah, and traditional cigarettes because of their experience of nicotine inhalation in e-cigarettes (NYTS, 2019). It is believed that these e-cigarette devices can deliver nicotine efficiently to the brain and the lungs, according to a study released by the Tobacco Center of Regulatory Science (TCORS), which was funded by the FDA through the National Institutes of Health (NIH) (Leventhal et al., 2015). The participants in this longitudinal study comprised 2,530 students, who, at the beginning of 9th grade had never used tobacco at the time of the first survey. Two hundred and twenty-two of these students during the first survey, had used electronic cigarettes, also called vaping, while 2,308 had never tried vaping (Leventhal et al., 2015). The survey was repeated in six and 12 months consecutively. By the end of the six-month period, 30.7% of those students who were using e-cigarettes had begun smoking either traditional cigarettes, hookahs, cigars, or a combination of any of the combustible tobacco products compared to 8.1% of those students who had never tried e-cigarettes (Leventhal et al., 2015). As the students were ushering into the 10th grade, around the 12th month, differences in tobacco smoking rates

continued to persist among students who had not used e-cigarettes versus the students who had (Leventhal et al., 2015).

It is estimated that over one million teenagers begin smoking every year (CDC, 2017). According to the then Health and Human Services Secretary Kathleen Sebelius, "every day, almost 4,000 youth try a cigarette for the first time and 1,000 youth become regular daily smokers" (CDC, 2017, p. 1). The use of e-cigarettes among middle and high school students has more than doubled from 2011 to 2012, according to a survey from the National Youth Tobacco Survey (NYTS), a school-based, pencil-and-paper questionnaire given to U.S. middle and high school students, grades 6 through 8 and 9 through 12 respectively (CDC, 2013). Additionally, according to the report, more than 75% of youth users smoke conventional cigarettes too. The findings from the NYTS in Morbidity and Mortality Weekly Report (MMWR) also indicate that there was an increase in the percentage of high school students who reported ever using e-cigarettes from 4.7% in 2011 to 10% in 2012, while during the same period those who claimed to have used it within the past 30 days rose from 1.5% to 2.8%. Use among middle school students also doubled during the same period (CDC, 2013). CDC also stated: "Nicotine is a highly addictive drug. The increased use of e-cigarettes by teens is deeply troubling, said then CDC Director Tom Frieden. Many teens who start with e-cigarettes may be condemned to struggling with a lifelong addiction to nicotine and conventional cigarettes" (CDC, 2013, p. 1).

The study also found that 76.3% of middle and high school students who used e-cigarettes within the past 30 days also smoked conventional cigarettes in the same period (CDC, 2013).

The most up-to-date and recent 2018 NYTS data showed that there was an alarming increase in the use of e-cigarettes and vaping between 2017 and 2018. During this same period, more than 3.6 million middle and high school children used e-cigarettes; an increase of 48% among middle school students and 78% among high school students respectively (NYTS, 2019). Also, in 2018 approximately 4.9 million e-cigarettes users within 30 days used some kind of tobacco product; an increase from 3.6 million in 2017. This sharp increase caused by a surge in the use of e-cigarettes erased progress achieved in the past in mitigating and abating tobacco product use by the youth, according to a recently published CDC's Vital Signs report (CDC, 2019). Additionally, 27.1% or greater than 1 in 4 high school students and 7.2% or approximately 1 in 14 middle school students in 2018 had smoked a tobacco product. For five years in a row, the most prevalent use of tobacco product were e-cigarettes among high school students (20.8%), followed by 8.1% of traditional cigarettes, 7.6% of cigars, 5.9% of smokeless tobacco, 4.1% of hookah, and 1.1% of pipe tobacco. Similarly, among middle school students, e-cigarettes use was the most common (4.9%), followed by 1.8% of traditional cigarettes, 1.8% of smokeless tobacco, 1.6% of cigars, 1.2% of hookah, and 0.3% of pipe tobacco. The most common tobacco product use combination among middle and high school students was conventional and e-cigarettes (CDC, 2019c).

The NYTS study has many strengths that included a sample that is demographically diverse, repeated measures of the use of tobacco, follow-up rate that was high, and detailed assessment of multiple combustible products of tobacco (Leventhal et al., 2015). One limitation of the study was that the characteristics of the product such as flavor and the strength of nicotine were never assessed. As a result, the study could not determine the association with combustible tobacco initiation to the type of electronic cigarette use or specific frequency (Leventhal et al., 2015). The study focused primarily on initiation outcomes. Further study is needed in the future to evaluate if the use of e-cigarettes is associated with increasing risk to escalate to traditional and frequent combustible use of tobacco. Generalizability may be restricted; the fact that the present sample was obtained from a specific location. Investigation of other ages is warranted since use of combustible tobacco is commonly initiated by the youth pre–9th grade and the use of e–cigarettes after 9th grade (Leventhal et al., 2015). There was no assessment of some relevant covariates such as exposure to advertising, seeking sensation, and academic performance, among others, and therefore should include these in a future study (Leventhal et al., 2015).

Study Variables and Measures

The independent variables were e-cigarettes, allowance, age and gender, and the dependent variable was traditional cigarettes use. Demographic variables were used in this study. Such variables included race, ethnicity, education level, employment, and behavior variables related to smoking such as time the first cigarette was smoked, quitting attempts, number of attempts in the last year, number of cigarettes smoked, and the stage at which

change happened. A third variable such as access may causally be related to racial and

ethnic differences in smoking outcomes. Secondary data analysis was conducted to

"examine the potential influences of all these variables on cessation outcomes following

treatment with an effective behavioral– tailored smoking cessation intervention" (Dube et

al., 2010, p. 2). The sample size for the entire study was $n = 15,801$ out of a total sample

size of 18,866. The same recruitment method was used for each study sample along with the

same intervention method (Koh & Sebelius, 2012; Lenk et al., 2012). All the variables were

designed to be assessed at the time of phone survey as well as every measure involved a

self-report. Other variables were included in the survey such as age and gender. Questions

such as "what is your age, how many years of school, involved open-ended responses and

multiple-choice responses with the categories of male/female; Hispanic/Latino; African

American/Asian/White; among others" (Koh & Sebelius, 2012; p. 5).

Smoking of tobacco is an issue that affects both adults and the youth. A study

conducted by the Global Youth Tobacco Survey (GYTS) revealed that in the Gulf

Cooperation Council region, the current rates of smoking cigarettes and other tobacco

products among adolescents between 13-15 years of age were very alarming. In 2005, 8.0%

of adolescents in the United Arab Emirates (UAE) was found to be cigarette smokers, while

28.8% was found to use other products of tobacco (Hassounah et al., 2014). In Saudi Arabia,

the rate for adolescent cigarette smokers in 2007 was 6.7% while the rate for those who used

other tobacco products was 11.9%. Similar rates in youth smoking prevalence were found in

Kuwait in 2009 at 12.2%; in Yemen-2008 at 3.9%; in Qatar-2007 at 6.5%; and in Bahrain -

2002 at 10.6% respectively; while those using other products of tobacco were 11.8%, 12.4,

15.6, and 15.3% respectively (Hassounah et al., 2014). Oman was the only exception in the region with the lowest prevalence of 1.8% of current youth cigarette smokers, while 2.2% used other tobacco products (Hassounah et al., 2014).

Income/Socioeconomic Status

Studies indicate that income is a predictor of youths smoking of cigarettes, electronic or traditional (CDC, 2016). Youths with more weekly allowance or spending money are believed to be able to afford tobacco products and the likelihood of them smoking cigarettes. Those whose parents have higher socioeconomic status (SES) will have more money to spend (Soteriades & DiFranza, 2013). This is in contrast to past studies which revealed that children whose parents have low SES are, on average, more likely to have adequate disposable income compared to children with parents of higher SES (CDC, 2019; Chen, et al., 2019). This is because, according to Soteriades and DiFranza (2013), parents who are poor have the tendency to sacrifice so that they can meet their children's desires and needs, albeit existing studies suggest that youths with large amounts of disposable income are more inclined to use available resources to support risky behaviors such as smoking (Soteriades & DiFranza, 2013). Based on these findings, it was hypothesized that young people from lower SES backgrounds are likely to have adequate disposable income compared to their peers in the higher SES groups, and that the use of e-cigarettes will be higher among those with more disposable income regardless of the SES of their parents (Soteriades & DiFranza, 2013). The disposable income of these adolescents included weekly allowances and money they have earned from working the month before. Similarly, in households where the annual income was

$20,000.00 or less, 30% of adolescents were more likely to smoke compared to those

from families whose income was in the $20,001 – 30,000.00 range (CDC, 2019;

Soteriades & DiFranza, 2013). It is important to note that in this Massachusetts sample

representative of adolescents, two independent predictors that were significant for

adolescents' penchant to smoke cigarettes were lower educational status of the parent and

lower household income (American Psychologic Association [APA], 2020; Soteriades &

DiFranza, 2013).

Age

The age period described in this study from 9th to 10th grade is a critical period of

transition from middle to high school where adolescents have to adjust, usually

accompanied by moving to a much larger school with a student body that is also large

and much more diverse, coupled with new demands academically and exposure to older

students and new social networks or encounters (Leventhal et al., 2015). This is the

period that adolescents express the propensity or desire to initiate smoking or are

motivated to seek out fresh, new experiences. According to Leventhal et al., (2015) the

beginning of high school or the first year is the most vulnerable period to initiate risky

behavior (Leventhal et al., 2015).

National estimates in 2014 indicated that 16 percent of 10th grade students

reported using e-cigarettes within the past 30 days, while 43% of the students reported

that they never tried smoking tobacco (Leventhal et al., 2015). The effects of nicotine

inhalation and the sensations enjoyed from e-cigarettes can increase the natural tendency

for adolescents to try other combustible products that deliver nicotine such as cigarette

smoking. However, if the use of e-cigarettes is a risk factor for initiating traditional cigarette smoking, then the increased prevalence of e-cigarette inhalation within the adolescent population could potentially and eventually worsen the epidemic of smoking-related illness (Leventhal et al., 2015).

Gender

E-cigarettes use among the youth has dramatically increased over the last few years as a result of increased awareness of electronic nicotine delivery systems (ENDS), and peer pressure is a major contributing factor (Roohafza et al., 2014). In addition to peer pressure, adolescent smoking behavior is influenced by a smoking parent, a family member smoking at home, and a smoking teacher, among others (Roohafza et al., 2014). Smoking among United States girls, according to a national study, on average is heavy and prevalent, especially within the American Indian community, while it is lower among Hispanic and White girls, and lowest among African American and Asian American girls. Among high school girls, smoking increased dramatically from 17% in 2007 to 34.7% in 2013, and currently 35.2% of high school female seniors are smokers (Roohafza et al., 2014). The study revealed that it is easier for girls to purchase cigarettes than boys, even at younger ages. Additionally, girls or women have a hard time quitting smoking than boys or men and are more likely to be dependent on cigarettes than boys (Roohafza et al., 2014).

Boys, on the other hand are more likely to use illicit drugs and e-cigarettes than girls, according to a qualitative study conducted in 2013 by researchers at the school of Public Health at the University of Texas Health Science Center at Houston, Texas

Southern University, Houston, Texas, and the University of Houston School of

Pharmacy, Houston, Texas (Peters et al., 2013). It was discovered that a small sample of

47 male students between 15 and 17 years of age in the local Houston school area

responded that they used e-cigarettes because it was easy to consume and conceal. They

also reported that the most common places they used e-cigarettes were at home,

bathrooms of the school, and along the staircases of the school. Interestingly enough, they

stated that e-cigarettes are easily accessible, more pleasing aesthetically, and a healthier

choice than traditional cigarettes. These are factors that make e-cigarettes popular and

attractive to them (Peters et al., 2013).

Differences in Race/Ethnicity in Electronic Cigarette Use

While e-cigarettes use is on the rise, very few studies have concentrated on its

prevalence among the ethnic/racial minority populations, most prominently Hispanic and

African American smokers, where smoking patterns differ from their White counterparts.

The associations between use of e-cigarette and ethnicity/race were examined, along with

reasons for using e-cigarettes among former and current smokers, and plans to keep

smoking e-cigarettes (Hooper et al., 2016). A total of 285 participants that were recruited

in 2011 between the months of June and November included 29% of Hispanics, 42% of

African Americans, and 29% of Whites. The surveys, which were administered via

telephone, assessed smoking of traditional cigarettes, use of e-cigarettes, and plans to

continue their use, reasons for using, and demographics (Hooper et al., 2016). The study

conducted multivariable logistic regressions and chi square analysis. For African

Americans, reporting ever-use was significantly less likely, compared to their Hispanic

and White counterparts; 50% for African Americans, and 71% each for Whites and Hispanics respectively; $p < 0.001$) (Hooper et al., 2016). However, plans to continue the use of e-cigarettes were found to be higher in African Americans, at 72% versus Whites and Hispanics, respectively at 53% and 47%; $p = 0.01$ (Hooper et al., 2016). The likelihood of African American participants to use e-cigarettes as aid for smoking cessation was higher than both Whites and Hispanics; $p = 0.03$ and $p = 0.48$ respectively. In comparison to Hispanics, the likelihood for White participants to use e-cigarettes as a way of saving money was higher ($p = 0.02$) (Hooper et al., 2016). Thus, the differences in race/ethnicity in the use of e-cigarettes as well as the reasons and intentions for using e-cigarettes were evident in this study. The implications in the findings are that there is the potential for continued use of e-cigarettes and dual use of smoking cigarettes and e-cigarettes (Hooper et al., 2016).

Environmental Variables and Intrapersonal Factors

Close environmental indicators using living situation of the family, family smoking history, and smoking of peers were measured and assessed with the questions: "Do you live with both biological parents most of the time vs. other?" "Does any of your siblings and immediate family such as sisters, brothers, parents, and grandparents have a cigarette smoking history (yes or no)?" "Among five of your closest friends, how many have smoked cigarettes within the past 30 days?" (range: 0—5) (Leventhal et al., 2016). Personality traits, mental health, smoking, risky behavior, and experimentation, among others, along with symptoms of depression were assessed and measured (Leventhal et al., 2016). Youth Behavior Risk Surveillance (YRBS) and Monitoring the Future (MTF)

were also used to measure "ever use of non-nicotine/tobacco substances" such as use of combustible cigarettes, e-cigarettes (yes or no)," full size cigars, and assessed alcohol use and other illicit drugs of abuse over the past six-months including marijuana. Smoking susceptibility was measured as well using a three-item index, with a summary of responses such as "If one of your closest friends offered you a cigarette, would you try to smoke it?" "Do you think you would smoke in the next 6- months?" and "Are you curious about smoking?" (1=Definitely Not; 2=Probably Not; 3=Probably Yes; and 4=Definitely Yes) (Leventhal et al., 2016, p. 5). Outcome expectancies for cigarette smoking were also assessed. An average of two responses was used such as "I think I might enjoy …smoking," which was then reversed to "I think I might feel bad…from smoking," with 1 representing Strongly Agree; 2=Agree; 3=Disagree; and 4=Strongly Disagree (Leventhal et al., 2016, p. 5).

Prevention and Intervention Strategies

According to the then Secretary of Health and Human Services, Kathleen Sebelius, every day in the U.S., more than 3,800 youth under the age of 18 years have a taste of their first cigarette, and more than 1,000 young people under 18 years become everyday smokers of cigarettes (U.S. Department of Health and Human Services, 2012). Over the last 50 years, researchers, scientists, and policy makers have figured out what works, and what steps that need to be taken if we really "want to bring to a close one of our nation's most tragic battles—one that has killed ten times the number of Americans who died in all of our nation's wars combined" (Hooper et al., 2016, p. 5). The fact that a large number of Americans who start smoking daily during their adolescent years become addicted to

nicotine by the time they become young adults is alarming enough to accelerate our efforts in the fight against tobacco use in helping to protect the youth from lightening their first cigarette (U.S. Department of Health and Human Services, 2012). One study suggested that the way to end the tobacco epidemic is by developing large scale smoking cessation interventions among the youth, adolescents, and adults because of the health impact and the financial and economic burden on public health and health care costs on society (Thompson, 2013). In areas where public health falls short in terms of available resources, a request for proposal (RFP) is imperative to secure funds and grants to combat or mitigate these circumstances adolescents find themselves in.

Making cigarettes inaccessible to minors and a heavy levy on the price have proven effective in the past and public health must continue these efforts. The mission and goals of smoking cessation is to improve the health of the community through prevention and intervention of diseases and the promotion of healthy behaviors and a healthy environment (Thompson, 2013). How do we accomplish this? This will be done through assessments, evaluations, community education, monitoring and surveillance of disease, and disease control through health services. The other objective will be to focus more resources on low socioeconomic and at-risk neighborhoods where improvement is much needed. Changing behavior by creating awareness will be an offshoot of this objective (Thompson, 2013). Health communication campaigns that are designed to discourage risky behaviors and promote healthy habits will be a form of intervention with no ethical challenges. The obligation to preserve one's health should be a public duty (Bayer et al., 2013). Therefore, intervention by the government and/or public health is justified to prevent bad health

choices. This will reduce healthcare costs and perhaps the national debt, and ultimately

decrease mortality on a system that is overburdened with chronic diseases. The historic

Family Smoking Prevention and Tobacco Control Act (FSPTCA) bestows power upon the

U.S. Food and Drug Administration (FDA) to regulate tobacco products so that use of these

products by minors can be prevented and help reduce the impact on public health. Many of

the important provisions of the law include banning of cigarettes that have certain types of

flavorings such as fruit and candy, marketing and advertising practices directed at minors,

and restricting cigarettes that are sold as singles. The warning labels required by the law to

be displayed on cigarettes must be graphic and bold enough to make it abundantly clear to

young people about the dangers of smoking (U.S. Department of Health and Human

Services, 2014).

Summary

There is no denying the fact that the popularity of e-cigarette use continues to rise

in the United States as well as internationally. The literature review presented in chapter

2 shed adequate light on this problem. While e-cigarettes use may be associated with less

toxic chemicals compared to traditional cigarettes, the contents of e-cigarettes, however,

have been found to be potentially dangerous, with such components as heavy metals,

organic compounds that are volatile, and carcinogens (NCBI, 2016). Longitudinal studies

with data relating to mental health and substance use among 9th and 10th grade students

were reviewed and assessed about six months apart, in 2013 and 2014 respectively using

pencil and paper surveys (Leventhal et al., 2015). Other sociodemographic characteristics

that were also assessed include income, highest level of parental education attainment,

race and ethnicity, age and gender. Grades 9 through 10 are critical transitional grade levels from middle to high school where adolescents go through a lot of adjustments (Leventhal et al., 2015).

The need to increase public understanding and awareness of the use of e-cigarettes becomes imperative for the health of the general public, which is what this study is intended to do. The rapid gain in popularity of e-cigarette smoking among middle and high school students in the United States is a huge concern, according to a National Youth Tobacco Survey (NYTS) study funded by the CDC (CDC, 2011). While it is not known whether e-cigarettes are harmful and addictive or has any correlation with smoking conventional cigarettes, the nicotine effects from inhalations and the sensations derived from these can augment the natural tendency for the youth to try other nicotine combustible products including smoking of traditional cigarettes (Amrock et al., 2016; Hooper et al., 2016). There is no question that nicotine, as noted by researchers, is the primary ingredient in both e-cigarettes and traditional cigarettes and indisputably the most addictive product on the market today (CDC, 2014; University of California San Francisco ([UCSF], 2014). Nonetheless, public health officials are still concerned about the possible correlation between e-cigarettes and traditional cigarettes, and strongly feel that the roles socioeconomic factors and demographics play are imperative (Amrock et al., 2016). Here is the problem: We know that smoking is addictive and causes lung cancer. What we don't know is how many of these adolescent e-cigarette smokers will end up smoking traditional cigarettes (CDC, 2014). This is the crux and focus of the study and the research gap needed to be explored – to determine what percentage of

youth e-cigarette smokers go on to smoke traditional cigarettes and the role

socioeconomic status and demographics play in this transition.

It is worth mentioning that the fight against smoking was intense in the 1950s and

the 1960s with tremendous gains and going back to this era will be a total failure.

Therefore, we need to do all we can to prevent young people from developing these

dangerous habits. The study details, along with the research design and rationale behind

it, population description, literature search strategy, dependent and independent variables,

and inclusion and exclusion criteria were provided in chapter 3. I also described the

techniques for data analysis.

Chapter 3: Research Method

Introduction

Considering the prevalence and the rapid increase in the popularity of e-cigarette use among U.S. middle and high school students, an important initial step will be to determine the strength of association between electronic cigarettes use and the impact on smoking traditional cigarettes. This will assist in shedding light on the severity and magnitude of the problem. The NYTS is a self-administered, school-based pencil-and-paper questionnaire given to U.S. middle and high school students, Grades 6 through 12 respectively. These surveys on adolescents' smoking have been conducted yearly since 1999, and in 2011, students and schools voluntarily participated in the NYTS with student participation being held anonymous (Dutra & Glantz, 2014). The purpose of my dissertation was to explore the relationship between smoking of electronic cigarettes and their effect on smoking traditional cigarettes among students in Grades 6 through 12; between 12-18 years of age in the United States and to determine the role demographics and socioeconomic status play in this predisposition. The question was: Does smoking of electronic cigarettes predispose adolescents to smoking traditional cigarettes? Will factors such as demographics and socioeconomic status contribute to this predisposition, if any?

Section one of chapter 3 described the research design and rationale, followed by a description of statistical analysis, after the research questions were restated, and then the description of the population that was used for this study. In the sections following that, I described the dependent and independent variables, along with the literature search

strategy that identified the various studies for inclusion, statistical analysis, the methodology used, the techniques for data analysis and sensitivity analysis, and the threats to validity. I also described the inclusion and exclusion criteria for this research project.

Research Design and Rationale

Variables

The purpose of my dissertation was to explore the relationship between smoking of e–cigarettes and their effect on smoking traditional cigarettes among students in grades 6 through 12; between 12-18 years of age in the United States and to determine the role demographics and socioeconomic status play in this predisposition.

Dependent variable: The dependent variable was traditional cigarettes use.

Independent variable: The independent variables were electronic cigarettes, allowance, age, and gender.

Confounding variables: Race/ethnicity, education, employment are the confounding variables in the study.

Research Design

This study was designed to test several hypotheses using secondary data, making quantitative, cross-sectional research an appropriate methodology. A cross-sectional design was the design of choice because it is focused on finding relationships between variables at one moment in time, and it is an appropriate design when the research question is focused on an opinion, prevalence of a disease, or a present practice as in the case of rising e-cigarettes use among the youth (Sullivan, 2012). This study design did

not require randomization and involved groups of individuals usually identified at a given point in time with information or data collected at that particular point in time. It generally uses survey techniques to collect data and very useful for estimating the prevalence of disease or specific risk factors at a point in time, while allowing for stratification (Porta, 2008; Sullivan, 2012).

Using secondary data from the CDC, a statistical analysis was conducted to determine the association between the dependent and independent variables, if any, and the strength of association between them, since in general, a single study is not adequate to answer compelling research questions (Wilson, 2012). Furthermore, the results of multiple studies on different populations have the tendency to be more generalizable (Wilson, 2012). The NYTS sponsored by the CDC has been collecting and analyzing data on smoking since 1999 but only the 2011 datasets were used because they contained all the relevant variables for my research questions.

Time and Resource Constraints

Time and resource constraints exist in a study of this magnitude, since acquiring all the necessary documents relevant to this study is not possible within the allotted time frame. Since e–cigarettes are new on the market, gaining access to unpublished research material on the study topic was time consuming and difficult. Additionally, there was not a wide array of published journal articles to choose from, and careful selection of a few available peer-reviewed articles was painstaking. The Walden library was an excellent resource in this regard.

Methodology

In the context of this study, the research methodology was aimed at providing a plan for investigating the research problem within the frameworks specified. A quantitative, cross- sectional methodology was employed in this study, which involved secondary data collection, and information obtained was quantified and subjected to statistical analyses. Multiple logistic regression analysis was performed to explore the extent to which the chosen constructs predicted behavior retrospectively and future behavior (Creswell, 2009).

Study Population and Selection of Participants

The target population for this study was middle and high school students across the United States, grades 6-12. Our future leaders, the youth is the most vulnerable population among all smokers. Statistics indicate that each year more than one million teenagers begin smoking and an estimated 91% takes up smoking during adolescence (CDC, 2016). Furthermore, over 80% of adults who are established smokers began smoking before the age of 18 (CDC, 2016; McKenzie et al., 2005). Studies again showed that many light smokers become heavy smokers (more than half a pack a day) as they become older (McKenzie et al., 2005). The increasing use of tobacco and e–cigarettes among the youth (middle and high school students) is the center of my discussion. A descriptive, multivariable statistical analysis was used to examine demographic differences such as age, gender, income, socioeconomic status, smoking status, and the independent association between them. The original study used a cross sectional analysis of survey data and a "stratified, three-stage cluster sample" representative of U.S. middle

and high school students in 2011 ($n = 18,866$), who completed the self-administered 2011

National Youth Tobacco Survey (NYTS)/questionnaire using paper and pencil (Dutra &

Glantz, 2014). Sampling more clusters increases the likelihood of reducing sampling

error due to the homogeneity of the clusters, meaning that people in these clusters are

likely to be similar to each other (Crosby et al., 2013). Students and schools voluntarily

participated in the NYTS with student participation being held anonymous. In fulfillment

of the No Child Left Behind Act requirements, parents were given informed consent and

the option to remove their children from participation. In all, 178 schools participated, out

of a final sample of 214 (Amrock et al., 2016). The rate of participation of the schools

turned out to be 83.2% and an 88% rate of student participation (Amrock et al., 2016).

Sample and Sampling Procedure

Sample size is very crucial in any study. Without an appropriate sample size, data

may not be reliable, and conclusions may be based on misinformation. The sample under

observation must accurately represent the target population (UNC, 2010). In a

quantitative study such as the one being embarked upon; the study explored the

prevalence of teenage smoking between Grades 6 through 12—those likely to smoke

traditional cigarettes after trying electronic cigarettes.

Inclusion and Exclusion Criteria.

Inclusion criteria are attributes and/or characteristics that a prospective subject

must have in order to be part of a study, while the criterion for exclusion is the exact

opposite with subjects having characteristics that do not qualify for inclusion in a study.

Such characteristics may include demographic factors such as race/ethnicity, gender, and

age (Salkind, 2010). Included in this study were middle and high school students, from grades 6 through 12, between 12-18 years of age in the United States who use e-cigarettes and their effect on smoking traditional cigarettes. Also included were sociodemographic characteristics such as income, highest level of parental education attainment, race and ethnicity, age and gender and informed consent given to parents with the option to remove their children from participation. Use of combustible cigarettes, e-cigarettes, full size cigars with yes or no questions, alcohol use and other illicit drugs of abuse over the past six-months including marijuana were all part of the inclusion criteria (Leventhal et al., 2016, p. 5). Excluded from this study were boys and girls who were frequently absent, were home schooled, or were institutionalized.

Power Analysis.

In determining the sample size, the larger the sample size, the more reliable or believable the results can be. Conversely, if the sample size is inadequate, this can result in a Type I error, which may lead to rejecting the null hypothesis. The standard error, statistical power, effect size, and alpha are central in determining a sample size that is adequate (Frankfort-Nachmais & Nachmias, 2008). Effect size (ES) is an index that measures the magnitude of the effect of a treatment, independent of the sample size, unlike the test of significance. Statistical power can be used to identify the probability of an underlying correlation within the population (Cohn & Becker, 2003). The following must be considered when determining the sample size: the prevalence rate (baseline) of the risk factor/condition that needs to be measured; the confidence interval (CI); the odds ratio (OR); effect size, and the level of statistical significance. We can also use published

sample size tables as in the case of NYTS, replicate sample size of previous research

studies, or use census of a small population (Kadam & Bhaleraos, 2010). If we know the

population under study in a community, in this case middle and high school students in

the United States, 12-18 years of age, we can estimate the sample size needed, accepting

a 5% margin of error, 95% CI and 50% response rate. We can also use the G*Power to

calculate sample size and statistical power for the different t-tests, F tests, Chi Square, z

tests, among others (Cohn & Becker, 2003). Also, G*Power can be used to compute

effect sizes and to display the results of power analysis graphically. "Sample estimates

for hypothesis testing are often based on achieving 80% or 90% power" (Sullivan, 2012;

p. 180). Therefore, the ES is connected to the power, the level of significance (α), and

the sample size (*n*). The study will be able to reach statistical significance (*P*<0.01)

because the sample size is large, given that α is 0.05. The *p*-value to be obtained in the

study is a function of both ES and sample size, therefore the effect size will be

statistically significant (Becker, 2000).

Procedures for Recruitment, Participation, and Data Collection

The NYTS codebook for the electronic cigarette dataset obtained from CDC

(permission letter in Appendix A) shows a sample size of approximately 18,866 middle

and high school students across the United States, which is what I used for my data

analysis. Among these were those who smoked traditional cigarettes; those who smoked

electronic cigarettes and were more likely to try traditional cigarettes, and those who

smoked other conventional cigarettes (CDC, 2015). With a total sample of 18,866,

students completed the paper and pencil questionnaires from the NYTS, with an overall

participation rate for both the schools and students combined being 73% (Amrock et al., 2016).

As mentioned earlier, the proposed study used a cross sectional analysis of survey data and a "stratified, three-stage cluster sample" representative of U.S. middle and high school students in 2011 ($n = 18,866$), who completed the self-administered 2011 National Youth Tobacco Survey (NYTS) using paper and pencil (Dutra & Glantz, 2014). Students and schools voluntarily participated in the NYTS with student participation being held anonymous. Exclusion criteria were not applied at this stage of the study. All students from grades 6 through 12 were eligible to participate. In fulfillment of the No Child Left Behind Act requirements, parents were given informed consent and the option to remove their children from participation. In all, 178 schools participated, out of a final sample of 214 (Amrock et al., 2016). The rate of participation of the schools turned out to be 83.2% and 88% rate of student participation.

Instrumentation and Operationalization of Constructs

Instrumentation

There are several types of instruments used in data collection, and pilot testing the data collection instrument(s) is imperative to allow a team of researchers to assess their utility, comprehension, developmental, cultural, and relevance of gender, age, income, race and ethnicity, among others for the target population (Crosby et al., 2013). The NYTS, in collaboration with the CDC, have developed survey instruments, particularly paper and pencil questionnaires used to conduct surveys on adolescents' smoking yearly since 1999, and in 2011, students and schools in the United States voluntarily participated

in the NYTS, with student participation being held anonymous (Dutra & Glantz, 2014). The legitimacy and authenticity of these studies give credence to the current study being undertaking by me in terms of data reliability and validity. The NYTS data collection process with the use of a standardized questionnaire that is considered reliable and valid, based on established theory is done with vigor, and consistently achieve the same results using the same appropriate sampling methods and instruments under the same/identical conditions or circumstances week after week, and the conclusions/references published in these studies make the results reliable and valid. Again, the NYTS uses survey instruments such as paper and pencil, self-administered questionnaires, telephone interviews, and face-to-face interviews (Dube et al., 2010). Notwithstanding, data were gathered through the use of questionnaires by representatives of U.S. middle and high school students in 2011 ($n = 18,866$), who completed the self-administered 2011 National Youth Tobacco Survey (NYTS) questionnaires using paper and pencil (Dutra & Glantz, 2014).

Issues of Validity and Reliability

Crosby et al., 2013 stated that "Given the enormous consequences from smoking, it is essential that we understand how to measure this behavior so that valid and useful conclusions can be drawn from our research" (Crosby et al., 2013, p. 243). With the use of self-administered questionnaire, study participants are usually asked to self-report their behavior or report to an interviewer. There is the possibility that information may be inaccurate or falsified or recall bias may jeopardize the results to some extent. For example, Crosby et al., 2013, suggests that one of the problems among participants in

terms of the number of days a person smoked within the past thirty days is such that some people may have trouble organizing their memory around thirty days, "some of which may have occurred during the current month and some in the previous month. The month is a much more common organizing framework for memory" (p. 245). Another problem that may influence the outcome using these particular instruments is the fact that some smokers, especially for relatively new smokers, their pattern of smoking from week to week may be irregular compared to people who have been smoking for a while and may be consistent in how much they smoke from day to day when the question was asked about how many cigarettes they smoked a day (Crosby et al., 2013).

A general rule of thumb using the above-mentioned instruments is to keep things simple. If the questions are simple enough, the researcher will get a more accurate reporting to minimize any threats to the study's validity. As mentioned earlier, retrieving information from memory of someone may involve how well the subject comprehends the question; information retrieval, the judgment process to determine if the information retrieved is adequate, and response generation where the information retrieved is assessed to determine if the response is a reflection of the subject's belief system (Crosby et al., 2013). Data reliability may also depend on the quality of the data entry or the test, or the instrument used to collect the data may be flawed. Another common threat to validity is missing data. For example, data from survey could be missing because a question was sensitive, or a page was skipped, or an answer may not be known to the subject (Issel, 2009).

NYTS Dataset

The data that NYTS provides are adequate and good representation of all middle and high school students in the 50 contiguous states of the U.S. and the District of Columbia. Since 2011, the CDC and the FDA have been collaborating to administer the NYTS annually. I was able to obtain the 2011 NYTS datasets from the Centers for Disease Control and Prevention (CDC) with no special permissions required. At the time of this study, this was the most current dataset available that contained all the necessary variables. NYTS is a paper and pencil survey questionnaire administered to the U.S. middle and high school students in grades 6 through 12. The objective is to support any estimation of tobacco-related attitudes, behaviors, and knowledge in a national population of these students enrolled in private and public schools in the U.S. More precisely, the NYTS study is designed to produce, on a national level, estimates at a 95% confidence interval (CI) and a margin of error of 5% by race and ethnicity (Hispanic, non-Hispanic black, non- Hispanic white, and other), school level (middle and high school), sex (male and female), and by grade (6 through 12) (Hooper et al., 2016).

Table 1 below displays how the variables were operationalized. The table shows the key questions and the possible responses that were retrieved from the 2011 NYTS questionnaire codebook. The primary dependent variable in the table is traditional cigarettes use, and the primary independent variable is electronic cigarette use. There are two questions that were used: one for the dependent variable and the other one for the independent variable. One question measured the direct use of tobacco substances for the dependent variable and the other question measured the direct use of e-cigarettes for the

independent variable among teens in the U.S. Also listed are the covariates which are age and gender.

Table 1

Operationalization of Variables

Type of Variable	Name of Variable	Source of Variable/ Smoking Questions	Possible Responses	Measurement Level
Dependent	Traditional Cigarette Use	"Ever used tobacco substances such as combustible cigarettes, full size cigars?"	Yes, No	Nominal
Independent	Electronic Cigarette Use	"Ever used e-cigarettes?"	Yes, No	Nominal
	Race	Race: White Non-White	White Non-White	Nominal
	Allowance	Low High	Low = 0 High = 1	Ordinal
	Gender	Gender	Male, Female	Nominal
	Age Group	Middle & High school 6-12 grades	Years of age	Interval

Data Analysis Plan

IBM SPSS Statistics version 27 software was used for the analysis with alpha set at 0.05 (Hooper et al., 2016). Initial analysis for the overall sample included descriptive statistics by race/ethnicity, age, gender, and household income. Chi-square is based on the null hypothesis assumption that no relationship exists between the dependent and the independent variables. Smoking status was evaluated using the chi- squared tests for

variables that were categorical such as age and gender, followed by a bivariate and

multivariable logistic regression analysis, which examined the independent association

between the odds of 1: ever use; 2. use past 30 days; 3. plans to continue use of e-

cigarettes, and race/ethnicity after adjusting for smoking status and all demographics.

After adjusting for smoking status and all demographics, I tested differences in

race/ethnicity and their reasons for use of e-cigarettes among ever-users.

With a statistical power of 0.80, effect size of 0.3, and alpha value set at 0.05 to prevent a

type I error, G* power 3.1.9.4 (Faul et al., 2009) was used to estimate a minimum

required sample size for this study analysis to be 378, albeit 15,801 was used for the

analysis using logistic regression after data screening and cleaning; enough to produce

valid results (Faul et al., 2009). The original sample size was 18,866 students selected by

NYTS using random sampling approach. As a general rule, for this study, a 95%

confidence level was allocated. The margin of error allowed for this project was 0.05

(Faul et al., 2009).

How Missing Values were handled-Data Cleaning and Screening/Recoding

Missing data can occur in almost every research, which can cause a reduction in

statistical power and produce estimates that are biased, leading to conclusions that are

invalid (Papageorgiou et al., 2018). For this reason, to prevent erroneous data entries,

data screening and data cleaning were done before data analysis to alleviate any

distortion of the analysis. In conducting a study or research, missing values tend to occur.

Handling this depends on the reason why the data is missing as well as the number of

data that are missing (Institute of Health & Care Research, 2015). To account for missing

values, individuals with missing information were dropped. The fact that the rate of

missing data was below 10%, there was no need for any type of imputation. However, if

the rate was greater than 10%, implementing multiple imputation will be necessary

(Cheema, 2014). While there were 18,866 students in the original study, some cases were

not valid for the analysis. The resulting sample contained 15,801 students after students

with missing information on any variables of interest were dropped. This is tantamount to

case-wise deletion since only those included in the study had no missing values (Kang,

2013). For the purpose of this study's analysis, I recoded some variables to make them

appropriate in conducting the analysis. The variables recoded were e-cigarette use, age,

gender, race, and traditional cigarettes. The independent variable, e-cigarettes was

dichotomized or recoded from a nominal variable to a dichotomous variable with a yes or

no response as well as the dependent variable, traditional cigarettes, to make them

convenient for the regression analysis. Additionally, race/ethnicity was recoded as White

and Non-White because the group comprising "other" such as Pacific Islanders, Asians,

Hispanics/non-Hispanics among others, was too small and for that reason combined it

with Black and labeled it as Non-White and removed ethnicity since it was not directly

used in my data analysis.

Research Questions and Hypotheses

This study comprised of four main research questions (RQs), along with

hypothesis generated for each one of them. The RQs and hypotheses are shown below.

RQ 1: Among U.S. middle and high school students, Grades 6-12, does e-cigarettes use play a significant role in smoking traditional cigarettes when controlling for age, gender, race, and allowance?

>$H1_0$**:** Among U.S. middle and high school students, Grades 6-12, e-cigarettes use does not play a significant role in smoking traditional cigarettes when controlling for age, gender, race, and allowance.

>$H1_a$**:** Among U.S. middle and high school students, Grades 6-12, e-cigarettes use plays a significant role in smoking traditional cigarettes when controlling for age, gender, race, and allowance.

RQ 2: Among US middle and high school students, Grades 6-12, does allowance play a significant role in smoking traditional cigarettes when controlling for age, gender, race, and e-cigarettes?

>$H2_0$: Among U.S. middle and high school students, Grades 6-12, allowance does not play a significant role in smoking traditional cigarettes when controlling for age, gender, race, and e-cigarettes.

>$H2_a$: Among U.S. middle and high school students, Grades 6-12, allowance plays a significant role in smoking traditional cigarettes when controlling for age, gender, race, and e-cigarettes.

RQ 3: Among US middle and high school students, Grades 6-12, does age play a significant role in smoking traditional cigarettes when controlling for gender, race, allowance, and e-cigarettes?

$H3_0$: Among U.S. middle and high school students, Grades 6-12, age does not

play a significant role in smoking traditional cigarettes when controlling for

gender, race, allowance, and e-cigarettes.

$H3_a$: Among U.S. middle and high school students, Grades 6-12, age plays a

significant role in smoking traditional cigarettes when controlling for gender,

race, allowance, and e-cigarettes.

RQ 4: Among U.S. middle and high school students, Grades 6-12, does gender play a

significant role in smoking traditional cigarettes when controlling for age, race,

allowance, and e-cigarettes?

$H4_0$: Among U.S. middle and high school students, Grades 6-12, gender does not

play a significant role in smoking traditional cigarettes when controlling for age,

race, allowance, and e-cigarettes?

$H4a$: Among U.S. middle and high school students, Grades 6-12, gender plays a

significant role in smoking traditional cigarettes when controlling for age, race,

allowance, and e-cigarettes?

Table 2

Statistical Analysis Plan

Research Questions	Variables	Methods
1: Among US middle and high school students, grades 6-12, does e-cigarettes use play a significant role in smoking traditional cigarettes when controlling for age, gender, race, and allowance?	Traditional Cigarette Use E-cigarette Use Age Group Gender Race Allowance (SES)	A chi-square analysis was conducted to determine if allowance, age, gender, and race play a significant role in e-cigarettes initiation (independent variable) and traditional cigarettes (dependent variable), Multivariable logistic regression analysis was used to examine the independent association between e-cigarette use and smoking of traditional cigarettes
2: Among US middle and high school students, grades 6-12, does allowance play a significant role in smoking traditional cigarettes when controlling for age, gender, race, and e-cigarettes?	Allowance (SES) Traditional Cigarette Use Age Group Gender Race E-cigarette Use	A chi-square analysis was conducted to determine if allowance plays a significant role between e-cigarettes initiation (independent variable) and traditional cigarettes (dependent variable). Logistic regression was used to determine the adjusted odds of smoking among individuals with higher allowance (SES) versus those with low allowance (SES).

Research Questions	Variables	Methods
		The odds ratio (OR) was the primary metric to calculate the effect size in regard to the association that exists between e-cigarettes initiation and traditional cigarettes.
3: Among US middle and high school students, grades 6-12, does age play a significant role in smoking traditional cigarettes when controlling for gender, race, allowance, and e-cigarettes?	Age Group Traditional Cigarette Use Gender Race Allowance (SES) E-cigarette Use	Unadjusted odds ratio (OR) was used to evaluate the relationship between age and smoking. Smoking status was evaluated using the chi-squared tests for variables that are categorical such as age group. Multivariable logistic regression analysis, which was used to examine the independent association between the odds of ever use; and race after adjusting for smoking status and all demographics.
4. Among US middle and high school students, grades 6-12, does gender play a significant role in smoking traditional cigarettes when controlling for age, race, allowance, and e-cigarettes?	Gender Traditional Cigarette use Age Group Race Allowance (SES) e-cigarettes Cigarettes	Unadjusted OR was used to evaluate the relationship between gender and smoking. Logistic regression was used to assess the adjusted odds of gender differences in smoking. Multivariable logistic regression analysis was used to examine the independent association between the odds of: ever use; and gender after adjusting for smoking status and all demographics.

Threats to Validity

Threats to validity, whether internal or external can mar a study's authenticity or outcome. Every researcher strives to attain internal validity, the driving force of each study design, by answering the question as to whether changes in the independent variable caused a measurable change in the dependent variable (Polit & Beck, 2012). Were there any factors that occurred prior to the research study that would have jeopardized the internal validity? In short, validity is concerned with whether the procedure measures what it is intended to measure (Frankfort-Nachmias & Nachmias, 2008). Following is a discussion of the various threats to validity.

Internal Validity

In terms of threats to internal validity, our confidence may be compromised to saying that there is a relationship between the dependent and independent variables (Michael, 2016). However, I am very confident in this study's internal validity since the data sampled from this dataset was obtained from the CDC, which has a tight control over the data with regard to scientific rigor, and the fact that this data has been used by the NYTS over the years in multiple studies since 1999. Notwithstanding, a major threat to internal validity is the selection of subjects or participants and associated characteristics (Polit & Beck, 2012). There was nothing done in the sampling process during the course of the study that would have caused something else to happen to change the outcome, given the fact that data for the study was secondary data used by the NYTS with scientific accuracy. Some of the factors or threats that affect internal validity including selection bias, maturation, history, instrumentation, mortality, repeated testing,

temporal ambiguity, among others, will not be relative to this sampling process and quantitative cross-sectional study (Michael, 2016).

External Validity

External validity refers to the degree by which the findings of a study can be generalized. In my study, the question may be asked whether the participants sampled are a true representative of the population (UCF, 2013). Though this study was based on a large, nationally representative samples of middle and high school students, students who were schooled at home, institutionalized, or those who were habitual truants were not included (Hooper et al., 2016). The external validity of this study could not be overemphasized, given the fact that the representative sample was very large and covered 214 schools, out of which 178 participated, resulting in a participation rate of 83.2% and an 88% rate of student participation (Amrock et al., 2016). Additionally, out of the total sample of 21,584, 18,866 students completed the 2011 NYTS self-administered questionnaires using paper and pencil (Dutra & Glantz, 2014), with an overall participation rate for both the schools and students combined being 73%. All students from Grades 6 through 12 were eligible to participate (Amrock et al., 2016). The foregoing gave me confidence in the external validity of the study. One limitation, however, was the fact that I conducted my statistical analysis using secondary data, with no exposure to the original survey and the intentions of the researcher (s). Nonetheless, I had confidence in the authenticity and scientific rigor of the original data source provided by the CDC, given its unblemished reputation.

Ethical Procedures

The NTYS dataset being used in this study is public under the tight control of CDC who owns and maintains the integrity of the dataset. This data is available to research organizations and individuals interested in research. With this study using datasets that have been obtained from CDC's secondary databases used in previous studies, with access permission letter provided in Appendix A, issues such as anonymity and confidentiality were not important because the editors, authors, and reviewers of these datasets had already addressed these issues. No conflicts of interest associated with this existed. Despite the fact that concerns for ethics was at best minimal due to the use of secondary data, approval from the Walden Internal Review Board was obtained before moving forward with data management and analysis.

It was without question that certain key ethical conditions must be met before using secondary data. The data from the CDC had been de-identified in an effort to avoid exposure to participants' personal and/or confidential information, and to ensure that the results of the analysis did not permit re-identification of the participants. Results were reported in the aggregate and not on individual data. To meet confidentiality requirements of study participants, electronic data were stored on a computer that was password protected till the end of this study, at which point data was destroyed.

Summary

In this chapter, research questions and hypotheses, along with research design and rationale, time and resource constraints and methodology were explained. Also included and explained in this chapter are the study population and selection of participants, data

source and data analysis plan, threats to validity, and ethical procedures. Chapter 4

focused on analysis of data and the study results and data collection procedures were

explained as well.

Chapter 4: Results

Introduction

The purpose of my dissertation was to explore the relationship between smoking electronic cigarettes and their effect on smoking traditional cigarettes among students in Grades 6 through 12; between 12-18 years of age in the United States. The primary dependent variable was traditional cigarette use, and the independent variable was electronic cigarette use. Control variables included age, gender, allowance, and level of education. The intent of this study was to determine whether smoking electronic cigarettes predisposed adolescents to smoking traditional cigarettes, while also determining if factors such as demographics and socioeconomic status such as allowance contribute to this predisposition. I chose this age group because this population is the most vulnerable and comprises a new generation of smokers and teen vaping that is threatening to reverse the progress made over the years in the fight and reduction of tobacco. For teens who have never smoked or used any other tobacco products, e-cigarettes experimentation may be a gateway to nicotine addiction (USC, 2015).

Research Questions and Hypotheses

This study comprised of four main research questions (RQs), along with hypothesis generated for each one of them. The RQs and hypotheses are shown below. RQ 1: Among U.S. middle and high school students, Grades 6-12, does e-cigarettes use play a significant role in smoking traditional cigarettes when controlling for age, gender, race, and allowance?

$H1_0$**:** Among U.S. middle and high school students, Grades 6-12, e-cigarettes use does not play a significant role in smoking traditional cigarettes when controlling for age, gender, race, and allowance.

$H1_a$**:** Among U.S. middle and high school students, Grades 6-12, e-cigarettes use plays a significant role in smoking traditional cigarettes when controlling for age, gender, race, and allowance.

RQ 2: Among US middle and high school students, Grades 6-12, does allowance play a significant role in smoking traditional cigarettes when controlling for age, gender, race, and e-cigarettes?

$H2_0$: Among U.S. middle and high school students, Grades 6-12, allowance does not play a significant role in smoking traditional cigarettes when controlling for age, gender, race, and e-cigarettes.

$H2_a$: Among U.S. middle and high school students, Grades 6-12, allowance plays a significant role in smoking traditional cigarettes when controlling for age, gender, race, and e-cigarettes.

RQ 3: Among US middle and high school students, Grades 6-12, does age play a significant role in smoking traditional cigarettes when controlling for gender, race, allowance, and e-cigarettes?

$H3_0$: Among U.S. middle and high school students, Grades 6-12, age does not play a significant role in smoking traditional cigarettes when controlling for gender, race, allowance, and e-cigarettes.

*H*3$_a$: Among U.S. middle and high school students, Grades 6-12, age plays a significant role in smoking traditional cigarettes when controlling for gender, race, allowance, and e-cigarettes.

RQ 4: Among U.S. middle and high school students, Grades 6-12, does gender play a significant role in smoking traditional cigarettes when controlling for age, race, allowance, and e-cigarettes?

*H*4$_0$: Among U.S. middle and high school students, Grades 6-12, gender does not play a significant role in smoking traditional cigarettes when controlling for age, race, allowance, and e-cigarettes?

*H*4a: Among U.S. middle and high school students, Grades 6-12, gender plays a significant role in smoking traditional cigarettes when controlling for age, race, allowance, and e-cigarettes?

Chapter 4 describes the data collection process to answer the research questions and any discrepancies from the 2011 NYTS secondary dataset obtained from the CDC, the time frame and response rates, a description of the statistical analysis and the study results. Also, a description of the population that was used for this study and sample representatives, along with univariate/bivariate and demographic characteristics were provided. Descriptive statistical analysis, procedures and findings were explained. Finally, the results with tables and summary of the findings were presented in the conclusion of this chapter.

Data Collection

Data collection began immediately after receiving IRB approval (# 01-28-21-0366050) from Walden University on January 28, 2021. I used the 2011 archived NYTS secondary datasets offered by the CDC. I obtained the NYTS datasets from the CDC with no special permissions required and with no actual recruitment, response rates or time frame (Hooper et al., 2016; NYTS, 2020). The NYTS, in collaboration with the CDC, have developed survey instruments, particularly a self-administered, school-based pencil-and-paper questionnaire given to U.S. middle and high school students, grades 6 through 12 respectively to conduct surveys on adolescents' smoking yearly since 1999 (Dutra & Glantz, 2014). The NYTS study has many strengths that included a sample that is demographically diverse, repeated measures of the use of tobacco, follow-up rate that was high, and detailed assessment of multiple combustible products of tobacco (Leventhal et al., 2015). The legitimacy and authenticity of these studies give credence to the current study being undertaken by me in terms of data reliability and validity.

The NTYS data collection process with the use of a standardized questionnaire is considered reliable and valid. This is based on established theory and the process is done with vigor. This process consistently achieves the same results using the same appropriate sampling methods and instruments under the same/identical conditions or circumstances week after week. The conclusions/references published in these studies make the results reliable and valid (Dube et al., 2010). Notwithstanding, data were gathered using questionnaires by representatives of U.S. middle and high school students in 2011 ($n = 18,866$) (Dutra & Glantz, 2014).

Discrepancies in the Dataset

There were no discrepancies in the dataset I obtained from the CDC since the

original study used a cross sectional analysis of survey data and a "stratified, three-stage

cluster sample" representative of U.S. middle and high school students in 2011

($n = 18,866$), who completed the self-administered 2011 National Youth Tobacco Survey

(NYTS)/questionnaire using paper and pencil (Dutra & Glantz, 2014). Sampling more

clusters increases the likelihood of reducing sampling error due to the homogeneity of the

clusters, meaning that people in these clusters are likely to be similar to each other

(Crosby et al., 2013).

Representativeness of the Sampled Population

The target population for this study was middle and high school students across

the United States, Grades 6-12, between 12-18 years of age who use e-cigarettes and their

effect on the transition to smoking traditional cigarettes. Also included in the dataset were

sociodemographic characteristics such as income, highest level of parental education

attainment, race and ethnicity, age and gender and informed consent given to parents with

the option to remove their children from participation (CDC, 2016). Students and schools

voluntarily participated in the NYTS with student participation being held anonymous. In

fulfillment of the No Child Left Behind Act requirements, parents were given informed

consent and the option to remove their children from participation. In all, 178 schools

participated, out of a final sample of 214 with the total number of students participating

being 18,866 (Amrock et al., 2016). Out of this, a representative sample of 15,801 middle

and high school students across the United was drawn after data cleaning and screening.

Table 3 below represents the variables in the study.

Table 3

Study Variables

Name of Variable	Unit	Measurement Level
Traditional Cigarette Use	Yes, No	Nominal
Electronic Cigarette Use	Yes, No	Nominal
Allowance	Low = 0 High = 1	Ordinal
Race	White Non-White	Nominal
Age Group	Years	Interval
Gender	Male Female	Nominal

Results

In this section, I presented the descriptive and inferential statistics for the study. I performed a descriptive analysis for the dependent and independent variables and covariates in this study and addressed each research question and hypotheses using the inferential statistics to determine the relationship between e-cigarettes use (independent variable) and traditional cigarettes use (outcome variable). The descriptive statistics of

the variables of this study are shown in Table 4 along with the responses of the participants ($N = 15,801$) presented below. A chi-square analysis was conducted to determine if allowance played a significant role between e-cigarettes initiation (independent variable) and traditional cigarettes use (dependent variable). This was used to examine the linear relationship between e-cigarette use and traditional cigarette smoking without accounting for any other factors that might affect traditional cigarette use. I also used two types of logistic regressions to examine the relationship between the independent variables of interest and traditional cigarette use. The first type of logistics regression I used was bivariate logistics regression which examined the role of each independent variable for predicting traditional cigarette smoking without accounting for other factors that might also predict traditional smoking. The second type of logistic regression I implemented was a multivariate logistic regression, which allowed me to control for other confounding variables when I examined the relationship between a given independent variable of interest and traditional cigarette smoking. For each of the research question, I used the multivariate logistic regression to answer it.

Descriptive Statistics

The descriptive statistics for this study are shown below in Table 4. For this analysis, I used SPSS version 27 to perform frequency and percentage in describing the participants in the study. The respondents were selected from the 2011 NYTS. Of the 15,801 participants, 1,747 (11.1%) did smoke traditional cigarettes in the past 30 days and 14,054 (88.9%) did not smoke traditional cigarettes in the past 30 days. As for ever used e-cigarette, 499 (3.2%) students answered yes to ever used e-cigarettes and 15,302

(96.8%) said no to ever used e-cigarettes, with 5,125 students (32.4%) getting low

allowance and 10,676 students (67.6%) getting high allowance.

Table 4

Descriptive Statistics

Variable	Frequency	Percent
Traditional cig. use		
Yes	1,747	11.1
No	14,054	88.9
Ever used e-cigs		
Yes	499	3.2
No	15,302	96.8
Allowance		
Low	5,125	32.4
High	10,676	67.6
Age Group		
Middle School	5,058	32.0
High School	10,743	68.0
Gender		
Female	8,062	51.0
Male	7,739	49.0
Race		
Non-white	8,848	56.0
White	6,953	44.0
N = 15,801		

Statistical Assumptions

When using logistic regression in data analysis, certain assumptions must be met

to ensure that the results are valid. Logistic regression is used to predict the probability

that an observation will fall into one of two categories relating to a dependent variable

that is dichotomous based on at least one independent variable that could either be categorical or continuous (Laerd Statistics, 2018). In this analysis, traditional cigarettes (dependent variable) were measured on a dichotomous scale with the response options of yes to cigarettes smoking and no to cigarettes smoking. This assumption was met. A second assumption on logistic regression is that of having one or more independent variables that can either be categorical or continuous. Age, an independent variable in this analysis is a continuous variable along with another independent variable, gender, a nominal variable which is categorical or dichotomous (male and female); followed by independent variable race, also a nominal/categorical variable (White and non-White). This assumption was also met. Another assumption in this analysis was, the observations must be independent of each other and must not come from matched data or repeated measurements. This is true because data from participants in the original NTYS survey were independently collected, making the observations in this secondary data analysis independently recorded. Therefore, this assumption was met.

On the assumption of multicollinearity, logistic regression requires that there should be very little or no correlation between the independent variables. Therefore, the independent variables allowance, age, gender, and race were not too highly correlated in this study. A linear relationship is assumed to exist between any independent variables that are continuous although a linear relationship is not required between the dependent and independent variables in this analysis. It only requires that the independent variables are related linearly to the log odds.

Finally, a large sample size was required using logistic regression. Out of a total sample

of 18,866 students who participated in the original survey, 15,801 students were used for

this data analysis, which exceeded the sample size requirements of 378, thus meeting the

required assumptions for logistic regression. In conclusion, all assumptions were met.

As shown in Table 5, a chi-square analysis was conducted between the dependent

variable and all the independent variables and covariates to determine if allowance, age,

gender, and race played a significant role in e-cigarettes initiation, leading to smoking of

traditional cigarettes. The results below indicate that there was a correlation between e-

cigarettes use and traditional cigarettes use with the Pearson Chi Square value at

1,388.037 and a $p = .0001$, with allowance, age, gender, and race playing a statistically

significant role, $p = .0001$.

Table 5

Pearson Chi Square test between traditional Cigarettes use and each of the independent variables.

Independent Variables	Value	Df	P value
Ever used e-cigs	1,388.037	1	.0001
Allowance	140.376	1	.0001
Age Group	332.301	1	.0001
Gender	30.798	1	.0001
Race	35.301	1	.0001
N = 15,801			

Table 6 shows the results of a bivariate logistic regression analysis that was

conducted to depict if there was a correlation between smoking of e-cigarettes and

traditional cigarettes by evaluating gender, age, race, and allowance, among others. These are viewed as predictors of trying e-cigarettes among middle and high school students in the U.S. (JAMA Pediatrics, 2014). Both the bivariate and multivariate logistic regression analysis below indicated that there was a statistically significant relationship between all the variables; e-cigarettes ($p < .05$), allowance ($p < .05$), age ($p < .05$), gender ($p < .05$), and traditional cigarette use. The results of the study concluded that e-cigarettes use was associated with higher odds of smoking traditional cigarettes (UOR = 16.123; CI = 13.343-19.482; $p < .05$). Having high allowance relative to having a low allowance affected the odds of smoking of traditional cigarettes (UOR = 2.070; CI =1.831-2.340; $p < .05$). Being White relative to non-white increased the odds of smoking traditional cigarettes (UOR = 1.351; CI =1.223-1.493; $p < .05$). Similarly, the odds of smoking traditional cigarettes were higher among high school students, grades 9 through 12 compared to middle school students, grades 7 through 8 (UOR = 3.565; CI =3.085-4.119; $p < .05$); whereas being a male increased the odds of smoking traditional cigarettes relative to a female (UOR = 1.326; CI =1.200-1.466; $p < .05$).

Table 6

Bivariate Logistic Regression of each Variable with Traditional Cigarette Use

Variable	Unadjusted odds ratio	95% CI	*df*	*P*
Ever used e-cigs				
Yes	16.123	13.343-19.482	1	.0001
no[b]				
Allowance				
High	2.070	1.831-2.340	1	.0001
low[b]				
Age Group				
High School	3.565	3.085-4.119	1	.0001
Middle School[b]				
Gender				
Male	1.326	1.200-1.466	1	.0001
Female[b]				
Race				
White	1.351	1.223-1.493	1	.0001
Non-white[b]				
N = 15,801				

Note: [b =] reference category; CI = confidence interval; df = degrees of freedom; *p = 0.05

In this study, a multivariate logistics regression analysis was conducted to answer the four research questions. The results are presented in Table 7 below, followed by the explanation of the research questions and hypothesis. The following variables were adjusted for: age, gender, race, allowance and ever used e-cigarettes. Ever used e-cigarettes was categorized into two levels with 0 = no, and 1 = yes, whereas allowance was categorized as low allowance = 0 and high allowance = 1. Similarly, age group was categorized where 0 = middle school and 1 = high school, followed by dichotomous

variables gender with female = 0 and male = 1, while race was categorized as White = 1

and non-White = 0. As shown from Table 7 below, each of the independent variable

allowance, age, gender, and race was a significant predictor of smoking of e-cigarettes

and transition to smoking traditional cigarettes among U.S. adolescents ($p < .05$).

Table 7

Multivariate Logistics Regression for Traditional Cigarette Use

Variable	Adjusted Odds Ratio	95% CI	Df	P
Ever used e-cigs				
Yes	13.384	11.014-16.263	1	.0001
no[b]				
Allowance				
High	1.730	1.521-1.967	1	.0001
low[b]				
Age Group				
High School	3.015	2.599-3.498	1	.0001
Middle School[b]				
Gender				
Male	1.234	1.110-1.372	1	.0001
Female[b]				
Race				
White	1.228	1.105-1.365	1	.0001
Non-white[b]				
N = 15,801				

Note: [b] = reference category; CI = confidence interval; df = degrees of freedom; *$p = 0.05$

Statistical Analysis findings, organized by Research Questions and/or Hypotheses

RQ1**:** The first research question asked if e-cigarettes use played a significant role in smoking of traditional cigarettes when controlling for age, gender, race, and allowance. The results from the logistic regression indicated that e-cigarettes use significantly predicted smoking of traditional cigarettes (AOR = 13.384; $p < .05$). Based on these results, we rejected the null hypothesis that among U.S. middle and high school students, grades 6-12, e-cigarettes use does not play a significant role in smoking traditional cigarettes when controlling for age, gender, race, and allowance.

RQ2: The second research question asked if allowance played a significant role in smoking of traditional cigarettes when controlling for age, gender, race, and e-cigarettes. The results from the logistic regression indicated that high allowance significantly predicted smoking of traditional cigarettes (AOR = 1.730; $p < .05$). Students with high allowance are believed to be able to afford tobacco products and may increase their penchant for smoking cigarettes. Based on these results, we rejected the null hypothesis that among US middle and high school students, grades 6-12, allowance does not play a significant role in smoking traditional cigarettes when controlling for age, gender, race, and e-cigarettes.

RQ3: The third research question asked if age played a significant role in smoking traditional cigarettes when controlling for gender, race, allowance, and e-cigarettes. The results from the logistic regression indicated that age significantly predicted smoking of traditional cigarettes (AOR = 3.015; $p < .05$). The odds of smoking among high school students are higher compared to middle school students. Based on these results, we

rejected the null hypothesis that among US middle and high school students, grades 6-12, age does not play a significant role in smoking traditional cigarettes when controlling for allowance, gender, race, and e-cigarettes

RQ4: The fourth research question asked if gender played a significant role in smoking traditional cigarettes when controlling for age, race, allowance, and e-cigarettes. The results from the logistic regression indicated that age significantly predicted e-cigarettes use and smoking of traditional cigarettes (AOR = 1.326; $p < .05$). The odds of smoking among male students are higher compared to middle school students. Based on these results, we rejected the null hypothesis that among US middle and high school students, grades 6-12, gender does not play a significant role in smoking traditional cigarettes when controlling for allowance, age, race, and e-cigarettes.

Summary

In this chapter, I presented the findings of the secondary data analysis and the study results. This included data collection procedures, descriptive statistics, discrepancies in the dataset, research questions and hypotheses, and the findings organized by research questions. This quantitative cross-sectional study was conducted to explore the relationship between smoking of e-cigarettes and their effect on smoking traditional cigarettes among U.S. adolescents. Results from both the bivariate and multivariate logistic regression established a strong correlation between e-cigarette use and smoking of traditional cigarettes. The first, second, third, and fourth null hypothesis were tested using multivariate logistic regression and were all rejected, indicating that e-cigarettes use, allowance, age, gender, and race play a significant role in smoking of

traditional cigarettes. In Chapter 5, I provided the interpretation of the findings,

discussion for the limitations of the study, social change implications, and

recommendations for future research.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of my dissertation was to explore the relationship between smoking of e-cigarettes and their effect on smoking traditional cigarettes among students in Grades 6 through 12; between 12-18 years of age in the United States and to determine the role demographics and socioeconomic status played in this predisposition. In this quantitative cross-sectional study, data from the 2011 NYTS were used for this analysis. E-cigarettes and its associated vaping devices that were introduced in the U.S. in 2007 were originally designed to help with smoking cessation, especially for smokers who were concerned about their health. Instead, e-cigarettes and vaping have become the new wave of addiction to nicotine, increasing their popularity among the youth and adolescents because of their appealing design and enticing flavors and the misconception that they are harmless (Jenssen & Boykan, 2019). New evidence shows that vaping is accompanied by high levels of toxic chemicals that can severely injure the lungs and cause death. In 2016, the US Surgeon General Vivek Murthy repeated its warning that e-cigarettes use among the youth and adolescents is a "major public health concern" (Dinardo & Rome, 2019).

A bivariate logistic regression analysis was conducted to determine the relationships between the variables of interest and traditional cigarettes use while the multivariate logistic regression was conducted to answer the research questions. Both the bivariate and multivariate logistic regression analysis indicated a statistically significant correlation between the use of e-cigarettes and use of traditional cigarettes with socio-demographics playing a statistically significant role. In this chapter, I discussed the

findings of the study and its interpretation, study limitations, recommendations for future research, and social change implications.

Interpretation of Findings

Secondary data from the 2011 NYTS were analyzed for each research question. Bivariate logistic regression was used for the analysis to determine the relationship between e-cigarettes use and subsequent traditional cigarettes use without adjusting for any potential confounders. Multivariate logistic regression analysis was also used to analyze each research question. The analysis and interpretation of the findings organized by research question are presented below.

Research Question 1

Research question 1 focused on whether e-cigarettes use played a significant role in smoking of traditional cigarettes when controlling for age, gender, race, and allowance. The results of the multivariate logistic regression analysis indicated that there was a statistically significant relationship between e-cigarettes use and smoking of traditional cigarettes (AOR = 13.384; CI = 11.014-16.263; $p < .05$). Consequently, use of e-cigarettes among U.S. middle and high school students, grades 6-12 increased the odds of smoking traditional cigarettes by more than 13 times as shown above. This positive association is consistent with the 2018 NYTS study that found that between 2017 and 2018, current use of e-cigarette, otherwise known as "vaping" increased at an alarming rate among middle school and high school students in the United States, with more than 3.6 million children vaping in 2018 (NYTS, 2020). Based on these results, the null

hypothesis of no association between e-cigarettes use and smoking of traditional

cigarettes was rejected.

Research Question 2

Research question 2 asked if allowance played a significant role in smoking

traditional cigarettes when controlling for age, gender, race, and e-cigarettes among U.S.

middle and high school students, grades 6-12. The results from the multivariate logistic

regression indicated that high allowance significantly predicted smoking of traditional

cigarettes (AOR = 1.730; CI = 1.521-1.967; $p < .05$). The odds of smoking traditional

cigarettes for students with a monthly allowance was 1.7 times higher compared to those

without a monthly allowance and was statistically significant ($p = .000$). Based on these

results, we rejected the null hypothesis of no association between allowance and

smoking.

Research Question 3

Research question 3 asked if age played a significant role in smoking traditional

cigarettes. The results from the multivariate logistic regression showed that age

significantly predicted smoking of traditional cigarettes (AOR = 3.015; CI = 2.599-3.498;

$p < .05$). The odds of smoking based on age was 3 times higher among high school age

students compared to middle school age students and was statistically significant ($p =$

.000). With this conclusion, the null hypothesis of no association between age and

smoking was rejected.

Research Question 4

Research question 4 asked if gender played a significant role in smoking traditional cigarettes. Results from the multivariate logistic regression indicated that gender significantly predicted smoking of traditional cigarettes (AOR = 1.326; CI = 1.110-1.372; $p < .05$). Other things being equal, the effect of gender (male) was 1.3 times higher than female ($p = .000$). Based on these results, we rejected the null hypothesis of no association between gender and smoking.

Discussion of the Findings

The results of the study concluded that e-cigarettes use was associated with higher odds of smoking traditional cigarettes and may encourage conventional use of cigarettes among middle and high school students in the United States (UOR = 16.123; CI = 13.343-19.482; $p < .05$). Thus, the odds of smoking traditional cigarettes among middle and high school students were 16 times higher and statistically significant ($p = .000$) among students who used e-cigarettes, when controlling for allowance, age, gender, and race. Similarly, having high monthly allowance relative to having a low allowance increased the odds of smoking e-cigarettes 2-fold and possible predisposition to traditional cigarettes, when controlling for age, gender, and race (UOR = 2.070; CI =1.831-2.340; $p < .05$). Being White relative to non-white increased the odds of smoking e-cigarettes almost one and a half times and possible predisposition to traditional cigarettes (UOR = 1.351; CI =1.223-1.493; $p < .05$), confirming the 2016 Hooper et al. study that indicated 71% of Whites significantly reporting ever-use ($p < .001$), compared to 50% of their non-White counterparts. Similarly, the odds of smoking e-cigarettes and

possible predisposition to traditional cigarettes was more than 3 times higher and statistically significant ($p = .000$) among high school–age students, grades 9 through 12 compared to middle school–age students, grades 7 through 8 (UOR = 3.565; CI =3.085-4.119; $p < .05$); whereas being a male student increased the odds of smoking e-cigarettes by more than 1 and possible predisposition to traditional cigarettes relative to a female student (UOR = 1.326; CI =1.200-1.466; $p < .05$).

Findings in the Context of SEM

This study employed quantitative methodology along with the social ecological model (SEM), as the framework to guide the design. In 1988 Kenneth McLeroy and others proposed the ecological model of health behavior believed to provide frameworks that are comprehensive for understanding the interacting and multi-level determinants of the behaviors of health (Glanz & Bishop, 2010). At its core, the concept of ecological models is that behavior comprises several levels of influences that usually include interpersonal, intrapersonal, community, policy, physical, environmental, and organizational phenomenon (McLeroy et al., 1988). These models have shown promise in guiding comprehensive approaches to changing certain behaviors such as smoking (Sallis et al., 2015). In this study, the SEM was used as the theoretical framework for health behavioral change in providing an understanding of smoking among middle and high school students in the U.S., grades 6 through 12. Smoking is a behavioral issue that is characterized by conscious willingness and influenced by a wide array of sociodemographic characteristics including race, age, gender, allowance, education, and employment playing a key role (Park et al., 2017). The findings of this study based on the

2011 NYTS data analysis I conducted revealed a statistically significant relationship between the predictor variables aforementioned and smoking of e-cigarettes and traditional cigarettes use.

The SEM posited that smoking and tobacco use are not only an individual behavioral problem but recognized widely as a public health and a social problem. An ecological perspective is required to explain the changes in population in regard to smoking. In conclusion, the SEM was instrumental in identifying the sociodemographic factors of race, age, gender, allowance, education, and employment in its application to smoking among middle and high school students.

Limitations of the Study

Several limitations can be noted in this study. First, the survey was only limited to participants who go to public schools. While this study was based on a large, nationally representative samples of U.S. middle and high school students, students who were schooled at home, institutionalized, or those who were habitual truants were not included. Neither did the study include students who go to private or charter schools (Hooper et al., 2016). This means that the rates of smoking prevalence that were reported probably underestimated the actual smoking prevalence in the entire student population, albeit these underestimates may be small. The fact that not all students in the U.S. participated, we cannot generalize the findings from a sample to the entire U.S. population though the sample is a representative of the U.S. population. Therefore, the findings lack generalizability to the entire U.S. adolescent population.

A second potential limitation may be participants' admission of SES, which may be inaccurate. This may be considered self-admission bias (Creswell, 2012). It cannot be determined if participants under reported or over reported e-cigarettes smoking behaviors since data were self-reported (Creswell, 2012). A third limitation is the use of the 2011 NYTS dataset, which was the most current dataset available that contained all the variables at the beginning of the study in 2014.

Another limitation of the study was that of the dependent and independent variables, which measured the perceptions of the subjects, but not the actual behaviors (caught in action) (Leventhal et al., 2015). The characteristics of the product such as flavor and the strength of nicotine were never assessed. As a result, the study may not be able to determine the association with combustible tobacco initiation to the type of electronic cigarette use or specific frequency (Leventhal et al., 2015). Further study is needed in the future to evaluate if the use of e-cigarettes is associated with increasing risk to escalate to traditional and frequent combustible use of tobacco. Lastly, anytime an instrument is used, the results of the study are subject to the known validity and reliability of that particular instrument (Creswell, 2012).

Recommendations

This quantitative, cross-sectional study using data from the 2011 NYTS was aimed to explore the relationship between smoking of e-cigarettes and their effect on smoking traditional cigarettes among students in grades 6 through 12; between 12-18 years of age in the United States, and to determine the role demographics and socioeconomic status play in this predisposition. The U.S. Surgeon-General, Luther Terry

in 1964, called smoking public enemy #1 because it has been found to be the major cause

of disability and premature or preventable death, while in 2020, a key finding from the

Surgeon General's report indicated that smoking continues to be the leading cause of

preventable death, disease, and disability in the U.S. (CDC, 2020). The economic and

financial burden on society and public health is enormous with an estimated $193 billion

annually in medical cost related to smoking illnesses in the United States alone (CDC,

2014; ODHP, 2021). The impact of smoking on future health is a priority and requires

immediate intervention, with tobacco use being "one of the nation's deadliest and most

costly public health challenges" (Grimshaw & Stanton, 2010; ODHP, 2021, p. 1). Given

the deleterious effects of smoking on the public's health, a comprehensive and

multicomponent approach to prevent smoking is needed and that must include mass

media, community-wide strategies, and school policies. Part of a community-wide

mobilization efforts must include retailer laws that are strong and retailer education,

accompanied by reinforcement (Grimshaw & Stanton, 2010).

Other interventions that have proven successful in reducing cigarette smoking

among young people is making the tobacco products unavailable to buy; increasing price

and taxes of tobacco products; raising the minimum age to 21 for purchasing tobacco

products, control media campaigns, and limit advertising and promotion (CDC, 2017;

NICE, 2010). Four laws signed by President Obama– the Children's Health Insurance

Program Reauthorization Act (2009), the Family Smoking Prevention and Tobacco

Control Act (2009), the Prevent All Cigarette Trafficking Act (2010), and the Patient

Protection and Affordable Care Act (2010) collectively give federal agencies more

funding and authority to regulate all products related to tobacco and reduce access to

tobacco products by the youth, and access to dependence treatments must be increased

(Koh, 2012). School-based educational programs have also proven effective when

combined with community-based initiatives involving the media and other strategies

(CDC, 2017). In many states, there are no restrictions on the sale of e-cigarettes to

minors. Local and State laws banning smoking in public places must include e-cigarettes,

coupled with a more sophisticated intervention for the youth than those for adults

(American Lung Association, 2020b; Cohen et al., 2010). Another recommendation,

based on the findings of this study, is to target the youth with profitable health

intervention programs that could ameliorate their overall health. This study did not

investigate the various types of e-cigarettes use among adolescents and the different types

of flavors, therefore future research is needed to investigate the different types and

designs and e-cigarette use patterns. This may help public health to develop education

programs that specifically target users of these various designs and flavor types.

Additionally, future surveys must include adolescent populations from private and charter

schools, given the lack of generalizability of the study findings. This will ensure

generalizability of future study findings.

Implications for Social Change

Walden University defines social change as "a deliberate process of creating and

applying ideas, strategies, and actions to promote the worth, dignity, and development of

individuals, communities, organizations, institutions, cultures, and societies. Positive

social change results in the improvement of human and social conditions" (Walden

University, 2020). Based on this definition, Walden's ultimate goal is simply to improve our social systems. It is our universal and professional duty as ambassadors of public health to uphold this tenet and embark on a mission to make our world a better place for all.

The SEM postulates that smoking and tobacco use are not only an individual behavioral problem but recognized widely as a public health and a social problem. This model has shown promise in guiding comprehensive approaches to changing certain behaviors such as smoking (Sallis et al., 2015). In this study, the SEM was used as the theoretical framework for health behavioral change in providing an understanding of smoking among middle and high school students in the U.S. Smoking is a behavioral issue and to promote the social change Walden envisions, it is incumbent upon us as public health ambassadors to provide nothing short of compassionate and excellent public health services in ways that impact society in lieu of the findings of this study. An example is to provide access to smoking cessation intervention programs and train health professionals to do follow-ups through phone calls and advice to influence adolescents to quit smoking. Improving the community's health, especially the future leaders of our country must be a top social change priority. However, the process of change cannot be accomplished without careful planning, execution, and surveillance to ensure that implementation is both beneficial and sustainable (Novick, 2008). Promoting the worth and dignity of these young adults is our public duty as public health practitioners, given the fact that the odds of smoking traditional cigarettes was 13 times higher for those who used e-cigarettes, according to this study findings. Indeed, the significant outcome of this

study must be a valuable lesson and the excellent foundation it has provided must encourage future research.

Conclusion

The purpose of this study was to determine if smoking of e-cigarettes leads to smoking of traditional cigarettes among middle and high school students in the United States and to assess if demographic factors and socioeconomic status play a role. The results of the study concluded that e-cigarettes use was associated with higher odds of smoking traditional cigarettes and may encourage conventional use of cigarettes among middle and high school students in the United States. In other words, students who smoke e-cigarettes were 13 times more likely to smoke conventional cigarettes. This positive association is consistent with the 2018 NYTS study that found that between 2017 and 2018, current use of e-cigarette, otherwise known as "vaping," increased at an alarming rate among middle and high school students in the U.S., with more than 3.6 million children vaping in 2018 (NYTS, 2020). This study findings in terms of the odds ratio could be a major concern among public health officials, given the fact that tobacco addiction is a major health problem throughout the world. Despite the overall results from this study compared to previous findings from other investigations, more regulation is needed immediately since intervention is the key to fight teenage smoking. Designing and implementation of any intervention requires policy makers to consider ways to mitigate socioeconomic disparities since socioeconomic factors play a key role in the current prevalence of smoking of electronic cigarettes among the youth (Amrock et al., 2016).

If smoking among the youth continues at the current rate in the U.S., 5.6 million of U.S. teenagers below the age of 18 will die prematurely from illnesses related to smoking. That translates to approximately 1 out of every 13 young Americans 17 years of age or younger living today (CDC, 2019c). Several studies have indicated that the primary ingredient in e-cigarettes is nicotine just as it is in traditional cigarettes (University of California San Francisco [UCSF], 2014). Public health professionals and healthcare experts such as epidemiologists, public health research scientists, physicians, medical scientists, and clinical researchers, among others all agree that nicotine is unquestionably the most addictive drug in use today (Jenssen & Boykan, 2019). However, the extent to which e-cigarettes are addictive and harmful in relation to traditional cigarettes remains unknown (Amrock et al., 2016). Therefore, more research is needed given the deleterious effects and the health threat smoking poses to our future leaders, the youth, and the economic and financial burden it imposes on society. It is imperative that policy makers and researchers understand these health risks to prevent premature death and disability among our youth.

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Appendix A: Dataset authorization letter from CDC

Dataset authorization letter from CDC

On Thu, Jun 9, 2016 at 5:13 PM, NCCD/OSH/OSH Inquiries (CDC) <nccdoshinquiries@cdc.gov> wrote:
 Dear Mr. Dwumfour-Poku,
  Thank you for contacting the Centers for Disease Control and Prevention (CDC), Office on Smoking and Health. The National Youth Tobacco Survey (NYTS) has included questions regarding e-cigarette use since 2011. You can access NYTS datasets and documentation at http://www.cdc.gov/tobacco/data_statistics/surveys/nyts/index.htm.
  You may also find the information provided at http://www.cdc.gov/tobacco/basic_information/e-cigarettes/youth-intentions/index.htm about a study on youth intentions to smoke that was published in the journal, *Nicotine & Tobacco Research*, to be of interest.
  Office on Smoking and Health
 National Center for Chronic Disease Prevention and Health Promotion
 Centers for Disease Control and Prevention