

## **ABSTRACT**

Using the Social Ecological Model as a Framework to Understand Psychosocial Environmental Variables that Mediate or Moderate Nicotine Addiction

By

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Despite increased awareness of the harms of cigarette smoking as well as improved prevention efforts, tobacco and smoking-related morbidity and mortality continue to be a leading cause of death and disability in the United States. This study used the Social Ecological Model (SEM) as a framework to explore four levels of influence on smoking behaviors. The SEM allows for an understanding of the complex and interactive effects of individual, relationship, community, and societal levels of influence that may contribute to behaviors like cigarette smoking. Understanding these effects may help clinicians, researchers, and educators to identify behavioral and community leverage points for health promotions within society. This study used archival data to explore the influence of several psychosocial environmental variables on cigarette smoking behaviors and uncover potentially causal (i.e., mediation) and relational (i.e., moderation) pathways present in the data. In the current study, negative binomial regression was utilized to explore whether specific psychosocial environmental variables at the different levels of influence outlined in the SEM act as mediators or moderators between participants' level of addiction to nicotine and their smoking cessation efforts in the last 12 months. Results indicated that mental health disorder status was a significant mediator and employment status, age at

smoking initiation, history of a substance use disorder, and whether participants worked in a smoke-free environment each acted as moderators for the relationship between participants' level of addiction to nicotine and their number of quit attempts in the last year. These results have implications for understanding smoking behaviors and treating nicotine addiction. This analysis may be used to guide counselor education, smoking cessation interventions, and public policy as it relates to cigarette smoking and addiction.

*Keywords: Smoking, Social Ecological Model, Nicotine Addiction*



USING THE SOCIAL ECOLOGICAL MODEL AS A FRAMEWORK TO UNDERSTAND  
PSYCHOSOCIAL ENVIRONMENTAL VARIABLES THAT MEDIATE OR MODERATE  
NICOTINE ADDICTION

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by

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## **CHAPTER I: INTRODUCTION**

### **Introduction**

Over half a century ago, the Surgeon General of the United States, Luther Terry, M.D., released a landmark report warning of the health consequences related to tobacco use and smoking cigarettes to the public (Center for Disease Control and Prevention [CDC], 2018). Dr. Terry worked with an advisory committee to review over seven thousand articles related to tobacco use and cigarette smoking with the aim of assessing the scientific knowledge of tobacco use and the effect of smoking on humans (Ruble, 2014). The group determined that smoking was causally linked to lung and laryngeal cancer in men and the most significant cause of chronic bronchitis (Ruble, 2014). The report also provided compelling evidence of the significant role of smoking in other major illnesses including cardiovascular disease, emphysema, and other forms of cancer (Brawley, Glynn, Khuri, Wender, & Seffrin, 2014). This landmark report was released on January 11, 1964. Just one year later, Congress passed the Federal Cigarette Labeling and Advertising Act of 1965 requiring manufacturers to include a warning label on all cigarette packages and annual reports to Congress from the Federal Trade Commission (FTC) and Department of Health, Education, and Welfare (DHEW). The annual reports by the FTC and DHEW provided information to Congress about the effectiveness of the new warning label system and the results of ongoing monitoring of health risks related to smoking (CDC, 2017). The release of the Surgeon General's report in 1964 and the extensive media coverage the report received influenced public opinion and there was a significant decline in cigarette sales within the first two months after the report's release (Federal Trade Commission, 1967; Brawley, et. al., 2014). Since the landmark Surgeon General's report in 1964, there have been dozens of federal, state, and local laws and actions regulating tobacco sales, marketing (CDC, 2017; National

Cancer Policy Forum; Board on Health Care Services; Institute of Medicine, 2013).

Increased public awareness and scientific evidence have helped to fuel the progression of comprehensive tobacco control policies in the U.S. (Cummings, Fong, & Borland, 2009; United States Public Health Service Office of the Surgeon General [USPHS OSG], 2014). These factors have led to declines in smoking prevalence and social acceptance of smoking (Cumming & Proctor, 2014). In fact, smoking prevalence in the United States has declined substantially over the years with 42.4% of the population smoking in 1965, down to 30.1% in 1985, 19.3 % in 2010, and only 14 % of adults in 2017 (DHHS, 1989; CDC, 2018b; DHHS 2014). Furthermore, the US Surgeon General's report released in 2006 concluded that there is no safe level of secondhand smoke exposure, leading state, and local governments to pass smoke-free policies (US Department of Health and Human Services, 2006). Presently, twenty-seven states and hundreds of cities and counties have enacted comprehensive smoke free-laws for workplaces, restaurants, and bars and an additional three states have passed smoke-free laws covering restaurants and bars (tobaccofreekids.org, 2019). Despite considerable progress since the first Surgeon General's report, smoking continues to be the single largest cause of preventable disease and death in the United States (CDC, 2018a).

Cigarette smoking is the most common method of using tobacco, though many people consume smokeless tobacco products and e-cigarettes which also deliver nicotine to users. Cigarettes are specifically designed to be extremely effective at delivering nicotine to the smoker, with 1-2 milligrams of nicotine delivered through inhalation per cigarette (NIDA, 2019). Nicotine is a highly addictive substance that can be difficult to quit. Although, research indicates that the majority of smokers would like to quit smoking, only around seven percent of smokers are able to quit in a given year which highlights the addictive nature of nicotine and smoking

(NIDA, 2019; Babb, Malarcher, Schauer, Asman, & Jamal, 2017). Though there have been decreases in smoking rates overall, there are still sub-populations in the US that smoke at disproportionately higher rates than other groups (CDC, 2019c). Not only does smoking lead to disease and disability, but it also harms nearly every organ in the human body (CDC, 2019a). Determining whether psychosocial-environmental variables influence the relationship between an individual's level of nicotine addiction and an individual's quit attempts may assist in understanding how to treat individuals seeking nicotine addiction treatment. This study used mediation and moderation analysis to explore the influence of specific psychosocial-environmental variables on the relationship between level of physical addiction to nicotine and the behavioral measure of quit attempts.

This chapter provides an introduction to the current study. The current study is aimed at investigating whether an individual's level of addiction to nicotine is mediated or moderated by psychosocial-environmental variables' influence on the number of attempts at smoking cessation through the framework of the Social Ecological Model of Health Behaviors (SEM; McLeroy, Bibeau, Steckler, & Glanz, 1988). The purpose of this chapter is to address (a) the general background of the study including the theoretical framework employed, (b) the statement of the problem (c) the study rationale including compelling arguments for why this study should be completed (d), the research question posed (e) the study significance, (f) clearly identified variables and their operational definitions and (g) a brief summary of the chapter.

### **Background of the Study**

Despite increased awareness of the harms of cigarette smoking as well as improved prevention efforts, tobacco and smoking-related illness and injury continue to be a leading cause of death and disability in the United States (Golechha, 2016; CDC, 2019a). The consequences of

smoking behaviors, including smoking-related illnesses and deaths, are a major public health concern (CDC, 2018a; CDC, 2018b; West, 2017). The total cost of smoking is estimated at over \$300 billion a year, with approximately \$170 billion spent annually for expenses incurred from direct medical care for adults and greater than \$156 billion in lost productivity from premature death and secondhand smoke exposure (Xu, Bishop, Kennedy, Simpson, & Pechacek, 2015; USPHS OSG, 2014). Comprehensive treatment approaches, as well as tobacco control programs and policies, are vital to continue progress toward ending the tobacco epidemic and curbing the financial, emotional, and health-related burden of smoking-related death and disability.

To effectively create comprehensive treatment approaches as well as tobacco control programs and policies to combat the tobacco epidemic, there must be an increased understanding of the psychosocial-environmental variables that influence smoking cessation efforts. Understanding the multiple variables related to cigarette smoking behaviors, including levels of nicotine addiction and psychosocial-environmental variables' mediating smoking cessation efforts, is vital to reduce the harms associated with tobacco use and non-nicotine related addictions in general. Additionally, exploring a range of variables that increase an individual's risk for smoking and smoking-related morbidity and mortality may allow for a better understanding of how to approach prevention and intervention efforts aimed at addressing the problem. Furthermore, investigating the multiple environmental variables that influence smoking behaviors and perpetuate the addictive cycle may allow for targeted treatment approaches to improve treatment outcomes and prolonged smoking cessation efforts for individuals. This study utilized the SEM as a framework to understand the various levels of influence on the individual and how that relates to their cigarette smoking behaviors.

## **Problem Statement**

Our current understanding of the complex interplay of factors related to cigarette smoking behaviors is lacking. Many studies have addressed individual variables related to smoking engagement and continued use, but there is a dearth of current research that provides a comprehensive approach to understanding the variables related to cigarette smoking in the US, especially through the multiple levels of influence of the SEM. Currently, there is no recent study exploring the multitude of psychosocial-environmental variables and various levels of influence on cigarette smoking and how these variables influence the behaviors of individuals who smoke cigarettes. To date, there have been no studies specifically exploring whether specific psychosocial-environmental variables mediate or moderate the relationship between an individual's level of addiction and their number of quit attempts. Additionally, there are growing disparities in smoking prevalence among individuals who are economically disadvantaged, experience mental illness, and have a history of a substance use disorder (SUD), which may highlight larger structural and societal forces at work (Heatherton, et al., 1991; Pomerleau, Majchrezak, & Pomerleau, 1989). Thus, the purpose of this study is to generate a comprehensive portrait of the various aspects influencing smoking behaviors. This will be key in helping to reduce smoking prevalence and mitigate the death and disability associated with this public health concern especially in marginalized populations (i.e., individuals with a mental health diagnosis a history of a SUD or are currently unemployed) that are more heavily impacted by smoking (Prochaska, Das, & Young-Wolff, 2017; Campbell, Le, Gubner, & Guydish, 2019; Fu & Liu, 2019). This study addresses this gap in current research by offering a holistic perspective of the multiple levels of influence that influence cigarette smoking.

## Study Justification

This study used the SEM as a framework to assess and explore the various levels of influence on smoking behaviors. The SEM originated from Bronfenbrenner's (1977) ecological model and further developed by McLeroy, Bibeau, Steckler, and Glanz (1988), explores the individual, relationship, community, and societal levels of influence on health-related behaviors. Using this framework allows for a more comprehensive biopsychosocial understanding of individuals who engage in cigarette smoking. This study explored the influence of individual, relationship, community, and societal variables on smoking behavior (i.e., quit attempts in the past year). Individual variables included (a) level of addiction to nicotine, (b) the presence of a mental health disorder, (c) employment status, (d) age at smoking initiation, (e) history of a SUD, and (f) number of quit attempts in the last 12 months (i.e., number of smoking cessation efforts). The relationship level variable analyzed in the current study is whether the individual lives with a smoker. Community level variables include personal environment and social norms related to smoking behaviors, specifically whether the individual works in a smoke-free environment. Societal levels of influence include the consideration of local legislation related to smoking behavior and programs offered for smoking cessation.

With the morbidity and mortality associated with smoking and addiction, understanding addiction from a holistic perspective like the SEM may allow for more personalized and efficient treatment approaches. Understanding the complex interplay of the individual, relationship, community, and societal levels of influence may provide information to assist in the development of more effective treatment approaches. The SEM allows for an understanding of a range of factors that put people at risk for engaging in specific behaviors such as cigarette smoking and addiction (CDC, 2019b). Counselor Educator programs may utilize the knowledge

acquired in this study to appropriately and effectively teach students treatment approaches to assist in smoking cessation. These approaches, if successful, may also provide a framework to be used in the treatment of other addictions.

### **Research Questions**

An analysis of archival data from a previously conducted study is used to answer the following research questions:

1. Do psychosocial environmental variables influence the relationship between participants' level of addiction and their number of quit attempts?
  - a. Does mental health disorder status mediate the relationship between participants' level of addiction and their number of quit attempts?
  - b. Does employment status moderate the relationship between participants' level of addiction and their number of quit attempts?
  - c. Does age at smoking initiation moderate the relationship between participants' level of addiction and their number of quit attempts?
  - d. Does a history of a Substance Use Disorder moderate the relationship between participants' level of addiction and their number of quit attempts?
  - e. Does living with a smoker moderate the relationship between participants' level of addiction and their number of quit attempts?
  - f. Does working in a smoke-free environment moderate the relationship between participants' level of addiction and their number of quit attempts?

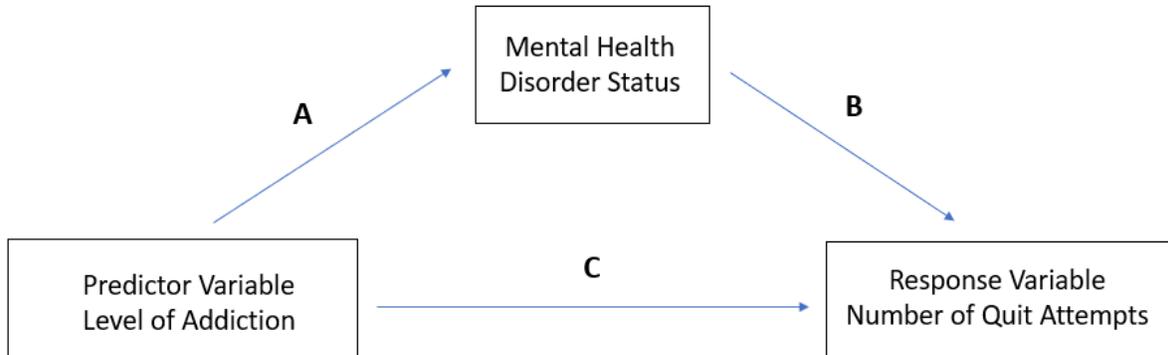
Mediation and moderation analyses were conducted utilizing level of addiction to nicotine as the predictor or independent variable and number of quit attempts in the last 12 months as the outcome or dependent variable. In this study, mediation analysis was conducted to determine if

mental health disorder status mediates the relationship between the independent and the dependent variables:

(1.a) Mental health disorder status

**Figure 1**

*Mediation Model for Mental Health Disorder Status*

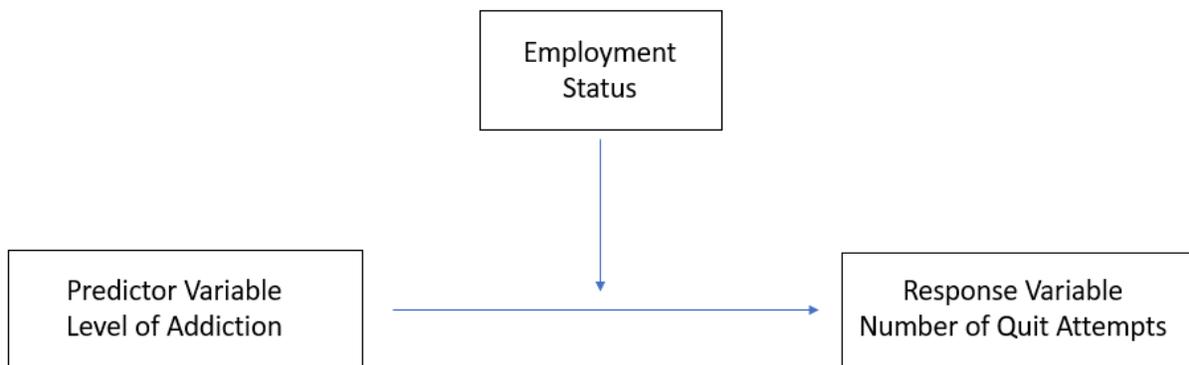


Additionally, moderation analyses were conducted to determine if the following variables act as moderators between the independent and dependent variables:

(1.b) employment status,

**Figure 2**

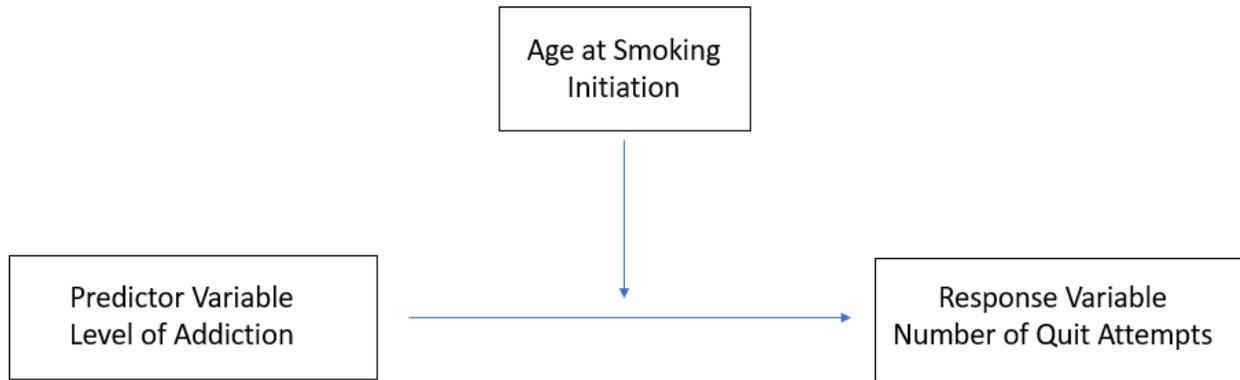
*Moderation Model for Employment Status*



(1.c) age at smoking initiation,

**Figure 3**

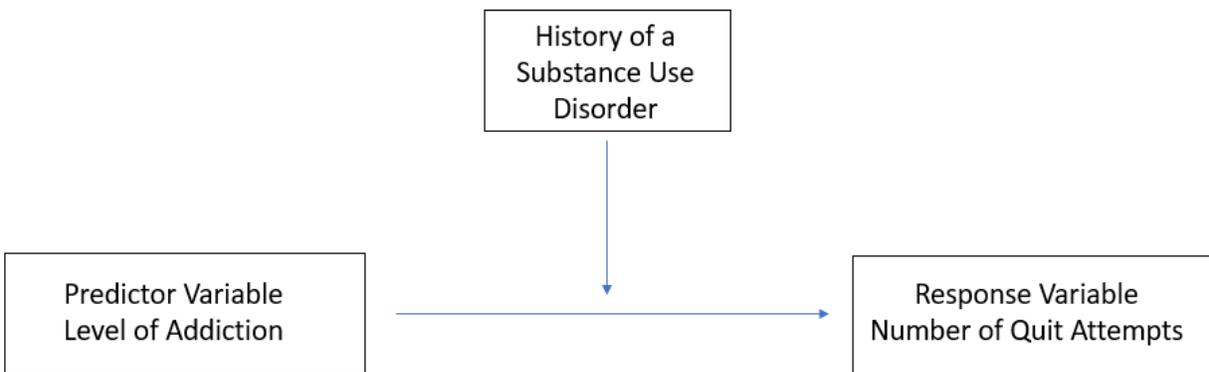
*Moderation Model for Age at Smoking Initiation*



(1.d) history of a substance use disorder,

**Figure 4**

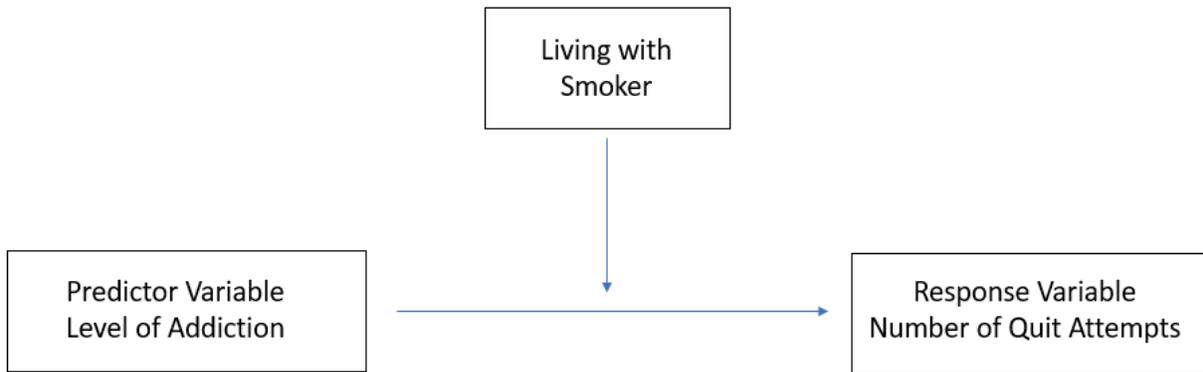
*Moderation Model for History of a Substance Use Disorder*



(1.e) whether the individual lives with a smoker, and

**Figure 5**

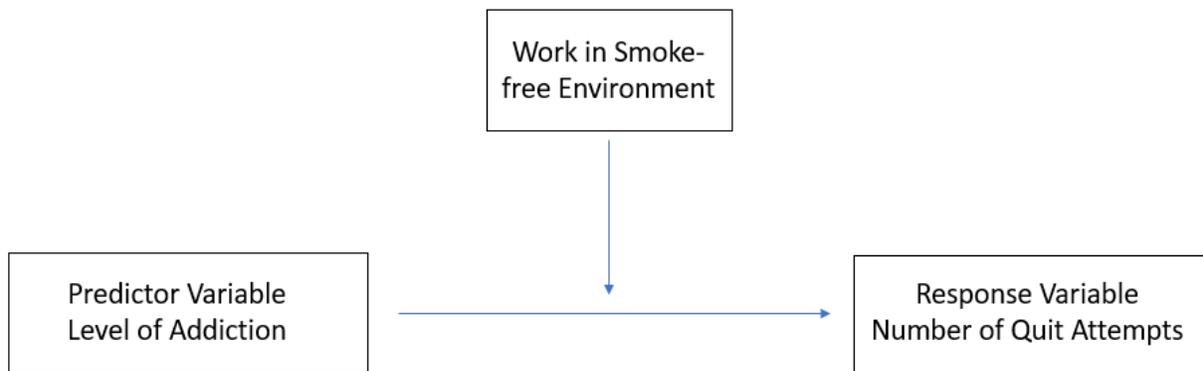
*Moderation Model for Living with a Smoker*



(1.f) whether the individual works in a smoke-free environment

**Figure 6**

*Moderation Model for Working in a Smoke-free Environment*



**Study Significance**

The current study may have implications for treatment, research, and counselor education related to cigarette smoking and nicotine addiction. Furthermore, because this study explored broad psychosocial and environmental variables related to nicotine addiction, the results may provide a basis for further understanding the complexity of addiction in general, beyond the

narrow scope of cigarette smoking. The SEM allows for an understanding of the complex and interactive effects of individual and environmental variables that determine behaviors like cigarette smoking. Understanding these effects may help counselors, researchers, and educators to identify behavioral and community leverage points for health promotions within society.

Further knowledge of the behavioral and psychosocial environmental variables that moderate cigarette smoking may assist in creating effective treatment programs for cigarette smoking and smoking cessation. In the US, tobacco control has reduced smoking prevalence by more than half since the 1964 landmark Surgeon General's report was released, but there are still individuals suffering from the adverse effects of cigarette smoking (USPHS OSG, 2014). Further research and the ongoing quest to find more evidence-based treatment approaches is imperative to continue to mitigate the harms associated with smoking cigarettes. Studies such as this current study are needed to explore the variety of variables that influence smoking behaviors.

Specifically, determining whether psychosocial-environmental variables influence (mediate or moderate) the relationship between level of physical addiction to nicotine and number of quit attempts may allow for a more comprehensive understanding of smoking behaviors and may contribute to more effective treatment options. Examining the variables associated with quit attempts and nicotine dependence can provide a framework for smoking treatment and counselor education.

Additionally, exploring the variables associated with quit attempts and nicotine dependence can provide valuable information for counselor educators and counselors on how to improve smoking cessation programs and integrate smoking cessation training into counselor education. As cigarette smoking is the number one preventable cause of death and disability in the US, finding ways to teach counselors to provide effective treatment to client's smoking

cessation efforts is key (CDC, 2018b). Counselors often do not receive formal training in the treatment of tobacco dependence (Laschober & Eby, 2013; Ziedonis, Guydish, Williams, Steinberg, & Foulds, 2006). In fact, the accrediting body for counselor education, the Council for Accreditation of Counseling and Related Educational Programs (CACREP) does not explicitly include required training and education on tobacco cessation or nicotine addiction in the most recent set of standards provided to counselor education graduate programs (CACREP, 2016). Counseling education programs may want to consider including smoking cessation and nicotine addiction into counselor education.

The importance of integrating smoking cessation services into counselor education may be best understood by recognizing the smoking behaviors of the populations often served by counselors. Counselors often provide services to individuals, couples, groups, and families addressing mental health concerns and issues related to substance use and misuse (American Counseling Association, 2019). Individuals with a mental health diagnosis experience higher levels of morbidity and mortality due to smoking-related causes than the general population (CDC, 2018). Research around smoking and mental health indicates that not only do smokers with a mental health disorder smoke at higher rates, but they also have higher levels of smoking when compared with other smokers (Lawrence, Mitrou, & Zubrick, 2009). The highest prevalence rate for cigarette smoking in a specific subpopulation is found in individuals with a SUD (SAMHSA, 2018). Even though these populations are smoking at much higher rates and are impacted more drastically than the general population by smoking-related death and disability, counselors who work with these populations often do not have extensive training or any training at all in smoking cessation treatment (Laschober & Eby, 2013; Ziedonis, Guydish, Williams, Steinberg, & Foulds, 2006). Furthermore, since studies have indicated that tobacco

cessation raises the likelihood of clients sustaining sobriety, counselors working with clients receiving treatment for a SUD may want to offer smoking cessation treatment to clients working towards abstinence (Baca & Yahne, 2009). Other research indicated that chronic smoking adversely affected brain structural recovery and aspects of neurocognitive recovery in individuals with an alcohol use disorder during continued abstinence from alcohol, further underscoring the importance of integrating smoking cessation into treatment for individuals with SUDs (Yeh, Gazdzinski, Durazzo, Sjostrand, & Meyerhoff, 2007). Additionally, since there are higher prevalence rates for smoking with individuals with a SUD or a mental health diagnosis, counselors are in a unique position to help introduce evidence-based smoking cessation practices into their work with clients who smoke. These counselors may have already built rapport with clients through the therapeutic alliance, which may allow for a seamless introduction of treatment options available for clients interested in smoking cessation. Research has shown that “counselors have considerable discretion in terms of choosing to provide tobacco cessation to patients who smoke” (Eby, Laschober, & Muilenburg, 2014, p. 319).

### **Operational Definitions**

The current study uses an archival dataset. Please note that the following operational definitions used in the current study are the same definitions used for the original study.

**Level of nicotine addiction.** In the archival dataset collected for the original study, the level of nicotine addiction was assessed by the Fagerström Test for Nicotine Dependence (FTND). The same definition is used for the current study. The FTND is a standard instrument that was developed to assess the intensity of an individual’s physical addiction to nicotine. The FTND is a self-report instrument, which provides an ordinal measure of nicotine dependence related to cigarette smoking and is composed of six items designed to evaluate the quantity of

cigarette consumption, the compulsion to use, and dependence. Scores for the Fagerström Test for Nicotine Dependence are summed to yield a total score: with yes/no items scored 0 to 1 respectively, and multiple-choice items scored from 0 to 3. The intensity of a patient's physical dependence on nicotine is based on the total Fagerström score, with a higher total indicating a greater intensity of physical dependence. (Heatherton, et al., 1991; Pomerleau, Majchrezak, & Pomerleau, 1989).

**Mental Health Disorder.** For the original study, the presence of a Mental Health Disorder in participants was limited to individuals undergoing current treatment for a mental health disorder as diagnosed by a healthcare provider. Individuals without current or recent treatment of a mental health disorder were excluded from the study. Mental Health Disorder status was based on patient self-report during screening, confirmed at the study visit, and was also determined by the answer to the following three survey questions: “Have you ever been diagnosed with a mental illness?,” “If yes, what is your primary mental health diagnosis for which you are receiving treatment?” and “Please list any secondary mental health diagnoses for which you are receiving treatment (check all that apply).”

**No Mental Health Disorder.** Individuals included in this designation had no current or historical diagnosis of a mental health disorder. Mental Health Disorder status was based on patient self-report during the screening process, confirmed at the study visit, and was also determined by the answer to the following three survey questions: “Have you ever been diagnosed with a mental illness?,” “If yes, what is your primary mental health diagnosis for which you are receiving treatment?” and “Please list any secondary mental health diagnoses for which you are receiving treatment (check all that apply).”

**Employment status.** Participants were asked if they work and were provided with the

following options (Full-time, Part-time, unemployed, student, volunteer, and other) for the purposes of this study full-time and part-time is considered an affirmative response).

Employment status was based on participants' response.

**Age at smoking initiation.** This is the age in years that the participants provided for the following question "At what age did you start smoking cigarettes?"

**Substance Use Disorder.** Individuals in this cohort indicated an affirmative response to a history of treatment for a Substance Use Disorder in the survey data collected during the study.

**Number of quit attempts in the last year.** Is the number of times the participant indicated they "... made a serious attempt to quit smoking in the last 12 months?"

**Presence of smokers in participant's home.** This term is based on participants' answer to the following question "Do other smokers live in the same house/apartment as you?"

**Individual works in a smoke-free environment.** This variable was based on participants' answer to the following question: "If you work, is your workplace smoke-free?"

### **Summary of the Chapter**

This chapter introduced how this study aims to investigate whether psychosocial-environmental variables mediate or moderate the relationship between an individual's level of addiction to nicotine and the number of attempts at smoking cessation through the framework of the SEM of health behaviors. This chapter addressed the general background of the study and outlined the use of the SEM as the theoretical framework used in this study. Additionally, this chapter provided the statement of the problem, including the rationale behind the study with compelling arguments for why this study should be completed. The research question was provided. Additionally, information on the study's significance was presented with clearly identified variables and their operational definitions.

## **CHAPTER II: REVIEW OF THE LITERATURE**

### **Introduction**

The current study examines whether various psychosocial-environmental variables influence the relationship between an individual's level of addiction to nicotine and the quantity of their attempts at smoking cessation. In this study, the influence of these variables is explored through mediation and moderation analyses. Chapter two consists of a review of relevant research for the topic at hand, including research related to nicotine addiction and cigarette smoking as well as prevalence and historical patterns related to cigarette smoking. This study used the Social Ecological Model of health behaviors (SEM) as a framework to assess and explore the various levels of influence on smoking behaviors, including each of the psychosocial-environmental variables explored (McLeroy, Bibeau, Steckler, & Glanz, 1988). A description of the SEM is provided, the theoretical framework supporting this study. The purpose of this chapter is to expand upon (a) the current state of cigarette smoking in the United States; (b) a more detailed description of the SEM (McLeroy et al., 1988); (c) the variables explored in this study for the individual level of influence of the SEM; (d) the variables explored in this study for the relationship level of influence of the SEM; (e) the variables explored in this study for the community level of influence of the SEM; (f) the variables explored in this study for the societal level of influence of the SEM; and (g) an overview of the chapter.

### **Cigarette Smoking in the United States**

Despite years of prevention efforts, tobacco use remains the leading preventable cause of disease, disability, and death in the United States (Center for Disease Control and Prevention [CDC], 2019a). In 2016, 37.8 million U.S. adults in the United States alone were current cigarette smokers (Jamal et al., 2018). Smoking-related morbidity and mortality

disproportionately affects certain groups at higher rates than others, and there are apparent sociodemographic disparities in smoking prevalence that persist today (CDC, 2019c; Drope et al., 2018). From a public health standpoint, cigarette smoking continues to be a significant health concern with major costs to individual lives, community health, and society. Each year, the United States spends nearly \$170 billion in direct medical care to treat smoking-related diseases in adults (Xu, Bishop, Kennedy, Simpson, & Pechacek, 2015). Additionally, estimations of the economic cost of lost productivity due to premature death and exposure to secondhand smoke are greater than \$156 billion annually (U.S. Department of Health and Human Services [US DHHS], 2014).

The influence of cigarette use is far-reaching. Cigarette smoking is a major cause of disease and death worldwide. In the United States alone, cigarette smoking is responsible for more than 480,000 premature deaths per year in the United States, with more than 41,000 deaths resulting from secondhand smoke exposure, which equates to approximately one in five deaths annually (US DHHS, 2014). There are a variety of smoking-related illnesses that contribute to the morbidity and mortality associated with the use of cigarettes. Smoking is known to cause cancer, heart disease, stroke, lung diseases, diabetes, and chronic obstructive pulmonary disease (COPD) and can increase the risk for a multitude of other conditions (CDC, 2018). In order to potentially mitigate some of the problems associated with cigarette smoking, we may need a comprehensive framework through which to view the current state of smoking behaviors.

The use of the SEM as a framework for exploring cigarette smoking may allow for an understanding of the complex and interactive effects of individual and environmental variables that determine behaviors like cigarette smoking. Understanding these effects may help

counselors, researchers, and educators to identify behavioral and community leverage points for health promotions within society.

### **Social Ecological Model Framework**

The use of the SEM is increasing in popularity particularly in research related to health promotion and behavior change (Joseph et al., 2014), with the Institute of Medicine, the USDHHS, and the CDC using the SEM as a framework to explore prevention and behavior change (IOM, 2005; CDC, 2019b). Social ecological models have been used frequently to guide practices in public health interventions and health promotion practices due to the emphasis on the interactive characteristics of individuals with their social environments. In fact, the CDC encourages many of its grantees to adopt a social ecological perspective when developing program designs for studies (Golden & Earp, 2012). The SEM creates a comprehensive portrait of health behaviors and emphasizes the contextual factors at play that are related to the behaviors. The SEM provides a framework for potentially understanding the interactions between individual, relationship, community, and societal variables (McLeroy et al., 1988). Certainly, smoking behaviors and addiction are most likely not isolated from these variables' influence on an individual's level of addiction and quit attempts. Therefore, using the SEM to explore the variables related to cigarette smoking and addiction may allow for a comprehensive approach to understanding the complexity of cigarette smoking as a behavior.

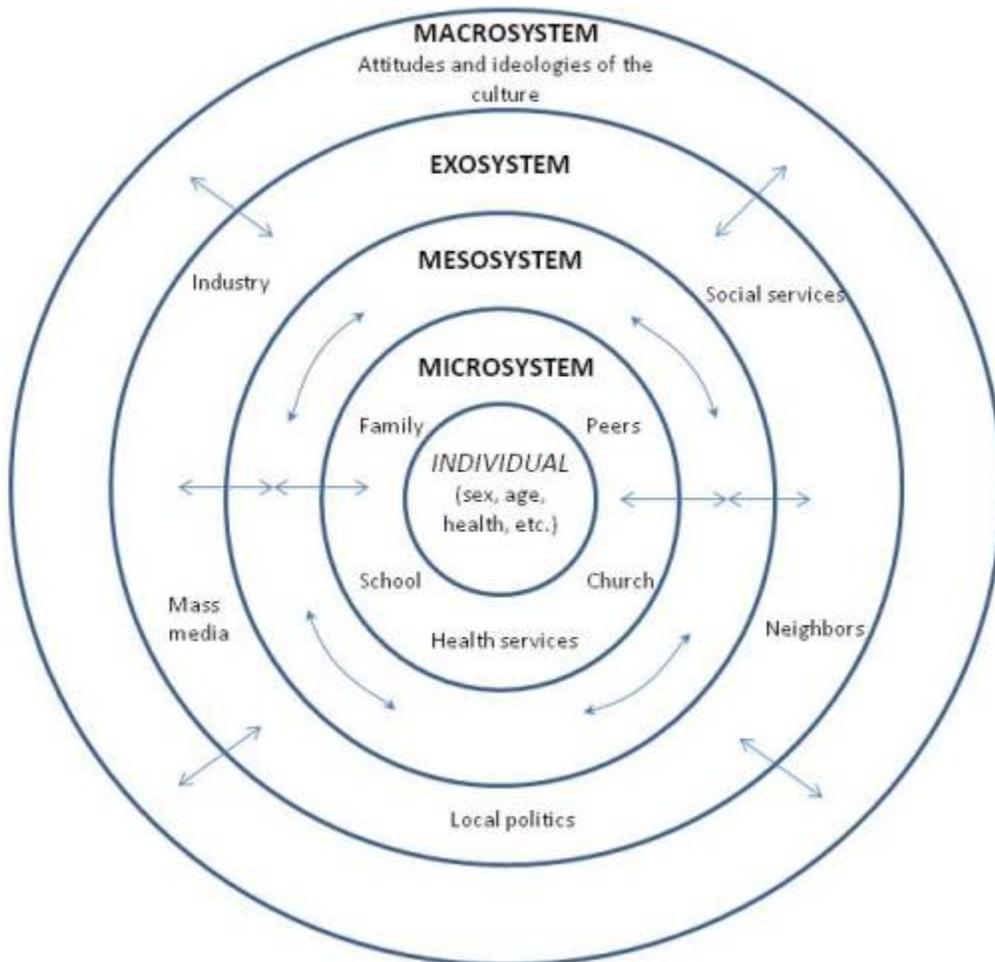
The SEM often used in health promotion and behavior research was developed by McLeroy, Bibeau, Steckler, and Glanz (1988) and is based on Urie Bronfenbrenner's (1979) ecological model. The SEM framework proposed by McLeroy et al. (1988) suggested that behaviors result from an interplay of different influences at five different levels: intrapersonal, interpersonal, organizational (or institutional), community, and public policy. Additionally, the

authors of the SEM presented possible intervention strategies at each of the five levels of influence (McLeroy et al., 1988). The SEM had origins in Urie Bronfenbrenner's (1979) ecological model that articulated the complexity of relationships that exist among environmental and social variables in relation to human development.

Bronfenbrenner was a developmental psychologist that created the ecological model in the late 1970s to help explain how children's' innate characteristics and qualities interact with their environments in such a manner that influences how they grow and develop. Until his death in 2005, Bronfenbrenner further developed the ecological model, expanding it to a theory, and later to the Process–Person–Context–Time model (Eriksson, Ghazinour, & Hammarström, 2018; Bronfenbrenner & Ceci, 1994). The theory supported the idea that in order to fully understand a child, one must study the different environments or ecological systems in which they live. Bronfenbrenner's (1979) model included the following levels or ecosystems: microsystem, mesosystem, exosystem, and macrosystem, with the chronosystem, later added to incorporate the dimension of time as it relates to child development (Bronfenbrenner, 1986, 1989). Refer to figure 7 below for a diagram of Bronfenbrenner's (1977) ecological theory of human development. The most intimate and innermost system, the microsystem, includes the child's home, an ecological system including relationships with his or her immediate surroundings, including family, school, childcare, and neighborhood. The ecosystems expand out to the macrosystem, which includes the culture and society in which the child lives and includes societal, religious, and cultural values and influences (Bronfenbrenner, 1977).

**Figure 7**

*Bronfenbrenner's (1977) Ecological Theory of Human Development*



*Note.* This figure illustrates the second revision of the ecological theory (Bronfenbrenner, 1977)

Unlike the ecological theory that focused on child development, the use of health as a construct was first conceptualized in the SEM and focused on the major contributors to health and health-related behaviors (Kilanowski, 2017). The change was meaningful because research and prevention efforts in health promotion have often been critiqued for focusing on lifestyle changes without considering the multitude of contextual variables that influence health behaviors (Golden & Earp, 2012). The SEM was developed to describe the complex relationships found between social (e.g., social community) and structural (e.g., access to care) factors, personal

behaviors, the physical environment, and health. The SEM emphasized the interaction between, as well as the interdependence of the numerous variables within and across the many levels of influence involved in a consequential public health concern. This social ecological perspective underscores the importance of understanding the interactions present between individuals and their physical and sociocultural environments. Additionally, the SEM provides a perspective of reciprocal causation for individual health behaviors by acknowledging that individual behavior both shapes and is shaped by the social environment and context. Thus, the SEM can be used to model how behavior can influence and be influenced by the various levels of an individuals' social-ecological environment (interactions between individuals, their relationships, community, and society.) Therefore, understanding these reciprocal interactions can help to optimize intervention points for health promotion (Glanz, Rimer, & Lewis, 2002).

Stokols (1992, 1996) focused on using the SEM to obtain practical guidelines for developing and assessing health promotion programs and interventions. He contended that the multiple levels of influence present in an individual's life have a collective effect on that individual's health. As individuals interact differently with their environment through their unique belief systems and behaviors, creating sustainable change in a system is generally most effective by targeting each factor concurrently though he recognized that this might be impractical in some instances. The purpose of a multifactor approach is related to the fact that social, physical, and cultural aspects of an environment are complex, and the environmental context of an individual may influence the health and health behaviors of individuals in diverse ways. If targeting all factors simultaneously is unfeasible, he recommended that the intervention focuses on at least two levels of influence (Stokols 1992, 1996). This distinction is important as some researchers have highlighted the dearth of multilevel interventions within public health,

citing that the lack of such interventions may be due to operational challenges and costs of multilevel interventions (Schölmerich & Kawachi, 2016). Other researchers have proposed that simply the knowledge of the important relationships between the levels can be used to optimize the effectiveness of an intervention (Golden & Earp, 2012; Meadows & Wright, 2008). In the current study, pulling from some of Stokols' practical recommendations for utilizing the SEM, a simplified version of the SEM is used with four levels of influence.

In the present study, the SEM used is based on the CDC's SEM developed for violence prevention. This SEM includes four major levels of influence that impact behavior: individual, relationship, community, and societal (CDC, 2019b). The CDC's model of SEM is used for the purposes of the current study, because this model, though slightly simplified, still recognizes the complex range of aspects that put people at risk for engaging in certain behaviors such as cigarette smoking and addiction. In order to fully understand cigarette smoking and addiction to nicotine, the psychosocial and environmental variables that influence the risk of developing an addiction to nicotine, as well as potential barriers to smoking cessation, should be understood through the four levels of influence used in this specific iteration of the SEM. As mentioned previously, the SEM shows that health-related behaviors are influenced by the interactions between individuals and their environments (CDC, 2019b; Institute of Medicine, 2005), which is integral to understanding target areas for multi-level interventions for smoking. The SEM highlights that there is a need for a combination of individual level and environmental/policy level interventions to achieve changes in health behavior. The most effective approach to public health prevention and understanding of cigarette smoking will use a combination of interventions at all levels of the model (CDC, 2019b). For the current study, the CDC's model was used because of the model's elegance and focus on four major levels of influence: individual,

relationship, community, and societal. See figure 8 below. Please note that potential variables at each of these levels are reviewed below, however, as the current study utilized archival data, only variables at the individual, relationship, and community levels were analyzed. These variables are distinguished below as appropriate.

## Figure 8

*The Social-Ecological Model: A Framework for Prevention*



*Note: A Framework for Prevention from the CDC (2019b) Model for Violence Prevention*

### **Individual Level of the Social Ecological Model (SEM)**

The individual level of the SEM includes various individual characteristics (McLeroy et al., 1988; CDC, 2019b). The first level in the SEM is the individual level, which identifies biological and personal history characteristics. More often than not, health behavior research and intervention efforts target the individual level of influence, as this level is the level in which health behaviors are most clearly observed as it focuses on the characteristics of the individual. Additionally, the characteristics of this level are often the easiest to identify, measure, and collect. Other health promotion programs like behavior modification focus on modifying variables present at the individual level of influence, which can limit the effectiveness of the programs, whereas the SEM conceptualizes this information as part of the full picture (Stokols, 1996). The individual level includes but is not limited to personal characteristics (e.g., level of

education and employment status), biological factors (e.g., age and gender), behavior (e.g., substance use and number of cigarettes smoked per day), and personal experience (National Center for Injury Prevention and Control, 2015).

The individual variables to be analyzed in the current study include (1) the level of addiction to nicotine, (2) mental health disorder status, (3) age at smoking initiation, (4) employment status, (5) history of a substance use disorder, (6) and number of quit attempts in the last 12 months. Average number of cigarettes per day smoked is included in the literature review although it is not an individual factor analyzed. Average number of cigarettes per day is one of the 6 questions that make up the Fagerström test of nicotine independence which is how the score for level of addiction to nicotine is determined. Individual variables such as vocational status, mental health status, and history of a substance use disorder have been shown to impact smoking-related behaviors in individuals (Prochaska, Das, & Young-Wolff, 2017; Campbell, Le, Gubner, & Guydish, 2019; Fu & Liu, 2019; CDC, 2018, January).

#### **Level of addiction to nicotine.**

As an individual level variable for the current study, the level of addiction to nicotine is vital for several reasons. Nicotine, a chemical contained in tobacco, is a psychoactive substance that influences an individual biologically. Nicotine influences several neurological regulators that impact behavior and mood while acting as a stimulant for the brain (Jiloha, 2010). Since the 1960s, it has been widely accepted that nicotine is the addictive substance contained in cigarettes that drives an individual's addiction to smoke (Glantz & Forbes, 1996). Nicotine is unique in that it has a biphasic effect that allows users to, at times, feel energized, and at other times it appears that cigarette smoking lessens the effect of stressful stimuli. The biphasic effect is due to the fact that short inhalations can have a stimulant effect, whereas when cigarettes are smoked in long,

deep inhalations, the user may experience a tranquilizing effect (Nicotine, 2019). The half-life of nicotine is only about 2 hours, requiring users to smoke frequently in order to maintain desired levels of nicotine (Fagerstrom, 2012).

The addiction potential of nicotine contained in cigarettes and other tobacco products is an important driving force in cigarette smoking behaviors. The US surgeon general (2010, p. 105) concluded that “the pharmacological and behavioral processes that determine tobacco addiction are similar to those that determined the addiction to drugs such as heroin and cocaine.” Even though nicotine is the most significant addictive component of tobacco smoke, it is most likely not the sole substance involved in the development of tobacco dependence (Fagerstrom, 2012). Additionally, although nicotine is highly addictive and is believed to be the substance primarily responsible for getting users addicted to cigarette smoking, nicotine is not listed among the carcinogens present in tobacco smoke, thus not recognized as a cancer-causing substance in combustible tobacco (Gottlieb & Zeller, 2017; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Meeting Lyon, France, & International Agency for Research on Cancer, 2007; Villanti et al., 2019). As nicotine is highly regarded as one of the most addictive substances in cigarettes, it may be important to assess an individual’s level of addiction to nicotine when studying smoking behaviors.

In this study, the level of addiction to nicotine was based on a composite score assessed using the Fagerström Test of Nicotine Dependence (FTND). The FTND was first developed as the Tolerance Questionnaire (Fagerström, 1978) when the recognition of tobacco smoking as a potential addiction was just beginning to emerge and then expanded to the FTND (Heatherton, et al., 1991; Fagerström, 2012). As the understanding of the determinants of tobacco dependence has become more well-known, one of the previous authors of the FTND proposed the renaming

of the test to the Fagerström Test for Cigarette Dependence (FTCD, Fagerström, 2012). The FTND is a standard instrument for assessing the intensity of physical addiction to nicotine. The test was designed to provide an ordinal measure of nicotine dependence related to cigarette smoking. It contains six items that evaluate the quantity of cigarette consumption, the compulsion to use, and dependence (Heatherton, et al., 1991). In scoring the FTND, yes and no items are scored from zero to one, and multiple-choice items are scored from zero to three. The items are summed to yield a total score of zero to ten. The higher the total Fagerström score, the more intense the patient's physical dependence on nicotine (Heatherton, et al., 1991).

The Fagerström score indicates the level of addiction to nicotine and has been used as a variable in many studies. Recent research has determined that an individual's Fagerström score correlates with the likelihood of treatment attendance, and authors suggested that the Fagerström score could be used to recognize smokers that were at an increased risk of not attending treatment (Hughes & Davies, 2019).

#### **Average number of cigarettes smoked per day.**

The level or amount an individual smokes (i.e., number of cigarettes per day (CPD)) has been found to be a strong predictor of an individual's ability to quit smoking and is often associated with genetic markers (Kumasaka et al., 2012; Liu et al., 2010; Richmond-Rakerd, 2017; 2016). The average number of CPD is a standard measure of smoking behavior in that it quantifies the number of cigarettes an individual smokes daily. A pack of cigarettes contains 20 cigarettes, and individuals who smoke over 20 cigarettes a day are often considered "heavy" smokers (Serxner, Catalano, Dooley, & Mishra, 1993; Powell et al., 2013).

Researchers have used CPD for a broad range of reasons. There have been studies that use this way of quantifying cigarette behaviors to determine cigarette quantity and exposure

(Powell et al., 2018), find baseline smoking levels (Worley et al., 2018), and categorize the level of smoking (Serxner, Catalano, Dooley, & Mishra, 1993). There has been anecdotal evidence that implies that quitting "cold turkey" is the best way to quit smoking rather than a gradual reduction in CPD. However, a metaanalysis found that a reduction of CPD before a predetermined quit-day and quitting abruptly with no reduced intake, produced similar results (Lindson, Aveyard, & Hughes, 2010). Other studies have shown that when individuals reduce the number of cigarettes they consume before quitting entirely, this action may increase the likelihood that they will quit and does not appear to influence relapse rates for individuals after they quit smoking (Falba, Jofre-Bonet, Busch, Duhovny, & Sindelar, 2004). Cigarette smokers working towards smoking cessation may find it is easier to reduce the number of cigarettes smoked per day than it is to not smoke at all on some days. (Henry et al., 2017).

Cigarettes per day consumed is also related to the nicotine levels of cigarettes. In a six-week NIDA supported study, researchers assigned participants to seven types of cigarettes that varied in nicotine content. The researchers found that participants assigned to 2.4 mg of nicotine or less per gram versus the 15.8 mg per gram cigarette smoked 23 to 30% fewer cigarettes per week (which can be assumed to be related to a decrease in average CPD). Additionally, individuals assigned to the lowest dose of nicotine (0.4 mg) had reductions in their nicotine dependence over the 6-week study period (Donny et al., 2015). Conversely, researchers used the National Health and Nutrition Examination Survey (NHANES) to study the nicotine intake of US adult smokers from 1988 to 2012. The authors found that although there have been reductions in daily cigarette consumption and smoking prevalence rates, reduction in cigarette consumption has been offset by increases in the nicotine content per cigarette smoked (Jarvis, Giovino, O'Connor, Kozlowski, & Bernert, 2014). Please note that for each of the variables

reviewed below, CPD is often used to quantify smoking behavior.

### **Presence of a Mental Health Disorder.**

Specific populations, including people with a mental health diagnosis, have a higher smoking prevalence and much higher smoking rates than the general population (CDC, 2019c; Forman-Hoffman, Hedden, Glasheen, Davies, & Colpe, 2016; Weinberger, Funk, & Goodwin, 2016). In 2018, SAMHSA found that for adults over 18 in the US, 28.1% with any mental illness and 37.2% with a serious mental illness were past month cigarette smokers. However, in that same year in the US, only 16.3% of adults without any mental illness were cigarette smokers in the past month (SAMHSA, 2019a). In fact, people with mental illnesses and addictions smoke approximately half of all cigarettes produced and are only about half as likely as other smokers to quit (SAMHSA, n.d.).

Furthermore, population-level data collected in the United States indicated that one in four individuals in the United States have been diagnosed with a mental health disorder, however this population smokes 40% of the cigarettes consumed in the country (Lipari & Van Horn, 2017; CDC, 2019; SAMHSA, 2013). In other words, remarkably 25% of the United States population consumes 40% of all cigarettes smoked annually. National survey data from the United States and Australia revealed that adults with mental health disorders smoked at almost twice the rate of adults without mental health disorders (Lawrence, Mitrou, & Zubrick, 2009). Based on population data and previous research, individuals with a mental health disorder clearly engage in different smoking behaviors than the general population.

Research investigating the relationship between smoking and mental health indicates that not only do smokers with a mental health disorder smoke at higher rates, but they also have higher levels of smoking when compared with other smokers (Lawrence, Mitrou, & Zubrick, 2009). Additionally, the average number of cigarettes smoked is greater among those with a

current mental health disorder than those without a mental health disorder, with males and females with a mental health disorder smoking 2 to 3 packs more cigarettes than males and females without a mental health disorder respectively (Lipari & Van Horn, 2017). Though presence of a mental health disorder has been shown to influence smoking rates and prevalence, the presence of a mental health disorder may not be related to smoking cessation attempts. Research investigating cigarette smoking and quitting-related factors from a nationally representative large-scale sample of the Health Center Patient Survey participants explored the relationship between certain smoking behaviors and mental health status. Authors found that smokers with and without a serious mental illness did not significantly differ in their odds of making a quit attempt or plans to quit in the past 12 months (Kalkhoran et al., 2019). Despite the fact that these populations are smoking at much higher rates and are impacted more drastically than the general population by smoking-related death and disability, there is not a strong understanding of how these variables influence behavior. The presence of a mental health diagnosis evidently affects smoking behaviors (Prochaska, Das, & Young-Wolff, 2017).

Cigarette smoking is a significant contributor to health disparities, especially for individuals with mental health disorders and those of lower socioeconomic status (Higgins et al., 2017). Individuals with a mental health diagnosis have higher levels of morbidity and mortality than the general population due to smoking-related illnesses, including cardiovascular and respiratory diseases and cancers (CDC, 2018; Liu et al., 2017; Bandiera, Anteneh, Le, Delucchi, & Guydish, 2015). Research has shown that individuals with a mental health disorder die eight to 25 years earlier than the general population with the primary causes being chronic, tobacco-related, diseases such as cardiovascular and respiratory diseases (Colton & Manderscheid, 2006; Lawrence, Hancock, & Kisely, 2013; Prochaska, Das, & Young-Wolff, 2017). Recent research

has been conducted with findings indicating that tobacco-related conditions account for approximately half of the total deaths for individuals with schizophrenia, bipolar, and depression in a large-scale study of tobacco-related mortality in individuals with psychiatric conditions (Callaghan et al., 2014). With estimates of smoking prevalence ranging from 45% to 88% among individuals with schizophrenia (Dickerson, 2018; Kalman, Morissette, & Georger, 2005; Lasser et al., 2000, Cooper et al., 2012; de Leon & Diaz, 2005, Hennekens, Hennekens, Hollar, & Casey., 2005) and 30 to 60% among individuals with major depressive disorder (MDD) and other mood disorders (Weinberger et al., 2018; Kalman, Morissette, & Georger, 2005; Poirier et al., 2002) the death toll for these diagnoses is high. Additionally, there is evidence of a growing disparity in mortality rates between individuals with and without mental health diagnoses, because of increased mortality due to common conditions for people with mental health disorders (Lawrence, Mitrou, & Zubrick, 2009). There is clearly a relationship between smoking behaviors of individuals with mental health disorders and their physical health, morbidity, and mortality. However, there is also a relationship between mental health treatment and smoking.

An individual with a mental health disorder has smoking behaviors that may be influenced by their participation or lack of participation in treatment for their mental health disorder. Lawrence, Mitrou, and Zubrick (2009) explored the relationship between accessing mental health treatment and smoking and found that most cigarette smokers who met the criteria for an ICD-10 mental health disorder were not accessing mental health services. However, the study also revealed that the rate of smoking for the group not accessing mental health treatment was similar to that of smokers who had accessed services. Lifetime smokers with a mental health disorder receiving mental health-related treatment were more likely to have quit smoking than their counterparts not receiving treatment (Cook et al., 2014). Lawrence, Mitrou, and Zubrick

(2009) found that the levels of psychological distress a smoker experiences are related to the average number of cigarettes that the individual consumes in a day. The study specifically found that higher levels of distress were linked with a higher average number of CPD (Lawrence, Mitrou, & Zubrick, 2009). A meta-analysis conducted of 26 tobacco intervention studies determined that quitting smoking was significantly associated with reductions in anxiety, depression, and stress. Additionally, smoking cessation was associated with improvements in overall mood and quality of life when compared with individuals that continued smoking (Taylor, McNeill, Girling, Farley, Lindson-Hawley, & Aveyard, 2014). Furthermore, individuals with a mental health disorder are less likely to stop smoking than those without a mental health disorder; however, research indicates that many smokers with mental health disorders want to quit (CDC, 2013).

Although individuals with a mental health disorder often have a powerful desire to quit, there are barriers to smoking cessation for this population that are not present in other special populations, including biochemical processes that make smoking cessation more difficult. In a metanalysis investigating barriers to smoking cessation for a variety of special populations, symptom management was reported as a significant barrier in studies involving individuals with a mental health diagnosis (Twyman et al., 2014). Evidence suggests that some symptoms of mental health diagnoses have been improved through the biochemical processes related to nicotine and other chemicals inhaled while smoking (Dani & Harris, 2005). Other research has shown that tobacco use reduces the therapeutic blood levels of several psychiatric medications, and this reduction should be considered when assessing an individual's response to pharmacotherapy (Kroon, 2007; Zevin & Benowitz, 1999). Conversely, the psychiatric drug and tobacco interaction may need to be considered when individuals are quitting smoking, as

smoking cessation may necessitate a reduction in the dosage of psychiatric medications (Kroon, 2007). Understanding the influence of these individual characteristics on smoking cessation and an individual's level of addiction is needed to mitigate the damaging effects of cigarette smoking on individuals with a mental health disorder.

### **Employment Status.**

As an individual level variable for the current study, employment status is important for several reasons. Previous research has indicated that tobacco use is influenced by economic insecurity, such as unemployment. Barnes and Smith (2009) hypothesized that individuals might engage in smoking behaviors in response to the presence of economic insecurity and instability partly as a form of "self-medication." They determined that a mere one percent increase in the probability of becoming unemployed led to an individual being 2.4 percent more likely to continue smoking. Researchers investigating how likely individuals are to adopt negative health behaviors like cigarette smoking during periods of economic downturns (e.g., recessions) found that individuals who experienced a measured decrease in economic resources were significantly more likely to start smoking cigarettes. Furthermore, they found that it was more common for an individual to become a smoker if they had an unemployment episode (Kalousova & Burgard, 2014).

Additionally, research from a longitudinal Health and Retirement Study surveying older Americans found that involuntary job loss was associated with increased risk of smoking relapse in smokers that had previously quit and increased the quantity of cigarette consumption by smokers (a 30% increase over baseline). Even though the average time since quitting was over 16 years, the relapse rates were noticeable, particularly when considering the potential health impacts of smoking relapse among older workers (Falba, Teng, Sindelar, & Gallo, 2005).

Interestingly, Charles and DeCicca (2008) found that when there was an overall increase in the metropolitan unemployment rate, their estimates showed an increase in smoking behaviors for those with the low predicted future employment and reductions in smoking for those most likely to be employed. Other research has that the proportion of current and ever smokers were considerably higher among unemployed individuals than those with employment, with unemployed smokers also initiating smoking at an earlier age (Lee, Crombie, Smith, & Tunstall-Pedoe, 1991). Golden and Perreira (2015) found when studying the Great Recession that individuals who had experienced a recent involuntary job loss smoked at higher rates than their employed peers, with involuntary job loss associated with a 0.29-point increase on a psychological distress score. As evidenced by previous research, smoking behaviors are clearly influenced by employment status. Moreover, employment status influences other individual level variables as well as other levels of influence.

Employment status is an essential factor due to its interactions with other individual level variables as well as variables at other levels of influence. Previous studies have shown that employment status can have a considerable impact on several other individual variables and additional levels of influence within the SEM, including the relationship and community levels of influence. Grafova and Monheit (2019) found that the effect of unemployment on smoking is dependent upon the duration of unemployment, with longer durations of unemployment having a negative effect on smoking behavior even though they also found a positive initial impact on smoking behaviors when individuals were first unemployed. These results highlighted the potential role of prolonged stress on smoking behaviors, which can also influence other individual variables such as substance misuse and mental health (Grafova & Monheit, 2019). Previous research has found that unemployment can adversely influence health in many ways,

including changes in behavior like increased risk-taking and stress, reduced use of health care resources, and poorer quality of diet.

Additionally, prolonged lifetime unemployment was associated with chronic diseases and disability. For example, individuals with diabetes and high lifetime unemployment have shown to have a longer duration of diabetes (Laditka & Laditka, 2015). An example of smoking behaviors and the relationship between societal or community levels of influence can be found in a study conducted in China, which is the largest consumer of cigarettes (Yang, Jason & Yang, 2011). Researchers studied a large representative sample of smokers in China and found a relationship between the regional unemployment rate and an individual's smoking rate, with unemployment rate positively related to smoking behavior (Wang, Shen, & Cochran, 2016). In that study, researchers showed how variables at a societal level of influence (e.g., regional unemployment rate) influences individual variables (e.g., rate of smoking). These findings underscore how employment status, specifically unemployment, can influence different variables within the individual level of influence as well as different variables contained in other levels of influence.

#### **Age at smoking initiation.**

The Center for Disease Control (2018) reports more than 3,800 youth under the age of 18 smoking their first cigarette every day. The U.S. Department of Health and Human Service (2014) estimates that if smoking among youth in the United States continues at the current rate, one in every 13 Americans aged 17 years or younger who are alive today are expected to die prematurely from a smoking-related illness. Studies have shown that nicotine addiction and dependence is stronger when smoking initiation occurs in early adolescence. Furthermore, individuals who begin smoking as adolescents are more likely to continue smoking into

adulthood, become addicted to smoking and nicotine, develop into daily smokers, and become heavier smokers in adulthood (Chen & Millar, 1998; DiFranza, 2015; Doubeni, Reed, & DiFranza, 2010). Early age of smoking initiation is also a significant risk factor for long term smoking behaviors and dependence. Individuals with a younger age of smoking initiation had lower confidence in their self-efficacy for being able to quit smoking, and less interest in quitting smoking, with these beliefs persisted well into adulthood. Furthermore, a strong relationship between age of smoking initiation and smoking in the social environment (e.g., smoking among friends and smoking among coworkers) has been found, with individuals with earlier ages of smoking initiation reported a larger prevalence of smokers in the social environment (Landon et al., 1999). Chen & Millar (1998) found that when smoking began in early adolescence, adults had a lower cumulative probability of smoking cessation and greater daily cigarette consumption. Furthermore, contrary to what is often thought, symptoms of physical dependence on nicotine often appear when adolescents are only smoking a few cigarettes per month, with physical dependence as an earlier part of the addictive cycle. Nicotine addiction often begins during adolescence and persists into adulthood (DiFranza, 2015).

While exploring the impact of age at initiation of smoking in the U.S., Choi and Stommel (2016; 2017) found that early smoking initiation increases risks for smoking-related illnesses (e.g., cardiovascular/metabolic (OR=1.67), pulmonary (OR=1.79) diseases, and smoking-related cancers (OR=2.1) for current smokers) and mortality. They also found that early smoking initiation was more predominant among adolescents in families with less educational achievement (e.g., less than a high school education) and low socioeconomic backgrounds (Choi & Stommel, 2016; 2017). Korean researchers looking at adolescent smoking behaviors found a strong correlation between earlier ages at smoking initiation in adolescence and subsequent

adolescent smoking levels. They found that adolescents that started smoking at an earlier age progressed to more frequent and heavier smokers than adolescents that began smoking when they were older (Hwang & Park, 2014).

Previous research has shown that early age initiation of cigarette smoking is a predictor of future substance abuse, which is another example of the crossover between individual level variables. A study explored the relationship between age-at-initiation of regular smoking and age-at-initiation of substance use and determined “that for every 12-month increase in the age-at-initiation of regular cigarette smoking, the age-at-initiation increased for marijuana by two months (RR=0.17, 95% CI=0.13-0.21), for cocaine by 1.7 months (RR=0.15, 95% CI=0.09-0.19) and methamphetamine by 2.3 months (RR=0.20, 95% CI=0.09-0.29)” though no significant association was found for age-at-initiation for heroin use (Pradhan & Shaya, 2018, p. s237). The aforementioned study showed that an increase in age at smoking initiation is associated with an increase in age-at-initiation for several illicit substances underscoring the importance of intervention efforts targeting adolescent smoking initiation (Pradhan & Shaya, 2018). Another study used data from the National Longitudinal Study of Adolescent to Adult Health (Add Health) in the US and investigated the relationship between adolescent marijuana use and subsequent tobacco use. The authors found an association between adolescent marijuana use and later daily smoking among women, with findings that indicated that women who used marijuana in adolescence were at 1.71 times increased risk of initiation to daily smoking by the age 29-31 (Nguyen, Ebnesajjad, Stuart, Kennedy, & Johnson, 2019).

#### **Presence of a substance use disorder.**

The presence of a substance use disorder (SUD) is another crucial individual level variable related to smoking. In 2015, the National Survey on Drug Use and Health found that

approximately 27.1 million adults 12 years of age and older reported the current use of an illicit substance. Additionally, 20.8 million adults met the criteria for a SUD, and over 21.7 million reported needing treatment for a SUD. Among addiction treatment clients, smoking rates are 3-4 times higher than those of the general population (Pagano, Tajima, & Guydish, 2016).

Furthermore, about 70-80% of individuals in treatment for SUDs smoke which is much higher than the 16.3% of individuals in the general adult population, and though smoking rates among individuals in the general population have decreased over recent decades, smoking rates among individuals in SUD treatment have stayed consistent (Knudsen, 2017; SAMHSA, 2019a).

A survey of 1,153 patients enrolled in addictions treatment across the United States found that 77.5% of the sample reported smoking cigarettes, 26.6% smoking e-cigarettes, 15.4% little filtered cigars or cigarillos, 11.4% smokeless tobacco, and 8.4 % smoking cigars, which was consistent with other studies (Campbell, Le, Gubner, & Guydish, 2019). Despite the high prevalence rate of individuals in addiction treatment that smoke, only about one-third of addictions treatment programs have instituted smoke-free policies, and only about 30 to 50% of treatment programs reported providing smoking cessation counseling services to patients (SAMHSA, 2019b; Knudsen, 2017). The belief that quitting smoking will interfere with substance use disorder recovery and abstinence has dissuaded some patients from quitting, especially as staff and patients often perceive tobacco as less harmful than alcohol and other drugs (González-Roz et al., 2019).

### **Number of quit attempts.**

The number of quit attempts an individual has in the last year was the outcome variable investigated in this study. The number of quit attempts in a given year is an important individual variable that has been related to smoking behaviors. Relapse following a smoking cessation

attempt is quite common. In fact, as many as 94% of smokers that quit for at least one day return to smoking within months (CDC, 2011; McCarthy, Ebssa, Witkiewitz, & Schiffman, 2015). In previous studies, the number of past quit attempts has been shown to increase odds of an individual's initial success in smoking cessation (Garey et al., 2019; McCarthy et al., 2015). Interestingly, research has shown that a higher motivation to quit is also predictive of number of quit attempts, but not necessarily predictive of maintenance or continued abstinence from smoking, indicating that an individual may need to be more than just motivated to quit to be successful in their smoking cessation efforts (Borland et al., 2010).

Previous research has indicated that understanding an individual's smoking cessation history may be used as a way of predicting future cessation efforts, though not necessarily as an indicator of future sustained smoking cessation success. Furthermore, for some individuals, repeated failures to maintain abstinence from cigarettes may be related to the difficulty of quitting smoking for that individual based on differences in physiological responses or issues related to a person's capacity for self-regulation (Partos, Borland, Yong, Hyland, & Cummings, 2013). Partos et al. (2013) suggested that repeated failures at quitting smoking may also be due to a reduction in feelings of self-efficacy due to multiple failed attempts as well as self-regulatory or cessation fatigue. These ideas as to why some individuals have a greater number of quit attempts than others were the basis for their study, which determined that the more attempts at smoking cessation an individual makes, the more likely that they are to make subsequent quit attempts. Additionally, the authors found that a failed quit attempt within the last year or two was associated with a significant reduction in the likelihood of achieving sustained abstinence when compare with someone who had never tried to quit smoking. These results were consistent even when adjusting for measures of nicotine addictions, quit method, smoking cessation

pharmacotherapy, and self-efficacy (Partos et al., 2013). In other words, Partos et al. (2013) found that although the likelihood that an individual would make another quit attempt increased with additional quit attempts, failed quit attempts were actually associated with a significant reduction in a person being able to maintain abstinence after quitting. These results highlight the importance of understanding what variables influence the relationship between an individual's level of addiction to nicotine and their number of quit attempts.

The SEM allows for understanding the complex relationships between the different levels of influence, as well as the different variables investigated. Using the SEM in this study highlighted the different interactions within the individual level variables. For example, there is a positive relationship between problematic substance use and unemployment (Compton, Gfroerer, Conway, & Finger, 2014; Henkel, 2011). A relationship between age at initiation of smoking and substance misuse and vice-versa has been observed (Nguyen et al., 2019; Pradhan & Shaya, 2018). Additionally, the relationships between several individual variables have been previously explored, with unemployed individuals more likely to be smokers, have a SUD, and engage in risky patterns of alcohol use. There is a cyclical relationship between substance use and unemployment in that unemployment is a significant risk factor for substance use and the development of SUDs. Additionally, problematic substance use increases the likelihood of unemployment and the difficulty of finding and maintaining a job (Henkel, 2011). Furthermore, individual and relationship level variables are related. For example, quitting alcohol intake was positively associated with smoking cessation, whereas separation from a spouse was negatively associated with smoking cessation (Oshio, 2018). Many interactions may be found within and between the different levels of influence.

## **Relationship Level of the Social Ecological Model**

McLeroy's SEM encourages the researcher to broaden the scope of investigations from individual characteristics to the relationships influencing personal health behaviors. The second level of the SEM explores relationships that may increase the risk of cigarette smoking and addiction. Individuals are influenced by their relationships with their friends and family, and these relationships contribute to personal behaviors and perceptions of use. The relationship vector of the social ecological model includes interpersonal social networks and support systems that can influence individual behaviors, including family, friends, peers, healthcare team members, and co-workers (McLeroy et al., 1988; CDC, 2019b). The relationship level variable that was analyzed in the current study is whether the individual lives with a smoker.

### **Living with other smokers.**

The presence of other smokers in an individual's home is an important relationship level variable. Previous research has shown that an individual's relationship and immediate social environment can have a strong impact on their smoking behaviors. For example, a higher proportion of smokers in an individual's immediate social environment, like one's home, was negatively associated with long term abstinence (Van den Brand et al., 2019). As people commonly live with their partners, exploring how partners' health behaviors influence one another is an important part of this variable. Long term quit success was negatively associated with having a partner who smokes, used to smoke, or no partner when compared to having a non-smoking partner (Van den Brand et al., 2019). The influence of the partner relationship is further supported by research related to how an individual's partner can both positively and negatively shape health behaviors. For example, Margolis and Wright (2015) found that partners who quit smoking at the same time had the highest probabilities of smoking cessation. Mai, Ho,

Wang, Ho, and Lam (2018) studied influences on smoking behaviors in Chinese adults and found that living with a smoker was significantly associated with lower odds of intention to quit in smokers and smoking cessation, especially if there was smoking inside the home. The relationships present in the home, and smoking status of the individuals within the home, can influence smoking behaviors for all household members, even adolescents raised in a home with smokers.

Research related to smoking in young adults found that being exposed to smoke at home and in cars for nonsmokers was associated with smoking initiation (Kalkhoran, Neilands, & Ling, 2013). Quit attempts in adolescents have been shown to be most prevalent in the absence of smoking family members. Furthermore, simply living with family members who smoke, without exposure to secondhand smoke in the home, has predicted significantly lower odds of successful quit attempts in adolescent smokers (Wang, Ho, Lo, & Lam, 2013). An adolescent's smoking behavior can also positively be influenced by those they live with, including a parent's smoking cessation. A study looking at the long-term prospective relationship between parents' smoking cessation and their young adult children's smoking cessation collected data on parents' smoking status when children were aged 8 and 17 years of age, as well as children's smoking status at 17 and 28 years of age. The authors found that parents' early smoking cessation was associated with their young adult children's smoking cessation, and this link remains significant by the time the children reached the age of 28 (Bricker, Otten, Liu, & Peterson, 2009). These studies may indicate that having family members who smoke, especially parents, may have a role-modeling effect on adolescents. This role modeling effect is further supported by research showing associations with lower smoking initiation rates and higher cessations rates in homes that have smoking restrictions in place that are reinforcing anti-smoking beliefs of non-smoking

parents since the associations were less clear in homes with at least one smoking parent or adult (Emory, Saquib, Gilpin, & Pierce, 2010). Additionally, living in a home with a total smoking ban has shown to reduce smoking and increased quitting attempts in smokers when compared to living in a home with no ban (Zablocki et al., 2014). This previous research indicates that exposure to smoking influences an individual's smoking behaviors.

Research conducted on secondhand smoke exposure (i.e., exposure to smoke from burning tobacco products such as cigarettes) also supports the idea that exposure to other smokers who are smoking in an individual's home can influence that individual's personal smoking behaviors. Research has shown that individuals exposed to secondhand smoking were less likely to quit smoking and individuals not exposed to secondhand smoke were also less likely to be smokers in the first place (Yan et al., 2015). Yang et al. (2015) found that secondhand smoke exposure increased the odds of smoking initiation 1.91 times. The majority of studies in a review of 35 studies on secondhand smoke found that exposure to second-hand smoke was associated with the greater likelihood of initiating smoking and being a smoker, as well as poorer smoking cessation outcomes (Okoli & Kodet, 2015).

Individuals' most primary source of social support is with whom they live. Indeed, social support is often a predictor of smoking cessation success. For example, having children in the household is positively and significantly associated with increases in quitting attempts, but has an inverse relationship with quitting success. This relationship suggests the importance of addressing relationships in the home and potentially providing additional support to individuals that may be highly motivated to quit but have difficulty maintaining the changes in behavior at home (Zhao, Borrego, Raisch, Bakhireva, & Georgopoulos, 2013). Relational factors are often integral to smoking cessation success. These factors include the help and support of family and

friends, family members urging the smoker to quit or enforcing a home ban on smoking, and a close family member or friend quitting smoking themselves (Henry, Gettens, Savageau, Cullen, & Landau, 2017; Buczkowski, Marcinowicz, Czachowski, & Piszczek, & 2014; Christakis & Fowler, 2008).

### **Community Level of the Social Ecological Model**

Community related characteristics that influence cigarette smoking include understanding the influence of workplace, school, and neighborhoods on smoking behaviors. Exploring the variables of the community level of influence helps identify characteristics of the community that are associated with perpetuating smoking behaviors, and involves settings and institutions like schools, workplaces, and neighborhoods in which social relationships take place.

Community level variables have been established and include personal environment and social norms related to smoking behaviors. The current study explored whether participants work in a smoke-free environment as the community level of influence variable analyzed in this study.

#### **Working in a smoke-free environment.**

Working in a smoke-free environment is an important community level variable. Smoke-free workplaces are associated with lower cigarette consumption among smokers and a reduction in prevalence rates of smokers in these environments (Fichtenberg & Glantz, 2002). An individual's perception of community level norms may be influenced by local tobacco control policies, such as workplace and restaurant smoking bans because people will observe fewer people smoking or regard a local "no smoking" sign as an indicator of community disapproval for the behavior (Zablocki et al., 2014). For example, a study of current and former smokers employed in smoke-free hospitals was compared with current and former workers employed at non-smoke free workplaces. The results of the study indicated that employees in workplaces with

smoking bans have higher smoking cessation rates than employees where smoking is allowed, though smoking relapse is similar among both groups of employees (Longo, Johnson, Kruse, Brownson, & Hewett, 2001). Additional investigations into workplace environments with total smoke-free policies found reductions in smoking prevalence, and fewer cigarettes per day smoked, with an overall relative reduction of 29%. The authors in this 2002 article reported that in order to achieve similar relative reductions in smoking to workplaces with total smoke-free policies, the taxes on a pack of cigarettes would need to increase from \$0.76 to \$3.05 in the US (Fichtenberg, & Glantz, 2002). These smoke-free policies most likely influence social norms and are the cause of smoking behavior change through the community level social interactions at work. Not only do workplace smoking policies influence smoking prevalence and consumption, but also these bans affect exposure to secondhand smoke.

Secondhand smoke is often found at workplaces with lower-income positions and in environments that are not covered by typical local legislation related to smoking bans (Holmes & Ling, 2017). Researchers investigating smoking in San Francisco's Bay area found that, despite California's indoor air policy and Smoke-free Workplace policy of 1994, 33% of young adults in that area reported exposure to secondhand smoke while at work. The individuals working in lower-income positions and non-office environments like maintenance, construction, and transportation, experienced the greatest exposure to secondhand smoke at work, often in areas or workplace environment exempt from the indoor air policy. Authors suggested that more comprehensive workplace smoking ban coverage is needed to mitigate the harms of work environments where secondhand smoke exposure occurs. This exposure at work may cause reductions in worker's number of quit attempts and increases in disease risks as a consequence of secondhand smoke exposure (Holmes & Ling, 2017). Smoke-free policies in the workplace

influence exposure to secondhand smoke and the perpetuation of smoking behaviors within the community level of influence.

Further underscoring the importance of community levels of influence on smoking behaviors, researchers have investigated how social norms established within social networks can influence smoking behaviors. Christakis and Fowler (2008) examined the patterns of repeated smoking behavior and social-network ties of a densely connected network of 12,067 individuals over 32 years and found that “Smoking behavior spreads through close and distant social ties, groups of interconnected people stop smoking in concert, and smokers are increasingly marginalized socially” (p. 2249). Thus, highlighting a potential network phenomenon in smoking cessation with social norms augmenting an individual’s decision to quit. These findings may indicate that collective, community level interventions may be more effective than individual interventions and underscore the importance of understanding smoking behaviors at the community level of influence (Christakis & Fowler, 2008).

### **Societal Level of the Social Ecological Model**

Societal levels of influence include the consideration of local legislation related to smoking behavior and programs offered for smoking cessation. In general, this level of the SEM is related to broad societal factors such as policies related to health, the economy, educational systems, and social norms. These policies can shape smoking behaviors by either encouraging or inhibiting these behaviors (CDC, 2019b). For example, statewide legislation to require smoke-free workplaces or taxation of cigarette products would be considered factors related to the societal level of the SEM. As noted above, societal level variables were not be examined in this study. However, this level of influence is explained below to provide an understanding of this final level of the SEM.

There are societal variables, including local, state, and national laws, policies, and social norms that impact smoking-related behaviors. Policies related to access to healthcare services and laws restricting the use and purchase of cigarettes are part of this societal domain. Societal factors like social norms and values also play an important role in the behavioral choices' individuals make. Positive influences on social norms and values can occur through effective health promotion and marketing strategies, and conversely, negative influences like social stigma and targeted marketing can be detrimental at the societal level.

An example of a societal level policy that influences smoking behaviors can be found in differences in local legislation in different regions of California. Research conducted in California found that smokers living in areas with a complete or partial city ban on smokers had a higher reduction in cigarette consumption and quit attempts when compared with smokers that did not report living in a city with a smoking ban. The authors found that the “odds of reduction in cigarette consumption was 1.7 times (OR=1.7, 95% CI=1.02–2.7) higher and the odds of quit attempt was 1.8 times (OR=1.8, 95% CI=1.05–2.9) higher among smokers reporting complete/partial city bans versus smokers not reporting such a ban.” (Zablocki et al., 2014, p. 75).

Another example of a societal level policy that has influenced and shaped smoking behaviors was observed after changes to healthcare policy was implemented in Massachusetts. Researchers investigating the effects of the Massachusetts Medicaid program MassHealth offering tobacco cessation treatment to enrollees found a reduction in smoking rates. The increased access to tobacco cessation treatment in this population may have helped to reduce smoking rates among enrollees, which is significant as the smoking rate in non-elderly Medicaid enrollees is more than double the rate for those with private insurance. Although a significant

number of individuals quit smoking after coverage for tobacco cessation treatment was offered, the majority of individuals surveyed in this study still smoked, indicating that access to smoking cessation benefits alone is not enough to help people quit smoking (Henry et al., 2017). Several proven population-based interventions have helped to reduce cigarette smoking, including tobacco price increases, unfettered access to tobacco cessation counseling and medications, and comprehensive smoke-free laws (CDC, 2018, January).

A final example of how societal level federal tax policies and laws have influenced individual smoking behaviors is with the US cigarette taxes. The federal government in the US raised the cigarette tax from \$ 0.39 to \$ 1.01 per pack in 2009. Hasselt et al. (2015) utilized data from the 2002-2011 National Survey on Drug Use and Health (NSDUH) and found that the 2009 federal cigarette tax increase was associated in a considerable reduction of smoking behaviors among youth and young adults, with individuals reducing their average days smoked and cigarettes smoked per day after the federal tax increase. Moreover, the authors found a reduction in overall smoking initiation among youth (12-17 years of age) though not among young adults (18-25 years of age). Interestingly, though the authors observed overall changes in smoking behaviors, there were variations in the strength of associations between smoking outcomes and the tax increase by sex, age, and race. Specifically, the authors did not find associations between the tax increase and any smoking outcome for black youth, and the only significant association for black young adults was days smoked per month. The likelihood of smoking initiation, however, decreased significantly for male, female, and white youth, and among white young adults after the implementation of the tax increase (Hasselt et al., 2015). This study shows that societal level changes can have a major influence on smoking behaviors, including smoking initiation among youth and overall smoking rates among individuals aged 12-25 years old.

Federal legislation and tax policies are societal level interventions that have been shown to influence smoking behaviors for individuals, much like health promotion strategies and social norms and stigmas.

Influences on social norms can occur through positive, effective health promotion strategies, while social norms can also be damaged by stigmatizing beliefs about marginalized populations, which can lead to detrimental practices at the societal level (e.g., lack of treatment options for individuals with mental health disorders or SUDs). For instance, effective health promotion practices like some carried out by the Food and Drug Administration (FDA) can cause positive societal level shifts in smoking behaviors. With the help of the Tobacco Control Act of 2009, the FDA has been able to research newer tobacco products, take steps to decrease the sale of tobacco products to children, and also have the resources to conduct public education campaigns about the harms of tobacco products (Gottlieb & Zeller, 2017). Furthermore, negative influences like the absence of specialized treatment approaches for specific high-risk, marginalized populations can also impact smoking behaviors at the societal level. For example, there is an absence of population-specific pharmacological treatment approaches for individuals with a history of a SUD or diagnosed mental health diagnosis. Research on smoking cessation efforts related to mental health suggests that societal level tobacco control policies and smoking cessation interventions designed to target the general population have not worked as effectively for those individuals with mental health disorders (Cook et al., 2014). These societal level variables can have far-reaching consequences for individual smoking behaviors.

### **Conclusion and Summary**

Despite prevention efforts, tobacco and smoking-related illness and injury continues to be a leading cause of death and disability in the United States (Golechha, 2016; CDC, 2019a).

Though there have been declines in overall smoking rates over the last 20 years, there remains a large proportion of the population still smoking (CDC, 2018, January). Current interventions for smoking cessation often fall short, especially for certain individuals and special populations. With the growing prevalence of premature death and disability due to addictions, specifically cigarette smoking, alternative frameworks for conceptualizing treatment are necessary. Cigarette smoking and addiction to nicotine is a complex behavior, and as such, it requires complex solutions. A more intricate understanding of the behavior is required.

This study seeks to do this by attempting to understand cigarette smoking through the SEM framework. Smoking behaviors exist within a complex social ecological system. The SEM provides a framework for understanding the variety of factors that put people at risk for smoking behaviors and addictions. The SEM helps us understand the individual, relationship, community, and societal levels of influence (McLeroy et al., 1988). Through the delineation of the SEM and the variables chosen, the current study recognizes the influence of numerous factors on the relationship between an individual's level of addiction to nicotine and their number of quit attempts in the last year, which can impact an individual's responses to treatment. This study aims to explore the mediating and moderating effects of specific individual, relationship, and community variables on the relationship between an individual's level of addiction to nicotine and their number of quit attempts in the last 12 months. The results of this study may allow us to tailor treatment approaches and intervention strategies for smoking behaviors. Mediation and moderation analyses are powerful tools used in research in prevention and treatment. The understanding of variables that mediate or moderate a variable such as the level of addiction's effect on outcomes like quit attempts can provide a great deal of vital information to guide policy and treatment approaches (Roberts, Scammacca, & Roberts, 2018). As cigarette smoking is a

complex behavior, it requires a complex framework and analysis through which to understand better and address the behavior.

The different levels of influence that comprise the SEM are vital to understanding major health-related behaviors like addiction and smoking. This chapter sought to synthesize the information for each of the four levels of influence as it relates to smoking behaviors. Smoking behavior research and information for each of the variables investigated in this current study were presented as well as information about influencing variables at the societal level of the SEM. Variables at the societal level of influence were not analyzed in this study, though the information was provided in this study about potential influencing variables at this level of the SEM. This chapter seeks to explore and synthesize the literature related to each of the four levels of influence contained in the CDC's SEM of health behaviors: the individual, relationship, community, and societal level of influence (CDC, 2019b).

## **CHAPTER III: METHODS**

### **Introduction**

This chapter provides an overview of the methods used to investigate the multiple levels of influence (individual, relationship, community, and societal) on cigarette smoking and addiction to nicotine in cigarettes. Specifically, this study explored six variables that mediated or moderated the relationship between the participant's level of addiction to nicotine, or score on the Fagerström Test of Nicotine Dependence (FTND) and their number of unsuccessful smoking cessation attempts in the last year. In this study, the independent variable is the level of addiction to nicotine and the dependent variable is the number of quit attempts. The current study included five moderating variables: employment status, smoking initiation, history of a SUD, living with a smoker, working in a smoke-free environment and one mediating variable: mental health disorder status. This chapter includes the primary research questions, sample, research design, instrumentation, statistical analysis, and procedures. The chapter concludes with a discussion of the ethical considerations and limitations of the study.

### **Research Questions**

1. Do psychosocial environmental variables influence the relationship between participants' level of addiction and their number of quit attempts?
  - a. Does mental health disorder status mediate the relationship between participants' level of addiction and their number of quit attempts?
  - b. Does employment status moderate the relationship between participants' level of addiction and their number of quit attempts?
  - c. Does age at smoking initiation moderate the relationship between participants' level of addiction and their number of quit attempts?

- d. Does a history of a Substance Use Disorder (SUD) moderate the relationship between participants' level of addiction and their number of quit attempts?
- e. Does living with a smoker moderate the relationship between participants' level of addiction and their number of quit attempts?
- f. Does working in a smoke-free environment moderate the relationship between participants' level of addiction and their number of quit attempts?

### **Research Design**

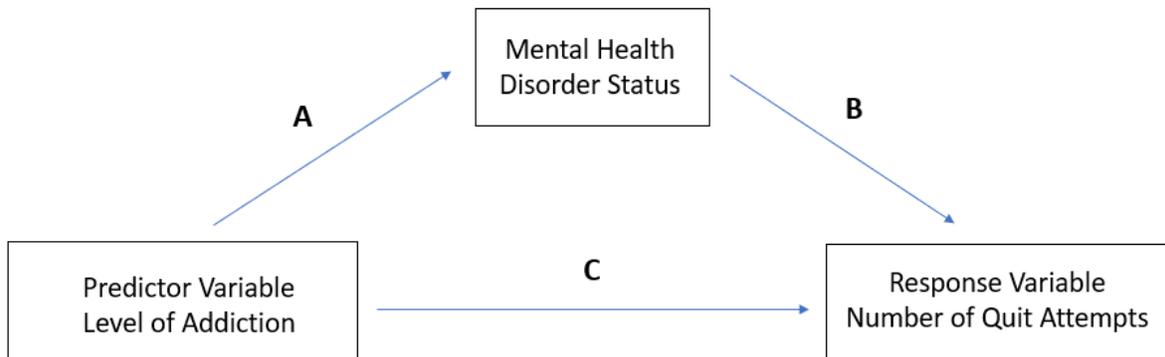
The current study used survey methodology to explore the relationships between specific variables collected from a group of individuals who identified as current cigarette smokers in eastern North Carolina at the time of data collection. The study was conducted using a secondary dataset of self-reported demographics, smoking-related behaviors and beliefs, environmental variables, and the status of participants mental health disorder status and SUD treatment history. Specifically, this study was interested in determining whether specific psychosocial-environmental variables moderate or mediate the relationship between a participants' level of addiction to nicotine and their number of attempts at smoking cessation through the framework of the Social Ecological Model (SEM) of health behaviors. The current study is using the SEM as adapted by the Center for Disease Control (CDC) for violence prevention (CDC, 2019) and includes the analysis of variables associated with three levels of influence contained in the SEM: the individual, relationship, and community levels of influence. The variables associated with the societal level of influence were discussed in detail in chapter two and were not be included in the statistical analysis. The individual variables analyzed in the current study included (1) level of addiction to nicotine, (2) the presence of a mental health disorder, (3) employment status, (4) age at smoking initiation, (5) history of a SUD, and (6) number of quit attempts in the last 12 months

(i.e., number of smoking cessation efforts). The relationship level factor that analyzed in the current study is whether the individual lives with a smoker. Community level variables include personal environment and social norms related to smoking behaviors, specifically working, or not working in a smoke-free environment. Mediation and moderation analyses were conducted utilizing level of addiction to nicotine as the predictor or independent variable and number of quit attempts in the last 12 months as the outcome or dependent variable. In this study, mediation analysis was conducted to determine if the following variable mediates the relationship between the independent and the dependent variables:

(1.a) Mental health disorder status

**Figure 9**

*Mediation Model for Mental Health Disorder Status*

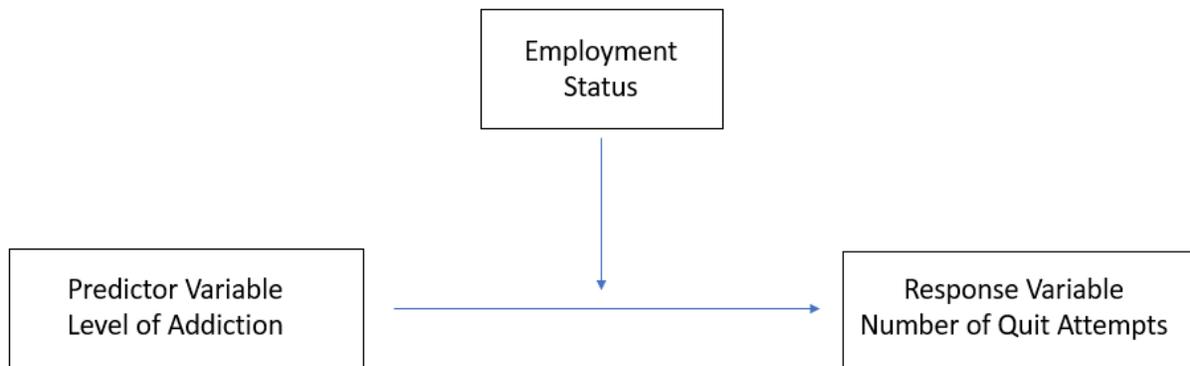


Additionally, a moderation analysis was conducted to determine if the following variables act as moderators between the independent and dependent variables:

(1.b) employment status,

**Figure 10**

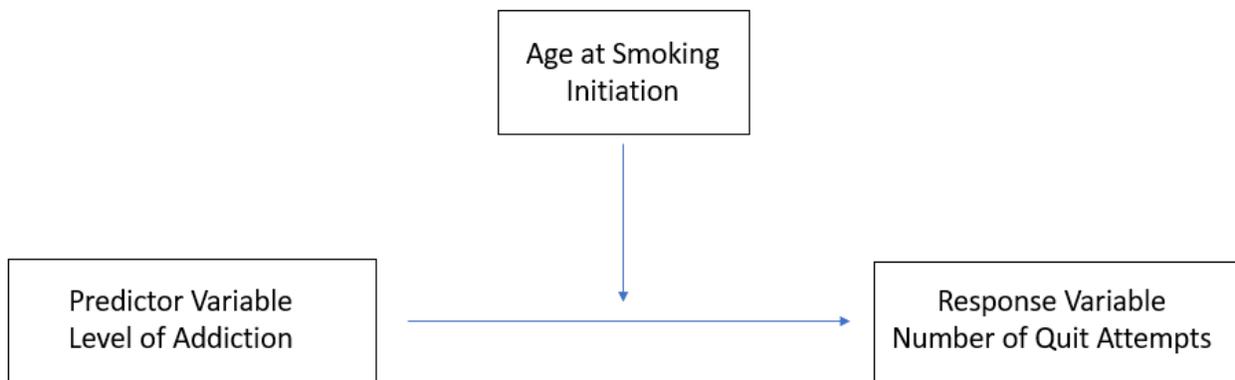
*Moderation Model for Employment Status*



(1.c) age at smoking initiation,

**Figure 11**

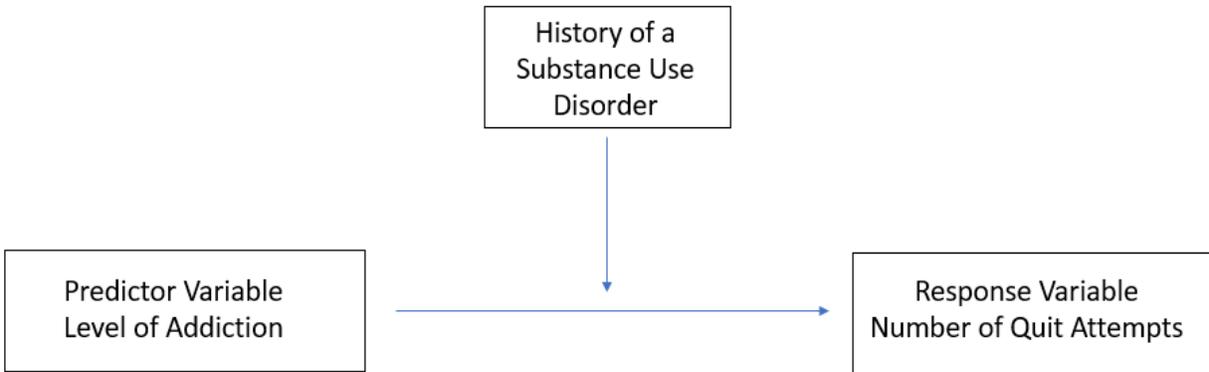
*Moderation Model for Age at Smoking Initiation*



(1.d) history of a substance use disorder,

**Figure 12**

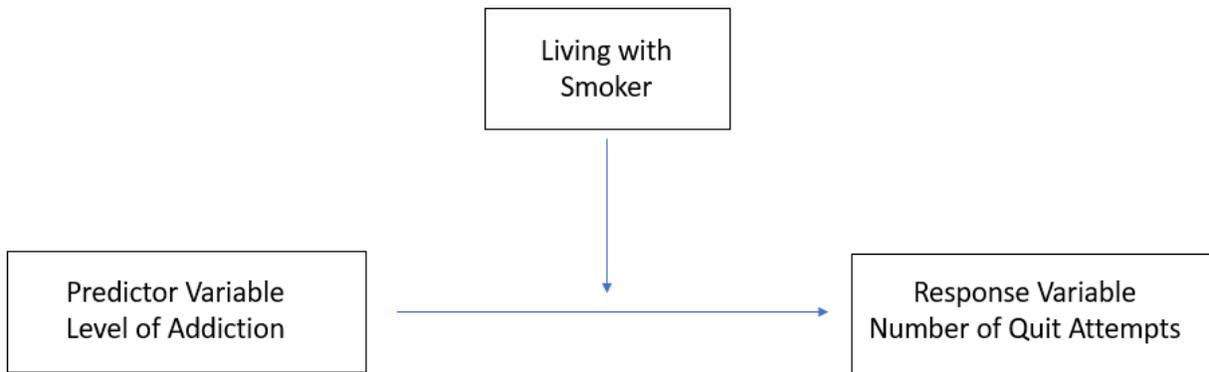
*Moderation Model for History of a Substance Use Disorder*



(1.e) whether the individual lives with a smoker, and

**Figure 13**

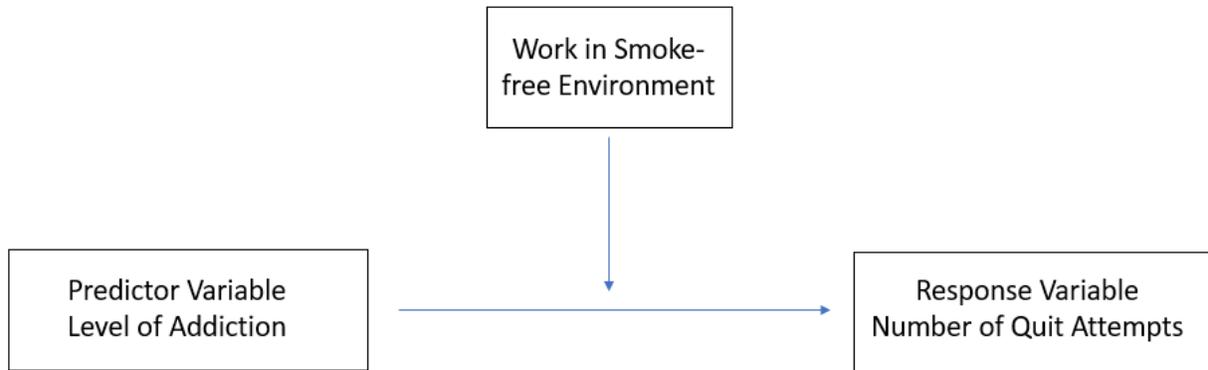
*Moderation Model for Living with a Smoker*



(1.f) whether the individual works in a smoke-free environment.

**Figure 14**

*Moderation Model for Working in a Smoke-free Environment*



**Sample and Sampling**

Participants were recruited from the Department of Psychiatry and Behavioral Medicine clinic, Family Medicine clinic, and on the campus of East Carolina University. Interested parties were required to be at least 18 years of age and current smokers (having smoked at least one cigarette a week). The contact information was collected via a standard contact form created for the study. Interested parties were contacted via phone by study staff at the Department of Psychiatry and Behavioral Medicine. On the phone, an initial screening interview was conducted after a member of the study staff provided basic information about the premise of the study and the research aims. The screening interview consisted of a series of screening questions used to determine whether a client was appropriate for the study and met all eligibility criteria. If an individual met all criteria, further information regarding the study visit was provided, and a study visit was scheduled.

The sample consisted of approximately 150 participants from eastern North Carolina. Study inclusion criterion included participants were required to be current cigarette smokers, with an average of at least one cigarette per day smoked over the past 30 days. The sample consisted of African American, Mexican American, or Chicano, individuals with multiple

ethnicities, and white individuals that were at least 18 years of age. Participants provided their average daily cigarette consumption and, based on this report, were placed into one of three categories: less than 15 cigarettes per day, 15-25 cigarettes per day, or greater than 25 cigarettes per day. These categories are associated with light, moderate, and heavy smoking behaviors. Participants were ineligible for participation in the study if they: were currently using a Monoamine oxidase inhibitors (MAOI) or tricyclic antidepressant, used marijuana or any illicit substance (illegal in the state of NC) in the last 30 days, were currently using smoking cessation pharmacotherapy or current smoking treatment, had used an electronic cigarette or other non-cigarette tobacco products within the last 30 days, had their hair dyed or chemically treated in the last 30 days, were currently abusing alcohol or other substances (including prescriptions) that could interfere with the metabolism of nicotine, or were not current smokers. Many of the ineligibility requirements were related to medications and substances known to interfere with nicotine metabolism.

Participants were categorized by mental health status based on their response to the question, "Have you ever been diagnosed with a mental illness?" which was followed by two subsequent questions about their mental health diagnosis. The two follow up questions were as follows: "If yes, what is your primary mental health diagnosis for which you are receiving treatment?" and "Please list any secondary mental health diagnoses for which you are receiving treatment." To increase validity for this variable, participants were screened on the phone as to whether they were currently receiving treatment for a mental health disorder. This screening question was reaffirmed during the study visit by the research assistant. The mental health disorder sample consisted of individuals that were currently receiving treatment for a mental health disorder and currently using medication for psychiatric illness, while the no mental illness

sample was required to have no reported history of a mental health diagnosis during their lifetime and no history of use of psychiatric medications. The screening of these two groups was initially conducted on the phone and then reaffirmed during the study visit.

Additionally, statistical power was estimated. In order to detect effective sizes, statistical power is estimated based on a general, though less robust, method. Green (1991) suggests that for regression analysis  $n > 50 + 8 * p$  (where  $p$  is the number of predictors) for testing the multiple correlation can be used. With a sample of  $n=150$ , it was determined that there should be sufficient power to include up to 25 predictors ( $50+8*p=50+8*25=250$ ) with a medium-sized relationship. In all but one of the models used in the current study the sample size was  $n=150$ . The model for working in a smoke-free environment had a sample size  $n=62$  because only 62 employed participants took part in the study. Smaller relationships could be detected with fewer covariates in the models chosen. Since smaller relationships are detected with fewer covariates in each model, each model was explored separately in this study. Therefore, one separate step by step mediation analysis was conducted, and five separate moderation analyses were performed.

### **Archival Data Collection Procedures**

This section outlines the archival data collection procedures used for the current study examining the psychosocial-environmental variables that influence the relationship between level of addiction to nicotine and smoking cessation attempts. Participants were recruited from the East Carolina University (ECU) Department of Psychiatry and Behavioral Medicine Clinic, the ECU Family Medicine Clinic, and on the campus of ECU. The recruited participants filled out an IRB approved contact form providing their contact information to study staff. Study staff contacted potential participants and completed a screening questionnaire during the phone conversation. Based on the response to the screeners, participants were either scheduled for a

clinic visit, placed on a call list with details explaining the delay in scheduling or disqualified from participating in the study. Study visits were completed between September 2016 and February 2019. Participants included in the study were scheduled for a study visit conducted at the offices of the ECU Department of Psychiatry and Behavioral Medicine.

For each study visit, participants arrived at the psychiatry clinic and were greeted by a study member at the entrance to Psychiatry and Behavioral Medicine. Next, participants were asked to rinse their mouth with fresh water to prepare for the saliva bio sample collection. Participants were also asked to refrain from consuming any beverages during the study visit. After arriving in the designated study room, participants were provided with a detailed description of the study, and the informed consent document was reviewed in detail. After answering all potential questions, clients were then asked to complete a 72 item self-report questionnaire with questions related to demographics, smoking behaviors, level of addiction to cigarettes, self-efficacy related to smoking cessation, levels of motivations to quit smoking, perceptions of healthcare provider support, and history of substance use disorders and mental health diagnoses. If participants required any assistance with survey completion, including asking questions or technical support, the research assistant was there to provide the participant with assistance.

After the survey data collection, biospecimens were collected from each participant. The biospecimens collected for this study included a 5 mL saliva sample and a 50 mg hair sample. Each sample was labeled with the date, time, participant category (mental illness or no mental illness), participant sex, and category of cigarettes consumed per day (CPD; <15, 15-25, >25 CPD).

For the saliva sample, participants were allowed up to an hour to produce 5 mL of saliva in the container provided. If participants had trouble producing saliva, they were offered a small sheet of parafilm to chew to stimulate saliva production. The time of use for each piece of parafilm was noted on the biospecimen vial. Participants were not allowed to consume food or drink within 30 minutes of saliva collection and were asked to rinse their mouth with fresh water prior to the collection of the biospecimen. Saliva samples were stored at -40 degrees Celsius.

Hair was collected during the study as well. The use of chemicals or dyes in hair one month prior to the visit was prohibited and was part of the screening questionnaire. Participants that screened positively for chemical use in hair were not barred from the study, but rather offered to come in at a later date for a study visit if they committed to refraining from using chemicals in their hair for at least one month. For hair collection purposes, study staffed donned nitrile gloves and collected approximately 50 mg of hair from each participant. Hair was collected within one to two centimeters from the scalp. The location of hair on the scalp and distance from the scalp was recorded on the envelope. Each hair sample was placed in a lab designated envelope for storage.

Survey data was stored on a password-protected computer, and paper copies of forms, including the informed consent, were locked in an office drawer within a locked office.

### **Instrumentation**

The self-report data sample was collected from a group of volunteer subjects. The 72-item self-report questionnaire was developed on nicotine addiction and mental health treatment research and grounded in theory. For the purposes of this analysis, thirteen of the questions were used.

### **Level of Addiction to Nicotine (measured by the Fagerström Test for Nicotine Dependence)**

The self-report questionnaire used in the current study contained the six-item Fagerström Test for Nicotine Dependence (FTND), also called the Fagerström Test for Cigarette Dependence (Fagerström, 2012). The FTND is a standard instrument that was developed to assess the intensity of an individual's physical addiction to nicotine. The FTND is considered a gold standard measure to assess cigarette dependence (Svicher, Cosci, Gianni, Pistelli, & Fagerstrom, 2018). As perhaps the most widely used measure of nicotine dependence, the FTND is extensively used for studying the likelihood of smoking cessation as well as the genetic and epidemiological risk factors (Glasheen et al., 2018). The FTND provides an ordinal measure of nicotine dependence related to cigarette smoking and is composed of six items designed to evaluate the quantity of cigarette consumption, the compulsion to use, and dependence. Scores for the FTND are summed to yield a total score: with yes/no items scored zero and one respectively, and multiple-choice items scored from zero to three. The intensity of a patient's physical dependence on nicotine is based on the total Fagerström score, with a higher total indicating a greater intensity of physical dependence (Heatherton, et al., 1991; Pomerleau, Majchrezak, Pomerleau, 1989). The summed items yield a total score of zero through ten, with a higher total Fagerström score indicating a greater intensity of physical dependence on nicotine (Heatherton, et al., 1991). For the purposes of this test, the scores are the individual's composite score and range from zero to ten. Studies have shown that the FTND does not have strong psychometric properties despite the widespread use of the scale in research (Korte, Capron, Zvolensky, & Schmidt, 2013). Since the FTND is considered a gold standard to assess cigarette dependence and level of addiction to nicotine it was employed in this study.

The reliability of the FTND has been studied extensively as the measure serves as a common instrument used in nicotine research. A metaanalysis of the FTND looked at test re-test reliability of the FTND across a variety of types of participants and countries and found the reliability of the FTND to be anywhere from 0.65 (for smokers with schizophrenia; Weinberger et al. 2007) to 0.91 (in male former smokers; Meneses-Gaya, Zuardi, Loureiro, & Crippa, 2009; Vink et al., 2005). Additionally, Meneses-Gaya et al.'s (2009) metaanalysis identified 14 studies assessing the internal consistency of the FTND and found that the Cronbach's alpha coefficient ranged from 0.55 to 0.74, which is considered moderate internal consistency. Based on one week, test-retest intervals, a study of smokers with a diagnosis of post-traumatic stress disorder (PTSD) found that the FTND is stable (0.82) for smokers with psychiatric illness, supporting the potential reliability of the FTND with individuals with mental health disorders (Buckley et al., 2005).

The validity of the FTND has also been studied over the years. The FTND has been shown to predict smoking cessation attempts (Bobo, Lando, Walker, & McIlvain, 1996; Fagerstrom, Russ, Yu, Yunis, & Foulds, 2012; Pinto, Abrams, Monti & Jacobu, 1987). Meneses-Gaya and colleagues (2009) reviewed 26 studies in their metaanalysis and only found one study from Japan evaluating the sensitivity and specificity of the FTND. This study involved a set of patients with cancer and used the Diagnostic and Statistical Manual of Mental Disorders third edition. The authors found the FTND showed satisfactory sensitivity (0.75) and specificity (0.80) when the researchers used a cut-off score for nicotine dependence of 5/6, suggesting the FTND is valid for studying nicotine dependence in cancer patients (Mikami et al., 1999). Additionally, a study was conducted of smokers with PTSD which investigated the convergent validity of the FTND and found that the total FTND score significantly correlated  $r = 0.40$  ( $df = 74$ ;  $p < 0.01$ )

with baseline expired carbon monoxide levels and correlated  $r = 0.38$  ( $df = 74$ ;  $p < 0.01$ ) with the number of milligrams of nicotine consumed per day (Buckley et al., 2005).

### **Number of Quit Attempts in the Last Year**

The operational definition of the number of quit attempts in the last year for this study was based upon the answer to two questions related to cessation attempts in the last 12 months. The value used in this analysis was derived from the answer the participant reported for the following two questions: “Have you made a serious attempt to quit smoking in the last 12 months?” and “if yes how many times?” For the purposes of this study, the analysis focused on the number of times the individual indicated that they have made “a serious attempt to quit smoking in the last 12 months.” A serious quit was defined as having quit smoking for at least a 24-hour period. The initial yes/no question was used to verify that the two answers were in agreement. For example, if an individual provides an answer of one or greater for the number of quit attempts they have had in the last year, this was verified by the answer to previous yes/no question regarding whether they have made a quit attempt in the last 12 months. However, if an individual answered “no” to the question of whether they have made a serious quit attempt in the past 12 months, while also having an answer of one or greater for the number of quit attempts, the participant's response was excluded from the study.

The number of quit attempts has been shown to predict smoking cessation outcomes (Partos, Borland, Yong, Hyland, & Cummings, 2013; Garey. et al., 2019; McCarthy, Ebssa, Witkiewitz, & Schiffman, 2015). There are no psychometric properties for this measure as it is not a validated measure though it is used commonly in research and has been used in a multitude of other studies (Garey, et al., 2019; McCarthy et al., 2015; Partos et al., 2015). In the current

study, the number of quit attempts analyzed in the study was based on the number of quit attempts the participant indicated they had engaged in the last 12 months.

### **The Presence of a Mental Health Disorder**

The operational definition for the presence of a mental health disorder in this study is based on the parameters outlined in the sample and sampling section of this chapter. The presence of a mental health disorder was limited to individuals undergoing current treatment and taking psychiatric medications for a mental health disorder as diagnosed by a healthcare provider. The answer to this question was determined through questions during the screening phone call, confirmed at the study visit, and was also based on the answer to the following three questions: “Have you ever been diagnosed with a mental illness?,” “If yes, what is your primary mental health diagnosis for which you are receiving treatment?” and “Please list any secondary mental health diagnoses for which you are receiving treatment (check all that apply).”

This measure does not have psychometric properties as it is not a standardized measure, though it has been used in nicotine research. In previous research, the response to this question has been validated in a number of ways, which is why the study was designed in such a manner to determine participant eligibility and response for this variable (Dickerson, 2018; Kalkhoran, Thorndike, Rigotti, Fung, & Baggett, 2019; Sharma-Kumar, Meurk, Ford, Beere, & Gartner, 2018). Participant responses were corroborated through specific screener questions, and detailed eligibility criteria explained for each group during the screening process, verifying the information during screening with the participant during the study visit, and through the questions asked in the survey.

## **Employment Status**

The operational definition of employment status was based on the participant's response to the survey question, "Do you work?" Participants were provided with the following response options: Full-time, Part-time, unemployed, student, volunteer, and other. For the purposes of this study, full-time and part-time were considered an affirmative response to the question of whether the participant was employed at the time of taking the survey. Therefore, if a participant answered that they are unemployed, a student, or a volunteer, they were considered to be not currently working for the purposes of this study. The participants that answered other in the survey were required to provide information related to why they designated other as their employment status, and this category was considered on a case-by-case basis.

As this variable, employment status is not a standardized measure or questionnaire; there are no psychometric properties provided for this variable. Other studies have used employment status as a variable when looking at smoking behaviors (Barnes & Smith, 2009; Charles & DeCicca, 2008; Golden & Perreira, 2015; Jung, Oh, Huh, & Kawachi, 2013; Kalousova & Burgard, 2014; Lee, Crombie, Smith, & Tunstall-Pedoe, 1991).

## **Age at Smoking Initiation**

The operational definition for age at smoking initiation is the age in years that the participants provided for the following question "At what age did you start smoking cigarettes?" In the survey, participants were asked to provide their age in years when they began smoking.

There is no reliability or validity data for age at smoking initiation used in this analysis as it is not a measure with psychometric properties. The age at smoking initiation variable is used in this study as it is commonly used in research studying smoking and has been shown to be a

variable that influences smoking behaviors. (CDC, 2018; Chen & Millar, 1998; Choi & Stommel, 2016; 2017; DiFranza, 2015; Doubeni, Reed, & DiFranza, 2010; Landon et al., 1999.

### **History of a Substance Use Disorder (SUD)**

The operational definition of this variable is based on whether the participant indicated in their survey that they have a history of treatment for a SUD. Specifically, this variable is based on the response to the question, “Have you ever had treatment for a substance use disorder?” and was further validated by the participants response to, “If yes-please specify” Participants were required to answer an open-ended response if they answered yes to the first question.

There are no psychometric properties available for this variable though it is a variable that has been investigated in relation to smoking behaviors extensively in previous research (Forman-Hoffman, Hedden, Glasheen, Davies, & Colpe, 2016; Higgins et al., 2017; Weinberger, Funk, & Goodwin, 2016).

### **Living with other Smokers**

Participants answered a question related to living with other smokers during the survey. The operational definition for this variable is based on the presence of other smokers living in his or her home. The value of this variable is based on a Yes/No response to the question “Do other smokers live in the same house/apartment as you?” This variable also does not have any psychometric properties though it is a topic often used in smoking and nicotine research (Klein, Forster, Erickson, 2013; Mai, Ho, Wang, Ho, & Lam, 2018; Wang, Ho, Lo, & Lam, 2013).

### **Working in a Smoke-free Environment**

The operational definition of this question is whether the participant indicates that they work in a smoke-free environment. The value of this variable was determined based on the answer to the following question: “If you work, is your workplace smoke-free?” The answers

provided were yes, no, or not applicable. There are currently no psychometric properties available for this variable though it has been investigated in previous literature when researching smoking.

### **Statistical Analysis**

In the current study, the analysis focused on whether specific individual, relationship, and community level variables influence the relationship between participants' level of addiction to nicotine and their number of quit attempts in the last 12 months. Specifically, moderation and mediation analyses were used to explore whether individual, relationship, and community level factors influenced the relationship between participants' level of addiction to nicotine and their number of smoking cessation attempts in the last 12 months. Seven separate analyses based on two different models (mediation and moderation) were conducted in this study. These analyses were conducted separately due to the small sample size. In this section, a description of mediation, why mediation is used in this study, the series of steps required to complete the mediation analysis are described, a description of moderation, why moderation is used in this study, the use of a negative binomial regression model, and the assumptions needed for this statistical analysis are described.

Both moderation and mediation test the influence of a third variable on the relationship between X, the predictor variable, and Y, the outcome variable. Whereas mediation tests a hypothetical causal link or chain, potentially describing the how or why of the relationship between X and Y, moderation tests when or under what conditions an effect occurs or whether a moderator affects the direction and strength of the relationship between X and Y. Specifically, moderators can influence the relationship between X and Y in a few ways; it can strengthen, weaken, or reverse the nature of the relationship (Blair, 2020).

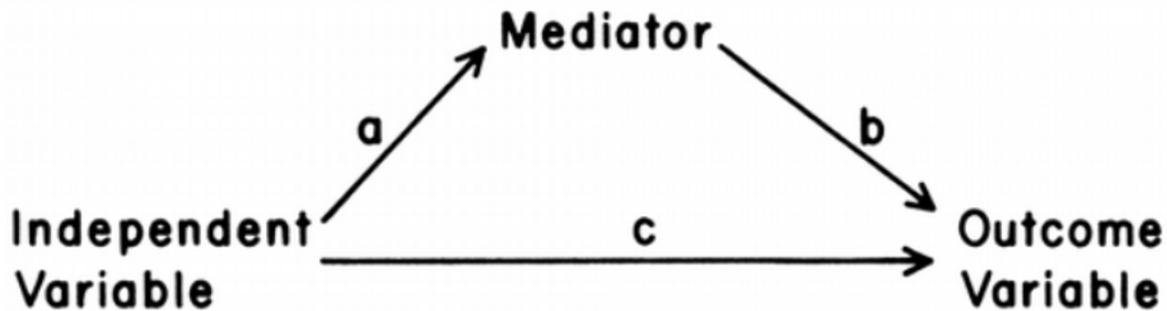
## **Mediation**

In the current study, negative binomial regression, a generalized linear model, was used for both mediation and moderation analyses. The reason for using negative binomial regression is covered in more detail in the following section. Negative binomial regression was used to explore whether participants' mental health diagnosis status acts as a mediator between the level of addiction to nicotine and the number of smoking cessation efforts in the last 12 months.

The use and importance of mediating variables has been established in psychology and social sciences in part due to Woodworth's (1929) Stimulus-Organism-Response (S-O-R) theory. The S-O-R theory, which has been around for almost a century, explains that the relationship between the stimulus and response (or behavior) is mediated by processes internal to the organism. This theory has been credited as a very general and basic formulation of a mediation hypothesis (Baron & Kenny, 1986). In this theory, the mediating mechanisms internal to an organism relate to how a stimulus results in a response (MacKinnon, Fairchild, & Fritz, 2007). An organism can mediate the effect of a stimulus on the response (Woodworth, 1928). Mediation is critical for applied research in prevention and treatment as the understanding of factors that mediate a variable such as a type of treatment's effect on outcomes can provide a great deal of vital information to policymakers and stakeholders (Roberts, Scammacca, & Roberts, 2018).

**Figure 15**

*Mediational Model (Baron & Kenny, 1986)*



Baron and Kenny (1986) explain:

A variable functions as a mediator when it meets the following conditions: (a) variations in levels of the independent variable significantly account for variations in the presumed mediator (i.e., Path *a*), (b) variations in the mediator significantly account for variations in the dependent variable (i.e., Path *b*), and (c) when Paths *a* and *b* are controlled, a previously significant relation between the independent and dependent variables is no longer significant, with the strongest demonstration of mediation occurring when Path *c* is zero. In regard to the last condition, we may envisage a continuum. When Path *c* is reduced to zero, we have strong evidence for a single, dominant mediator. If the residual Path *c* is not zero, this indicates the operation of multiple mediating factors. Because most areas of psychology, including social, treat phenomena that have multiple causes, a more realistic goal may be to seek mediators that significantly decrease Path *c* rather than eliminating the relation between the independent and dependent variables altogether. From a theoretical perspective, a substantive reduction demonstrates that a given mediator is indeed potent, albeit not both a necessary and a sufficient condition for an effect to occur. (p. 1176)

Barron and Kenny's (1986) model is used in this analysis as an initial investigation into the relationships among the variables explored in this study. There are more complex models for testing mediation that involve mediator confounder variables and account for other potential forms of bias in their design, but since this study was not designed specifically for mediation analysis and therefore the dataset itself is limited, a traditional approach to mediation analysis was used. The traditional approach to mediation analysis was used in the current study to explore the data though it is now recognized that Barron and Kenny's (1986) simplistic method of mediation analysis is prone to bias (Richiardi, Bellocco, & Zugna, 2013). This is further explained below.

### **Mediation and Moderation in the Current Study**

As mentioned previously, testing mediation is often used to understand the mechanism through which the causal variable influences the outcome. In the current study, the causal variable is the level of addiction to nicotine, and the outcome is the behavioral measure of the participants' number of quit attempts. Mediation and moderation analyses are considered integral components to *process analysis*, but as Kenny (2018) emphasized, a mediation analysis tends to be more powerful than moderation analyses. However, both mediation and moderation should be considered as each contributes to our understanding of a relationship. Additionally, some of the variables explored in this study are not appropriate for mediation analysis such as age at smoking initiation and are thus explored through a moderation analysis. Mediation analysis is based on a causal pathway between the independent, mediator, and the dependent variable, therefore a predictor variable cannot be a mediator. For example, a variable such as age at smoking initiation cannot be used since age at smoking initiation is a precursor to smoking and the individual's subsequent level addiction. In the analysis employed in the current study, a series of regression

models (detailed below) were used to determine whether mental health diagnosis status acts as a mediator of the relationship between level of addiction to nicotine and the number of quit attempts in the last twelve months.

The generalized linear regression model (specifically, the negative binomial model) uses a transformation of the expected number of counts called a link function to establish a linear relationship between the level of addiction to nicotine and number of quit attempts (McCullagh, 1992). Pearson's correlations of the continuous variables were run and scatterplots with the binary variables set as markers were also created to ascertain the presence of relationships between variables, including the independent and dependent variables (i.e., level of addiction to nicotine and number of quit attempts).

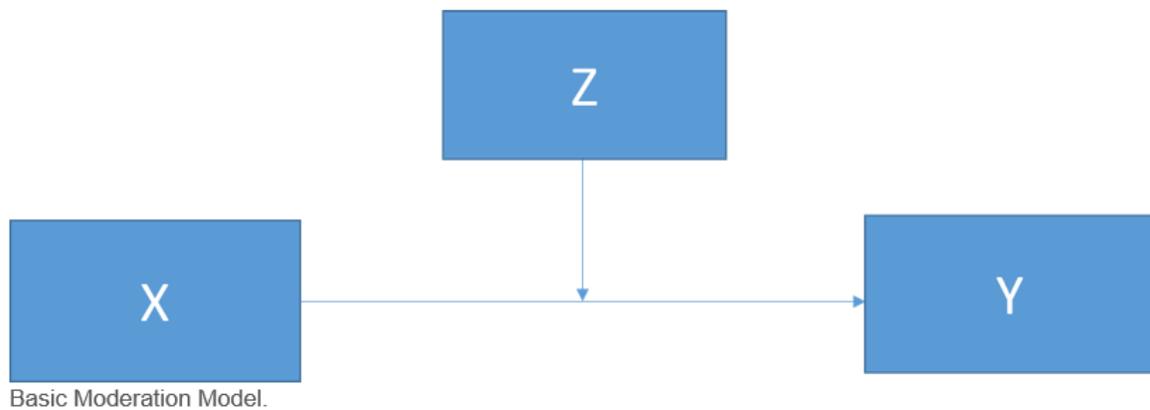
In the current study, the outcome variable is a count. Counts are discrete, not normally distributed, and do not typically meet the other assumptions of linear regression (Dettori & Norvell, 2018). Therefore, the generalized linear model was utilized and based on the negative binomial distribution for counts. Negative Binomial model of regression is more appropriate for use with over dispersed data than the Poisson model because the model is used for overdispersed counts (Hilbe, 2011). This model functioned in accordance with the outlined steps for mediation and moderation analysis below.

For the mediation analysis, the relationship between the predictor variable or X (level of addiction) to the outcome variable or Y (quit attempts) was examined first. The assessment of this relationship was the first step. Then a potential mediator or M (e.g., mental health status) was introduced. If the relationship between X and Y changed significantly (i.e., the slope parameter is lessened) after M is introduced, then M is acting as a mediator. Specifically, this study tested whether mental health diagnosis status as a potential mediator.

Furthermore, negative binomial regression was also used to explore whether various psychosocial environmental variables acted as moderators between the level of addiction to nicotine (independent or predictor variable) and smoking cessation efforts in the last 12 months (dependent or outcome variable). Specifically, the analysis was conducted to determine if employment status, age at smoking initiation, history of a substance use disorder, living with other smokers or working in a smoke-free environment were moderating variables.

**Figure 16**

*Basic Moderation Model (X=Independent Variable, Z=Moderator, Y=Dependent Variable)*



This general process was completed for each of the five psychosocial environmental variables that may have potentially acted as a moderator for the relationship between participants’ level of addiction to nicotine and their number of quit attempts in the last 12 months.

**Assumptions**

For both the analysis of moderation and for mediation there is an assumption that the mediating or moderating variable is not caused by the dependent variable: the number of quit attempts. Additionally, it is assumed that there is little to no measurement error in the mediator

or moderator variable and if the error is high the structural equation model should be used to estimate latent variables (Blair, 2020). For the purposes of this study, it is assumed the variables are measured with minimal error in variable measurement and there is not adequate information available to utilize the structural equation model to estimate latent variables.

### **Generalized Linear Model**

In the current study, the generalized linear model was used as it assumes that the dependent variable (number of quit attempts) is not normally distributed (as this variable is a count) and allows for variance heterogeneity. Generalized Linear Models are an extension of linear models that allow the dependent variable or response distribution to be non-normal (Agresti, 2015). Nelder and Wedderburn (1972) originally combined and popularized Generalized Linear Models as a class of statistical models which includes logistic regression, Poisson regression, negative binomial regression as well as the normal linear regression model. Models within the Generalized Linear Models class have a link function component, a random component, and a systematic component or linear predictor (Agresti, 2015).

A negative binomial regression was used in this analysis, which is a type of generalized linear model in which the dependent variable is a count of the number of times an event occurs. Negative binomial regression can be used for over-dispersed count data (i.e., when the conditional variance exceeds the conditional mean) and is often viewed as a generalization of Poisson regression, since the negative binomial has the same mean structure as Poisson regression, with an extra parameter to model the over-dispersion. As mentioned previously, the Poisson regression model and the negative binomial regression model both use the natural log of the expected count as the link function. Furthermore, the negative binomial regression generally has narrower confidence intervals than those from a Poisson regression model, which is essential

for instances when the conditional distribution of the outcome variable is over-dispersed (UCLA Institute for Digital Research, n.d.). Furthermore, Brooks and colleagues (2017) explain the negative binomial distribution is defined as a mixture of Poisson distributions with Gamma-distributed rates, and that for both the Poisson and negative binomial distributions as the mean decreases the expected number of zeros also decreases. “A Poisson Process is a model for a series of discrete events where the *average time* between events is known, but the exact timing of events is random.” (Koehrsen, 2019, para. 3) Essentially, counts are often modeled by Poisson regressions or negative binomial regressions, and negative binomial regression was used in this study to account for potential overdispersion of the outcome variable.

The negative binomial model was used because of the over dispersed data and the fact that the outcome or dependent variable was a count. The negative binomial regression model for counts is given by the equation:

$$\text{Ln}(\gamma_j) = \mu + \beta_1 \text{LOA}_j + \beta_2 \text{MI}_j$$

Where  $\gamma$  is the mean or expected count of the Negative Binomial for the  $j$ th participant. Ln is the natural log function, the link function for the negative binomial generalized linear model (Hilbe, 2011; Wedderburn, 1974). The log mean is a linear function of the predictors with intercept  $\mu$ , a regression coefficient  $\beta_1$  for the level of addiction (LOA), and a coefficient  $\beta_2$  for mental health disorder status or Mental illness (MI) coded 1 for MI present and 0 for it being absent. In this model, a one-unit change in LOA results in a  $\beta_1$  increase/decrease in the log count of quit attempts depending on the sign of the coefficient. Similarly, when a subject has a mental health disorder (MI=1) then  $\beta_2$  is the increase or decrease in the log mean count depending on the sign of  $\beta_2$ .

Exponentiating the equation moves from log counts to counts and changes the

interpretation of the parameters.

$$\text{Exp}\left(\text{Ln}(\gamma_j)\right) = e^{\mu + \beta_1 \text{LOA}_j + \beta_2 \text{MI}_j}$$

In this exponentiated form, the regression parameters take on the interpretation as rate ratios. That is  $\beta_1$  is the relative rate increase in expected count for a one unit change in level of addiction, and  $\beta_2$  is the relative rate increase in expected count between a person with a mental health disorder versus someone without a mental health disorder. Also referred to as a rate ratio. The Poisson and the negative binomial models are often used to model the rate at which something occurs so the parameters within this model use the rate ratio. These interpretations will become more explicit in the results.

Prior to mediation and moderation analyses, appropriate psychosocial environmental variables, and the independent variable of level of addiction were centered. Centering is completed in interaction models to assist in the interpretation of parameter estimates and reduce multicollinearity potentially present in the data (Afshartous & Preston, 2011; Cohen, 2008). Centering of data is completed by subtracting a variable's mean or a meaningful constant from all observations of that variable in a dataset. When "mean-centering," this action causes the variable's new mean to be zero (Iacobucci et al., 2016). Centering changes the definition of the intercept increasing interpretability of the data. Centering variables can shift the intercept so that values are more meaningful. For example, number of quit attempts cannot be negative in practice and shifting the intercept by centering the data can help make the analysis more easily interpreted (Afshartous & Preston, 2011). Iacobucci et al. (2016) define multicollinearity as "the presence of correlations among predictor variables that are sufficiently high to cause subsequent analytic difficulties, from inflated standard errors (with their accompanying deflated power in significance tests), to bias and indeterminacy among the parameter estimates (with the

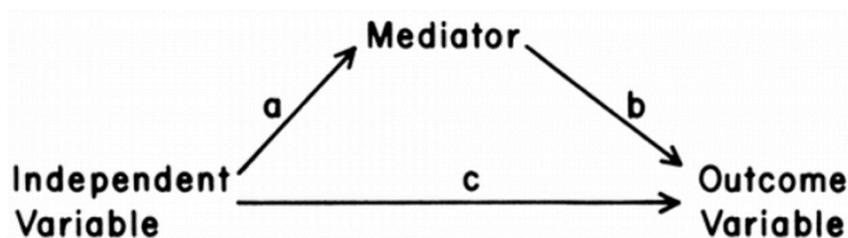
accompanying confusion regarding the interpretation and contributions of individual predictors).” In this dataset only age at smoking initiation was centered. Employment status, mental health disorder status, SUD history, living with other smokers, and working in a smoke free environment are all dichotomous variables.

### Steps for Mediation Analysis

For identification of each potential mediator, or specific psychosocial environmental factor, a series of regressions was run, consistent with recommendations for testing mediators (Baron & Kenny, 1986; Judd & Kenny, 1981). The terms independent, causal, and predictor variables are used interchangeably for the purposes of this study. Furthermore, the terms dependent, criterion, or outcome variable are used interchangeably to discuss the dependent variable. The independent variable used in this study was the level of addiction to nicotine, based on the Fagerström test of nicotine dependence. In this study, the dependent variable was the number of quit attempts over the last twelve months reported by the participants. During this analysis, separate coefficients for each equation were estimated and tested (Baron & Kenny, 1987). Employing these regression equations allowed for testing the various steps found in the mediation model.

**Figure 17**

*Mediational Model (Barron & Kenny, 1986)*



To test for mediation, a series of regression equations need to be estimated (Baron & Kenny, 1986), and four steps conducted (James & Brett, 1984; Kenny, 2018).

Step 1. The purpose of this step is to determine whether the independent variable or predictor variable (level of addiction to nicotine) is associated with the outcome or dependent variable (number of quit attempts). This is an important step as it establishes that there is an effect found between the two variables that can be mediated. This regression equation is describing the path labeled c in figure 17, where the independent variable is the criterion variable, and the dependent variable is considered the predictor in the regression equation. In the current study, the regression equation examined the effect between level of addiction to nicotine variable and the number of quit attempts variable.

Step 2. The second step essentially treats the mediator as an outcome variable to show that the predictor or independent variable brings about change in the mediator in the regression equation. The second step consisted of regressing the specific mediator on the independent variable. This step estimated and tested the path labeled “a” in figure 17. In this study, the level of addiction to nicotine was the predictor or independent variable, and mental health diagnosis status was the outcome variable. In this study, a logistic regression was executed between the level of addiction to nicotine and mental health diagnosis status to show that the level of addiction influenced mental health diagnosis status. A logistic regression analysis was conducted because mental health diagnosis status is a dichotomous variable.

Step 3. The purpose of step three is to demonstrate that the mediator affects the outcome variable in conjunction with the independent variable. The third step was to regress the dependent variable on the independent variable and the mediator. Therefore, the outcome variable was analyzed as the criterion variable in the regression equation, while the independent variable and mental health diagnosis status was analyzed as predictors to test path “b.”

Step 4. This final step establishes mediation of the relationship between the independent and dependent variables. This step specifically explores whether a mediator completely mediates the relationship between the independent and dependent variables. If a mediator completely mediates the relationship between the independent and dependent variables, then the effect of the independent variable on the dependent variable, when including the mediator in the model will be zero (labeled as path c). The effects described in steps 3 and 4 are estimated in the same equation. In this study, step four included evaluating the results of steps one through three in addition to exploring whether mediation is partial or complete by calculating the percentage change in the coefficient. When the reduction was 10% or more then partial mediation has occurred.

Specifically, when mental health disorder status (MI) is not included in the regression the regression model is

$$Ln(\gamma_j) = \mu + \beta_1^* LOA_j \quad (2)$$

Equation (1) is the baseline equation for all analyses of mediation and moderation. Note the asterisk on the LOA coefficient in this model.

When MI is included then mediation is said to occur if

$$\frac{|\beta_1^* - \beta_1|}{|\beta_1^*|} \geq 0.10$$

That is if the change in  $\beta_1^*$  by including MI constitutes 10% or more.

Kenny (2018) indicates that steps two and three are essential steps necessary to establish mediation, with step four only necessary if there is an expectation of complete mediation. The current study focused on steps one through three as complete mediation is not the goal of the present analysis. Though it can be argued that step 4 is essentially an interpretation of step 3 and

since partial mediation is possible this step should be investigated. In this study, step 4 was used to evaluate steps one, two and three and determine the nature of mediation.

Furthermore, Baron and Kenny (1986) stipulate that the following conditions must hold to establish mediation:

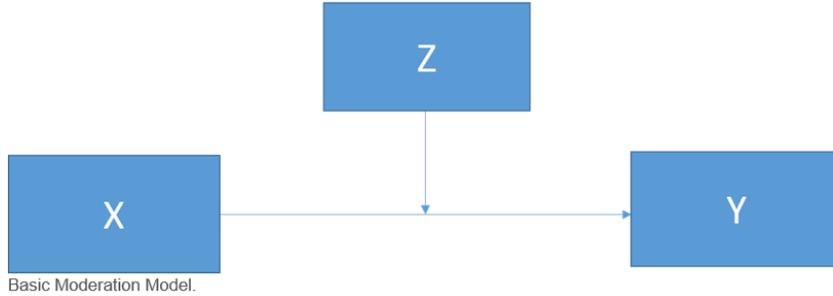
First, the independent variable must affect the mediator...; second, the independent variable must be shown to affect the dependent variable...; and third, the mediator must affect the dependent variable ... If these conditions all hold in the predicted direction, then the effect of the independent variable on the dependent variable must be less in the third equation than in the second. Complete mediation holds if the independent variable has no effect when the mediator is controlled.

### **Steps for Moderation**

To identify psychosocial variables that acted as moderators between participants' level of addiction to nicotine and number of quit attempts a series of steps were conducted. Moderation analysis tests under what conditions an effect occurs or whether a moderator affects the direction and strength of the relationship between the independent and dependent variables (Blair, 2020). The moderation analysis steps conducted in this analysis assessed the nature of the effect of different moderators on the relationship between the level of addiction to nicotine and number of quit attempts.

**Figure 18**

*Basic Moderation Model (X=Independent Variable, Z=Moderator, Y=Dependent Variable)*



The following steps are used to test for moderation, where introducing a moderating variable changes the direction or magnitude of the relationship between two variables, X and Y. A negative binomial generalized linear model was used to test each variable as a moderator.

A negative binomial regression in terms of moderation is given by the equation

$$\text{Ln}(\gamma_j) = \mu + \beta_1 \text{LOA}_j + \beta_2 \text{SUD}_j + \beta_3 \text{LOA} * \text{SUD}_j \quad (3)$$

Where  $\gamma_j$  is the mean or expected count of the Negative Binomial for the  $j$ th participant.

Ln is the natural log function, the link function for the negative binomial generalized linear model (McCullagh, 1992; Nelder & Wedderburn, 1972). The log mean is a linear function of the predictors with intercept  $\mu$ , a regression coefficient  $\beta_1$  for level of addiction (LOA), and a coefficient  $\beta_2$  for Substance Use Disorder (SUD) coded 1 for history of a SUD present and 0 for it being absent. Here one must be cognizant of the interaction term. The coefficient for interaction will 'moderate' the effect of LOA depending on the value of SUD.

When SUD is absent (SUD=0) equation (3) becomes equation (1)

$$\text{Ln}(\gamma_j) = \mu + \beta_1^* \text{LOA}_j$$

When SUD is present SUD=1, the equation becomes

$$\text{Ln}(\gamma_j) = \mu + \beta_1 \text{LOA}_j + \beta_2 + \beta_3 \text{LOA}_j = (\mu + \beta_2) + (\beta_1 + \beta_3) \text{LOA}_j$$

A one unit change in LOA will result in a  $\beta_1$  increase/decrease in the log count of quit attempts depending on the sign of the coefficient. Similarly, when a subject has a SUD (SUD=1) then  $\beta_2$  is the increase or decrease in the log mean count depending on the sign of  $\beta_2$ .

The following steps outline the process of assessing for moderation using the negative binomial regression model.

Step 1. First, it is necessary to determine whether a relationship exists between the independent variable, level of addiction to nicotine, and the dependent variable, the number of quit attempts in the last twelve months, by creating a scatterplot of the two.

Step 2. The independent variable and the dependent variable are entered into a negative binomial regression analysis to further assess the nature of this relationship.

Step 3. Next, the independent variable (X), dependent variable (Y), the potential moderator (Z) and the interaction term of X\*Z are analyzed in the negative binomial regression model. The inclusion of the interaction term determined if the effect of X depends on the level of Z.

A variable will be said to be a moderator if either the interaction term,  $\beta_3$  is statistically significant,  $p \leq 0.10$ , or if

$$\frac{|\beta_3|}{|\beta_1| + |\beta_3|} \geq 0.10$$

That is that  $\beta_3$  constitutes 10% or more of the total effect of LOA on number of quit attempts.

Step 4. For significant moderators (alpha level = 0.10, this alpha level is used because interaction tests are less powerful and there is a small sample size), the nature and direction of the effect of the moderator on the relationship between X and Y is determined using a graphical depiction of the relationship. All of the moderators used in this study are dichotomous variables except age at smoking initiation. Profile plots of all dichotomous variables are created for both

levels (yes and no) to illustrate the effect of moderation. These profile plots are a scatter plot of the number of quit attempts by level of addiction, with the two levels (yes and no) of the dichotomous variable added and a line fit to each level. For the age at smoking initiation variable, the only continuous variable assessed for moderation, the magnitude of change in the coefficient for the interaction term is explored to determine the nature and direction of the effect of this moderator on the relationship between X and Y. In other words, based on the sign of the coefficient, the interaction coefficient determines the nature and direction of the effect of the moderator on the relationship between X and Y, with an increase or decrease the slope of the level of addiction based on this sign, with negative values for the interaction causing a decrease in the process.

### **Statistical Analysis Performed**

In this study, descriptive statistics were obtained for each of the eight variables. Additionally, a correlation matrix was obtained in order to look at the correlations between all of the variables. A regression with the level of addiction regressed on the number of quit attempts was run to determine the relationship between the independent and dependent variables. The next step included introducing each of the moderating and mediating variables (i.e., the predetermined psychosocial environmental variables) into the regression equation to determine if the relationship between the independent and dependent variables is changed. For the mediation analysis, if the relationship between the independent (level of addiction to nicotine) and the dependent (number of quit attempts) was diminished when the variable mental health diagnosis status was introduced into the regression equation, the introduced variable was acting as a mediator. The slopes of the regression equations were compared to the initial regression equation between the independent and dependent variables to determine whether mental health diagnosis

was acting as a mediator. In the moderation analysis, if the interaction term introduced into the regression analysis is significant then that variable was acting as a moderator.

### **Limitations and Ethical Considerations**

The limitations of this study include the use of a secondary data set and using self-reported data, with a voluntary sample that may not be indicative of the cigarette smoking population in eastern North Carolina. The use of self-report survey data has limitations, including potential misunderstanding of questions and the potential for inaccurate reporting as well. The sample consisted of uneven numbers of individuals with specific psychosocial and environmental variables, such as an uneven number of individuals with and without mental health diagnoses, which may lead to difficulties in the inferences made through the statistical analysis portion of the study.

As this is a non-experimental design, it is impossible to truly establish cause and effect since there is no random assignment of participants to a control or treatment group, and no intervention introduced. Instead, the current study explored relationships between variables since there was no manipulation of an independent variable.

Additionally, a limitation of this study is that the type of approach used in this study may have limitations. The analysis used in this study may be viewed as what Edwards & Lambert (2007) refer to as a piecemeal approach to moderation and mediation analysis. This approach is criticized for not revealing the specific pathways the moderator or mediator influences (Edwards & Lambert, 2007). Furthermore, Edwards and Lambert (2007) contend that mediation analysis has advanced since the introduction by Baron and Kenny (1986) of the causal-steps procedure and the procedure in itself has limitations. A possible limitation of the causal steps procedure to mediation analysis is that the first step of this procedure requires a significant relationship

between X and Y, which can conceal a mediated effect when it is accompanied by a direct effect of an opposite sign. This can potentially cause significance not to be reached due to the opposite signs. Another limitation is the causal steps procedure does not directly test the mediated effect of X on Y because the coefficients are measured separately in steps 2 and 3 and can yield different results than the test of the product itself (Edwards & Lambert, 2007).

Another potential limitation to this study is related to data collection. Since the data collected in this study did not specifically fit the requirements of the structural equation model, it was assumed that the data was collected without error. Future studies can take steps to manipulate the mediator variable collection to ensure minimal mediator error and collect multiple indicators of the construct of the mediator in order to then use the structural equation model to estimate latent variables (Blair, 2020).

## **CHAPTER IV: RESULTS**

### **Introduction**

The primary purpose of this study was to examine psychosocial environmental variables to determine whether these variables act as mediators or moderators between participants' level of addiction to nicotine and their smoking cessation efforts over the last 12 months. Specifically, this study sought to assess whether mental health disorder status mediates the relationship between participants' level of addiction and their number of quit attempts in a 12-month period and whether employment status, age at smoking initiation, a history of a substance use disorder (SUD), living with a smoker, and working in a smoke-free environment moderates this same relationship. The present study used archival data from an anonymous, self-report, cross-sectional survey provided to individuals who smoke cigarettes between September 2016 and February 2019. This chapter provides the results of the study including the demographic information on respondents, and the statistical analysis conducted when exploring the research questions posed in this study.

### **Data Cleaning**

This study examined archival data collected from study visits completed between September 2016 and February 2019 at the offices of the East Carolina University (ECU) Department of Psychiatry and Behavioral Medicine. In total, the dataset consisted of 151 participants, with 150 of the cases containing a complete dataset. A participant was removed from the dataset because specific psychosocial environmental data was missing from the entry. The data was missing due to a technical issue with internet connectivity, which occurred during data collection. For the question related to working in a smoke-free environment, four participants who indicated they are not employed also indicated they work in a smoke-free

environment. Additionally, three participants who indicated that they are not employed answered that they do not work in a smoke-free environment. These seven participants were recoded based on supporting data in the survey and were not included in the moderation analysis for working in a smoke-free environment. In the moderation analysis for working in a smoke-free environment, smoke-free environment was coded as a dichotomous variable (either employed participants worked in a smoke-free environment or did not) and only the results from the 62 participants that indicated that they are employed were included in the analysis.

Additionally, during the data screening and cleaning stage. Two outliers were noted for number of quit attempts: 23 and 20 quit attempts. Upon further investigation both data points were considered influential observations that influenced the results. Both data points were vital to the results and followed a similar trend: they both had the highest level of addiction to nicotine, a Fagerström Test of Nicotine Dependence (FTND) score of ten, and significantly higher than average number of quit attempts. The average number of quit attempts for the sample was 1.22 attempts and the average level of addiction was 4.95. Furthermore, the decision to keep the outliers was based on a recommended practice in statistics. Altman et al. (2000) explain that outliers should not be excluded from the analysis unless there are major reasons to question their credibility as these outliers can have a pronounced effect on the statistical analysis.

Before data analysis, two continuous variables in this study were centered. Centering is often performed in interaction models to help in the interpretation of parameter estimates and to reduce multicollinearity present in the data (Afshartous & Preston, 2011; Cohen, 2008). The predictor variable level of addiction was centered using a meaningful constant. The variable level of addiction is based on the FTND and can range from zero to ten. Based on the range of the FTND, five was used as the meaningful constant for centering the level of addiction variable

since five is the mean value for the test. The mean of level of addiction in this sample was 4.95 though level of addiction in practice is always reported as an integer and not a fraction. Therefore, it was more appropriate to use five, or the midpoint value for the FTND, as the meaningful constant for centering. Additionally, age at smoking initiation was centered using the mean determined in the analysis, 16.57. These centered variables were used throughout the analysis.

## Descriptive Data Results

### Sample Sociodemographic Characteristics

The study sample (see tables 1 and 2) includes 150 participants living in North Carolina that are smokers. Participants had a mean age of 46.9+/-14.9 years of age, with a range from 21 to 75 years of age. The majority of participants were female (65.3%,  $n=98$ ), white (59.3%,  $n=89$ ), married (31.3%,  $n=47$ ), with some college, vocational, or trade school (44.7%,  $n=67$ ) and smoke 11-20 cigarettes per day (42.7%,  $n=64$ ).

**Table 1**

*Sample Descriptive Statistics for Age*  
Total Sample (N=150)

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Age	150	54.00	21.00	75.00	46.9133	14.88702

**Table 2**

*Sample Demographics Descriptive Statistics*

Sociodemographic Variable	Total Sample (n=150)	
	N	Percentage
Gender		
Female	98	65.3%
Male	52	34.7%
Race		
Multiple Ethnicity/other	3	2.0%
African American	57	38.0%

Mexican American or Chicano	1	0.7%
White	89	59.3%
Relationship Status		
Married	47	31.3%
Widowed	10	6.7%
Divorced	18	12.0%
Separated	14	9.3%
Domestic partnership or civil union	8	5.3%
Single, but cohabitating with significant other	17	11.3%
Single, never married	36	24.0%
Cigarettes Per Day		
10 or less	45	30.0%
11 to 20	64	42.7%
21 to 30	27	18.0%
>31	14	9.3%
Level of Education		
Less than High School	13	8.7%
High School Graduate	38	25.3%
Some College, Vocational, or Trade school	67	44.7%
College graduate	32	21.3%

Table 3 below shows the mean, standard deviation, and the variance for the continuous variables explored in this study, including the independent variable level of addiction, the dependent variable, number of quit attempts, and one of the potential moderators, age at smoking initiation. Furthermore, table 3 presents the descriptive statistics for the dependent variable. Notably, the count data for the dependent variable, number of quit attempts, is over dispersed, with a greater variance than mean value for number of quit attempts (mean = 1.22, variance = 8.53), which is why negative binomial regression analysis was used instead of the Poisson regression model (Hilbe, 2011). When count data is over dispersed a negative binomial regression is appropriate (Hilbe, 2012). The study sample had a mean score of 5 for level of addiction, which corresponds to a FTND score of moderate or medium nicotine dependence level

(Heatherton, et al., 1991). The number of quit attempts or smoking cessation attempts for this sample ranged from zero to 23, with a mean of 1.22 +/-2.53 quit attempts in the past 12 months.

**Table 3**

*Sample Descriptive Statistics of the Continuous Psychosocial Environmental Variables*

	N	Mean	Std. Deviation	Variance
Level of Addiction	150	4.95	2.53	6.41
Number of Quit Attempts	150	1.22	2.92	8.54
Age at Smoking Initiation	150	16.57	5.35	28.64
Age at Smoking Initiation Centered	150	.0	5.35	28.64
Level of Addiction Centered	150	-.047	2.53	6.41

**Table 4**

*Sample Descriptive Statistics for Dichotomous Psychosocial Environmental Variables*

	Total Sample (n=150)	Percentage
Sociodemographic Variable	N	%
<b>Mental Health Diagnosis</b>		
No	56	37.3%
Yes	94	62.7%
<b>Employment Status</b>		
Not Employed	88	58.7%
Employed	62	41.3%
<b>History of a SUD</b>		
No	128	85.3%
Yes	22	14.7%
<b>Living with a Smoker</b>		
No	70	46.7%
Yes	80	53.3%
<b>Smoke-free Work Environment</b>		
No	16	10.7%
Yes	46	30.7%
Not Employed	88	58.7%

Table 4 presents the results for the dichotomous psychosocial-environmental variables.

The majority of participants (62.7%;  $n = 94$ ) had a diagnosis of a mental health disorder.

Approximately, 58.7% ( $n = 88$ ) of the sample were not employed and 41.3% ( $n = 62$ ) reported they are employed (either part-time or full-time employment was considered employed). Full-time students and individuals reporting that they are on disability benefits were considered “not employed” for the purposes of the analysis. The majority of the participants reported that they did not have a history of a SUD (85.3%,  $n = 128$ ) and they currently live with another smoker (53.3%,  $n = 80$ ). When assessing the data of participants that were employed ( $n = 62$ ), the majority indicated that they work in a smoke free environment (74.2%,  $n = 46$ ). However, when evaluating the proportion of individuals who work in a smoke-free environment in the sample, only 30.7% ( $n = 46$ ) of the total sample work in a smoke free environment and 10.7% ( $n = 16$ ) work in an environment that allows smoking, with 58.7% ( $n = 88$ ) of the sample not employed.

**Table 5**

*Pearson’s Correlation Matrix of Continuous Psychosocial Environmental Variables*

		Number of Quit Attempts	Level of Addiction	Age at Smoking Initiation
Number of Quit Attempts	Pearson Correlation	1	.123	.168*
	Sig. (2-tailed)		.134	.039
	N	150	150	150
Level of Addiction	Pearson Correlation	.123	1	-.205*
	Sig. (2-tailed)	.134		.012
	N	150	150	150
Age at Smoking Initiation	Pearson Correlation	.168*	-.205*	1
	Sig. (2-tailed)	.039	.012	
	N	150	150	150

\*. Correlation is significant at the 0.05 level (2-tailed).

Table 5 presents the Pearson’s correlation matrix which indicates the extent to which each pair of variables is linearly related. Though very weakly related in the Pearson’s correlation matrix, there is a linear relationship between the predictor variable, or level of addiction, and the outcome variable, or number of quit attempts ( $r = 0.123$ ,  $df = 148$ ,  $p = .134$ ). The lack of significance is due to the fact that the Pearson’s correlation is based on a simple linear

regression, which is not the appropriate model or type of analysis for the data so the weakly linear relationship is not what will be used for the analysis in the study, but rather a negative binomial regression analysis. Please note that for the mediation and moderation analysis conducted, this relationship is assessed further using a negative binomial regression because negative binomial regression is more appropriate for analyzing the relationship between these two variables because the dependent variable is both over dispersed and a count. Additionally, Pearson's correlation describes linear relationships and not curvilinear relationships like the relationship present in this data and graphically depicted in figure 19 (Moore, Notz, & Flinger, 2013). The centered values for age at smoking initiation and level of addiction were used in the correlation matrix.

Furthermore, results in figure 19 indicate that there is a correlation ( $p \leq .05$ ) between variables number of quit attempts and age at smoking initiation ( $r = .168$ ,  $df = 148$ ,  $p = .039$ ) and level of addiction and age at smoking initiation ( $r = -.205$ ,  $df = 148$ ,  $p = .012$ ).

**Figure 19**

*Scatterplot of Number of Quit Attempts by Level of Addiction to Nicotine*

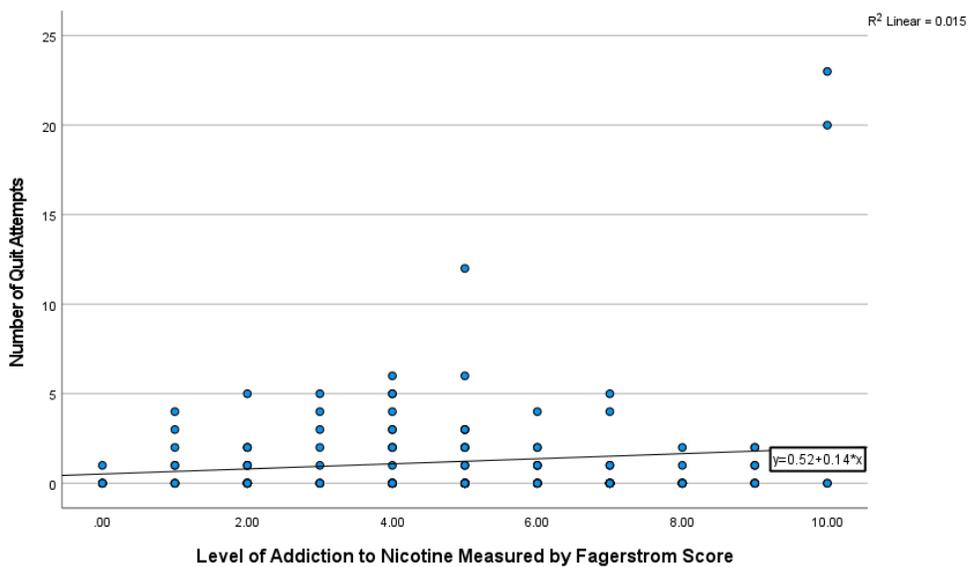


Figure 19 depicts the relationship between level of addiction and number of quit attempts. The linear relationship, though not most appropriate for this data set, shows the overall trend in the data, which is why it is presented here. The relationship between the variables was assessed with using negative binomial regression because linear regression is not appropriate, so the linear equation and  $R^2$  are not used for evaluating the relationship between the independent and dependent variables. The scatterplot (Figure 19) shows the data, and it appears participants' number of quit attempts generally increased until a moderate to low level of addiction to nicotine (around four). At that point, a downward trend for individuals with higher levels of addiction to nicotine is observed. Two outliers are observed at the highest level of addiction, ten, with a corresponding a high number of quit attempts.

As mentioned previously, the two outliers observed in this study were not removed from the dataset as they both follow a similar pattern and are significant to the analysis. These outliers are significant outliers with values greater than or equal to 20 quit attempts (the average number of quit attempts is 1.22). These outliers are 8.6 standard deviations from the mean. However, both high values correspond with the highest level of addiction possible (Fagerström score of 10), supporting that the outliers are not due to a data collection error, but rather a significant data trend.

### **Research Questions**

1. Do psychosocial-environmental variables influence the relationship between participants' level of addiction and their number of quit attempts?
  - a. Does mental health disorder status mediate the relationship between participants' level of addiction and their number of quit attempts?

- b. Does employment status moderate the relationship between participants' level of addiction and their number of quit attempts?
- c. Does age at smoking initiation moderate the relationship between participants' level of addiction and their number of quit attempts?
- d. Does a history of a Substance Use Disorder (SUD) moderate the relationship between participants' level of addiction and their number of quit attempts?
- e. Does living with a smoker moderate the relationship between participants' level of addiction and their number of quit attempts?
- f. Does working in a smoke-free environment moderate the relationship between participants' level of addiction and their number of quit attempts?

### **Addressing Research Question 1**

The overarching research question is: Do psychosocial-environmental variables influence the relationship between participants' level of addiction and their number of quit attempts?

Research Question one is the overarching question examining the mediating or moderating effects of six specific psychosocial-environmental variables on the relationship between participants' level of addiction to nicotine and number of quit attempts. In order to answer research question one, questions 1a through 1f are addressed.

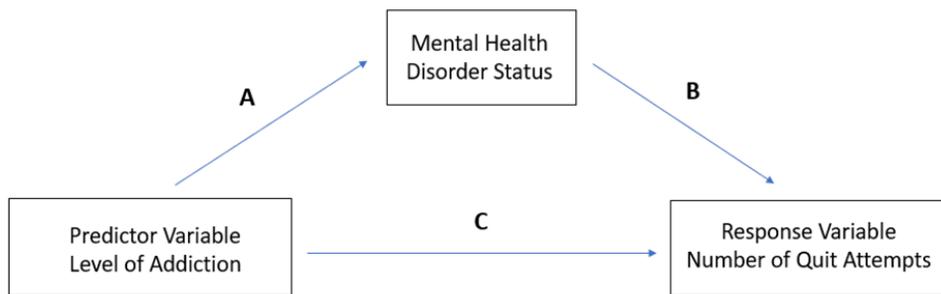
### **Addressing Research Question 1.a**

Research question 1a is: Does mental health disorder status mediate the relationship between participants' level of addiction and their number of quit attempts? This question explored whether mental health disorder status acts as a mediator, mediating the relationship between the independent and dependent variables in this study and is the only mediation analysis

performed in this study. Figure 20 below represents a diagram of the mediation mechanisms explored in question 1a.

**Figure 20**

*Mediation Model for Mental Health Disorder Status*



**Mediation Testing Steps Implemented.** As indicated in the methods section, four steps are required to conduct a mediation analysis:

**Step 1.** Exploring presence of an effect between the independent and dependent variables by determining if participants’ level of addiction to nicotine is associated with their number of quit attempts. This is Pathway “C” in figure 20.

**Step 2.** Estimating level of addiction to nicotine (independent variable) effects on mental health diagnosis status (mediator). Depicted as pathway “A” in Figure 20.

**Step 3.** Estimating the effects of mental health diagnosis status (mediator) on number of quit attempts (dependent variable) in combination with the independent variable by regressing the dependent variable on both the independent variable and the mediator. This allows for evaluating pathway “B” in figure 20 as pathway “A” was evaluated in step two.

**Step 4.** Evaluating steps one through three. If relationships in both pathways “A” and “B” are present and the relationship in pathway “C” is reduced, mediation is said to occur. This step includes evaluating the presence of mediation and whether mediation is partial or complete by

calculating the percentage change in the coefficient. If the reduction is more than 10%, partial mediation has occurred (Barron & Kenny, 1986).

### **Mediation Analysis Conducted.**

**Step 1.** Exploring presence of an effect between the independent and dependent variables by determining if level of addiction to nicotine is associated with number of quit attempts. (Pathway “C”).

For the first step in the analysis, the effect between the level of addiction to nicotine on the number of quit attempts was examined to determine whether there was a statistically significant effect of the level of addiction on the number of quit attempts. This initial step is completed to ensure that mediation analysis is an appropriate analysis to conduct in this study. The purpose of this step is to evaluate the presence of a statistically significant association between the independent variable (level of addiction to nicotine) and the dependent variable (number of quit attempts). Table 6 contains the regression results for the relationship between number of quit attempts in the last 12 months and level of addiction to nicotine described in step one of the plans for analysis.

This analysis was conducted using a negative binomial model-based estimator. Wald chi-square for level of addiction yielded a  $p=0.016$ . and for the intercept  $p=0.133$ , with the results of the omnibus as follows: likelihood ratio chi-square 5.874,  $df = 1$ ,  $p=0.015$ .

**Table 6**

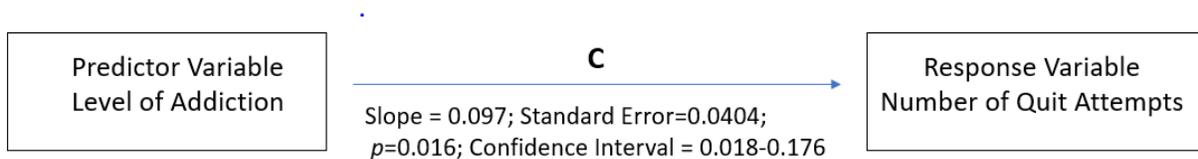
*Negative Binomial Regression Parameter Estimates Results: Direct Relationship between Level of Addiction and Number of Quit Attempts*

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			95% Wald Confidence Interval for Exp(B)		
			Lower	Upper	Wald Chi-Square	df	Sig.	Lower	Upper	
(Intercept)	.168	.1117	-.051	.387	2.258	1	.133	1.183	.950	1.472
Level of Addiction	.097	.0404	.018	.176	5.750	1	.016	1.102	1.018	1.193

Dependent Variable: Number of Quit Attempts  
Model: (Intercept), Level of Addiction Centered

**Figure 21**

*Results of Step 1 in the Assessment of Mediation*



The Direct Effect Model for the relationship between level of Addiction and log-number of quit attempts is:

$$\text{Ln}(\gamma_j) = 0.168 + 0.097 \times \text{Level of Addiction} = \text{Number of Quit Attempts}$$

This model estimates the parameters of model (2) in the statistical methods.

Therefore, an effect was found between the independent and dependent variables. The presence of a relationship between level of addiction to nicotine and number of quit attempts is a requirement for this type of mediation analysis. The results indicate that level of addiction to nicotine is associated with number of quit attempts ( $p=0.016$ ). Furthermore, in the initial model presented in table 6 Beta=0.097. Therefore, there is a 0.97 increase in log quit attempts per one-unit change in level of addiction. For the exponentiated beta results, there is a 10.2% increase in

the number of quit attempts per unit increase in level of addiction  $((1.102-1.00)*100 = 10.2\%)$ .

Another way to interpret this result is at the mean level of (centered LOA=0) the predicted number of quit attempts is 1.183. But with a one unit increase in LOA centered =1, the predicted number of counts is  $(1.183) \times (1.102) = 1.303$

**Step 2.** Estimating level of addiction to nicotine (independent variable) effects on mental health diagnosis status (mediator)

**Table 7**

*Results Logistic Regression: Level of Addiction effects on Mental Health Diagnosis (mediator)*

		B	Standard Error	Wald	df	<i>p</i>	Exp(B)/ Odds Ratio
Step 1 <sup>a</sup>	Level of Addiction	.163	.070	5.442	1	.020	1.177
	Intercept	.546	.173	9.935	1	.002	1.727

a. Variable(s) entered on step 1: Level of Addiction Centered

Results in Table 7 indicate that as level of addiction increases the chances of having a mental health disorder increase as well. During this step in the analysis, mental health disorder status was entered into the logistic regression model as the outcome variable and level of addiction was entered as the predictor variable in the model. The use of logistic regression for this step in the analysis was explained in the description of the steps for mediation analysis. Given that mental health disorder status is a dichotomous variable, logistic regression was appropriate for this step. Results in Table 7 indicate that with each increase in level of addiction there was a 1.73-fold increase in the odds of a participant having a mental health diagnosis. The results of this step indicate level of addiction effects mental health diagnosis status ( $p = 0.020$ ), or there is an effect present.

**Step 3.** Estimating the effects of mental health diagnosis status (mediator) on the number of quit attempts (dependent variable) in combination with level of addiction to nicotine (the independent variable). This step was completed by regressing the dependent variable on both the independent variable and the mediator. Table 8 contains the results of this analysis. The results of the omnibus test for this model are as follows: likelihood ratio chi-square 7.838,  $df=2$ ,  $p=0.020$ .

**Table 8**

*Negative Binomial Regression Parameter Estimates for Level of Addiction and Mental Health Disorder Status on Number of Quit Attempts*

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			95% Wald Confidence Interval for Exp(B)		
			Lower	Upper	Wald Chi-Square	df	Sig.	Exp(B)	Lower	Upper
(Intercept)	-.070	.2031	-.468	.328	.118	1	.731	.932	.626	1.389
Level of Addiction	.076	.0432	-.009	.160	3.084	1	.079	1.079	.991	1.174
Mental Health Disorder	.357	.2549	-.142	.857	1.964	1	.161	1.429	.867	2.356

Dependent Variable: Number of Quit Attempts

Model: (Intercept), Level of Addiction Centered, Mental Health Disorder Status

In this step, the effects of mental health diagnosis status (mediator) on the number of quit attempts (dependent variable) including the independent variable were assessed. This assessment was carried out by regressing the dependent variable on both the independent variable and the mediator. When the mediator, mental health disorder status, was included in the regression analysis, the slope parameter decreased by 0.021 indicating partial mediation.

**Step 4.** The slope (the beta-coefficient) for level of addiction changed from 0.097 to 0.076 (see Tables 6 and 8), which indicates partial mediation has taken place, with a 27.6% reduction in slope. The level of addiction parameter was significant at the 0.1 level ( $p = 0.079$ ).

Using the process outlined in chapter three, if  $|\beta_1^* - \beta_1| / \beta_1^* > 0.10$  then mediation has occurred. In this analysis,  $|0.076 - .097| / |0.076| = 0.276$  or a 27.6% decrease in the slope parameter. The level of addiction parameter was significant at the 0.1 level ( $p = 0.079$ ). Additionally, a 27.6% reduction in slope is a fairly large percent change in effect when the mediator is included in the model.

Furthermore, when participants do not have a mental health disorder or ( $MI=0$ ), the predicted count at mean level of addiction (centered=0) is 0.932, while if participants have a mental health disorder the predicted count at mean level of addiction (centered=0) is  $0.932 \times (1.429) = 1.332$ . Each of these values can be multiplied by 1.079 for each one unit change in level of addiction, or 1.001 for participants without a mental health disorder and 1.438 for participants with a mental health disorder.

Based on these two indicators, mental health disorder status is a mediating variable. Since mediators are part of a causal pathway, mental health disorder status may explain part of why the relationship between the level of addiction to nicotine and the number of quit attempts exists for participants in this study. Based on the exponentiated results in Table 8, the incidence rate of quit attempts in those with a mental health disorder is 1.43 times ( $\exp(.357)$ ) greater than those without a mental health disorder. There is a 43% ( $1.43 - 1.00 = .429$ ) greater incidence of quit attempts in participants with a mental health disorder.

**Figure 22**

*Boxplot of Level of Addiction by Mental Health Diagnosis Status*

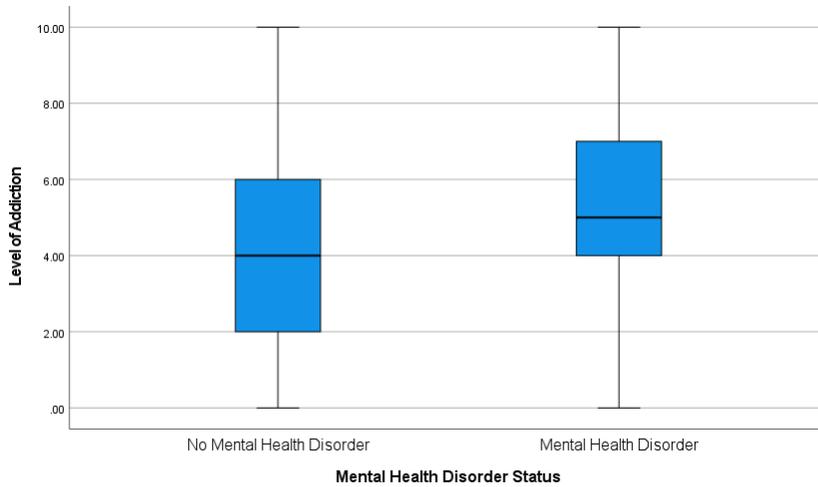


Figure 22 represents a boxplot of level of addiction to nicotine by mental health disorder status. This figure indicates that participants with a mental health disorder have a higher average level of addiction to nicotine than those without a mental health disorder. Furthermore, in general participants with a mental health disorder have higher levels of addiction than participants without a mental health disorder.

**Figure 23**

*Boxplot of Number of Quit Attempts excluding zero attempts by Mental Health Diagnosis Status*

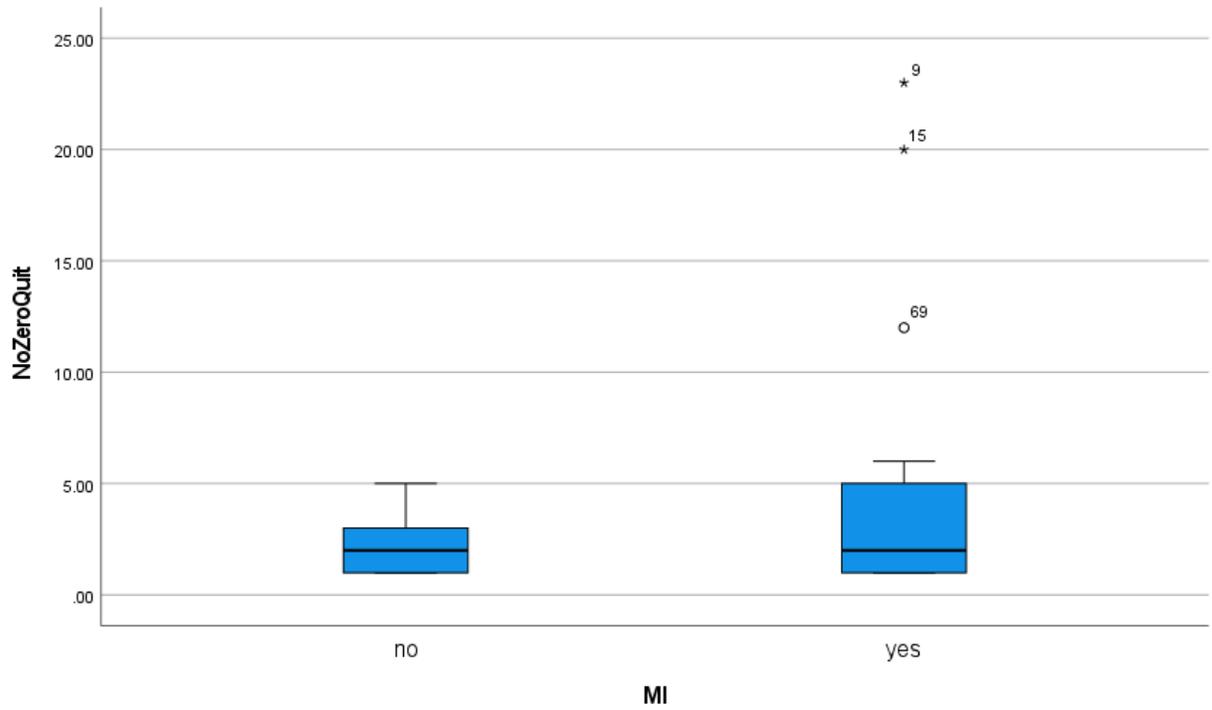
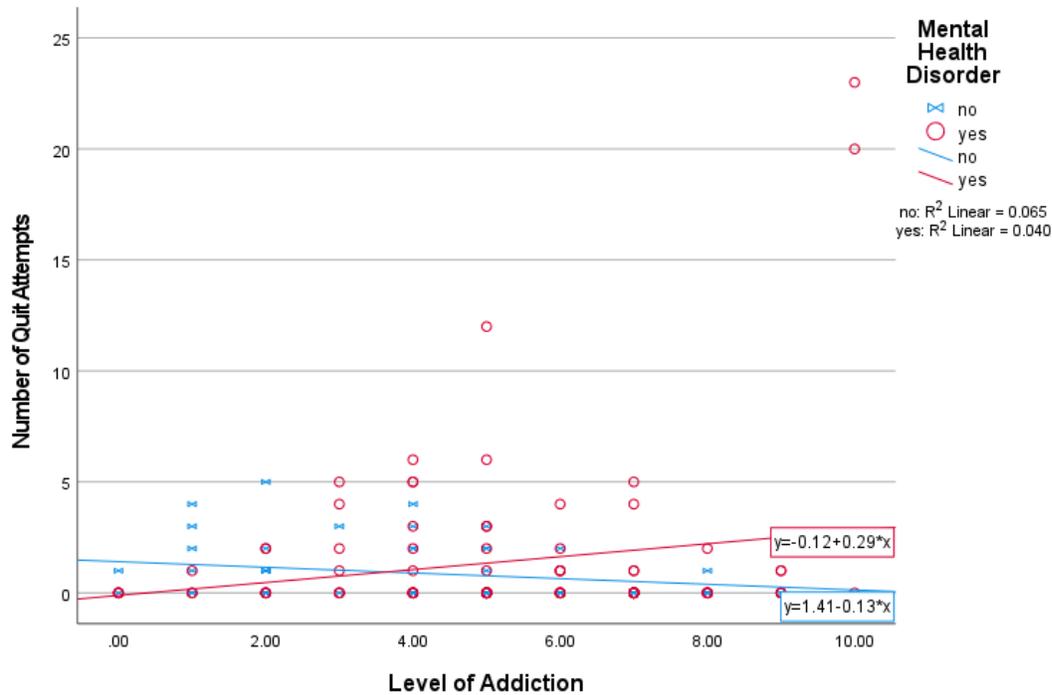


Figure 23 is a boxplot of number of quit attempts (excluding zero attempts at quitting) separated by mental health disorder status. This figure indicates that participants with a mental health disorder appear to have more attempts at quitting overall than those without a mental health disorder, even though they have similar values for mean number of quit attempts. Furthermore, participants with a mental health disorder had more extreme values with three participants with a mental health disorder attempting to quit ten or more times. This figure depicts the nature of mental health disorder status and quit attempts. The figure shows that although participants often did not try to quit, of the participants that tried to quit, those with a mental health disorder generally tried to quit more often than participants without a mental health disorder.

**Figure 24**

*Scatterplot of Number of Quit Attempts by Level of Addiction grouped by Mental Health Disorder Status*

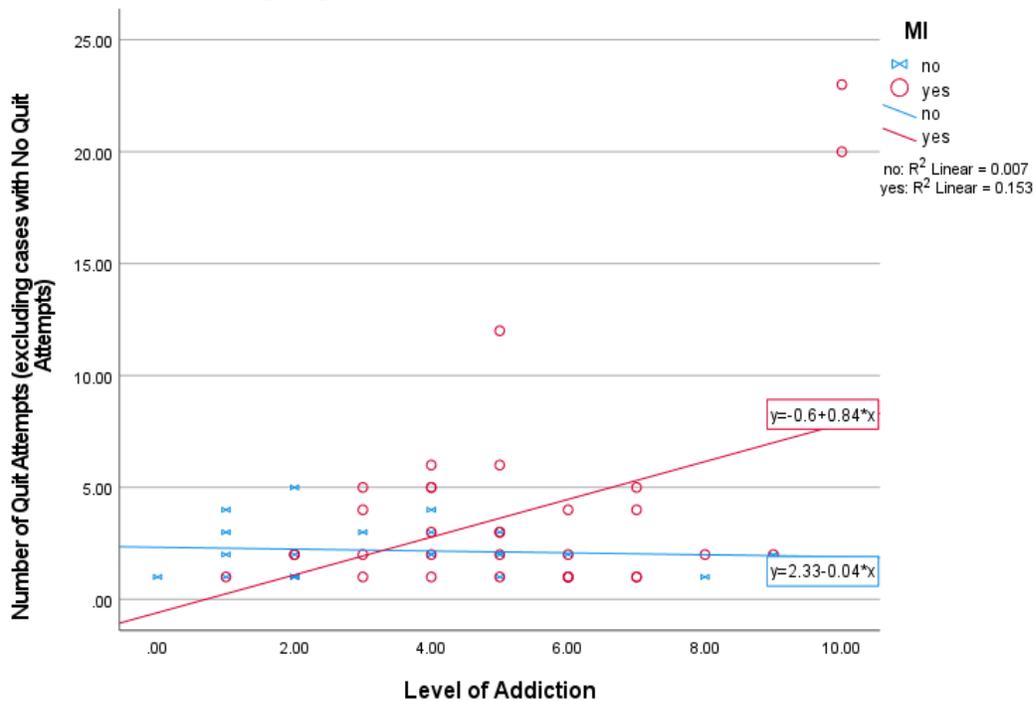


Even though the linear model is not appropriate for testing significance or formally assessing mediation and moderation, it can be used to understand the dynamics behind the data. Therefore, the linear relationship is shown to explore the dynamics between the groups. Figures 24 and 25 show that the number of quit attempts increase as their level of addiction increases for participants with a mental health disorder. The scatterplots which employ linear regression, allow for an understanding of the interaction present for each of the variables in the analysis through a graphical depiction of the interaction. In figure 25, the aforementioned relationship is more pronounced because participants that did not attempt to quit smoking were excluded from the scatterplot. Remarkably, the relationship between level of addiction and number of quit attempts for individuals without a mental health disorder did not change dramatically when cases with zero quit attempts were excluded from the scatterplot. However, there appears to be a more

pronounced relationship for individuals with a mental health disorder when cases with no quit attempts were excluded. The change in the results may be due to the fact that of the 94 individuals with a mental health disorder, 64.9 % ( $n = 61$ ) had zero quit attempts and only 35.1% ( $n=33$ ) had at least one quit attempt in the last year. Conversely, of the 56 individuals without a mental health disorder 60.7 % ( $n=34$ ) had no quit attempts and only 39.3% ( $n=22$ ) had at least one quit attempt in the last year.

**Figure 25**

*Scatterplot of Number of Quit Attempts (excluding cases with no quit attempts) by Level of Addiction to Nicotine grouped by Mental Health Disorder Status*

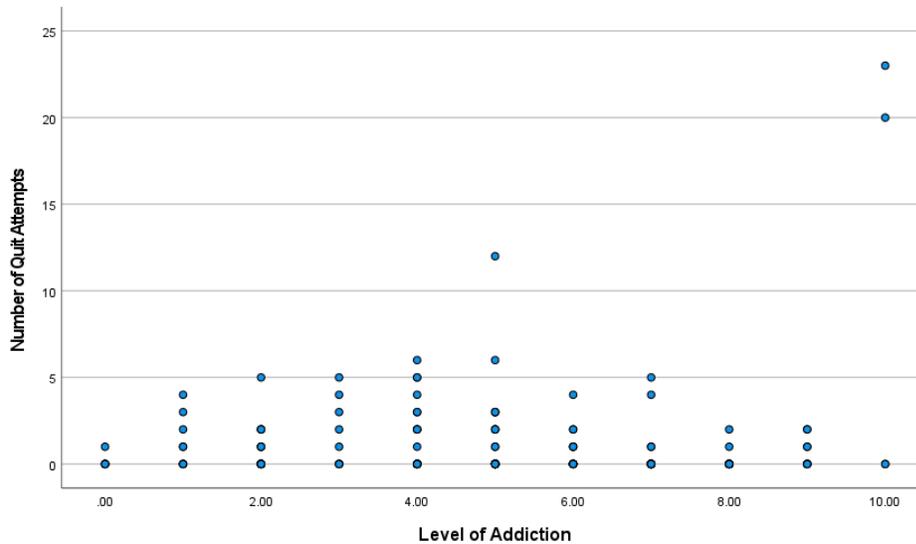


**Moderation Analysis.**

**Step 1.** The first step in the moderation analysis involved determining whether a relationship exists between the independent variable (level of addiction to nicotine) and the dependent variable (the number of quit attempts in the last twelve months) by creating a scatterplot of the two.

**Figure 26**

*Scatterplot of Number of Quit Attempts and Level of Addiction*



Based on figure 26, the scatterplot demonstrates that a curvilinear relationship exists between the independent and dependent variables. Participants' number of quit attempts appear to increase with level of addiction until level of addiction reaches five. After participants' level of addiction values reach a FTND score of five, the number of quit attempts begin to decrease as level of addiction increases, except for two outliers found at the highest level of addiction, a FTND score of ten. As mentioned previously, the outliers are included in the analysis. The outliers are essential datapoints and there is no reason to doubt the integrity of the data collection for these two datapoints. Additionally, the data appears to be over-dispersed and zero-inflated, which can be visualized in the graph. For every level of addiction there are a large number of individuals who have had zero quit attempts in the last 12 months.

In fact, ninety-four or 62.7% of participants indicated no quit attempts in that last 12 months, further underscoring the importance of using the correct model in this analysis.

**Step 2.** The independent variable (X) and the dependent variable (Y) were entered into a

negative binomial regression analysis

**Table 9**

*Negative Binomial Regression Parameter Estimates: Level of Addiction on Number of Quit Attempts*

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	<i>p</i>
Intercept	.168	.1117	-.051	.387	2.258	1	.133
Level of Addiction	.097	.0404	.018	.176	5.750	1	.016

Dependent Variable: Number of Quit Attempts

Model: (Intercept), Level of Addiction Centered

Steps three and four are conducted for each of the potential moderators or variables in research questions 1.b through 1.f below. Please refer to each specific section for the results. Table 9 shows the initial model for the independent and dependent variables. As outlined in Table 9, the initial model has B = 0.097 or 0.097 increase in log quit attempts per one-unit change in level of addiction.

**Addressing Research Question 1.b**

Research question 1.b is exploring the following question: Does employment status moderate the relationship between participants’ level of addiction and their number of quit attempts? Research question 1b involved examining the moderating effects of employment status on the relationship between level of addiction to nicotine and number of quit attempts. Please refer to steps one and two above for reference. The analysis for employment status as a moderator is explored in steps three and four below.

Please refer to the binomial regression analysis outlined in steps one and two at the beginning of the moderation section.

**Step 3.** Next, level of addiction (X), number of quit attempts (Y), employment status (Z),

and the interaction term of X\*Z were evaluated in the negative binomial model. The inclusion of the interaction term determined if the effect of X depends on the level of Z. If the X\*Z interaction is significant,  $p < 0.1$  or a 10% or more change as defined in the statistical section on moderation.

**Table 10**

*Negative Binomial Regression Parameter Estimates: Level of Addiction to Nicotine, Employment Status, and Interaction Term on Number of Quit Attempts*

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			95% Wald Confidence Interval for Exp(B)		
			Lower	Upper	Wald Chi-Square	df	Sig.	Exp(B)	Lower	Upper
(Intercept)	.209	.15	-.08	.50	1.97	1	.160	1.232	.92	1.65
Level of Addiction Centered	.168	.05	.07	.27	10.21	1	.001	1.183	1.07	1.31
Employment Status	-.445	.25	-.94	.05	3.13	1	.077	.641	.39	1.05
Level of Addiction Centered*Employment Status	-.312	.1	-.51	-.12	10.07	1	.002	.732	.60	.89

Dependent Variable: Number of Quit Attempts

Model: (Intercept), Level of Addiction Centered, Employment Status, Level of Addiction Centered \* Employment Status

Table 10 contains the negative binomial regression coefficients for each of the predictor variables along with their standard errors, Wald Chi-Square values,  $p$ -values (Sig.), 95% confidence intervals for the coefficients, and the exponentiated results. In this moderation analysis, all parameters except the intercept are significant. Since the interaction term is significant ( $p = .002$ ), an effect modification or moderation for employment status is present. Therefore, employment status is a moderator for the relationship between the independent and dependent variables.

The results displayed in Table 10 that level of addiction is positively associated with quit

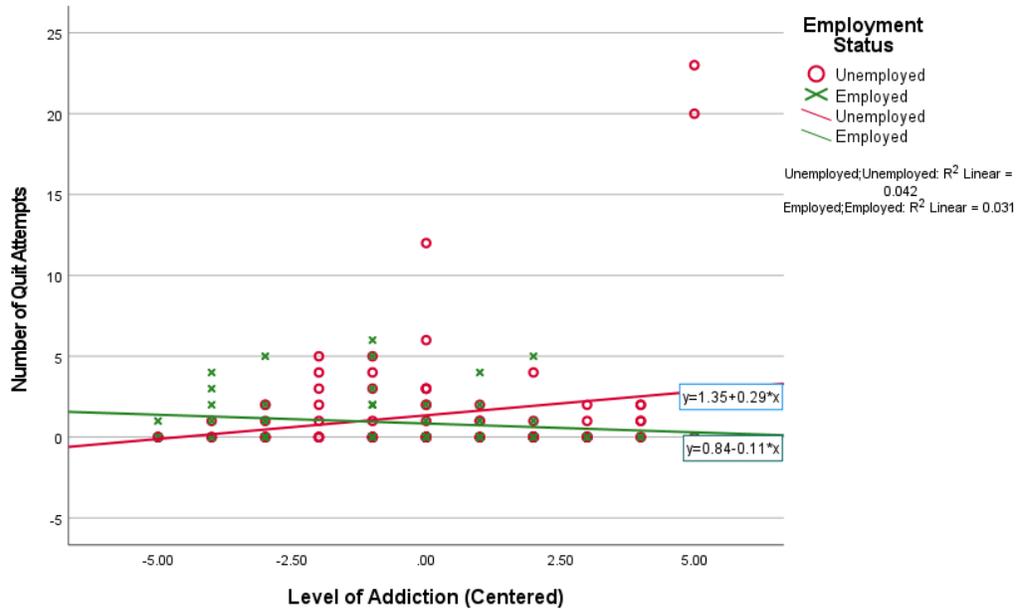
attempts (B-coefficient = 0.168). Therefore, clients are more likely to quit with a higher level of addiction. However, employment status is negatively associated with the number of quit attempts (B-coefficient = -0.445). The negative B-coefficient for the interaction term indicates that the employment status is either more negative or less positive as levels of addiction increase. Furthermore, since employment status has a negative coefficient, it reduces the overall intercept and therefore reduces the predicted mean count for quit attempts.

These results indicate that when a participant is employed, they appear to have fewer number of quit attempts. Additionally, if an individual is unemployed, the results indicate that as level of addiction increases there is also an increase in the number of quit attempts. The exponentiated B indicates the incidence rate of quit attempts in those with employment is .641 times less ( $\exp(-.445)$ ) than individuals who are unemployed or a 36% less incidence of quit attempts in employed participants (or % reduced  $(0.641-1.00)*100 = -35.9\%$ ).

**Step 4.** Since Employment Status is a significant moderator ( $p = .002$ ) a graphical depiction of the relationship was used to determine the nature and direction of the effect of the moderator on the relationship between level of addiction and number of quit attempts. The significance level of 0.1 is used throughout this study because interaction tests are less powerful and there is a small sample size in this study.

**Figure 27**

*Scatterplot of Number of Quit Attempts by Level of Addiction grouped by Employment Status*



Even though the linear model is not appropriate for testing significance or formally assessing mediation and moderation, it can be used to understand the dynamics behind the data. Therefore, the linear relationship is shown only to explore the dynamics between the groups. The profile scatterplot in figure 27 depicts the nature and direction of the effect of employment status as a moderator of the relationship between level of addiction and number of quit attempts. This profile plot displays the number of quit attempts by level of addiction, with the two levels of employment status (employed or unemployed) along with a line fit to both levels. This graph indicates that for individuals that are unemployed, the higher the level of addiction the greater the number of quit attempts. Conversely, for individuals who are employed, the higher the level of addiction the fewer number of quit attempts they will engage in.

**Addressing Research Question 1.c**

Research question 1.c is: Does age at smoking initiation moderate the relationship

between participants' level of addiction and their number of quit attempts? Research question 1.c involved examining the moderating effects of age at smoking initiation on the relationship between level of addiction to nicotine and number of quit attempts. Please refer to steps one and two at the beginning of the moderation analysis section for reference. The analysis for age at smoking initiation as a moderator is explored in steps three and four below.

**Step 3.** The level of addiction (X), number of quit attempts (Y), and the potential moderator or age at smoking initiation (Z) were all analyzed in the negative binomial regression model including the interaction term of X\*Z, or age at smoking initiation\* level of addiction. The analysis was conducted using a negative binomial model-based estimator, the omnibus test indicated that the likelihood ratio chi-square is 24.06,  $df = 3, p < 0.001$ .

**Table 11**

*Negative Binomial Regression Parameter Estimates: Level of Addiction to Nicotine, Age at Smoking Initiation, and Interaction Term on Number of Quit Attempts*

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
			Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
(Intercept)	.111	.116	-.117	.339	.911	1	.340	1.118	.890	1.404
Age at Smoking Initiation	.090	.024	.042	.137	13.902	1	.000	1.094	1.04	1.146
Level of Addiction Centered	.091	.044	.004	.177	4.187	1	.041	1.095	1.00	1.194
Age at Smoking Initiation*Level of Addiction	.017	.009	-.001	.036	3.462	1	.063	1.017	.999	1.036

Dependent Variable: Number of Quit Attempts

Model: (Intercept), Age at Smoking Initiation Centered, Level of Addiction Centered, Age at Smoking Initiation Centered \* Level of Addiction Centered

a. Fixed at the displayed value.

Table 11 contains the negative binomial regression coefficients for each of the predictor variables along with their standard errors, Wald Chi-Square values,  $p$ -values (Sig.), 95%

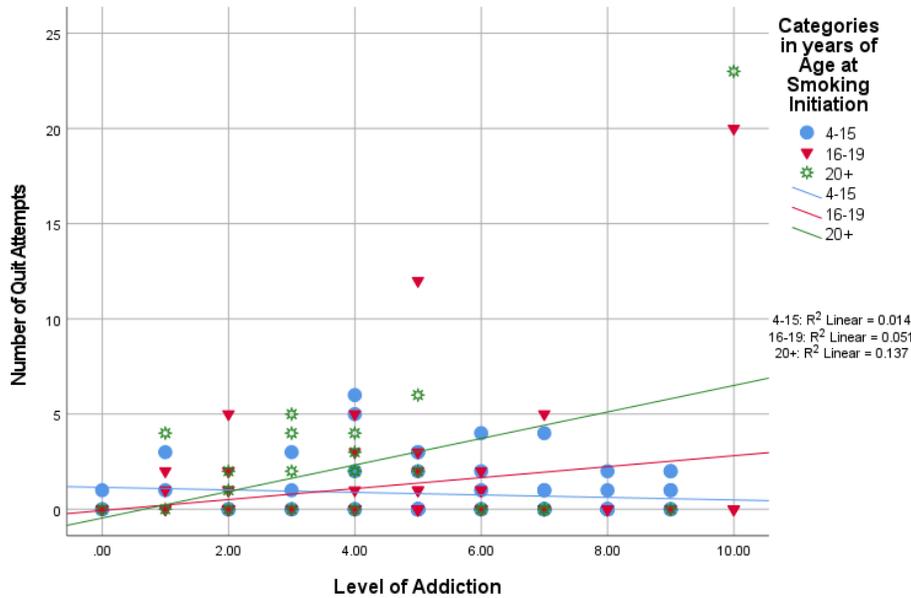
confidence intervals for the coefficients, and exponentiated results. The intercept is not statistically significant ( $p = 0.340$ ). However, the results displayed in Table 11 showed that level of addiction, the age at smoking initiation, and the interaction term are all significant ( $p = .041$ ,  $p < 0.0001$ , and  $p = .063$  respectively). The significant interaction term coupled with the theoretical basis for the interaction of age at smoking initiation and present level of addiction indicates that there is an effect modification for age at smoking initiation. Therefore, age at smoking initiation acts as a moderator for the relationship between level of addiction and number of quit attempts. When age at smoking initiation is included in the model, level of addiction to nicotine is positively associated with quit attempts (B-coefficient = 0.091). Additionally, age at smoking initiation is positively associated with quit attempts (B-coefficient = 0.090). There appears to be a synergistic effect present. Specifically, participants who started smoking later and with a higher level of addiction are more likely to have a greater number of quit attempts. Therefore, the interaction between age at smoking initiation and level of addiction appears to enhance quit attempts. The exponentiated B results indicate the incidence rate of quit attempts increases with every unit increase in age at smoking initiation, and there is a 1.094 times greater ( $\exp(.090)$ ) number of quit attempts for every unit increase in age at smoking initiation.

**Step 4.** As mentioned previously, age at smoking initiation is the only continuous variable assessed for moderation in this study. Therefore, the magnitude of change in the coefficient for the interaction term was explored to determine the nature and direction of the effect of this moderator on the relationship between X and Y. The beta coefficient for the interaction term (Level of Addiction\*Age at Smoking Initiation) was 0.017, which is a reduction from coefficient for the relationship between X and Y (B-coefficient=0.097). Additionally, since

the sign of the interaction coefficient was positive there is an increase in the slope for the relationship of level of addiction and number of quit attempts.

**Figure 28**

*Scatterplot of Number of Quit Attempts by Level of Addiction grouped by Categories of Age at Smoking Initiation*



As mentioned before, the linear model is not appropriate for testing significance or formally assessing moderation, however the model can be used to understand the dynamics behind the data. Therefore, the linear relationship is shown only to explore the dynamics between the groups. The references to the strength of the linear relationship are included here because they were used to understand trends in the data, but for those purposes only. With that understanding, Figure 28 represents the nature and direction of the relationship between number of quit attempts by level of addiction grouped by categories of age at smoking initiation. Age at smoking initiation was divided into three separate groups based on the age that participants first began smoking: 4 to 15 years of age, 16 to 19 years, and 20 years of age and older. These categories were determined based on the distribution of data for age at smoking initiation. Based on these different categories, it appears that there are differences in the relationship between

level of addiction and number of quit attempts for participants that initiated smoking during their childhood and earlier adolescence (four to 15 years), older adolescence/teenage years (16 to 19 years), and adulthood (20 years and older). The scatterplot indicates that there is a stronger linear relationship between level of addiction and number of quit attempts ( $R^2 = 0.137$ ) for adults, with adults more likely to engage in multiple quit attempts with higher levels of addiction. This same trend is observed in participants' who initiated smoking in their later teenage years (16 to 19 years) though the linear relationship is not as strong ( $R^2 = 0.051$ ). However, both the linear relationship for adults and older teens are greatly influenced by the two outliers. Furthermore, Figure 28 indicates a trend showing participants who initiated smoking during childhood and early adolescence appear to engage in fewer quit attempts as their level of addiction increases.

#### **Addressing Research Question 1.d**

Research question 1.d is: Does a history of a SUD moderate the relationship between participants' level of addiction and their number of quit attempts? In this study, 14.7% ( $n=22$ ) of participants indicated they had a history of a SUD. Question 1.d explores whether having a history of a SUD acts as a moderator for the relationship between participants' level of addiction to nicotine and their quit attempts. For this moderation analysis, please refer to the results in steps one and two in the initial section on moderation analysis conducted in this study.

**Step 3.** In step three, level of addiction (X), number of quit attempts (Y), history of a SUD (Z) as well as the interaction term of  $X*Z$  were analyzed in a negative binomial regression model. Table 12 displays the results of this analysis. For the model explored in Table 12, the omnibus likelihood ratio chi-square is 11.49,  $df = 3$ ,  $p = 0.009$ .

**Table 12**

*Negative Binomial Regression Parameter Estimates: Level of Addiction to Nicotine, History of Substance Use Disorder (SUD), and Interaction Term on Number of Quit Attempts*

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			95% Wald Confidence Interval for Exp(B)	
			Lower	Upper	Wald Chi-Square	df	Sig.	Lower	Upper
(Intercept)	.157	.1206	-.079	.394	1.702	1	.192	1.170	.924 1.483
Level of Addiction	.053	.0451	-.036	.141	1.356	1	.244	1.054	.965 1.151
History of SUD	-.340	.3715	-1.068	.388	.837	1	.360	.712	.344 1.474
Level of Addiction* History of SUD	.282	.1257	.036	.529	5.050	1	.025	1.326	1.037 1.697

Dependent Variable: Number of Quit Attempts

Model: (Intercept), Level of Addiction Centered, History of SUD, Level of Addiction Centered\* History of SUD

Table 12 contains the negative binomial regression coefficients for each of the predictor variables along with their standard errors, Wald Chi-Square values, *p*-values (Sig.), 95% confidence intervals for the coefficients and exponentiated results as well. The intercept, the level of addiction, and the history of a SUD are not statistically significant. However, the interaction term is significant ( $p=0.025$ ) indicating that moderation has occurred. The significant interaction term coupled with the theoretical underpinnings related to smoking behaviors of an individual with a history of a SUD and how that might influence their level of addiction points to the presence of an effect modification for a participant having a history of a SUD.

Results in Table 12 indicate that participants' history of a SUD is negatively associated with number of quit attempts (beta coefficient = -0.340). Therefore, it appears participants with a history of a SUD were less likely to quit smoking than those without. However, this parameter was not statistically significant ( $p = .36$ ). The level of addiction and the interaction term are positively associated with number of quit attempts (beta coefficient = .053 and beta coefficient =

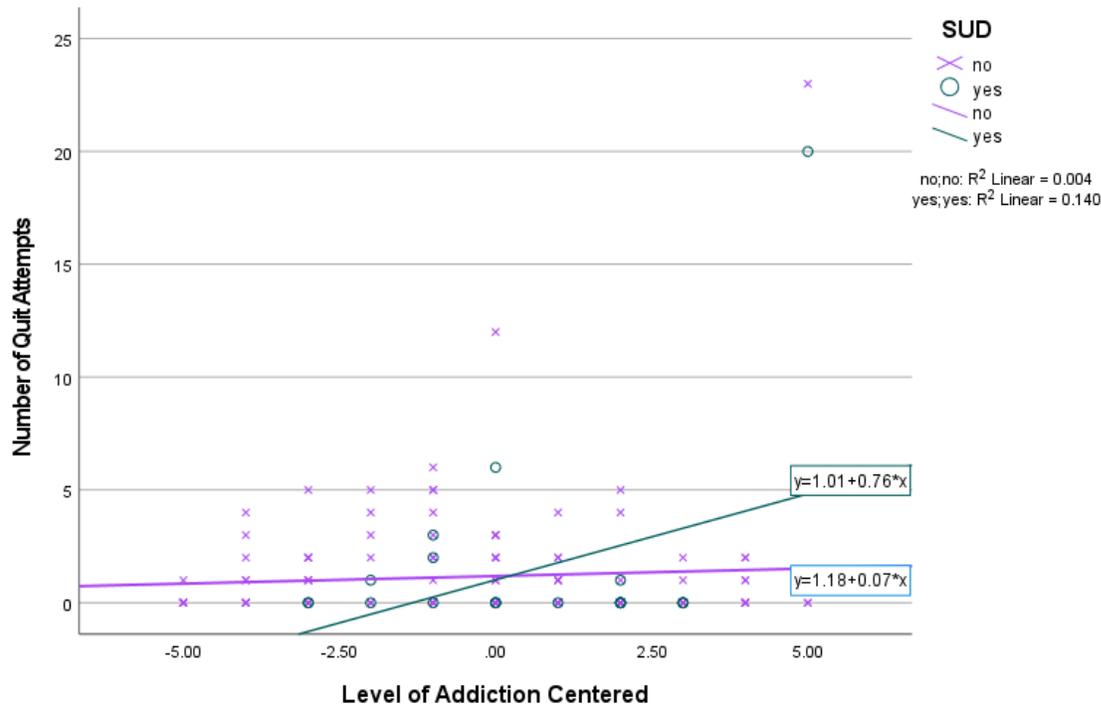
.282 respectively). The interaction term is the only parameter in the model that is significant ( $p = .025$ ). The interaction term is also positively associated with number of quit attempts, indicating that when participants have a history of a SUD, they are more likely to attempt quitting as their level of addiction to nicotine increases.

The fact that participants' history of a SUD acted as a moderator in this study is further supported in figure 29, which is a scatterplot of the number of quit attempts by level of addiction grouped by the presence or absence of a history of a SUD. The exponentiated B results indicate the incidence rate of quit attempts in those with a history of a SUD is .712 times less ( $\exp(-.340)$ ) than individuals without a history of a SUD. Therefore, there is a 29% less incidence of log quit attempts in participants with a history of a SUD (or % reduced  $(0.712-1.00)*100=-28.8\%$ ) than those without.

**Step 4.** Figure 29 is a scatter plot of the relationship between level of addiction and quit attempts and is grouped by whether or not participants have a history of an SUD. The results further support the results from Figure 29 and illustrate the interaction present. In this study, there is only a small portion (14.7%,  $n = 22$ ) of participants with a history of a SUD, which may skew the results and is a limitation of this variable.

**Figure 29**

*Number of Quit Attempts by Level of Addiction grouped by History of a Substance Use Disorder*



Though the linear model is not appropriate for use in this dataset for testing significance or formally assessing moderation, Figure 29 uses the linear model to better understand the dynamics behind the data. Therefore, the linear relationship is shown only to explore the dynamics between the groups. For participants with a history of a SUD as level of addiction increases so did their number of quit attempts.

**Addressing Research Question 1.e**

The sixth research question: Does living with a smoker moderate the relationship between participants' level of addiction and their number of quit attempts? Research question 1.e involved examining the moderating effects of living with a smoker on the relationship between level of addiction to nicotine and number of quit attempts. Please refer to steps one and two above for reference. The analysis for living with a smoker as a moderator is explored in steps

three and four below.

**Step 3.** Table 13 presents the results of the analysis when the independent, dependent, the potential moderator variable (living with a smoker), and the interaction term were analyzed in a negative binomial regression analysis. For the model explored in Table 13, the omnibus likelihood ratio chi-square is 7.58,  $df = 3$ ,  $p = 0.056$ .

**Table 13**

*Negative Binomial Parameter Estimates: Level of Addiction to Nicotine, Living with Smoker, and Interaction Term on Number of Quit Attempts*

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			95% Wald Confidence Interval for Exp(B)	
			Lower	Upper	Wald Chi-Square	df	Sig.	Lower	Upper
(Intercept)	.250	.1598	-.063	.564	2.455	1	.117	1.285	.939 1.757
Level of Addiction	.053	.0564	-.058	.163	.882	1	.348	1.054	.944 1.178
Live with a Smoker	-.171	.2242	-.610	.269	.579	1	.447	.843	.543 1.308
Level of Addiction * Live with a Smoker	.092	.0813	-.068	.251	1.276	1	.259	1.096	.935 1.285

Dependent Variable: Number of quit Attempts

Model: (Intercept), Level of Addiction Centered, Live with a Smoker, Level of Addiction Centered \* Live with a Smoker

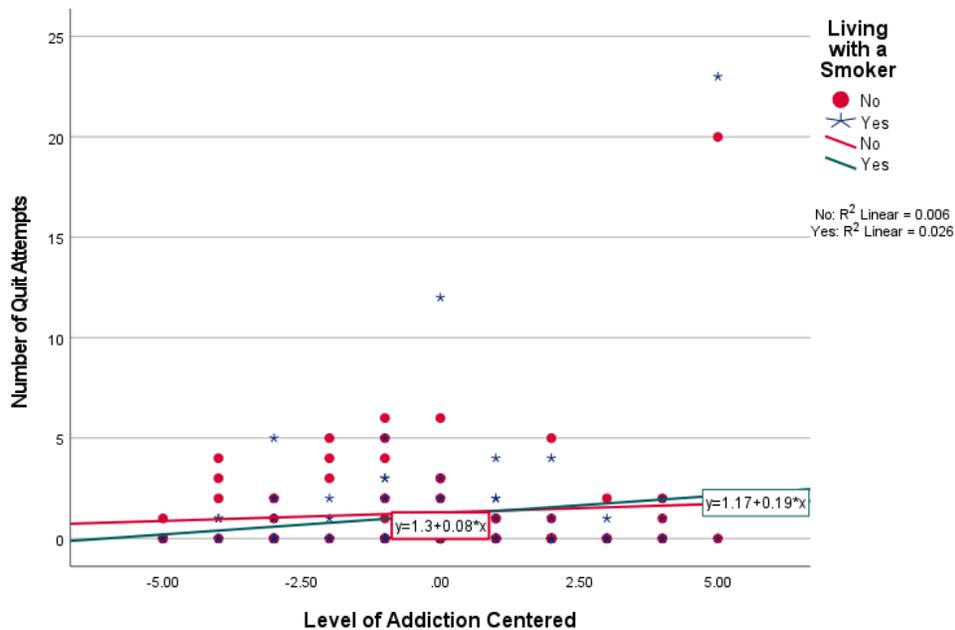
Table 13 displays the results of the moderation analysis for question 1.e. Table 13 contains the negative binomial regression coefficients for each of the predictor variables along with their standard errors, Wald Chi-Square values,  $p$ -values (Sig.), 95% confidence intervals for the coefficients, and exponentiated results. The parameters are not significant, therefore, living with a smoker does not appear to be a moderator based on these results. However, in chapter 3, an additional process for determining whether a variable is a moderator is outlined. Since there are no significant terms in this model, moderation will not be considered even though the additional process is mentioned in chapter 3.

The exponentiated B results indicate the incidence rate of log quit attempts in those that live with a smoker is .843 times less ( $\exp(-.171)$ ) than individuals that do not live with a smoker. Therefore, there is a 16% less incidence of log quit attempts in participants who live with a smoker (or % reduced  $(0.843-1.00)*100=-15.7\%$ ) than those that do not live with a smoker. The rate ratios for level of addiction and the interaction term are both close to one and therefore appear to have minimal impact.

**Step 4:** Although, there are no parameters that are significant, a scatterplot was developed to depict the nature and relationship of the variables. Figure 30 is a scatterplot of number of quit attempts by level of addiction grouped by whether or not the participant lives with a smoker. The linear model is not appropriate for testing significance or formally assessing mediation and moderation, it is used to understand the dynamics behind the data.

**Figure 30**

*Scatterplot of Number of Quit Attempts by Level of Addiction grouped by whether the Participant Lives with a Smoker*



### Addressing Research Question 1.f.

The final research question, question 1.f., is: Does working in a smoke-free environment moderate the relationship between participants' level of addiction and their number of quit attempts? Research question 1.f involved examining the moderating effects of workplace smoking status on the relationship between level of addiction to nicotine and number of quit attempts. Please refer to steps one and two above for reference. The analysis for the community level of influence variable, working in a smoke free environment as a moderator is explored in steps three and four below.

**Step 3.** In the third step, level of addiction (X), number of quit attempts (Y), working in a smoke free environment (Z) and the interaction term of X\*Z were evaluated in the negative binomial regression model. Only 41.3% of participants (n=62) indicated they were employed in the current study so question 1.f only includes responses from 41.3% of the sample. For the model explored in Table 14, the omnibus likelihood ratio chi-square is 6.185,  $df = 3, p = 0.103$ .

**Table 14**

*Negative Binomial Regression Parameter Estimates: Level of Addiction to Nicotine, Working in a Smoke-free Work Environment, and Interaction Term on Number of Quit Attempts*

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
			Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
(Intercept)	-.651	.5025	-1.636	.333	1.681	1	.195	.521	.195	1.396
Level of Addiction	-.405	.1922	-.781	-.028	4.431	1	.035	.667	.458	.973
Smoke-free Work Environment	.513	.5527	-.570	1.596	.862	1	.353	1.670	.565	4.935
Level of Addiction * Smoke-free Work Environment	.350	.2156	-.073	.773	2.636	1	.104	1.419	.930	2.166

Dependent Variable: Number of Quit Attempts

Model: (Intercept), Level of Addiction Centered, Smoke-free Work Environment, Level of Addiction Centered \* Smoke-free Work Environment

Table 14 displays the results of the moderation analysis for question 1.e. and contains the negative binomial regression coefficients for each of the predictor variables along with their standard errors, Wald Chi-Square values,  $p$ -values (Sig.), 95% confidence intervals for the coefficients, and exponentiated results. As mentioned in the data cleaning section, the data from only 62 participants is included in this moderation analysis because there were only 62 employed participants. The interaction term is remarkably close to being significant at the 0.1 level ( $p = 0.104$ ), however, the only parameter that is significant in this model is level of addiction ( $p = 0.035$ ). This parameter indicates that level of addiction is negatively associated with quit attempts (beta coefficient = -0.405). The interaction term is not significant, therefore, working in a smoke-free environment does not appear to be a moderator for the relationship between level of addiction to nicotine and number of quit attempts. However, an additional process for determining whether a variable is a moderator is outlined in chapter 3, which specified if a 10% or more change as defined in the statistical section on moderation, then moderation has occurred even without a significant interaction term. The equation outlined in chapter 3 is  $(|\beta_3| / (|\beta_1| + |\beta_3|)) \geq 0.1$ . This additional process was added due to the small size of the sample analyzed in the current study. The intercept coefficient for the interaction or  $\beta_3$  is 0.35 and the intercept for level of addiction,  $\beta_1$ , is -.405 with the introduction of the smoke-free work environment variable into the model signifying a 46.4% change  $((0.35)/(0.405+0.35) = .464$ , using the absolute value for all parameters). In other words,  $\beta_3$  constitutes 10% or more (46.4 %) of the total effect of level of addiction on the number of quit attempts.

Therefore, based on the assessment of moderation outlined in chapter 3, with 46.4% constituted greater than 10% of the total effect. This assessment coupled with the theoretical underpinnings associated with smoking environment present at participants' places of employment, whether participants work in a smoke-free work environment has an effect modification for the relationship between participants' level of addiction and their number of quit attempts.

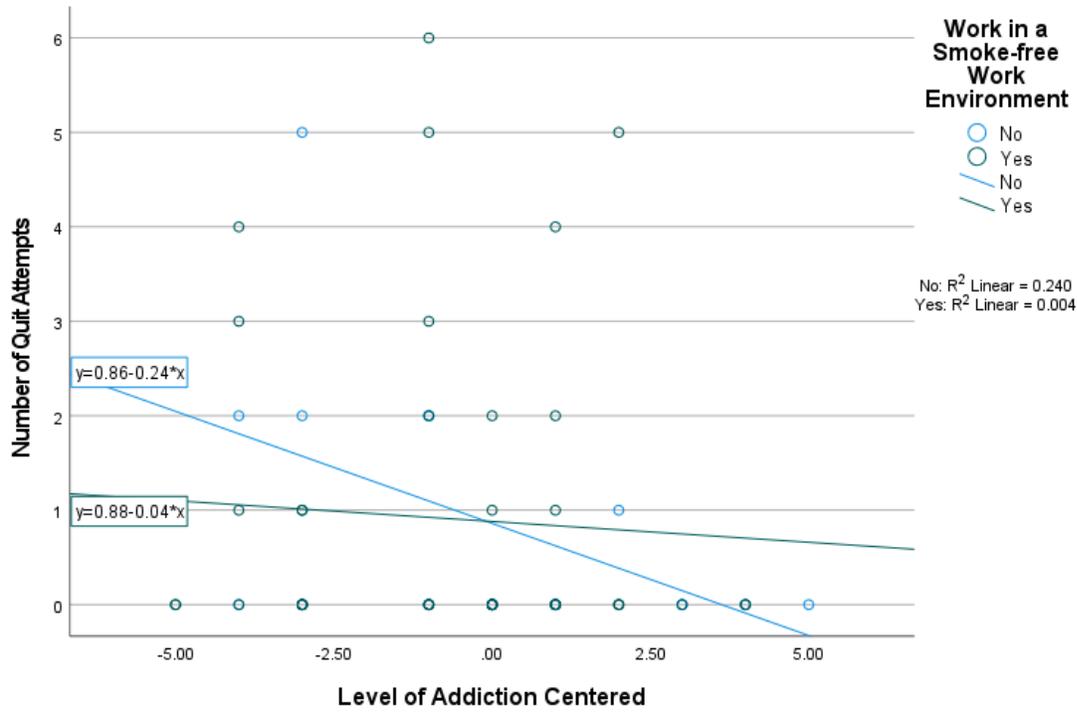
Furthermore, the results presented in Table 14 indicate that at lower levels of addiction individuals are more likely to quit than at higher levels of addiction regardless of whether the individual works in a smoke free environment or not. However, there is a more pronounced drop in quit attempts as level of addiction increases for individuals that work in environment that allows smoking. These results are further supported in Table 14.

Based on the exponentiated results in Table 14, the incidence rate of quit attempts in those working in a smoke-free environment is 1.67 times greater ( $\exp(.513)$ ) than for individuals who work in an environment that allows smoking. Furthermore, these results indicate there is a 67% greater incidence of quit attempts in participants' that work in a smoke-free environment (or % increased  $(1.67-1.00)*100=67\%$ ) than participants that work in an environment that allows smoking.

**Step 4:** Figure 31 shows the interaction present for working in a smoke free environment.

**Figure 31**

*Scatterplot of Number of Quit Attempts by Level of Addiction grouped by whether Participants Work in a Smoke-free Environment or an Environment that Allows smoking*



Even though the linear model is not appropriate for testing significance or formally assessing mediation and moderation, it can be used to understand the dynamics behind the data. Therefore, the linear relationship is shown only to explore the dynamics between the groups. Figure 31 indicates that for individuals who are employed, at lower levels of addiction it appears that participants have a higher number of quit attempts than at higher levels of addiction. This trend is observed in both participants that work in a smoke-free environment and those that work in an environment that allows smoking. There appears to be a more noticeable decline in quit attempts as level of addiction increases for individuals that work in environment that allows smoking.

## Summary

This study explored if psychosocial environmental variables influence the relationship between participants' level of addiction and their number of quit attempts. Specifically, the overarching question examined the mediating or moderating effects of six specific psychosocial environmental variables on the relationship between participants' level of addiction to nicotine and number of quit attempts. Based on the mediation analysis conducted, mental health diagnosis status acts as a mediator, partially mediating the relationship between participants' level of addiction and their number of quit attempts. The results of the moderation analyses conducted in this study determined that participant's' employment status, age at smoking initiation, history of a SUD, and whether the participant works in a smoke-free environment or not all appear to have an effect modification or a moderating effect on the relationship between the level of addiction to nicotine and the number of quit attempts. However, living with a smoker does not appear to be a moderator for the relationship. Since moderators can influence the relationship between the independent variable and the dependent variable in several ways (they can strengthen, weaken, or reverse the nature of the relationship) the nature of the influence of each moderator was also examined (Blair, 2020).

## **CHAPTER V: DISCUSSION**

Despite increased awareness of the harms of cigarette smoking and improved smoking prevention efforts, tobacco and smoking-related illness and injury continue to be a leading cause of death and disability in the United States (Golechha, 2016; CDC, 2019a). To add to the current understanding of the complex interplay of factors related to cigarette smoking behaviors, this study used the Social Ecological Model of health behaviors (SEM) as a framework (McLeroy, et al., 1988). The SEM is a unique model that explores health related behaviors like smoking cessation at four levels of influence: individual, relationship, community, and societal levels of influence. The SEM provides a comprehensive portrait of the multiple layers of influence that affect behavior (McLeroy, et al. 1988; CDC, 2019b). With the use of the SEM as a framework to explore the four levels of influence on smoking behaviors, the results of this study indicate that specific psychosocial variables acted as mediators or moderator for the relationship between participants' level of addiction to nicotine and their number of quit attempts in the last year.

The following chapter covers the interpretation of the results for each research question, the limitations of the study, and the implications of the results for future research, teaching, and clinical practice.

### **Interpretation of Results**

The current study explored whether specific psychosocial environmental variables influence the relationship between participants' level of addiction and their number of quit attempts. The results allowed for an investigation into the influence of individual, relationship, community, and societal variables on smoking behavior (i.e., quit attempts in the past year). The individual variables analyzed included (a) level of addiction to nicotine, (b) the presence of a mental health disorder (c) employment status, (d) age at smoking initiation, (e) history of a

Substance Use Disorder (SUD), and (f) number of quit attempts in the last 12 months (i.e., the number of smoking cessation efforts). The relationship level factor analyzed in the current study was whether participants live with a smoker. Community level variables include personal environment and social norms related to smoking behaviors; this study specifically analyzed whether the participant works in a smoke-free environment. As noted in chapter two, societal levels of influence were not analyzed in the current study.

In the present study, level of addiction was the independent variable and the number of quit attempts in the last 12 months was the dependent variable. The independent variable, level of addiction to nicotine, was determined by the Fagerström Test of Nicotine Dependence (FTND), a gold standard in the assessment of an individual's level of physical addiction to nicotine (Svicher, Cosci, Gianni, Pistelli, & Fagerstrom, 2018; Heatherton, et al., 1991). The six-item FTND is based on a summed score with scores ranging from zero through ten, with a higher total Fagerström score indicating a greater intensity of physical dependence on nicotine (Heatherton, et al., 1991). The dependent variable for the study is a behavioral measure of quit attempts over the last 12 months. Specifically, it is the number of times the participant indicated they "... made a serious attempt to quit smoking in the last 12 months?" Notably, these attempts can be considered unsuccessful quit attempts since only current smokers participated in this study.

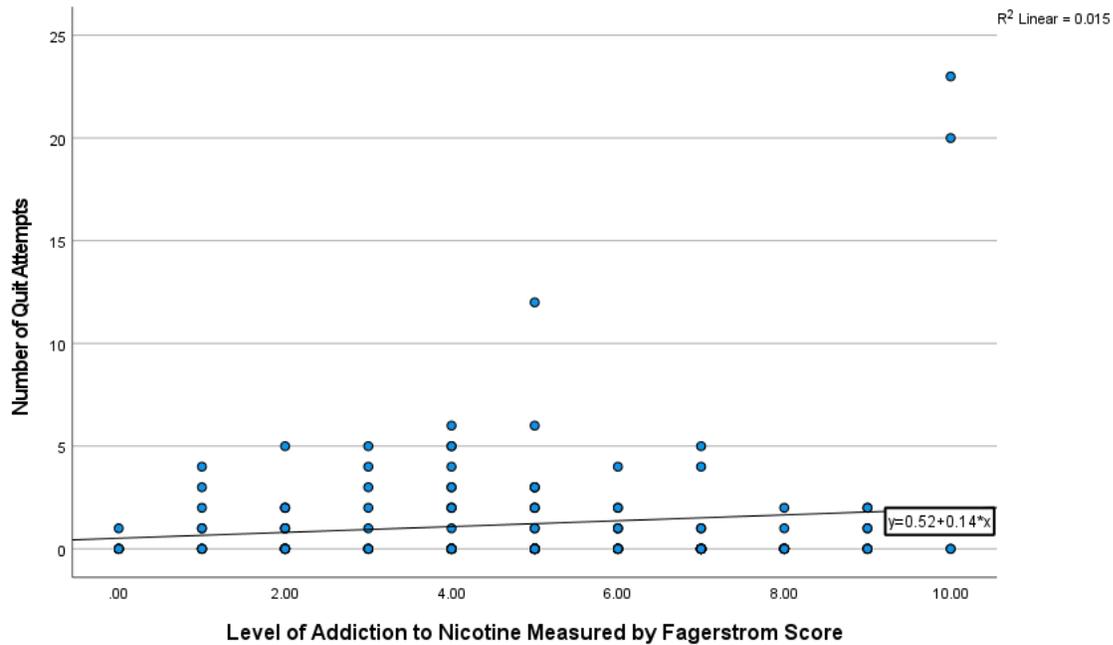
Negative binomial regression was employed to conduct six separate analyses: one mediation analysis and five moderation analyses. In each model, only one variable was included in the regression equation due to the small sample size ( $n=150$ ). What follows is an interpretation of the results for the relationship between the independent variable and dependent variable as well as the interpretation of the results for each research question.

## Interpretation of the Negative Binomial Regression Analysis of the Relationship between Independent Variable (Level of Addiction) and Dependent Variable (Number of Quit Attempts)

The relationship between the independent variable (level of addiction) and the dependent variable (number of quit attempts) was explored through statistical analysis and a scatter plot. Figure 32 demonstrates the curvilinear relationship between participants' level of addiction and their number of quit attempts. As participants' level of addiction increases, their number of quit attempts appear to increase until the level of addiction reaches a FTND score of four or five (moderate nicotine addiction). After reaching a moderate level of addiction (or FTND score of four), the number of quit attempts trends downward with the exception of two outliers that correspond to the highest level of addiction, ten.

**Figure 32**

*Scatterplot of Number of Quit Attempts by Level of Addiction*



Notably, the data is over dispersed, with a greater variance than mean value for number of quit attempts (mean = 1.22, variance = 8.53), which is why negative binomial regression analysis was used instead of Poisson regression model (Hilbe, 2011). Additionally, there are a large number of participants with no attempts at smoking cessation in the last 12 months, which means there is a large portion of zeros for the dependent variable. Although a considerable number of zeros were observed for the dependent variable in this dataset, negative binomial regression was more appropriate than a zero-inflated model or a hurdle model for a number of reasons including model fit. Both zero-inflated models and hurdle models separate the model into zero versus positive value counts during analysis (Hilbe, 2011). In the current study, likelihood ratio tests were used to compare the conventional negative binomial regression model to the zero-inflated negative binomial as outlined in Allison (2012) and the conventional model was a better model fit than the zero-inflated negative binomial. The mean for number of quit attempts was low, 1.22 attempts, so a higher number of zeros could be reasonably expected in the negative binomial regression analysis (Hilbe, 2011).

In the current study, 62.7% ( $n=94$ ) participants reported zero quit attempts in that last 12 months. The average number of quit attempts in this study was  $1.22 \pm 2.9$  attempts, ranging from zero to 23 smoking cessation attempts. The curvilinear relationship present between participants level of addiction to nicotine and their number of quit attempts speaks to the complexity of the relationship between participants' level of physical addiction to nicotine and the behavioral measure of the number of quit attempts in the last year. Furthermore, participants in the study were all current smokers so interpretations include the understanding that these quit attempts are unsuccessful in achieving sustained smoking cessation at the time of data collection. These results however are not unexpected. Research indicates it may take 30 or more quit attempts

before quitting successfully (Chaiton et al., 2016). Interpreting these results in the context of previous research is difficult because studies using these specific independent and dependent variables have not been explored until now. However, some approximations could include Hughes and Davies (2019), Crossnohere and associates (2020), and Enyioha and colleagues (2019).

The pattern observed in this study is similar to what Hughes and Davies (2019) found in Wales, United Kingdom where individuals with moderate and low Fagerström scores were more likely to engage in smoking cessation behaviors. Specifically, Hughes and Davies (2019) observed that individuals with moderate and low Fagerström scores (scores of 5 and 3-4 respectively) were more likely to attend subsequent free smoking cessation treatment sessions after their initial assessment session than individuals with very low or high baseline Fagerström scores (scores of 0-2 and 6-10 respectively). The odds ratios for each category of Fagerström score followed a similar curvilinear pattern as the current study with higher odds ratios for low (OR=1.07, 95% CI=1.00–1.14) and moderate (OR=1.15, 95% CI=1.08–1.24) Fagerström scores and lower odds ratios for very low (OR=1.03, 95% CI=0.94–1.12) and high (baseline). Though the current study looked at number of unsuccessful quit attempts in the last year and Hughes and Davies (2019) focused on treatment attendance, both are behavioral measures associated with the desire to quit smoking.

Conversely, Crossnohere and associates (2020) found that higher smoking dependence or level of addiction was associated with a higher likelihood of quit attempts in men. Smoking dependence was measured using the Heaviness of Smoking Index (HSI). The authors found differences in smoking behaviors among men and women, with the increased likelihood of men trying to quit smoking moderated by having friends who had quit smoking. However, these same

results were not found in the women in the sample. There is a common thread between Crossnohere et al.'s (2020) findings and the results of this study, in that the current study has two outliers with the highest number of quit attempts as well as the highest level of addiction (FTND score of ten) and both of these datapoints were men. Additionally, Kleinjan et al. (2008) found the presence of an association between higher levels of nicotine dependence and higher levels of readiness to quit, which resulted in a higher number of quit attempts in adolescents. Enyioha et al. (2019) found high nicotine dependence was associated with an increased willingness to try any evidence-based smoking cessation method instead of cold-turkey and smokers with a history of previous quit attempts were more willing to try an evidence-based smoking cessation method as well. These findings from Enyioha et al. (2019) appear to highlight the increased motivation and desire to try proven smoking cessation practices that individuals with higher levels of addiction and a history of smoking cessation attempts may have. However, in the current study, the higher number of quit attempts were generally reported by individuals with moderate levels of addiction to nicotine. This trend includes a lower number of quit attempts for lower and higher levels of addiction, except for two individuals with the highest level of addiction and number of quit attempts.

Based on the results of the current study, participants with moderate levels of addiction tend to try to quit more often than participants with other levels of addiction. This trend holds except for participants with the highest level of addiction. At the highest level of addiction individuals appear to have either a high number of quit attempts or zero quit attempts. The FTND has scores zero through ten corresponding to five different described levels of addiction (Heatherton, et al., 20). The two outliers in the study, each with 20 or greater quit attempts in the last year, also have the highest level of addiction, a score of ten on the FTND. These results were

supported, in part, by previous research. All participants involved in this study were current smokers, so it can be reasoned that at moderate levels of addiction, individuals have more unsuccessful quit attempts. Furthermore, at the highest level of addiction observed, there may have been an inflated number of unsuccessful quit attempts, where individuals, who were highly motivated to quit, were unable to achieve sustained remission due to their high level of physical addiction. Interventions can be focused on helping individuals with moderate and high levels of nicotine addiction find ways to maintain sustained smoking cessation efforts.

After exploring the direct relationship between the independent and dependent variables, the presence of a mental health disorder was introduced as a potential mediator for this relationship.

**Interpretation of the Results Pertaining to Research Question: Does mental health disorder status mediate the relationship between participants' level of addiction and their number of quit attempts?**

The mediation analysis determined that mental health disorder status partially mediated the relationship between participants' level of addiction and number of quit attempts. Mental health disorder status did not meet the criteria for full mediation, but rather mental health disorder status was a partial mediator, with the slope of the relationship between participants' level of addiction to nicotine (the independent variable) and their number of quit attempts (the dependent or outcome variable) significantly reduced by the presence of the mediator (mental health disorder status). Partial mediation was expected in this analysis rather than full mediation, as a partial mediation is present when the mediating variable is only responsible for part of the relationship between the independent and dependent variables. In full mediation, the relationship between the independent and dependent variable is due to the mediator, or in other words the

independent variable no longer affects the dependent variable after the mediator has been controlled, making the slope between the independent and dependent variable (or path “c”) zero (Kenny, 2018). In this study, the coefficient for path “c” was statistically significant (the relationship between level of addiction to nicotine and the number of quit attempts) and there was also significant mediation, these combined results indicate that there is evidence for partial mediation (MacKinnon, Fairchild, & Fritz, 2007).

Furthermore, when mental health disorder status was included in the regression analysis, the slope parameter decreased indicating partial mediation. Specifically, the slope (the beta-coefficient) for level of addiction changed from 0.097 to 0.076, which indicates partial mediation has taken place, with a 27.6% reduction in slope. A 27.6% reduction in slope is a fairly large percent change in effect. Based on these results and previous research indicating a strong relationship between mental health disorders and smoking behaviors, mental health disorder status is a mediating variable.

With the understanding that mediators are part of a causal pathway, mental health disorder status acting as a partial mediator in the current study may explain, in part, why the relationship between the level of addiction to nicotine and the number of quit attempts exists. Furthermore, the results indicate the presence or absence of a mental health disorder in participants in this study strongly influences the number of times the participant may quit if they have a certain level of addiction to nicotine. At a basic level, there is a relationship between participants’ level of addiction to nicotine and their number of quit attempts. When mental health disorder status is included, the previous association is partly explained by the presence or absence of a mental health disorder. Based on the results of the current study, the participants’ mental health diagnosis status mediates the relationship between participants’ level of addiction

to nicotine and number of quit attempts, suggesting that the presence of a mental health diagnosis could be an important individual level factor to consider when assessing smoking behaviors.

Additionally, differences were observed between smoking behaviors (average number of quit attempts and mean level of addiction to nicotine) for participants with and without a mental health disorder. Specifically, the incidence rate of quit attempts in those with a mental health disorder is 1.43 times greater ( $\exp(.357)$ ) than those without a mental health disorder or there is a 43% greater incidence of quit attempts in participants with a mental health disorder.

Furthermore, individuals with a mental health disorder had higher mean levels of addiction to nicotine ( $5.3 \pm 2.4$ ) than those without a mental health disorder ( $4.3 \pm 2.6$ ). Moreover, though participants in the study often did not try to quit, of the participants that tried to quit, those with a mental health disorder tried more often. When participants without at least one quit attempt were excluded from the calculations, individuals with a mental health disorder had an average of  $4 \pm 5$  quit attempts and those without a mental health disorder had an average of  $2.2 \pm 1.1$  quit attempts. When participants with no quit attempts were included in the analysis, participants with a mental health disorder in this study had an average of  $1.4 \pm 3.5$  quit attempts and participants without a mental health disorder had an average of  $0.9 \pm 1.3$  smoking cessation attempts. Therefore, participants with a mental health disorder on average had higher levels of addiction and higher numbers of quit attempts than those without a mental health disorder.

Not only were smoking behaviors different among mental health diagnosis groups when considered separately, but also mental health disorder status acted as a mediator for the relationship between participants' level of addiction and number of quit attempts. Results from the current study indicate that as participants' level of addiction increases their number of quit attempts do as well. However, for participants without a mental health disorder, as their level of

addiction increased their number of quit attempts slightly decreased. These results suggest that mental health disorder status is a key individual level factor to consider in research, clinical, and teaching contexts for nicotine addiction and smoking behaviors. Interpreting these results in the context of previous literature is challenging as mental health disorder status functioning as mediating variable for the relationship between level of addiction to nicotine and smoking cessation attempts has not been fully explored in previous research. However, some approximations would include Lipari & Van Horn (2017), Smith and colleagues (2014) and Kadkhoda and associates (2019).

The influence of mental health diagnosis status on smoking behaviors observed in this study are in agreement with previous research and literature especially as studies have shown a higher proportion of individuals with a mental health diagnosis are current smokers. Furthermore, during the assessment of the relationship between level of addiction and mental health disorder status, logistic regression, results revealed that with each increase in level of addiction there was a 1.73 fold increase in the odds of a participant having a mental health diagnosis. Results also indicated that the incidence rate of quit attempts in those with a mental health disorder is 1.43 times greater ( $\exp(.357)$ ) than those without a mental health disorder. These findings complement results from previous research.

Studies have uncovered major disparities in smoking prevalence and behaviors in individuals with a mental health disorder when compared to the general population. The presence of these disparities supports the results found in the current study which indicate mental health diagnosis status acts as a mediating variable for the relationship between participants' level of addiction and their number of quit attempts. In other words, mental health disorders, in part, explain the relationship between the independent and dependent variables. Remarkably, one in

four individuals have a mental health diagnosis, yet this small proportion of the population smokes 40% of all cigarettes smoked annually in the United States (Lipari & Van Horn, 2017; CDC, 2019c; SAMHSA, 2013). Smith and colleagues (2014) found that having a mental health disorder was associated with a “substantially greater likelihood of nicotine withdrawal syndrome; approximately 44% of nicotine withdrawal syndrome diagnoses were attributable to mental illness.” Furthermore, the authors determined that both nicotine dependence and withdrawal symptoms accounted for a lower likelihood of success in smoking cessation for smokers with a mental health disorder, despite the fact that smokers with mental health disorders were motivated to quit smoking (Smith et al., 2014). West and associates (2018) determined that the presence of a psychiatric disorder predicts failure to achieve sustained abstinence from cigarettes. These findings are in agreement with the findings of the current study, in that results showed that mental health disorder status in part explains the relationship between participants’ level of addiction to nicotine and the number of smoking cessation attempts they have engaged in within the last year.

On the contrary, Kalkhoran and associates (2019) did not find major differences in smoking cessation efforts and plans based on mental health disorder status. In fact, the authors observed that smokers with and without a serious mental health disorder did not differ significantly in their odds of making a quit attempt or plans to quit over the past 12 months (Kalkhoran et al., 2019).

These results highlight the importance of exploring individual level factors within the Social Ecological Model (SEM). The mediation analysis completed in this study indicates that mental health disorder status is an influential individual level factor to consider when assessing an individual’s cigarette smoking behaviors.

After exploring mental health disorder status as a potential mediator for the relationship between the level of addiction to nicotine and the number of quit attempts, moderation analyses were conducted for employment status, age at smoking initiation, history of a SUD, whether an individual lives with a smoker, and whether the participants work in a smoke-free environment.

**Interpretation of the Results Pertaining to Research Question 1b: Does employment status moderate the relationship between participants' level of addiction and their number of quit attempts?**

In the current study, the interaction term was significant for employment status and level of addiction ( $p = .002$ ), therefore an effect modification or moderation for employment status was present. In other words, employment status acts as a moderator for the relationship between the independent and dependent variables. Participants' employment status strengthens the relationship between participants' level of addiction to nicotine and the individual's smoking cessation attempts over the last 12 months. If an individual is unemployed, the results indicate that as level of addiction increases there is also an increase in the number of quit attempts. Conversely, for individuals that were employed, the higher the level of addiction the fewer number of quit attempts they engaged in over the last 12 months. These results may be due the financial burden of smoking for individuals with a high level of addiction who are unemployed. Additionally, job-related stress may lead to continued smoking in participants that are employed. Employment status was negatively associated with the number of quit attempts (B-coefficient = -0.445). Moreover, the exponentiated results indicates the incidence rate of quit attempts in those with employment is .641 times less ( $\exp(-.445)$ ) than individuals who are unemployed or there is a 36% less incidence of quit attempts in employed participants (or % reduced  $(0.641 - 1.00) * 100 = -35.9\%$ ). Previous research investigating employment status as a moderating variable

between level of addiction to nicotine and number of quit attempts has not been conducted, however several studies have looked at smoking behaviors in relation to employment status.

The current study determined that employment status moderates the relationship between level of addiction to nicotine and number of quit attempts and these results are in agreement with the results observed by Gariti and associates (2008). Gariti and associates (2008) observed differences in participation for smoking cessation activities based on employment status, though the authors speculated that these differences may be related to external factors associated with employment status. In their study, the authors screened light smokers for participation in a pharmacological and counseling intervention and found that younger, unemployed potential participants were more likely not to attend their in-person eligibility session following a telephone screener. Based on survey participant reports, the authors speculated that employment status impacted participants attending an in-person initial session for different reasons. The authors explained that unemployed individuals may have missed the initial session due to the cost of transportation needed to get to the appointment, whereas employed participants may have missed the initial in-person session due to scheduling conflicts with their job and personal life (Gariti et al., 2008). The authors also found that those who attended the first in-person eligibility session were more likely to have maintained abstinence at 12 weeks than those who did not attend the initial in-person screening appointment so determining how employment status affected treatment engagement is important. This study further underscores the importance of investigating the impact of employment status on the relationship between participants' level of addiction to nicotine and their number of quit attempts, but also the importance of exploring the multiple levels of influence on a person including the individual level variable of employment status. Golden and Perreira (2015) found that during the Great Recession individuals who

recently lost their jobs smoked at higher rates than their employed peers. These studies underscore the influence of unemployment on smoking behaviors.

Conversely, Barnes and Smith (2009) hypothesized that the presence of economic insecurity due to unemployment may lead to individuals engaging in smoking behaviors as a form of “self-medication. In their study, they found a one percent increase in the probability of becoming unemployed actually led to an individual being 2.4 % more likely to continue smoking. Furthermore, Kalousova and Burgard (2014) determined that it was more likely for an individual to initiate smoking if they had at least one episode of unemployment and that individuals often adopt negative behaviors like smoking during economic downturns like recessions often characterized by increases in unemployment.

These results highlight that employment status is another individual level variable outlined in the SEM, which should be explored when evaluating a person’s smoking behaviors, since employment status is a significant moderator of the relationship between participants’ level of addiction to nicotine and their number of quit attempts in the last year. The SEM is a powerful framework to assess smoking behaviors. Furthermore, while using the framework of the SEM other individual, relationship, and community level variables were explored.

**Interpretation of the Results Pertaining to Research Question 1c: Does age at smoking initiation moderate the relationship between participants’ level of addiction and their number of quit attempts?**

The results of the analyses conducted in the current study indicate that age at smoking initiation is a significant moderator of the relationship between participants’ level of addiction and their number of quit attempts. The significant interaction term determined through the negative binomial moderation analysis coupled with the theoretical basis for the interaction of

age at smoking initiation and present level of addiction indicates that there is an effect modification for age at smoking initiation. The results indicate that when age at smoking initiation is included in the model, level of addiction to nicotine is positively associated with quit attempts (B-coefficient=0.091) and age at smoking initiation is positively associated with quit attempts (B-coefficient=0.090). Furthermore, the analysis shows a synergistic effect. Participants who started smoking at an older age and individuals with a higher level of addiction are more likely to have greater number of quit attempts, with the interaction between age at smoking initiation and level of addiction enhancing quit attempts. These results were different depending on age group. Furthermore, the exponentiated B indicates the incidence of quit attempts increases 1.094 per each unit increase in age at smoking initiation. These results reveal as people begin smoking at older ages, they are more likely to quit smoking than those that started smoking earlier.

Further investigation into the nature and direction of the differences in the relationship between level of addiction and number of quit attempts by age at smoking initiation revealed interesting results. For the purposes of comparison, age at smoking initiation was divided into three separate groups based on the age that participants first began smoking: 4 to 15 years of age, 16 to 19 years, and 20 years of age and older. The aforementioned categories were determined by the distribution of data for age at smoking initiation. Results showed differences in the relationship between level of addiction and number of quit attempts for participants that initiated smoking during their childhood and earlier adolescence (four to 15 years), older adolescence/teenage years (16 to 19 years), and adulthood (20 years and older). Adults appeared more likely to engage in multiple quit attempts with higher levels of addiction. This same trend is observed in participants' who initiated smoking in their later teenage years (16 to 19 years)

though the association was not as strong. Interestingly, investigation into trends present in the data indicated that participants who initiated smoking during childhood and early adolescence appear to engage in fewer quit attempts as their level of addiction increases. Age at smoking initiation has not been explored as a moderator between level of addiction to nicotine and number of quit attempts in previous research though other studies have investigated similar variables.

The results of this study, in part, align with previous research that recognized early smoking initiation is related to continued smoking as an adult, nicotine addiction, daily smoking and heavier smoking habits as adults (Chen & Millar, 1998; DiFranza, 2015; Doubeni, Reed, & DiFranza, 2010). Chen and Millar (1998) determined that individuals who began smoking in early adolescence had a lower cumulative probability of quitting smoking and higher levels of daily cigarette consumption. In the present study, participants were only eligible for the study if they were current smokers. Therefore, all participants in the present study had not successfully quit smoking at the time of participation. Furthermore, participants in the current study who initiated smoking during childhood and early adolescence appeared to engage in fewer quit attempts as their level of addiction increases. This aligns with Barrington-Trimis and colleagues (2020) assertion that trends toward later ages of smoking initiation would have considerable implications for prevention efforts by delaying smoking initiation beyond adolescence into early adulthood since individuals who began smoking during adolescence are less likely to quit in adulthood. Furthermore, like the current study which found that participants who initiated smoking in adolescence were less likely to even attempt to quit, West and colleagues (2018) found that a younger age at smoking initiation is associated with lower success rates for smoking cessation and these lower rates of successful cessation hold steady regardless of treatment type.

Conversely, Morabia and colleagues (2002) studied female smokers and observed that younger smokers (women younger than 55) in their study tended to initiate smoking earlier and smoke more per day, but they also made more quit attempts before the age of 35 than older females in the study underscoring the importance of targeting smoking cessation campaigns aimed at helping younger individuals maintain sustained cessation. Whereas in the current study, participants with later ages of smoking initiation and individuals with higher levels of addiction tended to have higher numbers of quit attempts. In the present study, for each year later that individuals began smoking, there was a corresponding 1.094 increase in quit attempts. Furthermore, authors of the previous study also did not observe a correlation between earlier ages of initiation and higher levels of addiction (Morabia, Costanza, Bernstein, & Rielle, 2002) which was at odds with the results of the current study.

Based on these results and interpretations, age at smoking initiation is an important individual level variable to consider when using the SEM to assess an individual's smoking behaviors. The age at which an individual starts smoking influenced quit attempts and moderated the relationship between participants' level of addiction to nicotine and their number of quit attempts in the last year. Specifically, participants in the current study who initiated smoking during childhood and early adolescence appeared to engage in fewer quit attempts as their level of addiction increased. Furthermore, results indicate that the incidence of quit attempts showed to increase 1.094 per each unit, or year, increase in age for smoking initiation. Using age at smoking initiation as an individual level of influence variable in the SEM when assessing smoking behaviors can be a powerful tool. Additionally, other individual, relationship, and community level variables were explored in the current study.

**Interpretation of the Results Pertaining to Research Question 1d: Does a history of a Substance Use Disorder (SUD) moderate the relationship between participants' level of addiction and their number of quit attempts?**

Based on the results presented in chapter four, a history of a SUD appears to be a moderating variable for the relationship between participants' level of addiction to nicotine and their number of quit attempts. The significant interaction term ( $p=0.025$ ) coupled with previous research demonstrating the influence of an individual's history of a SUD on their level of addiction and smoking behaviors implies the presence of an effect modification or moderation for this variable. Furthermore, the results suggest that participants with a history of a SUD are more likely to attempt quitting unsuccessfully as their level of addiction to nicotine increases, which was reflected in the interaction term being positively associated with number of quit attempts. However, participants with a history of a SUD were less likely to quit smoking than those without a history of a SUD, with a 29% less incidence of quit attempts in participants with a history of a SUD than those without a history of a SUD. These results suggest that although individuals with a history of a SUD are less likely to quit than individuals without a history of a SUD, higher levels of addiction among individuals with a SUD can be an impetus for trying to quit smoking. Though previous research has not assessed these variables in the same manner as the current study some approximations include Knudsen (2017), Pagano, Tajima, and Guydish, (2016), González-Roz and colleagues (2019), and Weinberger and associates (2013).

Previous research has highlighted that patients in addiction treatment have higher smoking rates than the general population with smoking rates among individuals in SUD treatment consistently staying high over recent decades despite declines in smoking rates among the general population (Knudsen, 2017; Pagano, Tajima, & Guydish, 2016; SAMHSA, 2019a).

These differences may be due to beliefs related to smoking cessation interfering with SUD recovery and the perception of smoking being less harmful than other drugs by addiction treatment staff (González-Roz et al., 2019). Though the aforementioned research focused on smoking rates for individuals currently in treatment for a SUD, these trends are similar to the current study, which indicated that individuals with a history of a SUD are less likely to quit smoking than participants without a history of SUD. In the current study, not only were individuals with a SUD history less likely to quit smoking than those without a history, they also had 29% less incidence of quit attempts or trying to quit smoking. Moreover, Weinberger and associates (2013) found that current and past history of a SUD were associated with a decreased likelihood of quitting smoking and increased likelihood of smoking relapse for those that had quit smoking with a history of a drug use disorder. These results are in agreement with the results of the current study which found that participants with a SUD history were less likely to quit smoking than participants without a SUD history. Weinberger and associates (2013) also found withdrawal symptoms were greater for individuals with a current SUD, which may have contributed to less successful quit attempts and continued smoking for individuals recently in recovery. Since the current study did not ask how long ago the SUD occurred for participants, Weinberger and associate's findings with regard to withdrawal symptoms may have contributed to the current results of less quit attempts for individuals with a history of a SUD. Furthermore, their results are consistent with the results of this study, which demonstrate that for participants with a history of a SUD, their number of unsuccessful quit attempts increased as their level of addiction increased. Specifically, individuals in the current study had 29% less incidence of quit attempts than those without a history of a SUD, but as the level of addiction for individuals with a SUD increased, they were more likely to attempt smoking cessation.

A clinical history of a SUD is an important individual level variable to consider when using the SEM to assess a person's smoking behaviors and guide treatment approaches. Based on the fact that participants' history of a SUD moderated the relationship between participants' level of addiction and their number of quit attempts, assessing for a history of a SUD is an important individual level variable to consider. Results suggested that participants with a history of SUD were more likely to quit as their level of addiction increased and had a 29% less incidence of quit attempts than participants without a history of a SUD. This individual level variable should be considered when using the SEM to explore levels of influence that impact smoking behaviors. Using the framework of the SEM, the next variable assessed in this study was a relationship level variable, living with a smoker.

**Interpretation of the Results Pertaining to Research Question 1e: Does living with a smoker moderate the relationship between participants' level of addiction and their number of quit attempts?**

Living with a smoker did not moderate the relationship between the independent and dependent variables in this study. Specifically, living with another smoker did not strengthen or significantly influence the relationship between participants' level of addiction to nicotine and their number of quit attempts in the last 12 months. Although the current study found that living with a smoker does not moderate the relationship between level of addiction and number of quit attempts, the results indicated the incidence rate of quit attempts for those that live with a smoker is 16% less than participants who do not live with a smoker. Living with a smoker appears to have a minimal effect on their level of addiction, however. Previous research has not appeared to investigate whether living with a smoker moderated the relationship between participants' level of addiction and their number of quit attempts over the last year, however, some authors have

studied the influence of personal relationships and the home environment on individual smoking behaviors.

Previous research has found relationships and social environments can have a strong impact on smoking behaviors, including research showing that a higher number of smokers in an individual's immediate social environment is negatively associated with long term abstinence (Van den Brand et al., 2019). Additionally, successful long-term abstinence from smoking was negatively associated with having a partner who is a current or former smoker when compared to having a partner that was a non-smoker (Van den Brand et al., 2019). Other research found that living with a smoker was associated with lower odds of both smoking cessation and quit intentions (Wang, Ho & Lam, 2018), which is in contrast to the findings of this study which showed that participants who lived with a smoker had 16% less quit attempts than those that did not. Furthermore, personal relationships including parent child relationships and romantic partner relationships influence smoking behaviors (Kalkhoran, Neilands & Ling, 2013; Van den Brand et al., 2019)

Other research went a step further and explored whether living in a smoke-free environment impacted individual smoking behaviors. For example, Kahende and colleagues (2011) found that individuals living in a home with rules in place that forbid smoking indoors were more likely to have made a quit attempt than those living in a home that allowed smoking indoors. Alboksmaty and associates (2019) found former smokers living in smoke-free homes had 60% lower odds of relapse than those with smoking allowed inside. Additionally, previous research found that banning smoking in the home was related to a higher likelihood of successfully quitting, which points to the influence of environment on relationship norms in the home (Hyland et al., 2009). However, the current study did not explore whether participants had

rules in place for smoking behaviors in the home, though future studies could include questions related to social norms related to smoking within their home environment.

Although, living with another smoker does not appear to be a moderating variable for the relationship between participants' level of addiction to nicotine and their number of quit attempts, previous research indicates that it may still be an important relationship level variable to consider when using the SEM to explore smoking behaviors. There could be other smoking behaviors influenced by living with a smoker that were not assessed in this study.

### **Interpretation of the Results Pertaining to Research Question 1f: Does working in a smoke-free environment moderate the relationship between participants' level of addiction and their number of quit attempts?**

The variable associated with the community level of influence of the SEM assessed in this study is whether or not participants worked in a smoke-free environment. Whether participants worked in a smoke-free work environment was an important moderating variable assessed in this study. Though the interaction term was not significant ( $p=0.104$ ), the additional process for assessing moderation indicated a 46.4% change in the total effect of level of addiction on the number of quit attempts when the variable for working in a smoke-free environment was included in the model and thus an effect moderation is present. The sample size for this analysis was less than the other analyses conducted in the current study because only 62 participants indicated that they were currently employed. The results of the additional assessment for moderation coupled with the theoretical underpinnings associated with the smoking environment present at participants' places of employment indicates that whether participants work in a smoke-free work environment has an effect modification for the relationship between participants' level of addiction and their number of quit attempts. Based on the exponentiated

results detailed in chapter four, the incidence rate of quit attempts in those working in a smoke-free environment is 1.67 times greater than for individuals who work in an environment that allows smoking. The results indicated that there was a 67% greater incidence of quit attempts in participants that work in a smoke-free environment than participants that work in an environment that allows smoking. In other words, people who work in a smoke free environment are more likely to attempt smoking cessation than those in an environment that allows smoking. However, the results from the current study also indicate that as participants' level of addiction increases the number of quit attempts decrease for employed individuals regardless of work environment smoking policies. Though this specific analysis has not been completed in previous research some approximations include Longo and associates (2001) and Kahende and colleagues (2011).

Longo and associates (2001) found similar results to the current study where participants working in a smoke-free environment had more quit attempts than participants that work in an environment that allows smoking. Longo and associates (2001) found that employees at hospitals with smoking bans had higher rates of smoking cessation than hospitals without such policies in place, even though their results indicated that relapse rates for smoking engagement were similar among groups. This is similar to the current study which found that participants who worked in a smoke-free environment had 1.67 times more quit attempts than those that worked in an environment that allowed smoking. However, since all participants in the current study were smokers at the time of study visit their quit attempts cannot be considered successful smoking cessation.

Conversely, Kahende and colleagues (2011) did not find an association between workplace policies such as a smoke-free work environment and quit attempts. The results of the current study indicated that working in a smoke-free work environment had a moderating effect

on the relationship between the independent and dependent variables in this study, with an increased incidence of quit attempts for those that work in a smoke-free environment, but overall negative association for quit attempts for all employed participants as their level of addiction increased. Therefore, based on the results of the current study, there appears to be an association between workplace policies and quit attempts which is in contrast to Kahende and associates' (2011) findings.

In the SEM, community level variables are important to consider when assessing smoking behaviors. Specifically, understanding the influence of working in a smoke-free environment as a community level variable can assist with understanding the implications of this variable on smoking behaviors. Work-related smoking policies may influence social norms established in work environments, furthermore, social norms established within communities and social networks can significantly impact smoking behaviors (Christakis & Fowler, 2008). Using the SEM as a framework can allow for a better understanding of the effect of the work-place policies on smoking behaviors for the individual. Results show that the rate of quit attempts for those working in a smoke-free environment is greater than for individuals who work in an environment that allows smoking, underscoring the importance of recognizing the role of work environment on smoking behaviors.

### **Summary of Interpretations**

This study used the Social Ecological Model as a framework to assess specific psychosocial and environment variables that mediate or moderate nicotine addiction in order to understand the complex interplay of factors related to cigarette smoking behaviors. Six psychosocial environmental variables and their influence on the relationship between participants' level of addiction and their number of quit attempts were analyzed. The results of

the current study indicates that mental health disorder status mediated the aforementioned relationship and employment status, age at smoking initiation, history of a substance use disorder, and working in a smoke-free environment moderated that relationship. However, living with a smoker does not appear to moderate this relationship based on the results obtained in the current study. These results have major implications for future research, clinical practice, and teaching. However, these interpretations should be made with caution due to the following limitations.

### **Limitations**

There were several limitations present in this study including sampling method, sample size, and limitations related to the statistical analysis.

As this study is based on data collected from a pilot study, convenience sampling was necessary for data collection. This type of sampling impedes our ability to fully draw inferences about the entire population. The participants were screened to ensure that the sample was not homogenous, though the pilot study had difficulties with recruitment that led to a smaller sample size.

The majority of this sample included individuals with a mental health diagnosis, which could be a result of the sampling technique and participant recruitment practices the original study employed. The current study had a small sample size of only 150 participants. The small sample size decreases the statistical power of the results. Additionally, sample sizes in certain strata analyzed in this study were even smaller including whether participants worked in a smoke-free work environment, because only 62 participants in this study were employed.

The current study was not designed with the intention of using the specific statistical analyses employed in this study which may limit the generalizability of the results. Since the data

analyses were not planned prior to the study and incorporated into the study design and this study is not a randomized controlled trial, there is a risk of reporting bias present in the data and all findings from this analysis should be cautiously viewed (West, 2018). Especially as this study employs mediation and moderation analysis which are more appropriate when the study is designed following specific guidelines for such analyses. Furthermore, evaluating mediation in order to explain an observed effect is more susceptible to a chance finding as the mediators in this study were selected after the study had taken place. Whereas evaluating mediation in studies specifically intended for mediation analysis are designed in such a manner to reduce the potential for chance findings (Mackinnon, 2011; MacKinnon, Cheong, & Pirlott, 2012). The most conservative way to ensure that a mediator is not caused by a dependent variable in a study is to experimentally manipulate the variable or collect the measurement of the mediator before introducing the independent variable, which was not possible in this study and thus is a limitation (Blair, 2020). Doing so would allow the data to fit for a structural equation model.

For both the analysis of moderation and for mediation there is an assumption that the mediating or moderating variable is not caused by the dependent variable, or in this study, the number of quit attempts. In this type of analysis there should be little to no measurement error in the mediating or moderating variable and if the error is high the structural equation model should be used to estimate latent variables (Blair, 2020). For the purposes of this study, the assumption was made that the variables were measured with minimal error in variable measurement and there was not adequate information available to utilize the structural equation model to estimate latent variables. However, this could be considered a limitation of this study as there was no way to ensure that there was no measurement error in the variables assessed.

Another limitation in the current study is related to the statistical model used for the analyses. Negative binomial models were used in this analysis as they were more appropriate for the dataset than a Poisson model, since the data were over dispersed. However, the dataset had more zeros than expected for the dependent variable or the number of quit attempts. However, as the data for the current study was based on a survey, the zeros present are believed to be true zeros and therefore the data is not zero-inflated. Additionally, during data analysis, the data was explored using zero-inflated models, but the negative binomial model was a better fit for the data. However, even the negative binomial model was not a particularly good fit for the data which is a limitation of the current study. Furthermore, the limitations of the statistical analysis are detailed in chapter four.

### **Implications of Results**

The results of this study have implications for future research, counselor education, and clinical practice. These implications are provided in the following subsections with a detailed investigation into how these results can shape future approaches to research in the field of nicotine addiction and treatment approaches catered to individuals who smoke cigarettes. The psychosocial and environmental variables that influence the risk of developing nicotine addiction, as well as potential barriers to smoking cessation, should be understood through the four levels of influence used in this specific iteration of the SEM. Interventions can be focused on helping individuals with various levels of nicotine addiction to find ways to maintain sustained smoking cessation efforts. This study underscores the importance of assessing a variety of influencing variables when evaluating smoking behaviors.

## **Implications for Future Research**

This study explored whether specific psychosocial environmental variables influence (through mediation or moderation) the relationship between participants' level of addiction to nicotine and their number of smoking cessation attempts in the last year. Archival data was analyzed from a sample of 150 participants and several variables were determined to influence this relationship. However, a larger sample size would allow for more generalizable results. Future studies should explore the mediating and moderating qualities of these variables with a larger sample to see if the effects are maintained in a larger sample. Future research should also be conducted which collects data from a larger geographical area as the majority of the participants in the current study lived in eastern North Carolina, mainly Pitt, Lenoir, and Greene counties. By collecting data from multiple areas, the results may be more generalizable to a larger population (Kukull & Ganguli, 2012).

The current study explored whether various psychosocial environmental variables act as mediators and moderators between participants' level of addiction to nicotine and their smoking cessation efforts in the last 12 months using negative binomial regression. Specifically, the analysis was conducted to determine if participants' mental health diagnosis status was a mediator and if employment status, age at smoking initiation, history of a SUD, whether the participant lives with other smokers, or works in a smoke-free environment are moderating variables. The causal or independent variable in this analysis was an individual's level of addiction to nicotine and the outcome or dependent variable was the behavioral measure of the number of quit attempts. Mediation and moderation analysis were chosen for this study because this type of analysis tends to provide a powerful glimpse into the relationships present in the data, but future studies could use other types of analysis. For example, future studies could use a

hurdle model during analysis to account for the large number of zeros present in the data or a more complex analysis such as factor analysis within the SEM framework of the levels of influence to hone in on specific variables present in the dataset. A factor analysis would allow researchers to use data from the other questions in the questionnaire to statistically hone in on relevant variables related to smoking behavior outcomes present in the data. Additionally, factor analysis could be used to determine other potential relationships present between variables. Perhaps information about developing scales and subscales to measure each of the levels of influence of the Social Ecological Model could be made using factor analysis. These related variables determined by factor analysis could be explored further using mediation analysis.

For example, the results of the current study indicated the presence of a relationship between participants age at smoking initiation and participants' number of quit attempts. Additionally, participants' level of addiction is affected by their age of smoking initiation. A future direction could include analyzing a model where the relationship between age at smoking initiation and participants' number of quit attempts in the last year is mediated by participants' level of addiction. A participant's age at smoking initiation could possibly lead to differences in their level of addiction later in life and thus level of addiction could be a mediating variable for the relationship between age at smoking initiation and number of quit attempts. There are other mediation and moderation models using different variables that could be considered for future research using this data or similar datasets. Furthermore, there are different ways that the mediation and moderation analysis employed in this study could be analyzed.

The current study used the negative binomial regression model to assess mediation and moderation. The overall trend in the data has a quadratic component due to the curvilinear pattern present in the relationship between the independent and dependent variable. A quadratic

baseline model may be used to explore this data and may be more suitable in some regards. Further analysis could pursue this dataset using a more complex model that follows the mean trend more closely. This analysis could also follow the mean trend of the data more closely by removing the two outliers. Even though the outliers present in this data followed a similar pattern, both participants had not only the highest number of quit attempts reported in the study, but also the highest level of addiction possible, their removal would influence the model used.

Additionally, given the results of this study, future research could explore mediators and moderators at differing levels of addiction based on an individual's Fagerström score. Since the FTND score provides a total score from zero to ten for an individual's level addiction, determining mediators and moderators that influence quit attempts at each level of addiction could be an invaluable resource for clinicians. From a clinical perspective, if a provider could determine a FTND score and know which specific psychosocial and environmental variables effect smoking cessation at this level, this information could provide greater accuracy during assessments and clinical interviews. Furthermore, previous research determined that an individual's FTND score is correlated with the likelihood of their treatment attendance, and the authors of this research have suggested that the FTND score could also be used to recognize smokers that were at an increased risk of not attending treatment (Hughes & Davies, 2019). If a study is conducted which determines mediators and moderators that influence quit attempts at each level of addiction, the information gained from that study coupled with Hughes and Davies research could have major implications for tobacco treatment research and practice. Research assessing these variables at each FTND derived level of addiction could change not only clinical practices but research and teaching practices as well.

## **Implications for Teaching**

Currently, counselors-in-training are not required to learn about addiction to nicotine and smoking cessation interventions during their master's level coursework. This lack of training in nicotine addiction exists despite the fact that cigarette smoking remains the leading cause of preventable death and disability in the United States (CDC, 2019a). This coupled with the reality that individuals with mental health diagnoses, including those with SUDs, disproportionately smoke more than the general population underscores the importance of counselors-in-training learning ways to help clients with smoking cessation (Lipari & Van Horn, 2017; CDC, 2019c; SAMHSA, 2013).

The importance of integrating smoking cessation services into counselor education may be best understood by recognizing the smoking behaviors of the populations often served by counselors. Counselors often provide services to individuals, couples, groups, and families seeking assistance for mental health concerns and issues related to substance use and misuse (American Counseling Association, 2019). Individuals with a mental health diagnosis experience higher levels of morbidity and mortality due to smoking-related causes than the general population (CDC, 2018). Research investigating smoking and mental health indicates that not only do smokers with a mental health disorder smoke at higher rates, but they also have higher levels of smoking-related morbidity when compared with other smokers (Lawrence, Mitrou, & Zubrick, 2009). Furthermore, the highest prevalence rate for cigarette smoking in a specific subpopulation is found in individuals with a SUD (SAMHSA, 2018). Even though these populations are smoking at much higher rates and are impacted more drastically than the general population by smoking-related death and disability, counselors who work with these populations often do not have extensive training or any training at all in smoking cessation treatment

(Laschober & Eby, 2013; Ziedonis, Guydish, Williams, Steinberg, & Foulds, 2006).

Furthermore, since studies have indicated that tobacco cessation raises the likelihood of clients sustaining sobriety, counselors working with clients receiving treatment specifically for a SUD may want to offer smoking cessation treatment to clients working towards abstinence (Baca & Yahne, 2009). Other research indicated that chronic smoking adversely affected brain structural recovery and aspects of neurocognitive recovery in individuals with an alcohol use disorder during continued abstinence from alcohol, further underscoring the importance of integrating smoking cessation into treatment for individuals with SUDs (Yeh, Gazdzinski, Durazzo, Sjostrand, & Meyerhoff, 2007). Additionally, since there are higher prevalence rates for smoking with individuals with a SUD or a mental health diagnosis, counselors are in a unique position to help introduce evidence-based smoking cessation practices into their work with clients who smoke. These counselors may have already built rapport with clients through the therapeutic alliance, which may allow for a seamless introduction of treatment options available for clients interested in smoking cessation. Research has shown that “counselors have considerable discretion in terms of choosing to provide tobacco cessation to patients who smoke” (Eby, Laschober, & Muilenburg, 2014, p. 319).

Understanding the variables influencing the relationship between levels of nicotine dependence and number of quit attempts provides valuable information for counselor educators and counselors. The information gleaned from this study can be used to advance our understanding of smoking behaviors and smoking cessation. Armed with this knowledge, counselor educators can better train counseling students to recognize psychosocial environmental variables that influence smoking behaviors, specifically, smoking cessation attempts. Additionally, the results can be used to help create evidence-based smoking cessation programs

that consider the psychosocial environmental variables that influence behavioral outcomes like smoking cessation. Recognizing the variables that influence smoking cessation in individuals will allow for a more personalized approach to smoking cessation. From this study, mental health diagnosis status, employment status, age at smoking initiation, a history of a SUD, and the smoking-related policies present in the work environment appear to all be variables that influence an individual's number of smoking quit attempts.

Furthermore, utilizing the information gained for the multiple levels of influence related to smoking behaviors can be integrated into smoking cessation training within counselor education. Teaching students about the Social Ecological Model of health behaviors will encourage students think holistically when working with clients and promote an individualized treatment approach based on recognizing individual qualities as well as the multiple levels of influence contributing to client behavior.

Since cigarette smoking is the number one preventable cause of death and disability in the US, it is imperative that counselors are taught to provide clients with effective treatment strategies to aid in a client's smoking cessation efforts (CDC, 2018b). Currently, counselors generally do not receive formal training in the treatment of tobacco dependence (Laschober & Eby, 2013; Ziedonis, Guydish, Williams, Steinberg, & Foulds, 2006). The Council for Accreditation of Counseling and Related Educational Programs (CACREP) does not explicitly include required training and education in tobacco cessation or nicotine addiction (CACREP, 2016). Counseling education programs may want to consider including smoking cessation and nicotine addiction into counselor education including the information obtained in this study pertaining to client psychosocial and environmental variables that influence smoking cessation.

## **Implications for Clinical Practice**

Smoking behaviors do not exist within a vacuum. In order to fully understand and provide effective counseling for individuals who smoke cigarettes and are addicted to nicotine, the psychosocial and environmental variables which influence the risk of developing this addiction, as well as potential barriers to smoking cessation, should be understood through the four levels of influence used in this specific iteration of the SEM. When developing treatment strategies, mental health providers may want to consider the multiple levels of influence that are potentially shaping an individual's behavior. In this study, the relationship between participants' level of addiction to nicotine and their number of quit attempts in a 12-month period were explored. Furthermore, the influence of specific psychosocial environmental variables on this relationship were analyzed.

Since a number of individuals with a mental health disorder smoke, mental health providers treating clients with mental health concerns may want to incorporate evidence-based smoking cessation treatment into their practice. Counseling interventions can be targeted towards dual treatment for clients with a mental health diagnosis, with interventions aimed at mitigating the effects of negative symptoms associated with an individual's mental health disorder, while simultaneously supporting the client's smoking cessation efforts. As previously mentioned, smoking rates are higher among individuals with a mental health disorder than the general population, and these prevalence rates have been shown to vary among different types of mental health disorders (Cooper et al., 2012; de Leon & Diaz, 2005; Dickerson, 2018; Hennekens, Hennekens, Hollar, & Casey, 2005; Kalman, Morissette, & Georger, 2005; Lasser et al., 2000; ; Poirier et al., 2002; Weinberger et al., 2018). The importance of addressing tobacco use in individuals with mental health conditions cannot be overstated. Creating smoke-free mental

health treatment settings may be especially important in supporting smoking cessation efforts among individuals with a mental health diagnosis. Though the majority of psychiatric treatment units do not allow smoking indoors, many only have partial smoke-free policies in place, which allows psychiatric patients to smoke outdoors oftentimes despite total smoking bans present for all other patients in the hospital (Woodward & Richmond, 2019).

Previous research has explored the effect of counseling interventions on smoking cessation. A metaanalysis collected 49 articles with 33 trials of smoking cessation interventions comparing individual counseling to a minimal behavior intervention. Evidence from this metaanalysis showed that when pharmacotherapy was not offered to any participants, individual counseling was more effective than a minimal contact control such as brief advice, usual care, or the provision of self-help materials. Additionally, the authors found that individual counseling could increase the chance of quitting smoking by between 40% and 80%. (Lancaster & Stead, 2017). The research explored in the current study also indicates that smoking cessation interventions may also impact an individual's number of quit attempts in a 12-month period. Recognizing the relationship between the different variables at each level of influence in the SEM is an important advantage to using the SEM as a framework for health behaviors, because this understanding allows for a more comprehensive approach to developing targeted intervention strategies for counselors.

Counselors can also use the understanding of epidemiological changes in population level smoking behavior in their approach to treatment. Currently, at a population level, smoking prevalence rates have declined, and rates of smoking have also declined which has major implications for clinical practice. Goodwin et al. (2018) analyzed data from the National Household Survey on Drug Use and found a significant decline in cigarettes per day (CPD)

between 2002 and 2015, specifically that 37.8% of current smokers reported smoking more than 16 CPD in 2002 and this percentage declined to only 27.6% of current smokers reporting more than 16 CPD in 2015. Authors also determined that there was an increase of 6.6% in the use of 1-5 CPD and 3.5% 6-15 CPD in the same time period. These findings indicate a trend towards individuals consuming less CPD, which is important as CPD is an important predictor of an individual's ability to quit smoking (Goodwin et al., 2018). This trend is further supported by the National Health Interview Survey (NHIS) which showed that among daily smokers the average CPD declined from about 17 CPD in 2005 to 14 CPD in 2016, with the proportion of individuals who smoked 20-29 CPD dropped from 34.9% to 28.4 % in 2005 to 2016 respectively (CDC, 2018, January). Cigarette smokers working towards smoking cessation may find that it is easier to reduce the number of cigarettes smoked per day than it is to not smoke at all on some days. (Henry et al., 2017). Mental health providers can use this knowledge along with the knowledge gained in the current study to help clients with their smoking cessation efforts. Having providers armed with the knowledge of trends in smoking behaviors, specific psychosocial environmental variables that influence smoking behaviors, and how these translate into smoking cessation practices will enrich the field and help clients more effectively quit smoking.

The current study indicated that a variety of psychosocial environmental variables influence the relationship between level of dependence on nicotine or level of addiction and number of quit attempts. Studies from a variety of different countries at the population-level indicate that previous quit attempts and measures of motivation to quit are highly predictive of smoking cessation attempts, however Vangeli and associates (2011) found that only measures of dependence were consistently predictive of sustained cessation or successful quit attempts. Understanding the results from this study within the framework of the SEM coupled with

previous research that indicates level of addiction (or measures of dependence) is predictive of sustained smoking cessation can provide clinicians with powerful knowledge of smoking cessation factors to help clients.

Using the SEM, this study found that mental health disorder status mediates the relationship between participants' addiction level and their number of quit attempts. Additionally, the results of this study conclude that employment status, age at smoking initiation, history of a substance use disorder, and working in a smoke free environment are all variables that moderate the relationship between participants' level of addiction to nicotine and their number of quit attempts. Identifying mediators and moderators has important clinical implications because counseling interventions aimed at modifying an individual's level of addiction to nicotine may be more effective if these variables are considered when assessing clients and developing treatment plans. A significant relationship was found between an individual's level of addiction to nicotine and their number of quit attempts. The role of employment status, age at smoking initiation, mental health diagnosis status, history of a substance use disorder, living with another smoker, and working in a smoke free environment were examined and the influence of these variables are described.

### **Conclusion**

Despite prevention efforts, tobacco and smoking related illness and injury continue to be leading causes of morbidity and mortality in the United States (Golechha, 2016; CDC, 2019a). With the growing prevalence of premature death and disability due to addictions overall, alternative frameworks for conceptualizing substance use and treatment are necessary. Substance misuse including nicotine use disorder in the adult population exists within a complex social ecological system. The SEM provides a framework for understanding the variety of factors that

put people at risk for substance use disorders. This study used the SEM to understand individual, relationship, community, and societal levels of influence on cigarette smoking (McLeroy et al, 1988). Understanding the biological, social, and psychological components of addiction can assist in mitigating the far-reaching impacts of addictions on society. The current study investigated addiction through cigarette smoking, exploring specific psychosocial and environmental variables that influenced the relationship between participants' level of addiction to nicotine (measured using the Fagerström Test of Nicotine Dependence) and their number of quit attempts. Ideally, this information can be used to examine ways to maintain sustained smoking cessation efforts as well as systems-level changes to support smoking cessation in various populations.

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## APPENDIX A: IRB Documentation

East Carolina University



### Informed Consent to Participate in Research

Information to consider before taking part in research that has no more than minimal risk.

Title of Research Study: Differential effects of nicotine metabolite ratio on tobacco smoking and smoking cessation outcomes among smokers with mental illness.

UMCIRB 16-000034

Principal Investigator: Vivek Anand, MD (Person in Charge of this Study)  
Institution, Department or Division: Department of Psychiatry and Behavioral Medicine, Brody School of Medicine.  
Address: 905 Johns Hopkins Drive  
Brody School of Medicine at East Carolina University  
Greenville, NC 27834  
Telephone #: 252-744-1406

Researchers at East Carolina University (ECU) study issues related to society, health problems, environmental problems, behavior problems and the human condition. To do this, we need the help of volunteers who are willing to take part in research.

(Add the following if the participants will be patients at ECU)

Participant Full Name: \_\_\_\_\_ Date of Birth: \_\_\_\_\_

Researchers at East Carolina University (ECU) study issues related to society, health problems, environmental problems, behavior problems and the human condition. To do this, we need the help of volunteers who are willing to take part in research.

#### Why am I being invited to take part in this research?

The purpose of this research is to understand how nicotine is processed/metabolized and if the rate of this process is related to quitting tobacco use. You are being invited to take part in this research because of your smoking status. The decision to take part in this research is yours to make. By doing this research, we hope to learn if tobacco use and cessation are related to how nicotine is processed.

If you volunteer to take part in this research, you will be one of about 360 people to do so.

#### Are there reasons I should not take part in this research?

As a part of this study, saliva and hair samples from adult (over 18 years of age) participants will be collected. Other reasons which would make you ineligible to participate would be 1) Race other than White/European ancestry and Black/African ancestry 2) currently on treatment for tobacco smoking 3) using non-cigarette tobacco products (including e-cigarettes) 4) having no hair on the head (required for hair analysis) 5) if unable to provide consent.

#### What other choices do I have if I do not take part in this research?

You can choose not to participate.

#### Where is the research going to take place and how long will it last?

*Title of Study: Differential effects of nicotine metabolite ratio on tobacco smoking and smoking cessation outcomes among smokers with mental illness.*

The research will be conducted at 905 Johns Hopkins Drive, Brody School of Medicine at East Carolina University Greenville, NC 27834. You will need to come to 905 Johns Hopkins Drive, Greenville, NC 27834 only once during the study. The total amount of time will be around 45 minutes and will be completed on the same day.

**What will I be asked to do?**

You will be asked for:

1. Information related to demographics, history of psychiatric illness, history of treatment for psychiatric disorders, history of treatment for any substance use disorder, your smoking behaviors and exposure to secondhand smoke, intentions and attitudes towards smoking, reasons for smoking and past quit attempts and barriers to engaging in treatment for tobacco use disorder.
2. A saliva and hair sample. The saliva and hair sample will help us understand how nicotine is processed by the body and if it affects tobacco smoking or motivation to stop smoking.

**What might I experience if I take part in the research?**

We don't know of any risks associated with this research. Any risks that may occur with this research are no more than what you would experience in everyday life. We don't know if you will benefit from taking part in this study. There may not be any personal benefit to you but the information gained by doing this research may help others in the future.

**Will I be paid for taking part in this research?**

You will be provided with a gift card in the amount of \$19.25 upon participation

**Will it cost me to take part in this research?**

It will not cost you any money to be part of the research.

**Who will know that I took part in this research and learn personal information about me?**

The ECU researchers running this study, may know that I took part in this research.

- The sponsor of this study is ECU (Brody brothers endowment grant).
- The University & Medical Center Institutional Review Board (UMCIRB) and its staff have responsibility for overseeing my welfare during this research and may need to see research records that identify me.

**How will you keep the information you collect about me secure? How long will you keep it?**

The information will be password-protected and kept secured by the investigators in the computer. All the information will be anonymous, will not contain any identifiers and could not be linked to your identity or health information. The saliva and hair samples will also be stored without any identifying information. We will securely keep the information that we collect for six years.

**What if I decide I don't want to continue in this research?**

You can stop at any time after it has already started. There will be no consequences if you stop and you will not be criticized. You will not lose any benefits that you normally receive.

**Who should I contact if I have questions?**

The people conducting this study will be able to answer any questions concerning this research, now or in the future. You may contact the Principal Investigator at 252-744-1406 (weekdays, between 8 AM – 5 PM)

If you have questions about your rights as someone taking part in research, you may call the Office of Research Integrity & Compliance (ORIC) at phone number 252-744-2914 (days, 8:00 am-5:00 pm). If you would like to report a complaint or concern about this research study, you may call the Director of the ORIC, at 252-744-1971

*Page 2 of 3*

*Consent Version # or Date: \_\_\_\_\_*





**EAST CAROLINA UNIVERSITY**  
**University & Medical Center Institutional Review Board**  
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## Notification of Continuing Review Approval: Expedited

From: Biomedical IRB  
To: [Lauren Bethune Scroggs](#)  
CC:

[Lauren Bethune Scroggs](#)

Date: 12/4/2020

Re: [CR00008926](#)  
[UMCIRB 16-000034](#)

Differential effects of nicotine metabolite ratio on tobacco smoking and smoking cessation outcomes among smokers with mental illness.

The continuing review of your expedited study was approved. Approval of the study and any consent form(s) is for the period of 12/3/2020 to 12/2/2021. This research study is eligible for review under expedited category # 8a. The Chairperson (or designee) deemed this study no more than minimal risk.

As the Principal Investigator you are explicitly responsible for the conduct of all aspects of this study and must adhere to all reporting requirements for the study. Your responsibilities include but are not limited to:

1. Ensuring changes to the approved research (including the UMCIRB approved consent document) are only initiated with UMCIRB review and approval except when necessary to eliminate an apparent immediate hazard to the participant. All changes (e.g. a change in procedure, number of participants, personnel, study locations, new recruitment materials, study instruments, etc.) must be prospectively reviewed and approved by the UMCIRB before they are implemented;
2. Ensuring that only valid versions of the UMCIRB approved, date-stamped informed consent document(s) are used for obtaining informed consent (consent documents with the IRB approval date stamp are found under the Documents tab in the ePIRATE study workspace);
3. Promptly reporting to the UMCIRB all unanticipated problems involving risks to participants and others;
4. Applying for continuing review and receive approval of continuation of the study prior to the study's current expiration date. Application for continuing review should be submitted no less than 30 days prior to the expiration date. Lapses in approval (i.e. study expiration) should be avoided to protect the safety and welfare of enrolled participants and liability to the University; and

5. Submission of a final report when the study meets the UMCIRB criteria for closure. Study approval should not be allowed to expire simply because the study is completed, rather the UMCIRB should be formally notified of study completion via the final report process.

The approval includes the following items:

Document	Description
EAST CAROLINA UNIVERSITY TOBACCO RESEARCH-contactsheet.docx(0.01)	Recruitment Documents/Scripts
ECU TOBACCO RESEARCH-flyer.docx(0.01)	Recruitment Documents/Scripts
Informed Consent Document.doc(0.01)	Consent Forms
IRB-submission-proposal.docx(0.01)	Study Protocol or Grant Application
IRB-submission-screening-guideline.docx(0.01)	Interview/Focus Group
IRB-submission-screening-guideline.docx(0.01)	Scripts/Questions
Questionnaire.doc(0.01)	Surveys and Questionnaires
Questionnaire.doc(0.01)	Surveys and Questionnaires
Questionnaire.doc(0.01)	Interview/Focus Group
Questionnaire.doc(0.01)	Scripts/Questions

For research studies where a waiver or alteration of HIPAA Authorization has been approved, the IRB states that each of the waiver criteria in 45 CFR 164.512(i)(1)(i)(A) and (2)(i) through (v) have been met. Additionally, the elements of PHI to be collected as described in items 1 and 2 of the Application for Waiver of Authorization have been determined to be the minimal necessary for the specified research.

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

## APPENDIX B: Survey Instrument

Please Note: Questions used in Analysis for Dissertation Indicated by Yellow Highlight

### East Carolina Tobacco Research Study

#### 1. INSTRUCTIONS FOR PARTICIPANTS:

##### 1. INSTRUCTIONS FOR PARTICIPANTS

*Welcome to our survey, please follow the guidelines provided below when completing the survey.*

1. Please follow the instructions.
2. Please answer ALL questions in each SECTION.
3. Please read each question slowly and carefully.
4. If you have any questions about items in the survey please let the Research Assistant know so that he or she can help you.
5. If you would like to leave comments about a response, please add this information to the comments section at the end of the survey.
6. When you have completed the survey, please make sure that you have answered ALL of the questions in each sections.
7. When ALL survey questions are answered, please tell the Research Assistant that you are done.

Thank you for taking the time to complete this survey and participate in our study.

1. Please allow this space for research staff. (study number)

##### 2. SECTION A. DEMOGRAPHIC INFORMATION

## 2. SECTION A: DEMOGRAPHIC INFORMATION

2. In what year were you born? (enter 4-digit year; for example, 1976)

3. What is your gender?

- Male  
 Female

4. What is the highest grade or year of school you completed?

- Less than high school  
 High school graduate or GED  
 Some college/ vocational/ trade school degree  
 College graduate

5. Which race/ethnicity best describes you? (Please choose only one.)

- |   |  |
|---|--|
| <input type="radio"/> Black or African American   | <input type="radio"/> Asia American                              |
| <input type="radio"/> Mexican American or Chicano | <input type="radio"/> White (Caucasian)                          |
| <input type="radio"/> Cuban American              | <input type="radio"/> American Indian or Alaska Native           |
| <input type="radio"/> Puerto Rican                | <input type="radio"/> Native Hawaiian or Other Pacific Islander  |
| <input type="radio"/> Other Hispanic or Latino    | <input type="radio"/> Multiple ethnicity/ Other (please specify) |

6. Which of the following best describes your current relationship status?

- Married
- Widowed
- Divorced
- Separated
- In a domestic partnership or civil union
- Single, but cohabiting with a significant other
- Single, never married

7. What medications are you taking currently?

- |   |   |  |
|---|---|--|
| <input type="checkbox"/> Fluoxetine (Prozac)    | <input type="checkbox"/> Lorazepam (Ativan)                                     | <input type="checkbox"/> Ziprasidone (Geodon)                  |
| <input type="checkbox"/> Citalopram (Celexa)    | <input type="checkbox"/> Methylphenidate (Concerta, Focalin, Ritalin, Metadate) | <input type="checkbox"/> Aripiprazole (Abilify)                |
| <input type="checkbox"/> Sertraline (Zoloft)    | <input type="checkbox"/> Amphetamine (Adderall, Vyvanse, Dextroamphetamine)     | <input type="checkbox"/> Paliperidone (Invega)                 |
| <input type="checkbox"/> Paroxetine (Paxil)     | <input type="checkbox"/> Chlorpromazine (Thorazine)                             | <input type="checkbox"/> Lurasidone (Lauda)                    |
| <input type="checkbox"/> Escitalopram (Lexapro) | <input type="checkbox"/> Haloperidol (Haldol)                                   | <input type="checkbox"/> Carbamazepine (Tegretol)              |
| <input type="checkbox"/> Venlafaxine (Effexor)  | <input type="checkbox"/> Perphenazine (Trilafon)                                | <input type="checkbox"/> Lithium                               |
| <input type="checkbox"/> Duloxetine (Cymbalta)  | <input type="checkbox"/> Fluphenazine (Prolixin)                                | <input type="checkbox"/> Lamotrigine (Lamictal)                |
| <input type="checkbox"/> Bupropion (Wellbutrin) | <input type="checkbox"/> Risperidone (Risperdal)                                | <input type="checkbox"/> Oxcarbazepine (Trileptal)             |
| <input type="checkbox"/> Clonazepam (Klonopin)  | <input type="checkbox"/> Olanzapine (Zyprexa)                                   | <input type="checkbox"/> Valproic acid or Valproate (Depakote) |
| <input type="checkbox"/> Alprazolam (Xanax)     | <input type="checkbox"/> Quetiapine (Seroquel)                                  | <input type="checkbox"/> I am not taking any medications       |
| <input type="checkbox"/> Other (please specify) |   |  |
|   | <input type="text"/>  |  |

8. Have you ever been diagnosed with a mental illness?

- Yes
- No

9. If yes, what is your primary mental health diagnosis for which you are receiving treatment?

- Schizophrenia
- Schizoaffective disorder
- Major Depressive Disorder
- Bipolar Disorder 1
- Bipolar Disorder 2
- Other (please specify)
- Post Traumatic Stress Disorder
- Obsessive Compulsive Disorder
- Generalized Anxiety Disorder
- Social Anxiety Disorder
- Not applicable

10. Please list any secondary mental health diagnoses for which you are receiving treatment? (check all that apply)

- Schizophrenia
- Schizoaffective disorder
- Major Depressive Disorder
- Bipolar Disorder 1
- Bipolar Disorder 2
- Other (please specify)
- Post Traumatic Stress Disorder
- Obsessive Compulsive Disorder
- Generalized Anxiety Disorder
- Social Anxiety Disorder
- Not applicable

11. Do you currently or have you ever had any of the following? (check all that apply)

- |   |   |
|---|---|
| <input type="checkbox"/> Asthma                                       | <input type="checkbox"/> Obesity                                    |
| <input type="checkbox"/> High blood pressure                          | <input type="checkbox"/> Cardiovascular disease (e.g. heart attack) |
| <input type="checkbox"/> COPD (Chronic Obstructive Pulmonary Disease) | <input type="checkbox"/> HCV (Hepatitis C Virus)                    |
| <input type="checkbox"/> Chronic Bronchitis                           | <input type="checkbox"/> HIV (Human Immunodeficiency Virus)         |
| <input type="checkbox"/> Cerebrovascular disorders (e.g. stroke)      | <input type="checkbox"/> Chronic pain* (please specify-Question 12) |
| <input type="checkbox"/> Diabetes                                     | <input type="checkbox"/> Cancer* (please specify-Question 12)       |
| <input type="checkbox"/> High cholesterol                             | <input type="checkbox"/> Not applicable                             |
| <input type="checkbox"/> Emphysema                                    |   |

12. \*If you answered that you have had **cancer** and/or **chronic pain** above please specify here.

13. Have you ever had treatment for a substance use disorder?

- No
- Yes--Please specify

14. In what county/city do you live?

15. What is your health insurance status (check all that apply)?

- |   |   |
|---|---|
| <input type="checkbox"/> Medicaid                 | <input type="checkbox"/> Social security disability               |
| <input type="checkbox"/> Medicare                 | <input type="checkbox"/> I do not currently have health insurance |
| <input type="checkbox"/> Private health insurance |   |

**16. Do you work?**

- Full-time
  Student
- Part-time
  Volunteer
- Unemployed
  Other (please specify)

**17. If you work, is your work place smoke-free?**

- Yes
- No
- Not Applicable

**18. In your opinion, does smoking/tobacco use cause**

	Yes	No
Cancer	<input type="radio"/>	<input type="radio"/>
Heart disease	<input type="radio"/>	<input type="radio"/>
Lung disease	<input type="radio"/>	<input type="radio"/>
Mental illness	<input type="radio"/>	<input type="radio"/>
Addiction to other drugs	<input type="radio"/>	<input type="radio"/>
Premature death (dying earlier than normal)	<input type="radio"/>	<input type="radio"/>

**section b****3. SECTION B: SECONDHAND SMOKE AND SMOKING BEHAVIOR**

**In this section, we are interested in knowing about your exposure to secondhand smoke and tobacco use**

19. Do other smokers live in the same house/apartment as you?

- No
- Yes (how many)

20. Excluding yourself, how many people smoke inside your home every day or almost every day?

- None
- 1
- 2
- 3 or more

21. During the past 7 days, did someone smoke when you were...

	Yes	No	Does Not Apply
in a restaurant or café	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
in a car	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
in your house	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
in someone else's home	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
at work or school	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other (please specify)

22. Do any of the following people in your life currently smoke cigarettes?

	Yes	No	Does Not Apply
Spouse/ Partner/ Boyfriend or Girlfriend	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mother or Father/ Step-parent (s)/ Grandparents	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Brother(s)/ Sister(s)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Children	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Best/Close friends	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

23. On a scale of 0-10 with 0 being "not at all" and 10 being "all the time", how often would you say you are exposed to secondhand tobacco smoke on average? (Please choose one)

0=Not at all	1	2	3	4	5	6	7	8	9	10=All the time
<input type="radio"/>										

24. Have you ever used tobacco products (any amount)

- yes, cigarettes
- yes, tobacco products other than cigarettes
- yes, cigarettes and other tobacco products

25. Which tobacco products have you ever used? (Check all that apply)

<input type="checkbox"/> Cigarettes	<input type="checkbox"/> Chew tobacco/loose leaf
<input type="checkbox"/> Pipes	<input type="checkbox"/> Electronic cigarettes
<input type="checkbox"/> Hookas	<input type="checkbox"/> Cigarillos (little cigars)
<input type="checkbox"/> Cigars	<input type="checkbox"/> Other (please specify)
	<input type="text"/>

26. Have you used any tobacco products (any amount), at least once in the past month?

- Yes, I have only smoked cigarettes at least once in the past month
- Yes, I have used cigarettes and other tobacco products at least once in the past month

27. At what age did you start smoking cigarettes?

28. About how many cigarettes, on average do you smoke in a day?

- Less than 15 cigarettes/day (less than 3/4 a pack per day)
- Smokes 15-25 cigarettes/day (3/4 to 1-1/4 pack per day)
- More than 25 cigarettes/day (more than 1-1/4 pack per day)

29. On a scale of 0-10, with 0 being "not at all important" and 10 being "extremely important,"

How **important** is it for you to quit smoking/tobacco use?

- |                        |                       |                       |                       |                       |                       |                       |                       |                       |                       |                        |
|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|
| 0=Not at all important | 1                     | 2                     | 3                     | 4                     | 5                     | 6                     | 7                     | 8                     | 9                     | 10=Extremely important |
| <input type="radio"/>  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>  |

30. How **confident** are you that you can quit smoking/tobacco use?

- |                        |                       |                       |                       |                       |                       |                       |                       |                       |                       |                        |
|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|
| 0=Not at all confident | 1                     | 2                     | 3                     | 4                     | 5                     | 6                     | 7                     | 8                     | 9                     | 10=Extremely confident |
| <input type="radio"/>  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>  |



35. People smoke/use tobacco for different reasons. Why do you think people smoke/use tobacco?

- |   |  |   |
|---|--|---|
| <input type="checkbox"/> Addiction (can't stop)           | <input type="checkbox"/> Self-medication                       | <input type="checkbox"/> Improve mood           |
| <input type="checkbox"/> Others are smoking/peer pressure | <input type="checkbox"/> Increase sense of control             | <input type="checkbox"/> Clarity of thought     |
| <input type="checkbox"/> Anxiety                          | <input type="checkbox"/> Relaxation                            | <input type="checkbox"/> Increase socialization |
| <input type="checkbox"/> Symptom control                  | <input type="checkbox"/> Feelings of helplessness/hopelessness | <input type="checkbox"/> Daily routine/habit    |
| <input type="checkbox"/> Loneliness                       | <input type="checkbox"/> Feel better physically                | <input type="checkbox"/> Boredom                |
| <input type="checkbox"/> Lack of alternative activities   | <input type="checkbox"/> Only source of enjoyment              | <input type="checkbox"/> Peer pressure          |
| <input type="checkbox"/> Other (please specify)           |  |   |
|   | <input type="text"/>   |   |

### Block 3

#### 4. Fagerstrom Test for Nicotine Dependence

36. How soon after you wake up do you smoke your first cigarette/use tobacco?

- |                       |                       |                       |                       |
|-----------------------|-----------------------|-----------------------|-----------------------|
| After 60 minutes      | 31 to 60 minutes      | 6 to 30 minutes       | Within 5 minutes      |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

37. Do you find it difficult to refrain from smoking/using tobacco in places where it is forbidden (e.g. in church, at the library, in the cinema)?

- |                       |                       |
|-----------------------|-----------------------|
| No                    | Yes                   |
| <input type="radio"/> | <input type="radio"/> |

38. Which cigarette/tobacco product would you hate most to give up?

- |                              |                       |
|------------------------------|-----------------------|
| The first one in the morning | Any other             |
| <input type="radio"/>        | <input type="radio"/> |

39. How many cigarettes per day do you smoke?

10 or less

11-20

21-30

31 or more

40. Do you smoke more frequently during the first hours after awakening than during the rest of the day?

No

Yes

41. Do you smoke when you are so ill that you are in bed most of the day?

No

Yes

#### Block 4

#### 5. Crittenden Scale: READINESS, MOTIVATION, AND CONFIDENCE IN ABILITY TO CHANGE SMOKING BEHAVIOR

42. Are you *seriously* thinking of cutting down the number of cigarettes you smoke?

Yes

No

43. At present, *how much* do you want to cut down the number of cigarettes you smoke?

Not at all

A little

Some

Very much

44. If you *wanted* to cut down now, how sure are you that you would be able to do it?

- Not at all sure
- A little sure
- Somewhat sure
- Very sure

45. How *determined* are you to cut down?

- Not at all determined
- A little determined
- Somewhat determined
- Very determined

46. In the last year, did you ever *on purpose* quit smoking for at least 24 hours?

- Yes
- No

47. Are you *seriously* thinking about quitting smoking?

- Yes
- No

48. How much do you want to quit smoking?

- Not at all
- A little
- Some
- Very much

49. If you decide to quit smoking completely, *how sure* are you that you would be able to do it?

- Not at all sure
- A little sure
- Somewhat sure
- Very sure

50. Do you plan to quit smoking?

- Yes
- No

51. If you plan to quit smoking, *by when* do you plan to quit?

- 1 month
- 3 months
- 6 months
- More than 6 months

52. If you plan to quit smoking, *how determined* are you to quit?

- Not at all determined
- A little determined
- Somewhat determined
- Very determined

## Block 5

### 6. SECTION C: INTENTIONS, ATTITUDES, SOCIAL NORMS, AND PERCEIVED BEHAVIORAL CONTROL

**We would like to know some of your thoughts about quitting smoking or tobacco use.**

**53. INTENTION**

On a scale of 1 to 7 with 1 being 'strongly disagree' and 7 being 'strongly agree,' indicate to what extent you agree or disagree with the following statements:

	1=Strongly Disagree	2	3	4	5	6	7=Strongly Agree
I <b>plan</b> to quit smoking/tobacco use in the next six months.	<input type="radio"/>						
I <b>want</b> to quit smoking/tobacco use in the next six months.	<input type="radio"/>						
I <b>will</b> quit smoking/tobacco use in the next six months.	<input type="radio"/>						

**54. ATTITUDE:**

On a scale of 1 being '**harmful**' and 7 being '**beneficial**' How would you rate quitting smoking/using tobacco?

1=Harmful	2	3	4	5	6	7=Beneficial
<input type="radio"/>						

**55.** On a scale of 1 being '**good**' and 7 being '**bad**' How would you rate quitting smoking/using tobacco?

1=Good	2	3	4	5	6	7=Bad
<input type="radio"/>						

56. On a scale of 1 being **'pleasant for you'** and 7 being **'unpleasant for you'**  
How would you rate quitting smoking/using tobacco?

1=Pleasant for you	2	3	4	5	6	7=Unpleasant for you
<input type="radio"/>						

57. On a scale of 1 being **'worthless'** and 7 being **'useful'** How would you rate  
quitting smoking/using tobacco?

1=Worthless	2	3	4	5	6	7=Useful
<input type="radio"/>						

**58. Armitage Scale: SUBJECTIVE NORMS**

On a scale of 1 being '**strongly disagree**' and 7 being '**strongly agree**' please respond to the following

	1=Strongly Disagree	2	3	4	5	6	7=Strongly Agree
People who are important to me think I should quit smoking in the next 2 months.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People who are important to me would approve of my quitting smoking in the next 2 months.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People who are important to me want me to quit smoking/using tobacco in the next two months.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is expected of me that I will quit smoking/using tobacco.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel under social pressure to quit smoking/using tobacco.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Most of my peers think it is important to quit smoking/using tobacco.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**59. PERCEIVED BEHAVIORAL CONTROL:**

On a scale of 1 being '**strongly disagree**' and 7 being '**strongly agree**' please rate your response to the following statements:

	1=Strongly Disagree	2	3	4	5	6	7=Strongly Agree
I am confident that I can quit smoking/using tobacco.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The decision to quit smoking/using tobacco is beyond my control.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Whether I quit smoking/using tobacco is entirely up to me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**60. PERCEIVED BEHAVIORAL CONTROL:**

On a scale of 1 being '**easy**' and 7 being '**difficult**' please rate your response to the following statement:

**'For me to quit smoking/using tobacco is....'**

1=Easy	2	3	4	5	6	7=Difficult
<input type="radio"/>						

**Block 6****7. SECTION D: REASONS FOR SMOKING/TOBACCO USE AND PAST QUIT ATTEMPTS**

**61. Please indicate how often you have experienced these activities based on the following scale**

(1 = Never; 2 = Seldom; 3 = Occasionally; 4 = Very often)

**How often has a health care provider**

	1=Never	2=Seldom	3=Occasionally	4=Very often
<b>ASKED</b> you whether you smoke cigarettes or use other tobacco products?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>ADVISED</b> you to quit smoking or using tobacco products?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>ASSESSED</b> your readiness to quit or cut down smoking or using tobacco products?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>ASSISTED</b> you in stopping smoking/tobacco use by giving medications or counseling?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>ARRANGED</b> for you to be referred to stop smoking programs or follow up with you on your abstinence?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

62. What methods have you used to try and stop smoking in the past? (check all that apply)

- |   |   |
|---|---|
| <input type="checkbox"/> I have never tried to stop smoking                 | <input type="checkbox"/> Individual or group therapy  |
| <input type="checkbox"/> "Cold turkey"                                      | <input type="checkbox"/> Electronic cigarettes  |
| <input type="checkbox"/> Pharmacotherapy (e.g. NRT, bupropion, varenicline) | <input type="checkbox"/> Used other substances (e.g. alcohol, marijuana, smokeless tobacco) |
| <input type="checkbox"/> Other..... (e.g. exercise, meditation, hypnosis)   |   |
- 

63. Have you made a serious attempt to quit smoking in the past 12 months?

- Yes  
 No

64. IF yes, how many times? (If no please enter zero)

65. Have you made a serious attempt to quit smoking in the past 12 months and been successful for at least 24 hrs?

- Yes  
 No

**Block 7**

## **8. SECTION E: BARRIERS TO ENGAGING IN TOBACCO TREATMENT**

66. Please indicate to what extent do you agree or disagree with the following statement.

Health care providers can do little to influence the smoking/tobacco use of people.

1=Completely Disagree 2=Somewhat Disagree 3=Somewhat Agree 4=Completely Agree

67. Please indicate to what extent do you agree or disagree with the following statement.

Nicotine replacement therapy should be provided for all who smoke/use tobacco and want to quit or cut down their smoking/tobacco use.

1=Completely Disagree 2=Somewhat Disagree 3=Somewhat Agree 4=Completely Agree

68. Please indicate to what extent do you agree or disagree with the following statement.

A patient who smokes/uses tobacco needs to be motivated before he/she can be helped to quit or cut down.

1=Completely Disagree 2=Somewhat Disagree 3=Somewhat Agree 4=Completely Agree

69. Please indicate to what extent do you agree or disagree with the following statement.

Continuously asking patients who smoke/use tobacco to quit will make the patients stop being honest with their provider.

1=Completely Disagree 2=Somewhat Disagree 3=Somewhat Agree 4=Completely Agree

70. If you were to attend (or refer a friend) to a stop smoking program, would you prefer (choose all that apply)

- |   |   |
|---|---|
| <input type="checkbox"/> A program designed for only people with mental illnesses   | <input type="checkbox"/> A program that is for only your gender       |
| <input type="checkbox"/> A program for people with or without mental illnesses      | <input type="checkbox"/> A program that is for both males and females |
| <input type="checkbox"/> A program for people with the same mental health diagnosis |   |

### Block 8

## 9. SECTION F: INITIAL EXPERIENCE WITH TOBACCO

71. When you tried your first cigarette, did you experience any of the following...

	Yes	No
Feel dizzy	<input type="radio"/>	<input type="radio"/>
Cough	<input type="radio"/>	<input type="radio"/>
Feel sick	<input type="radio"/>	<input type="radio"/>
Feel high	<input type="radio"/>	<input type="radio"/>
Feel relaxed	<input type="radio"/>	<input type="radio"/>
Feel nervous	<input type="radio"/>	<input type="radio"/>
Feel good	<input type="radio"/>	<input type="radio"/>

### Block 10

## 10. SECTION G: SMOKER PROTOTYPES

72. Picture a typical cigarette smoker your age. Is your opinion of this person...

- Very negative
- Somewhat negative
- Neutral
- Somewhat positive
- Very positive

73. How much does the following characteristics describe a typical cigarette smoker your age?

	Not at all	A little bit	Somewhat	Quite a bit	Very much
Cool	<input type="radio"/>				
Smart	<input type="radio"/>				
Sexy	<input type="radio"/>				
Healthy	<input type="radio"/>				
Disgusting	<input type="radio"/>				
Unattractive	<input type="radio"/>				
Immature	<input type="radio"/>				
Inconsiderate	<input type="radio"/>				

## Block 9

### 11. SECTION H: FINAL THOUGHTS AND ADDITIONAL INFORMATION

74. How did you find the length of this questionnaire?

- Much too long
- A bit too long
- About right
- A bit too short
- Much too short

75. Did you have difficulty understanding any of the questions?

- No, I understood all the questions
- Yes, I had difficulty understanding a few questions
- Yes, I had difficulty understanding many of the questions

76. Would you be interested in participating in future research on this topic?

- No
- Yes

77. Do you have any comments about this survey? Are there any topics you think should have been included or excluded, or was there anything you liked or did not like about the survey?

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