

ABSTRACT

Title of dissertation: THE ASSOCIATION BETWEEN ELECTRONIC CIGARETTE USE AND CIGARETTE SMOKING BEHAVIOR AMONG YOUNG ADULTS IN THE UNITED STATES

Blair N. Coleman, Doctor of Philosophy, 2015

Dissertation directed by: Associate Professor Kerry M. Green
Department of Behavioral and Community Health

The prevalence of electronic cigarette (e-cigarette) use is rapidly increasing in adults and youth; however, little is known about the public health impact of their use. A debate over e-cigarettes has emerged in the literature; one side recognizes the potential benefit of e-cigarettes as a harm reduction tool, while others argue e-cigarette use may delay or deter smoking cessation due to dual use or increase the risk of initiation of conventional cigarettes among previous nonsmokers. Drawing on the Theory of Planned Behavior, this dissertation focused on attitudes, beliefs, and perceived social norms of e-cigarettes, as well as openness to conventional cigarette smoking among young adult users of the product.

Using a mixed methods approach, this dissertation analyzed secondary data from the 2012-2013 National Adult Tobacco Survey (NATS) as well as focus group data collected in five cities across the U.S. to better understand the relationship between e-cigarette use and cigarette smoking among young adults. In Study 1, quantitative analyses

found non-cigarette smoking young adults who have tried e-cigarettes were more likely to report openness to cigarette smoking in the future compared to those who have not tried e-cigarettes (AOR= 2.4; 95% CI= 1.7-3.3). In Study 2, qualitative findings suggest that young adult exclusive e-cigarette users were less interested in conventional cigarette smoking, and overwhelmingly described negative aspects to cigarette smoking that appeared to become more salient as a result of their e-cigarette use. In Study 3, focus group participants expressed many positive attitudes towards e-cigarettes, and simultaneously reported a lack of information and knowledge about the products.

The relationship between e-cigarette use and cigarette smoking is complex and multifaceted, and influenced by a myriad of individual and social factors. Although quantitative findings suggest young adults who have used e-cigarettes compared to those who have not used e-cigarettes were more likely to report openness to future cigarette smoking, qualitative findings did not support the notion that young adult e-cigarette users (who may have prior experience with cigarette smoking) are open to future cigarette smoking. These findings provide a basis for further exploration of the association between e-cigarette use and cigarette smoking.

THE ASSOCIATION BETWEEN ELECTRONIC CIGARETTE USE AND
CIGARETTE SMOKING BEHAVIOR AMONG YOUNG ADULTS IN THE UNITED
STATES

By

Blair N. Coleman

Dissertation submitted to the Faculty of the Graduate School of the
University of Maryland, College Park in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
2015

Advisory Committee:

Associate Professor Kerry M. Green, Chair

Dr. Benjamin J. Apelberg

Assistant Professor Craig S. Fryer

Professor Dr. Sally A. Koblinsky

Dr. Jessica M. Rath

© Copyright by
Blair N. Coleman
2015

Dedication

This dissertation is dedicated first and foremost to the participants who shared their opinions and candid thoughts during the focus group study. Thank you for helping me understand your experiences, and by doing so, making this research possible. Also, to my grandmother, Dorothy Coleman, who inspired and encouraged me to pursue my dreams.

Acknowledgements

Throughout my doctoral program I have had incredible support from mentors, friends and family, and faculty members—a heartfelt thank you to each of you for helping me reach this accomplishment.

To my dissertation committee Chair (and all-star mentor!), Dr. Kerry Green. Words cannot express how thankful I am to you for your guidance and encouragement throughout my doctoral program. From working as your TA, to quals preparations, and now to my dissertation you have always provided support and guidance in a way that challenged me and made me a better student. I have learned so much from you over the years—thank you.

To Dr. Pamela Clark, for believing in me and giving me the incredible opportunity to work with the “dream team” during the first two years of my doctoral program. You have always challenged and inspired me to be a better writer, researcher, and person. Your support throughout my doctoral program has meant so much to me. Thank you.

To Dr. Benjamin Apfelberg, the opportunity you gave me to join your team at CTP back in 2012 was one of the best things to happen in my professional career. The ability to gain practical experience in tobacco regulatory science as a doctoral student shaped the type of public health professional I want to become. I continue to be inspired by your patience, passion, and dedication to public service. Thank you for guidance over the past three years, and for all of your support on this project.

I am sincerely grateful to the rest of my dissertation committee for their time and support for this research—Dr. Jessica Rath, Dr. Sally Koblinsky, and Dr. Craig Fryer. The depth of knowledge and guidance each of you provided to this project was essential in helping me reach this stage. A special thank you to Dr. Jessica Rath, for your professional guidance and on-going support over the past several years.

To my unbelievably talented and passionate colleagues at CTP—particularly Drs. Sarah Johnson and Bridget Ambrose—who have provided incredible support and guidance to me over the past three years. Working with you and sharing your passion created a situation where I enjoy coming to work every day. For that and for the incredible amount I have learned from you, thank you.

Thank you to the faculty in the Department of Behavioral & Community Health who have guided me and provided unrelenting support—particularly Dr. Kathy Sharp and Dr. Robert Feldman. Also to my cohort—Erica, Alyssa, Krishna, Erin, Luciana, Daisy, Bina, and Tim—who have been incredibly supportive and caring since we started this journey together back in 2011.

To the two mentors who made everything possible: Drs. Elbert Glover and Steven Pokorny. Dr. Glover, thank for your believing in me and giving me the incredible opportunity to complete my doctoral studies at the University of Maryland. I promised I would make you proud! Dr. Pokorny, over the years I have learned so much from you personally and professionally. I’m so grateful for the countless hours you have spent providing professional advice and guiding me every step of the way. You both have challenged me and encouraged me to accomplish things at times I thought were impossible. Thank you for always believing in me.

Lastly, but certainly not least, to all of my friends and family—particularly my parents and Tom Nesmith—who have always encouraged and supported me, despite many moves across the country, work-filled weekends, and dare I say it—temper tantrums(!). Your love and support is what kept me going through the many years of undergraduate and graduate school, and is undoubtedly the main reason I was able to achieve this accomplishment—thank you.

TABLE OF CONTENTS

Dedication	ii
Acknowledgements	iii
List of Figures and Tables.....	vii
CHAPTER ONE: INTRODUCTION	1
1.1 Background	1
<i>1.1.1 Regulation of E-Cigarettes.....</i>	<i>3</i>
<i>1.1.2 Use of E-Cigarettes among Young Adults.....</i>	<i>4</i>
<i>1.1.3 Debate over the Population Impact of E-Cigarettes.....</i>	<i>5</i>
1.2 Conceptual Framework of the Study	6
1.3 Statement of the Problem.....	9
1.4 Purpose of the Study	10
1.5 Specific Aims, Hypotheses, and Research Questions	11
1.6 Summary.....	12
1.7 Definition of Terms.....	13
CHAPTER TWO: LITERATURE REVIEW	16
2.1 Background on E-Cigarettes and Emergence in the U.S. Marketplace.....	16
<i>2.1.1 Background and Diversity of E-Cigarette Products</i>	<i>16</i>
<i>2.1.2 Marketing and Sales of E-Cigarettes</i>	<i>18</i>
2.2 Prevalence of E-Cigarette Use in the U.S.....	19
2.3 Potential Public Health Benefits versus Harms Associated with E-Cigarette Use.....	22
2.4 Attitudes, Beliefs, and Social Norms	24
<i>2.4.1 Psychological Constructs</i>	<i>24</i>
<i>2.4.2 Openness/ Future Intentions to Smoke Cigarettes.....</i>	<i>26</i>
2.5 Conclusion	27
CHAPTER THREE: STUDY 1: ASSOCIATION BETWEEN ELECTRONIC CIGARETTES USE AND OPENNESS TO CIGARETTE SMOKING AMONG U.S. YOUNG ADULTS.....	29
INTRODUCTION.....	29
METHODS.....	32
<i>National Adult Tobacco Survey (NATS)</i>	<i>32</i>
<i>Study Population</i>	<i>33</i>
<i>Measures</i>	<i>33</i>
<i>Statistical Analyses.....</i>	<i>35</i>
RESULTS.....	37
DISCUSSION	39
<i>Limitations.....</i>	<i>42</i>
<i>Conclusions.....</i>	<i>43</i>
Table 3.1: Characteristics of Never Established Smoking Young Adults, ^a by Ever Use of E-Cigarettes --- NATS 2012-2013	45

Table 3.2: Prevalence of Openness to Cigarette Smoking and Factors Associated with Openness to Smoking among Young Adults ^a --- NATS 2012-2013	46
CHAPTER FOUR: STUDY 2: UNDERSTANDING THE RELATIONSHIP BETWEEN E-CIGARETTE USE AND CIGARETTE SMOKING AMONG YOUNG ADULTS: FINDINGS FROM A QUALITATIVE STUDY	48
INTRODUCTION	48
METHODS.....	51
RESULTS	55
DISCUSSION	60
Table 4.1: Characteristics of Young Adult E-Cigarette Participants by City (N=80)	67
Table 4.2: Summary of Key Findings by Theme	68
CHAPTER FIVE: STUDY 3: “<i>IT’S NOT SMOKE. IT’S NOT TAR. IT’S NOT 4,000 CHEMICALS. CASE CLOSED</i>”: EXPLORING ATTITUDES, BELIEFS, AND PERCEIVED SOCIAL NORMS OF E-CIGARETTE USE AMONG ADULT USERS	69
INTRODUCTION	69
METHODS.....	72
RESULTS	76
DISCUSSION	82
Table 5.1: Adult E-Cigarette Focus Group Participant Characteristics by City (N=116).....	88
Table 5.2: Summary of Key Findings by Construct.....	89
CHAPTER SIX: SUMMARY	90
6.1 Overview & Summary	90
6.2 Implications	93
6.3 Strengths & Limitations	95
6.4 Future Research Directions.....	97
APPENDICES.....	100
Appendix I: Methods	100
Appendix II: Moderator Guide.....	121
Appendix III: Focus Group Screener	126
Appendix IV: Focus Group Coding Dictionary	130
Appendix V: Human Subjects Protection.....	132
REFERENCES	134

List of Figures and Tables

Figure 1:	Conceptual Model.....	8
Figure 2:	Overall Design to Address Study Aims 1 and 2.....	102
Table 3.1:	Characteristics of Never Established Smoking Young Adults, by Ever Use of E-Cigarettes—NATS 2012-2013.....	45
Table 3.2:	Prevalence of Openness to Cigarette Smoking and Factors Associated with Openness to Smoking among Young Adults—NATS 2012-2013.....	46
Table 4.1:	Characteristics of Young Adult E-Cigarette Participants by City.....	67
Table 4.2:	Summary of Key Findings by Theme.....	68
Table 5.1:	Adult E-Cigarette Focus Group Participant Characteristics by City.....	88
Table 5.2:	Summary of Key Findings by Construct.....	89

CHAPTER ONE: INTRODUCTION

1.1 Background

Despite decades of reduction in cigarette smoking in the U.S., it is still the cause of approximately 480,000 premature deaths annually (U.S. Department of Health and Human Services [DHHS], 2014), and remains the leading preventable cause of morbidity and mortality throughout the world (World Health Organization [WHO], 2013). Recent data from the 2012-2013 National Adult Tobacco Survey (NATS) shows that although the prevalence of every day or some day cigarette smoking has significantly decreased since the 2009-2010 NATS (18.0% vs. 19.5%, respectively), cigarettes and other combustible tobacco products (e.g., cigars and pipes) remain the most prevalent forms of tobacco use among adults (Centers for Disease Control and Prevention [CDC], 2014). However, as the prevalence of cigarette smoking continues to decline, emerging products (e.g., electronic cigarettes and hookah) continue to grow in popularity.

According to data from the National Survey on Drug Use and Health (NSDUH) in 2012, young adults aged 18 to 25 had the highest rate of current use of any tobacco product (38.1%) compared to youth between the ages of 12 to 17 (8.6%) and older adults aged 26 or older (27.0%) (Substance Abuse and Mental Health Services Administration [SAMHSA], 2012). Moreover, although the greatest risk for cigarette smoking initiation occurs during adolescence, young adults are at risk for established smoking (Green et al., 2007) given that nearly all of cigarette smoking transitions from experimentation to daily smoking occurs before the age of 26 (USDHHS, 2012). Young adulthood, particularly between the ages of 18-25, is recognized as a distinct developmental period for identity

exploration (Arnett, 2000) and adoption of risky health behaviors, including tobacco use (Backinger, Fagan, Matthews, & Grana, 2003; Green et al., 2007; USDHHS, 2012). Moreover, studies examining industry documents have demonstrated that young adults have been an increasingly important target for tobacco industry marketing (Hafez & Ling, 2005; Ling & Glantz, 2002). Thus, young adulthood is a particularly salient time for public health intervention to prevent initiation and establishment of tobacco use behaviors.

As the overall prevalence of cigarette smoking continues to decline, this reduction in smoking prevalence has coincided with an increase in the use of other traditional and non-traditional tobacco products, such as electronic nicotine delivery devices (ENDS) – including e-cigarettes. Since entering the U.S. marketplace in 2007, e-cigarettes have surged in popularity among both youth and adults. Data from the 2011-2012 National Youth Tobacco Survey (NYTS) found that youth in grades 6-12 who reported that they had ever tried e-cigarettes doubled from 3.3% to 6.8% and current e-cigarette use increased from 1.1% to 2.1% (CDC, 2013). Similarly for adults 18 years of age or older, findings from a national consumer-based study found that ever use of e-cigarettes among adult respondents increased from 3.3% in 2010 to 6.2% in 2011 (King et al., 2013). As the landscape for tobacco products continues to become more diverse with the advent of novel products, an increase has also been observed in the rates of dual and polytobacco use in the young adult population. For example, one study by Rath et al. (2012) found a 30% dual use rate among current tobacco users in a nationally representative sample of young adults aged 18-34, which corroborates findings from earlier studies demonstrating a trend of polytobacco use in this population (Backinger et al., 2007). These findings

demonstrate the need for additional research to better understand the relationship between cigarette smoking and other tobacco products, such as e-cigarettes.

1.1.1 Regulation of E-Cigarettes

In 2009, The Family Smoking Prevention and Tobacco Control Act (Tobacco Control Act) gave the U.S. Food and Drug Administration (FDA) regulatory authority over the manufacturing, marketing, and distribution of cigarettes, roll-your-own tobacco, and smokeless tobacco (Government Printing Office [GPO], 2009). Although e-cigarettes are not currently regulated by the FDA's Center for Tobacco Products (CTP), in 2010 the U.S. Court of Appeals issued a decision in the case of *Sottera Inc. vs. FDA* which determined e-cigarettes and other products 'made or derived from tobacco' can be regulated as tobacco products under the Tobacco Control Act unless they are marketed for therapeutic purposes. Following this decision, in 2011 FDA announced its intent to expand jurisdiction; and most recently in 2014, the Agency released a proposed rule to extend its jurisdictional authorities to other tobacco products, including e-cigarettes (Government Printing Office [GPO], 2014). Under the current proposal, FDA would have the authority to regulate the manufacture, marketing and distribution of e-cigarettes.

When evaluating new tobacco products, FDA is required to assess the impact of the product and its marketing on the health of the population as a whole. This includes consideration of the potential for increased harm or benefit among current tobacco users, including delayed or decreased cessation, and the potential for harm among non-users of tobacco, including the potential for increased initiation of tobacco use and relapse among former tobacco users. In the case of e-cigarettes, while there is potential for substantial benefits to public health if current established adult cigarette smokers completely switch

to use of e-cigarettes, there is also concern that the appeal of e-cigarettes among youth and young adults could lead to initiation and consolidation of the use of potentially more harmful tobacco products, such as conventional cigarettes. Understanding the potential uptake of e-cigarettes among young adults is particularly important considering that nearly all adults who become daily smokers first started smoking by 26 years of age (USDHHS, 2012).

Until there is a final ruling granting the FDA regulatory authority over e-cigarettes, the availability of these products are largely or completely unregulated (Chen & Husten, 2014). As a result, several state and local jurisdictions have begun to enact local policies restricting the use of e-cigarettes in public spaces and sales of the products to minors. In the absence of federal regulation surrounding e-cigarettes, additional surveillance is critical to understanding patterns of use, as well as behavioral transitions between e-cigarettes and conventional cigarettes.

1.1.2 Use of E-Cigarettes among Young Adults

Nationally representative data on the use of e-cigarettes among young adults is limited, however, recent epidemiologic data demonstrates a growing trend of e-cigarette use in this population. For example, data from the 2012-2013 National Adult Tobacco Survey found that young adults aged 18-24 reported the highest prevalence of e-cigarette use (every day, some day, or rarely use) compared to the overall adult population (8.3% vs. 4.2%, respectively) (CDC, 2014). Similarly, evidence from the 2010 Consumer Styles survey show that young adults 18-24 were more likely to have used e-cigarettes compared to any other age group (Regan, Promoff, Dube & Arrazola, 2013). Data from two national surveys found age was inversely related to e-cigarette use, with adjusted

odds ratios of use decreasing by 2% to 3% (AOR= .98 and .97, respectively) in both samples with every year of increased age (Pearson, Richardson, Niaura, Vallone, & Abrams, 2012). Lastly, data from a national consumer-based web survey of U.S. adults found an increase in ever use of e-cigarettes among young adults aged 18-24 from 7.0% in 2010 to 8.1% in 2011. Although national data on the use of e-cigarettes among young adults is limited, the available data suggests that prevalence of e-cigarette use among young adults is high and steadily increasing.

1.1.3 Debate over the Population Impact of E-Cigarettes

A debate over e-cigarettes has emerged in the public health literature regarding the potential benefit of these products as a harm reduction tool, while others argue e-cigarette use may delay or deter smoking cessation due to dual use of these products or increase the risk of initiation of conventional cigarettes or other tobacco products (Fairchild & Bayer, 2015; Lee et al., 2013; Pepper and Brewer, 2013). The evidence on whether e-cigarettes are effective as a cessation tool is currently limited (Bullen et al., 2013; Etter et al., 2011; Etter & Bullen, 2014; Polosa et al., 2011; Siegel et al., 2011). Equally unclear is the potential for e-cigarettes as a harm reduction tool. While research indicates that replacing combustible cigarettes with e-cigarettes reduces toxicant exposure by 9 times to as much as 450 times (Goniewicz, et al., 2013), harmful and potentially harmful constituents known to cause cancer, respiratory, and heart disease have been identified in some e-cigarette aerosols, cartridges and emissions, and reliable estimates of the toxicity of e-cigarettes are currently limited (Cheng, 2014). Furthermore, e-cigarette products offer a spectrum of nicotine concentrations, which may have lasting

adverse consequences for brain development (USDHHS, 2014) and can result in (or exacerbate) nicotine addiction.

1.2 Conceptual Framework of the Study

To date, limited research has been conducted using behavioral theory to examine the relationship between e-cigarettes and conventional cigarettes among young adults, which is critical to understanding this behavior. The scientific literature has shown predictive validity for measures of self-reported openness to cigarette smoking (susceptibility to cigarette smoking) on cigarette smoking behavior (Choi, Gilpin, Farkas & Pierce, 2001; Mowery, Farrelly, Haviland, Gable & Wells, 2004; Pierce, Choi, Gilpin & Farkas, 1996; Wakefield et al., 2004); however, these constructs have not yet been examined in the context of e-cigarette use.

This dissertation research draws on the Theory of Planned Behavior (TPB) (Ajzen, 1991), which holds intention to engage in a behavior as the most proximal antecedent to behavior change. This dissertation also utilizes aspects of TPB by focusing on young adults' attitudes, beliefs, and perceived social norms surrounding e-cigarette use and its relationship to cigarette smoking behavior, and the manner in which they affect openness to conventional cigarette smoking (Figure 1). It is through TPB also, that a sense of directionality in the proposed relationships between the constructs is inferred, such that attitudes and perceived social norms precede the intention, which ultimately leads to engaging in cigarette smoking behavior. Moreover, the central notion tested in this dissertation postulates that e-cigarette users, because of their engagement with a tobacco product and the behavioral similarity of its use to that of conventional cigarette

smoking (e.g., nicotine delivery via inhalation, hand-to-mouth delivery), have more positive attitudes towards cigarette smoking, compared to e-cigarette non-users. In turn, their positive attitudes increase their intention to engage in cigarettes smoking. Thus, according to this model, a more positive attitude towards smoking is related to openness to try cigarette smoking.

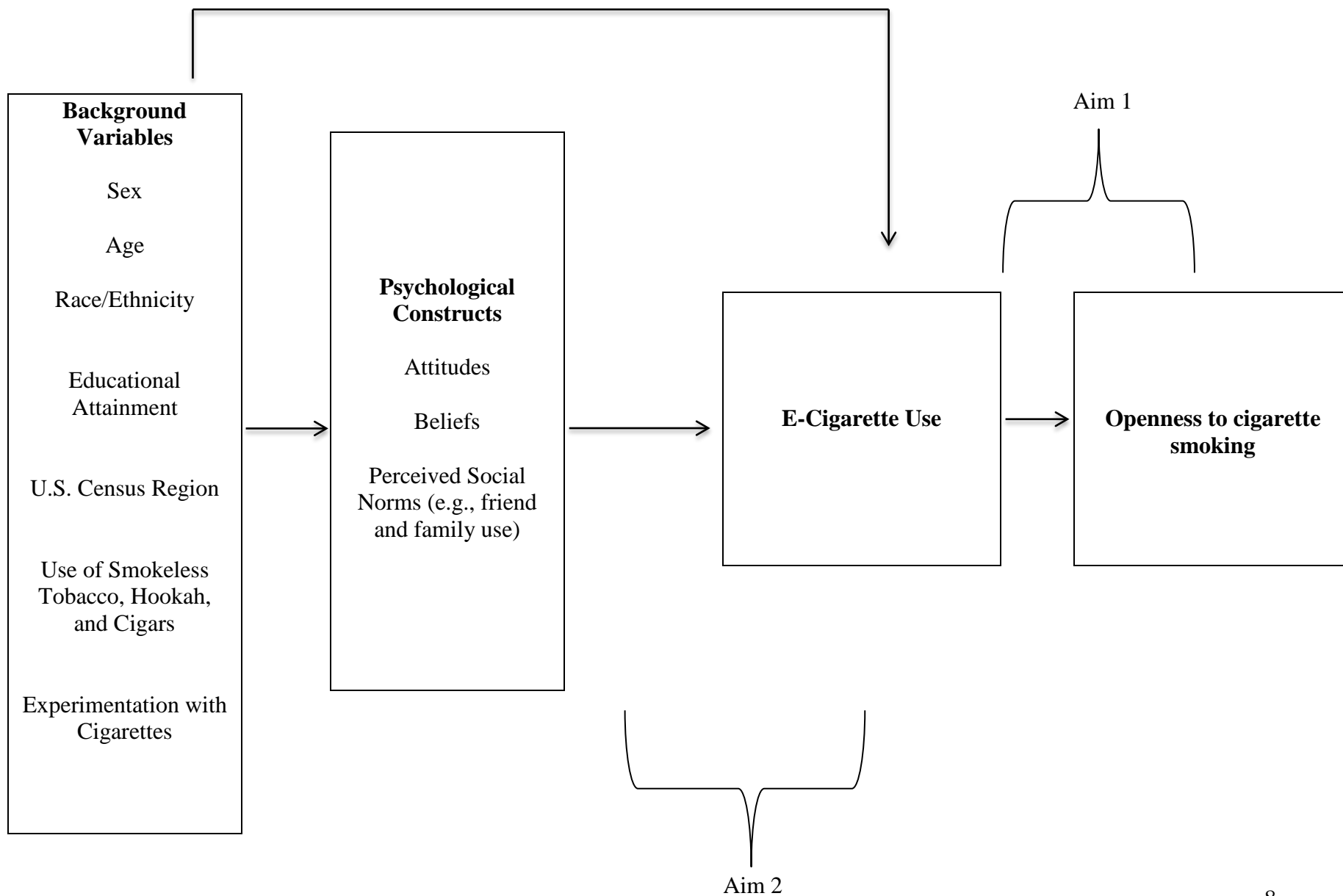


Figure 1: Conceptual Model

1.3 Statement of the Problem

Traditionally, epidemiologic data has shown that most tobacco use begins in early adolescence, with the majority (88%) of first use of cigarettes occurring before the age of 18 and nearly all first use (99%) of cigarettes occurs before age 26 (USDHHS, 2012). However, as the diversity of tobacco products on the U.S. market expands and attracts new users, young adults who otherwise may not have initiated conventional tobacco products could potentially be vulnerable to initiate novel tobacco products, such as e-cigarettes. This concept of vulnerability for tobacco initiation at an older age has been examined in the context of other alternative tobacco products such as hookah. For example, one study found that among students who had reported no pre-college hookah use, a high proportion (22%) initiated hookah during the first year after college entry (Fielder, Carey & Carey, 2012).

Provided that young adulthood is a crucial window for engaging in risk behaviors, including tobacco use (Arnett, 2005; Backinger et al., 2003; Green et al., 2007), research is needed to examine the uptake of e-cigarettes in this population as well as the potential for e-cigarette use to lead to the use of potentially more harmful tobacco products (e.g., conventional cigarettes). Moreover, since e-cigarette products are relatively new to the U.S. market, there is a gap in the scientific literature with respect to young adult users' attitudes, beliefs, and perceived social norms of these products and how these factors compare to that of conventional cigarette smoking.

1.4 Purpose of the Study

The purpose of this study was to examine the relationship between e-cigarette use and cigarette smoking behavior among young adults aged 18-29 in the U.S. More specifically, this study sought to determine if e-cigarette use among young adults is independently associated with openness to smoke conventional cigarettes as well as attitudes, beliefs, and perceived social norms of e-cigarettes compared to conventional cigarettes. To address this question, a quantitative analysis was conducted using a nationally representative sample of young adults in the U.S. to test the association between e-cigarette use and openness to smoke cigarettes as well as a qualitative investigation to further explore this association and provide additional insight into young adults' attitudes, beliefs, and perceived social norms of e-cigarettes and conventional cigarettes.

This study utilized existing data from a nationally representative sample of young adults aged 18-29, including both users and non-users of e-cigarettes, as well as qualitative responses from young adults who currently use e-cigarettes in five cities across the U.S. Using a mixed methods study design provided the ability to obtain complementary data on this topic, and triangulate data sources to develop a more complete understanding of the relationship between e-cigarettes and conventional cigarette smoking as well as young adults' attitudes, beliefs, and perceived social norms of electronic cigarettes and conventional cigarettes. Understanding the relationship between e-cigarettes and conventional cigarettes will provide valuable insight on possible transitions between these products and may also be used to enhance prevention efforts to reduce initiation of all tobacco products among young adults.

1.5 Specific Aims, Hypotheses, and Research Questions

This dissertation addressed two research aims, one accompanying hypothesis, which was tested quantitatively, and four research questions and related sub-questions, which were explored qualitatively:

Aim 1. To examine the association between e-cigarette use and openness to cigarette smoking among young adults.

Research question 1: How has using e-cigarettes affected young adults' attitudes and beliefs about conventional cigarettes, including their openness to trying conventional cigarettes soon or in the next year?

Hypothesis 1: Young adults who have ever used e-cigarettes are more likely to be open to cigarette smoking compared to those who have not used e-cigarettes.

Aim 2. To examine attitudes, beliefs, and perceived social norms of e-cigarettes among young adults as well as how perceptions of e-cigarettes compares to those associated with conventional cigarettes.

Research question 2: How do young adult e-cigarette users compare e-cigarettes to other tobacco products, including conventional cigarettes?

***RQ 2.1:** How do young adult e-cigarette users compare e-cigarettes to other tobacco products in terms of ingredients and nicotine content?*

***RQ 2.2:** How do young adult e-cigarette users compare e-cigarettes to other tobacco products in terms of use patterns?*

Research question 3: What do young adults believe are the health risks associated with e-cigarette use?

RQ 3.1: How do young adults describe the risks of e-cigarettes compared to those associated with conventional cigarettes?

Research question 4: How do young adults describe their friends' and family members' use of e-cigarettes?

RQ 4.1: How do young adult e-cigarette users describe their friends' opinions about their use of the product?

RQ 4.2: How do young adult e-cigarette users describe family members' opinions about their use of the products?

1.6 Summary

Using a mixed methods approach, this study examined the relationship between e-cigarette use and cigarette smoking behavior among young adults in the U.S. aged 18-29 years. This study tested the association between e-cigarette use and self-reported openness to try cigarette smoking and examined qualitative responses to further explore the nature of this association and provide additional insight into young adults' attitudes, beliefs, and perceived social norms of e-cigarettes and conventional cigarettes.

Given that the extant data on e-cigarette use among young adults is limited; the findings from this dissertation will contribute to the scientific literature regarding the relationship between e-cigarette use and conventional cigarettes in order to assess the potential public health impact of the growing trend of e-cigarette use in the U.S.

1.7 Definition of Terms

Young adult: The term young adult in this study reflects non-institutionalized adults between the ages of 18-29 years residing in the United States. Based on previous literature demonstrating differences between young adults aged 18-24 and older young adults aged 25-34 (Green et al., 2007), age groups will be examined in the quantitative analysis comparing those aged 18-24 and those 25-29 years of age.

Electronic Nicotine Delivery Systems (ENDS): A class of products that heat and vaporize a solution containing nicotine; also known as an “e-cigarette” (Adkison et al., 2013).

Electronic cigarettes or “e-cigarettes”: Battery-powered devices that provide doses of nicotine and other additives to the user in aerosol form.

E-Cigarette vapor: Although typically referred to as a vapor, aerosolized humectant (typically with a nicotine solution) from an e-cigarette, which forms a visible fog when exhaled by the user (Cobb & Abrams, 2011).

Openness to cigarette smoking: The absence of a firm intention not to smoke cigarettes as defined by Wakefield et al. (2004).

Attitudes: The degree to which a person has favorable or unfavorable evaluation of a behavior (Fishbein & Ajzen, 1975; Ajzen 1985).

Beliefs: An individual’s perception about consequences of a particular behavior (Fishbein & Ajzen, 1975; Ajzen 1985).

Perceived behavioral control: an individual’s perceived ease or difficulty of performing the particular behavior (Ajzen, 1991).

Social norms: Perceptions of which behaviors are typically approved or disapproved and assist an individual in determining what is acceptable and unacceptable social behavior (Cialdini, 2004; Fishbein & Ajzen, 1975)

Never established cigarette smoker: An adult ≥ 18 years of age who has never smoked 100 cigarettes in their lifetime and currently does not smoke cigarettes. This definition has been traditionally used in national surveys as a threshold to define ever versus never cigarette smoking status in adults (USDHHS, 2014).

Combustible tobacco products: Tobacco products designed to be chemically altered when burned. The smoke produced from the combustion serves as the delivery mechanism of the tobacco to the user (USDHHS, 2010). Examples of combustible tobacco products include cigarettes, cigars, and hookah.

Smokeless tobacco: Traditional smokeless tobacco (i.e. chewing tobacco, dip, or snuff) typically placed under the lip against the gums, as well as snus (a moist, smokeless tobacco usually sold in individual or pre-packaged small pouches) and dissolvable tobacco products (finely ground tobacco that are placed in the mouth or on the tongue and readily dissolve).

Hookah: Method in which tobacco smoke passes through water before inhalation (Maziak, Ward, Afifi Soweid & Eissenberg, 2005).

Cigars: A diverse set of products including little filtered cigars, cigarillos, and premium cigars manufactured in a variety of sizes, filters, tips, flavors, prices, and packaging (Delnevo, Giovenco, Ambrose, Corey & Conway, 2014).

Triangulation: Approach in mixed methods research that seeks convergence, corroboration, and correspondence of results from the different methods (e.g., quantitative and qualitative) (Creswell & Plano Clark, 2011).

CHAPTER TWO: LITERATURE REVIEW

The purpose of this chapter is to present a summary of the literature with respect to what is currently known about the use of electronic cigarettes and identify gaps in the literature regarding the factors associated with e-cigarette use and transitions between tobacco products. This chapter is organized into four sections: the first section will describe the emergence of e-cigarettes in the U.S. marketplace, as well as a brief summary as to the anatomy and known constituents in e-cigarette products; the second section will provide an overview of the prevalence of e-cigarette use in the U.S.; the third section will provide a summary of the debate in the public health literature as to the potential benefits versus potential harms associated with the use of e-cigarettes; and the final section will summarize the literature on attitudes, beliefs, and perceived social norms of e-cigarette use. This final section also includes a brief overview of the literature on measuring openness and future intentions to engage in cigarette smoking behavior.

2.1 Background on E-Cigarettes and Emergence in the U.S. Marketplace

2.1.1 Background and Diversity of E-Cigarette Products

Electronic cigarettes (e-cigarettes) are a part of a broader class of emerging tobacco products known as Electronic Nicotine Delivery Systems (ENDS). The term for ENDS originated from the World Health Organization's Study Group on Tobacco Regulation in 2009 to describe a heterogeneous collection of battery-powered devices that provide doses of nicotine and other additives to the user in aerosol form. Although the term ENDS is well recognized in the scientific community, the term electronic

cigarettes, or “e-cigarettes” is believed to be the most popular term used among consumers of the products. Given the relatively nascent market for these products, other terms have also gained in popularity to describe variations of ENDS products, such as “electronic hookahs”, “e-hookahs”, “vape pens”, and “e-pens”. The expanding marketplace surrounding these products, and the increase in efforts by the industry to brand these various product types, continues to pose significant challenges to public health officials attempting to capture the use of ENDS at the population level. As such, a recent study suggested the importance of including all available terms associated with ENDS products to avoid underestimating the overall use of nicotine-delivery systems at the population level (Richtel, 2014).

One of the main challenges faced by researchers and policymakers is that a standard definition of ENDS does not exist; and therefore, the design, ingredients (including flavors), and product attributes may vary by manufacturer (Cobb, Byron, Abrams & Shields, 2010). Moreover, it has been estimated that over 460 e-cigarette brands are currently on the market (Zhu et al., 2014), which limits the ability to generalize to a single product type. Despite these potential product differences, several characteristics of e-cigarettes have been noted in the literature to appear to be consistent across products, including: a cartridge containing a humectant carrier (such as propylene glycol or glycerine) mixed with varying concentrations of nicotine; a tube into which the cartridge is inserted for the user to inhale; and a battery powered heating element which transforms the liquid substance into an aerosol form (Cobb et al., 2010). E-cigarette products are often sold as either a disposable product, where the device is discarded after

the vaporized liquid is exhausted, or as a refillable product so that the “e-juice” (solution containing nicotine and other substances) can be replenished into the device.

Although the long-term health effects of e-cigarettes remain unknown, research is emerging examining the potential toxicity and health effects of e-cigarettes compared to conventional cigarettes and other nicotine replacement therapies (NRTs). For example, one study by Goniewicz and colleagues in 2014 generated vapor from twelve brands of e-cigarettes to screen for potentially toxic and carcinogenic compounds (e.g., volatile organic compounds [VOCs], tobacco-specific nitrosamines [TSNAs] and heavy metals) compared to a reference nicotine product (Nicorette inhalator). Results of this study concluded that although vapor generated from e-cigarettes does contain some levels of toxic compounds, the levels of these toxic compounds were reduced by 9 times to as much as 450 times compared to those in conventional cigarette smoke, and was often comparable to the trace amounts found in the reference nicotine product (Nicorette inhalator) (Goniewicz et al., 2014). However, a recent systematic review of the literature on chemicals in e-cigarette products revealed that harmful and potentially harmful constituents known to cause cancer, respiratory, and heart disease have been identified in some e-cigarette aerosols, cartridges and emissions, but reliable estimates of the toxicity of e-cigarettes are currently limited (Cheng, 2014).

2.1.2 Marketing and Sales of E-Cigarettes

Since entering the U.S. marketplace in 2007, e-cigarette sales have doubled every year and are expected to reach \$2 billion in 2013 and over \$10 billion by 2017 (Federal

Trade Commission, 2013; Herzog & Gerberi, 2013). Indeed increases in sales and use of e-cigarettes in recent years have been mirrored by increased advertising for these products; e-cigarette advertising expenditures across multiple media channels, including magazines, television, newspapers, and the Internet, has increased nearly three-fold, from \$6.4 million in 2011 to \$18.3 million in 2012 (Kim, Arnold & Makarenko, 2014). Some e-cigarette brands have been advertised as a cost-effective and socially acceptable alternative to conventional cigarette smoking (Cobb, Byron, Abrams & Shields, 2010; Henningfield & Zaatari, 2010), and certain online marketing has promoted anecdotal claims of smoking cessation benefits, along with direct and indirect health claims (Cobb, Brookover & Cobb, 2013; Grana & Ling 2014; Kim et al., 2014; Richardson, Ganz, Stalgaitis, Abrams & Vallone, 2013). More specifically, one study by Grana & Ling (2014) conducted a content analysis of electronic cigarette retail websites and found 95% of the websites made explicit or implicit health claims and 64% of the websites made smoking cessation claims. It is unclear to what extent such advertising is influencing consumer perceptions of e-cigarettes, particularly among individuals who might not otherwise use tobacco products or those who are attempting or thinking about quitting smoking (Richardson et al., 2014; Cobb et al., 2010; Cobb & Abrams, 2011).

2.2 Prevalence of E-Cigarette Use in the U.S.

In the U.S., a recent decline in cigarette smoking prevalence has coincided with an increase in the use of non-traditional and emerging tobacco products, such as e-cigarettes. The current estimation of prevalence of e-cigarette use in the U.S. is not completely understood given how quickly the marketplace is changing for these products,

as well as a limited number of nationally representative studies available documenting the use of e-cigarettes among demographic subgroups and the U.S. population as a whole. However, in recent years national surveillance systems have begun to track and monitor trends in e-cigarette awareness and use.

Evidence from the Consumer Styles survey, an annual cross-sectional consumer mail-in survey of approximately 10,000 adults, found that ever-use of e-cigarettes more than quadrupled from 2009 (0.6%) to 2010 (2.7%) (Regan, Promoff, Dube, & Arrazola, 2011). Young adults in this study aged 18-25 were most likely to have heard of e-cigarettes (41.0% vs. 32.2% among all adults). This study also found that use of e-cigarettes was higher among women and individuals with less education, which differs from a smaller study conducted by McMillen, Maduka and Winickoff (2012) that found prevalence of e-cigarette use was somewhat higher among men (2.2% vs. 1.4% for women) and those who reported some college education (3.7%) compared to those with a high school degree (1.7%). McMillen and colleagues also reported ever use of e-cigarettes overall was 1.8%, and was higher among nondaily smokers (8.2%), followed by daily smokers (6.2%) (McMillen, Maduka & Winickoff, 2012).

Another study used data from the Health Styles survey, a national consumer based study of U.S. adults, to measure ever use of e-cigarettes and found among all respondents, 2.1% in the 2010 mail-in survey, 3.3% in the web survey, and 6.2% in the 2011 web survey reported ever use of e-cigarettes (King, Alam, Promoff, Arrazola & Dube, 2013). Results of this study also found that ever use of e-cigarettes was

significantly higher among current smokers compared to both former and never-smokers, irrespective of the survey method (mail-in vs. web-based) and survey year.

Data from a national population study of 10,041 adults administered by Knowledge Networks in 2012, found that among all adults 8.1% had ever tried e-cigarettes and among current smokers, 32.2% had tried e-cigarettes (Zhu et al., 2013). Moreover, over 80% of current users of e-cigarettes reported non-daily use. Women in this study were statistically significantly more likely to report ever use of e-cigarettes (8.3%) compared to men (5.3%). Lastly, findings from a national online study (n=2,649) and the 2010 Legacy Longitudinal Smoker Cohort (n=3,658) suggests that rates of ever-use of ENDS are highest among current smokers (11.4%), followed by former smokers (2.0%) and never smokers (0.8%) (Pearson, Richardson, Niaura, Vallone, & Abrams, 2012). Based on estimates of current, former, and never smokers in 2008, these data would suggest that roughly 5 million smokers and more than 1 million former and never smokers have used ENDS (Pearson Richardson, Niaura, Vallone, & Abrams, 2012).

Although the published literature on ever use of e-cigarettes is limited, it is clear that use of these products is rapidly increasing. A key limitation of the studies presented above is that they mostly consist of cross sectional study designs and rely heavily on convenience samples, and therefore provide little insight as to the use of these products over time and may not be generalizable to the U.S. population. These studies do suggest, however, that e-cigarettes appear to be most common among current and former cigarette smokers, but more research is needed to determine the extent of non-smokers who are initiating e-cigarettes as well as transitions between e-cigarettes and conventional cigarettes.

2.3 Potential Public Health Benefits versus Harms Associated with E-Cigarette Use

As e-cigarettes continue to grow in popularity in the U.S., the public health research community remains at a divide regarding the potential benefits of these products as a harm reduction tool or smoking cessation aid versus potential harms such as encouraging uptake among individuals who might not otherwise use tobacco, or the potential to delay or hinder cessation efforts (Fairchild & Bayer, 2015; Pepper & Brewer, 2013). A growing body of literature has described the potential for e-cigarettes as an effective strategy for harm reduction, given that combustible cigarette smoking is the main driver of preventable mortality due to tobacco use (Cobb et al., 2010). That is, the advent of e-cigarettes may provide an opportunity for the distribution of an appealing and less harmful nicotine delivery mechanism, which has the potential to contribute to the reduction (or obsolescence) of conventional cigarette smoking (Abrams, 2014a). Moreover, a small number of longitudinal studies in Italy have examined the effectiveness of e-cigarettes as smoking cessation aids. For example, one study conducted a 12-month trial of 14 patients with schizophrenia and found seven of the participants were able to reduce their cigarette smoking by at least 50% and two others quit conventional cigarettes entirely (Caponnetto et al., 2013a). Another study by Caponnetto and colleagues (2013b) examined 40 smokers in a 6-month prospective randomized control trial of e-cigarettes where 13 reduced their cigarette consumption by 50% and nine participants reported quitting smoking entirely. Lastly, in another prospective trial 300 smokers were randomly assigned to either e-cigarettes with nicotine or e-cigarettes without nicotine (Polosa et al. 2013). At the end of 12-months, 11% of those using e-

cigarettes containing nicotine had quit compared to 4% of the non-nicotine group; with differences between the two cessation groups not being statistically significant. Although these studies demonstrate some promise for using e-cigarettes as a cessation tool, results should be interpreted with caution given they all relied on convenience samples of cigarette smokers (often reporting no intention to quit smoking) and several did not use an experimental designs to test the effect of e-cigarettes as a cessation aid.

At the same time, a body of literature is emerging that presents concerns for public health harm as a result of the growing popularity of e-cigarettes; such that e-cigarettes may act as a gateway to more harmful tobacco products (Grana, 2013), or renormalize smoking behavior (Fairchild, Bayer & Colgrove, 2014). Moreover, a concern has also been raised in the literature as to whether e-cigarettes will serve as “bridge products” that could sustain nicotine addiction and primarily be used in places where cigarette smoking is prohibited (Cobb & Abrams, 2011). However, the extent to which smokers are using e-cigarette products to circumvent smoking restrictions is unclear. One study by Dawkins and colleagues (2013) used an online survey to capture knowledge and the nature of e-cigarette use among users, and found about a third (36%) of e-cigarette users reported frequently using e-cigarettes in places where smoking was banned (Dawkins, Turner, Roberts & Soar, 2013). Another study of e-cigarette “aficionados” (n=104) found that 90% of experienced users reported they were able to use e-cigarettes where smoking was prohibited, although they did not clarify how often they did so (Foulds, Veldheer & Berg, 2011). Lastly, a large online survey administered across various countries found that among daily e-cigarette users, 71% reported using the product at work and 43% reported use in cafes, restaurants or bars, although given the

varying level of smoking restrictions across countries it is unclear whether participants were using e-cigarettes in these locations to circumvent smoking restrictions.

2.4 Attitudes, Beliefs, and Social Norms

2.4.1 *Psychological Constructs*

Research on psychological constructs including, attitudes, beliefs, and perceived social norms surrounding e-cigarettes is limited; however, due to the growing consumer interest in these products, this scientific literature is growing. To date, only a handful of published studies in the scientific literature, as described below, evaluate these psychological constructs as they pertain to e-cigarettes. Nationally representative survey data is especially limited; thus, much of the available data on perceptions are reported from smaller surveys based on convenience samples.

Data from the Minnesota Adolescent Community Cohort survey, a population-based prospective cohort study of 2,624 young adults aged 20-28, surveyed participants on perceptions of using e-cigarettes as a smoking cessation aid, and beliefs about their harmfulness and addictiveness relative to cigarettes (Choi & Forster, 2013). Investigators found that among young adults who were aware of e-cigarettes, 45% agreed that e-cigarettes helped people quit smoking, 53% agreed that e-cigarettes were less harmful than cigarettes, and 26% agreed that e-cigarettes were less addictive than smoking (Choi & Forster, 2013). An Internet survey of a convenience sample of current e-cigarette users found that the majority of respondents perceived e-cigarettes to be less toxic than tobacco (84%) and reported using e-cigarettes to deal with cravings for tobacco (79%) and withdrawal symptoms (67%), to quit smoking (77%), and to deal with situations where

smoking was prohibited (39%) (Etter & Bullen, 2011). Another study, which assessed perceptions of e-cigarettes among current smokers and recent quitters in New Zealand, found that nearly a third of smokers believed that e-cigarettes could help them quit smoking, and 58% said they would be willing to try e-cigarettes for that reason (Li, Bullem, Newcombe, Walker & Walton, 2013).

Evidence from two national surveys conducted by the American Legacy Foundation, including a national online study and the Legacy Longitudinal Smoker Cohort in 2010 found that a little under half of the sample believed that ENDS were less harmful than conventional cigarettes, and 40% of former smokers believed that ENDS and conventional cigarettes were equivalent in terms of harmfulness (Pearson, Richardson, Niaura, Vallone, & Abrams, 2012). Another study of college students from eight different institutions in North Carolina revealed 45% of e-cigarette users reported e-cigarettes were less harmful than conventional cigarettes compared to 22% of non-users. Lastly, a focus group study of young adults (18-26 years old) who had never tried e-cigarettes expressed mixed beliefs about the harmfulness of e-cigarettes relative to conventional cigarettes (Choi, Fabian, Mottey, Corbett & Forster, 2012). These study findings suggest, in conjunction with other studies cited above, that in general, e-cigarettes are perceived as a safer alternative to conventional cigarette smoking, and may offer potential as a cessation tool.

Few studies to date have examined perceived social norms of e-cigarette use, but recent studies suggest the social acceptability surrounding use of e-cigarettes may vary by age. For example, one study that consisted of e-cigarette users with a mean age of 43 found a small minority of the sample who were concerned about the social acceptability

of e-cigarette use and felt embarrassed about using the product (Dawkins, Turner, Roberts & Soar, 2013); while another study of University students between the ages of 19-22, few of whom had tried e-cigarettes, perceived e-cigarette use to be more socially acceptable than smoking (Trumbo & Harper, 2013).

2.4.2 Openness/ Future Intentions to Smoke Cigarettes

The relationship between e-cigarette use and openness to try conventional cigarettes has been largely unstudied, and longitudinal data will ultimately be needed to track transitions between these two products over time. Although research has not yet been published examining e-cigarettes smokers' openness to try conventional cigarettes, self-reported intentions to try smoking has been established in the literature as a known predictor of cigarette smoking behavior, irrespective of past smoking experience. For example, Wakefield and colleagues in 2004 assessed data from Monitoring the Future linking 12th graders' smoking stage and intentions to follow up measures at four and six year follow-up to determine smoking behavior. Investigators observed a dose-response relationship between levels of baseline smoking experience and the likelihood of future smoking, and a firm intention not to smoke had a statistically significant protective effect on future smoking behavior (Wakefield et al., 2004). Another study using a longitudinal sample of California adolescents found that cognitions about future smoking (self-reported intentions and self-efficacy) increase the risk of future smoking at all levels of previous smoking behavior (Choi, Gilpin, Farkas & Pierce, 2001). Lastly, Mowery et al. (2004) examined factors associated with openness to cigarette smoking using data from the 1999 and 2000 National Youth Tobacco Survey and found that among middle and high school students, being receptive to tobacco industry promotions and having friends

who smoke were associated with being open to smoking (Mowery et al., 2004). To date, there is no published research examining e-cigarette users' openness to try conventional cigarettes; however, measures of openness/ intentions to engage in cigarette smoking have been identified as predictors of future smoking behavior and should be explored in the context of e-cigarette use.

2.5 Conclusion

Despite a lack of scientific evidence as to the long-term effects of e-cigarettes, these novel tobacco products are rapidly increasing in popularity in the U.S. Young adults who are at a critical developmental period for tobacco use experimentation and progression to regular use (USDHHS, 2012) are particularly important to consider in research. Moreover, as the diversity of tobacco products available expands and attracts new users, young adults who otherwise may not have initiated conventional tobacco products may initiate novel products, such as e-cigarettes.

Although the extant literature is limited regarding patterns of use as well as attitudes, beliefs, and norms surrounding e-cigarettes, early studies demonstrate rapid proliferation of e-cigarette awareness and use in the U.S. Additionally, as these products gain in popularity, perceptions of lower risk compared to conventional cigarettes and effectiveness as a smoking cessation tool are becoming more widespread. Despite this increase in popularity, particularly among young adults, currently no literature exists on the relationship between e-cigarette use and conventional cigarette smoking behavior. Until longitudinal data becomes available to monitor patterns of e-cigarette use and transitions between products over time, research is critically needed to examine if an

association exists between e-cigarette use and use of conventional cigarettes. Moreover, data with respect to attitudes, beliefs, and perceived social norms of e-cigarettes compared to conventional cigarettes will also provide valuable insight as to the relationship between these two products.

CHAPTER THREE: STUDY 1: ASSOCIATION BETWEEN ELECTRONIC CIGARETTES USE AND OPENNESS TO CIGARETTE SMOKING AMONG U.S. YOUNG ADULTS¹

INTRODUCTION

Electronic nicotine delivery systems (ENDS), including electronic cigarettes (e-cigarettes), have surged in popularity among both youth and adults in the U.S. since their marketplace debut in 2007. During 2011-2012, the prevalence of ever e-cigarette use among U.S. youth in grades 6-12 doubled from 3.3% to 6.8% (CDC, 2013), with similar trends in e-cigarette use among adults (King, Alam, Promoff, Arrazola & Dube, 2013; Pearson, Richardson, Niaura, Vallone & Abrams, 2012; Regan, Promoff, Dube & Arrazola, 2011). The 2012-2013 National Adult Tobacco Survey found that U.S. young adults aged 18-24 reported the highest prevalence of e-cigarette use (every day, some day, or rarely) compared to the overall adult population (8.3% vs. 4.2%, respectively) (CDC, 2014).

Increased e-cigarette use has been accompanied by increased advertising for these products; e-cigarette advertising expenditures across multiple media channels, including magazines, television, newspapers, and the Internet, has increased nearly three-fold, from \$6.4 million in 2011 to \$18.3 million in 2012 (Kim, Arnold & Makarenko, 2014). Some e-cigarette brands have been advertised as a cost-effective and socially acceptable alternative to conventional cigarette smoking (Cobb, Byron, Abrams & Shields, 2010; Henningfield & Zaatari, 2010), and certain online marketing has promoted anecdotal

¹ Published in *Nicotine & Tobacco Research* (2015)

claims of smoking cessation benefits, along with direct and indirect health claims (Cobb, Brookover & Cobb, 2013; Grana & Ling 2014; Kim et al., 2014; Richardson, Ganz, Stalgaitis, Abrams & Vallone, 2013). Recent literature suggests young adults who had never used e-cigarettes, but expect positive outcomes from using them, have greater intentions to try e-cigarettes in the future (Pokhrel, Little, Fagan, Muranaka, & Herzog, 2013). In addition, researchers have suggested that increased variation across ENDS products, with a growing diversity of flavoring options, may lead to product appeal among young adults (Zhu et al., 2014).

While the U.S. Food and Drug Administration (FDA) does not currently regulate ENDS, in April 2014 the Agency released a proposed rule to extend its jurisdictional authorities to other tobacco products, including e-cigarettes (Government Printing Office [GPO], 2014). Under the current proposal, FDA would have the authority to regulate the manufacture, marketing and distribution of e-cigarettes. When evaluating new tobacco products, FDA is required to assess the impact of the product and its marketing on the health of the population as a whole. This includes consideration of the potential for increased harm or benefit among current tobacco users, including delayed or decreased cessation, and the potential for harm among non-users of tobacco, including the potential for increased initiation of tobacco use and relapse among former tobacco users. In the case of ENDS, while there is potential for substantial benefits to public health if current established adult cigarette smokers who would otherwise have not quit completely switch to use of ENDS, there is also concern that the appeal of ENDS among youth and young adults could lead to initiation of the use of potentially more harmful tobacco products,

such as conventional cigarettes. Understanding the potential uptake of ENDS among young adults is particularly important considering that nearly all adults who become daily smokers first started smoking by 26 years of age (DHHS, 2012).

To date, limited evidence exists regarding the relationship between e-cigarette use and conventional cigarette smoking intentions among non-smoking young adult e-cigarette users. However, theory suggests the potential for such a relationship to exist. For example, the Theory of Planned Behavior (TPB) posits that behavioral intentions arise from a combination of a person's attitudes and subjective norms about the behavior, as well as their perceived behavioral control (Ajzen, 1991). Indeed, extant evidence supports this theory in the context of tobacco use, showing that intentions are a strong predictor of adolescent smoking behavior (Choi, Gilpin, Farkas & Pierce, 2001; Wakefield et al., 2004). The behavioral similarities between e-cigarette use and conventional cigarette smoking (e.g. nicotine delivery via inhalation, hand-to-mouth-delivery), suggest the possibility that attitudes about the use of e-cigarettes may influence attitudes about conventional cigarettes. In turn, as suggested by TPB, these positive attitudes may lead to stronger intentions to try conventional cigarette smoking. Alternatively, it is possible that positive attitudes surrounding e-cigarettes may in fact reinforce negative attitudes towards cigarette smoking (e.g. due to the smell of conventional cigarettes, ash produced, etc.). Regardless, an initial step in understanding the relationship between e-cigarettes and conventional cigarettes is to explore if an association exists between e-cigarette use and openness to cigarette smoking.

To explore whether e-cigarette use among young adults is independently associated with being open to future conventional cigarette smoking, this study analyzed data from the 2012-2013 National Adult Tobacco Survey (NATS). This data release cycle of NATS included measures on self-reported openness to smoking conventional cigarettes ‘soon’ or ‘in the next year’ among young adults who were never established smokers (defined as those who have smoked less than 100 cigarettes in their lifetime and currently smoke “not at all”). This relationship was assessed by first comparing the characteristics of young adult never established smokers who have ever tried (or have never tried) e-cigarettes. Next, the relationship between e-cigarette use as well as the relationship between ever use of other tobacco products, and openness to smoking was examined.

METHODS

National Adult Tobacco Survey (NATS)

The 2012-2013 National Adults Tobacco Survey (NATS) is a stratified, nationally representative random-digit dialed telephone survey of non-institutionalized adults 18 years of age and older. The sampling design was comprised of independent samples drawn from 75% landline and 25% cell phone-only households in the 50 U.S. states and District of Columbia. The 2012-2013 NATS was a collaborative partnership between FDA’s Center for Tobacco Products (CTP) and CDC’s Office on Smoking and Health (OSH). A total of 57,994 completed interviews and 2,198 eligible partial interviews (at least 60% complete) were obtained between October 2012 and July 2013, yielding a total sample of 60,192 qualified interviews and a corresponding response rate of 44.9%.

Study Population

This study was restricted to the 4,310 young adult (aged 18-29) respondents who had never established cigarette smoking behavior. Young adult respondents were determined to be never established smokers if they responded “no” to the question, “Have you smoked at least 100 cigarettes in your entire life?”, and also responded “not at all” to the question, “Do you now smoke cigarettes every day, some days, or not at all?”. Young adults who reported current (every day or some days) use of other combustible products, including cigars and hookah, were excluded from the sample due to the potential for current use of other combustible tobacco products to confound the relationship between e-cigarette use and openness to smoking in the future given the behavioral similarity between use of these products to conventional cigarette smoking. Current users of non-combustible products, including traditional smokeless tobacco, snus and dissolvable tobacco products, were not excluded from the sample, but non-combustible product use was included as a covariate in the analysis.

Measures

E-cigarette Use

All survey respondents were asked the question “Before today, had you ever heard of electronic cigarettes, or e-cigarettes?” Those who answered “yes” were then asked “Have you ever used an electronic cigarette, even just one time in your entire life?” Ever e-cigarette users were defined as those who responded “yes”, while those responding “no” were defined as never e-cigarette users. Individuals who indicated never

having heard of e-cigarettes prior to interview were treated as never e-cigarette users in the analysis as they were not asked the e-cigarette use question.

Openness to Smoking

Openness to future cigarette smoking was assessed among young adults in the study population using two questions: “Do you think you will smoke a cigarette soon?” and “Do you think you will smoke a cigarette in the next year?” Response options were: “Definitely yes”, “Probably yes”, “Probably not”, and “Definitely not”. A binary composite variable was created, and those who responded with any response option other than a firm intention not to smoke (“Definitely not”) were categorized as being open to smoking cigarettes and, therefore, considered at risk for future smoking. This definition draws on previous research on susceptibility measures classifying susceptibility/ high-risk intentions as the lack of firm intention not to smoke (Choi et al., 2001; Mowery, Farrelly, Haviland, Gable & Wells, 2004; Pierce et al., 1996; Wakefield et al., 2004). A sensitivity analysis was also conducted classifying only “Definitely yes” and “Probably yes” as being open to smoking and “Probably not” and “Definitely not” as not being open to smoking cigarettes.

Other Tobacco Product Use

Other tobacco product use was assessed with measures of ever use of smokeless tobacco, hookah, cigars, and ever experimentation with cigarettes. Ever use of smokeless tobacco was defined as having used chewing tobacco, dip, or snuff 20 times or having tried snus or dissolvable tobacco even one time. Ever use of hookah was assessed using

the question, “Have you ever smoked tobacco in a hookah in your entire life?”. Ever use of cigars was assessed using the question, “Have you smoked cigars, cigarillos, or little filtered cigars at least 50 times in your entire life?” Lastly, ever cigarette experimentation was assessed using the question, “Have you ever tried cigarette smoking, even one or two puffs?” Respondents who selected “yes” were considered to have experimented with cigarettes at some point in their lifetime.

Demographic Characteristics

Demographic characteristics included: sex (male and female), age group (18-24 and 25-29 years), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, and other non-Hispanic), educational attainment (less than twelfth grade [no diploma]; high school diploma, GED, or equivalent; and some college or higher), and U.S. Census region (South, Midwest, Northeast, and West). The ‘non-Hispanic other’ category included respondents who were non-Hispanic and Asian, Native American or Alaska Native, Hawaiian or Pacific Islander, or multiple races.

Statistical Analyses

All analyses were conducted via SAS 9.3 using *proc surveyfreq* and *proc surveylogistic* commands to control for the complex survey design. Final weights were applied to reflect initial selection probabilities, non-response adjustment, weight trimming, and post-stratification to national adult population estimates. First, sample characteristics of young adults were examined by ever use of e-cigarettes. Next, prevalence estimates and 95% confidence intervals (CIs) of self-reported openness to

smoking were calculated, stratified by ever e-cigarette use, sex, age group, race/ethnicity, educational attainment, U.S. Census region, ever use of smokeless tobacco (chewing tobacco, snuff, dip, snus, or dissolvables), ever use of hookah, ever use of cigars, and ever experimentation with cigarettes. Differences between estimates were considered statistically significant if results from a bivariate Rao-Scott chi-square test, which incorporates a correction to account for the survey design effects, were $p < 0.05$. Lastly, we used bivariate logistic regression to estimate unadjusted (ORs) and multivariate logistic regression to estimate adjusted (AORs) odds ratios of openness to smoke cigarettes (i.e. lack of a firm intention not to smoke) among ever e-cigarette users, controlling for demographic characteristics and other tobacco product use. The adjusted regression model included the following covariates: sex, age group, race/ethnicity, educational attainment, U.S. Census region, ever use of e-cigarettes, ever use of smokeless tobacco, ever use of hookah, ever use of cigars, and ever experimentation with cigarettes. Additionally, to examine any differences among males and females by ever use of e-cigarettes, a sex interaction term was included in the adjusted model. Estimates with a relative standard error of $>30\%$ or a denominator of <50 were not reported consistent with the protocol for other large, nationally representative surveys (Johnson et al., 2013).

Of the 4,310 eligible young adults in NATS who have never established cigarette smoking behavior and do not regularly use other combustible tobacco products, approximately 7% partially completed the survey ($n=296$). Of these partial completes, 170 cases were excluded from the multivariate analysis due to missing data on a study

measure. There was no statistically significant difference ($p<0.05$) in demographic characteristics or tobacco use behaviors between respondents who completed the entire survey and those who partially completed the survey.

RESULTS

The mean age of the study population was 23.6 (standard deviation=3.4). Among young adults who had never established cigarette smoking behavior and who were not current smokers of cigarettes or other combustible tobacco products (unweighted $n=4,310$), 7.9% (95% CI= 6.9, 8.9) reported having ever tried e-cigarettes—14.6% (95% CI= 9.8, 19.3) of whom reported current use of the product (data not shown). Among those who have ever tried e-cigarettes (unweighted $n=328$), 61.2% were men (95% CI= 54.5, 67.9), 73.3% were aged 18-24 (95% CI= 67.9, 78.7), 57.6% were non-Hispanic Whites (95% CI= 50.9, 64.2), and 58.6% have completed some college education or higher (95% CI= 51.6, 65.6) (Table 3.1). Bivariate analyses indicated statistically significant differences by ever e-cigarette use for sex ($p<0.0001$), age group ($p<0.05$), education ($p<0.05$), those who ever used smokeless tobacco ($p<0.0001$), those who ever used hookah ($p<0.0001$), those who ever used cigars ($p<0.0001$), and those who experimented with cigarettes ($p<0.0001$). No statistically significant difference was observed by race/ ethnicity or United States Census region. Nearly half (46.1%; 95% CI= 39.5, 52.8) of young adults who had ever tried an e-cigarette reported being open to smoking cigarettes compared to 14.2% (95% CI= 12.8, 15.6) of those who had never tried an e-cigarette (Table 3.2). Openness to smoke conventional cigarettes was also high among young adults who had ever tried other tobacco products, such as smokeless

tobacco (34.9%; 95% CI= 28.1, 41.8), hookah (28.2%; 95% CI= 25.0, 31.5), cigars (38.5%; 95% CI= 29.2, 47.8) or conventional cigarettes (29.0%; 95% CI= 26.3, 31.7).

Unadjusted logistic regression analysis indicated that e-cigarette use was positive associated with being open to smoking (OR=5.2; 95% CI=3.9, 6.9). Additionally, young adults who had ever used other tobacco products were positively associated with openness to smoking compared to those who have not tried the products, including smokeless tobacco (OR= 2.9; 95% CI= 2.1, 4.0), hookah (OR= 2.7; 95% CI= 2.2, 3.3), cigars (OR= 3.3; 95% CI=2.2, 5.0), and cigarettes (OR=4.5; 95% CI= 3.6, 5.6), respectively. Results also show men were more likely to report openness to smoking than women (OR=2.1; 95% CI=1.7, 2.6), those aged 18-24 were more likely to report openness to smoking (OR=1.6; 95% CI=1.3, 1.9) than those aged 25-29, and those with some college education or more were less likely to report openness to smoking (OR = 0.6; 95% CI=0.4, 0.9) when compared to those with less than a high school diploma.

Following multivariate adjustment, those who had tried an e-cigarette were statistically significantly more likely than those who had never tried an e-cigarette to report openness to cigarette smoking (AOR= 2.4; 95% CI= 1.7, 3.3) after controlling for sex, age group, race/ethnicity, educational attainment, U.S. Census region, ever use of smokeless tobacco, ever use of hookah, ever use of cigars, and ever experimentation with conventional cigarettes. In the adjusted model, males had 1.8 times the odds as females (95% CI= 1.4, 2.3) and young adults aged 18-24 had 1.7 times the odds as those aged 25-29 (95% CI=1.3, 2.2) to report openness to smoking. Education remained inversely

related to openness to smoking, with those achieving some college or higher having lower odds of openness to smoking (AOR= 0.5; 95% CI= 0.3, 0.8) compared to those who had not received a high school diploma. In addition, those who reported ever using a hookah or ever experimentation with conventional cigarettes were statistically significantly more likely to report openness to smoking compared to those who had never tried hookah or experimented with conventional cigarettes (AOR=1.6; 95% CI= 1.3, 2.1 and AOR=3.5; 95% CI=2.7, 4.5, respectively). In a sensitivity analysis, classifying defining only those reporting “Definitely yes” or “Probably yes” responses as being open to smoking resulted in an adjusted odds ratio for ever e-cigarette users of 2.5 (95% CI= 1.5, 4.1) compared to those who have never tried an e-cigarette, indicating that in applying this alternative definition the association did not change significantly. Associations for the ever use of other tobacco products and demographic characteristics included in the multivariate model also remained the same in the sensitivity analysis.

A final model tested the interaction between sex and e-cigarette use (data not shown). This analysis found that the relationship between ever e-cigarette use and openness to cigarette smoking did not vary significantly by sex as the p-value of the interaction term was greater than 0.05.

DISCUSSION

This study is the first to examine the relationship between e-cigarette use and openness to smoke, defined as the lack of a firm intention not to smoke, in a nationally representative sample of young adults who had never established cigarette smoking

behavior. Our findings indicate that young adults who have ever tried e-cigarettes was positively associated with openness to smoking compared to those who have never tried e-cigarettes after adjusting for sex, age group, race/ethnicity, educational attainment, U.S. Census region, and ever use of smokeless tobacco, ever use of hookah, ever use of cigars, and experimentation with conventional cigarettes. Findings from this study also indicate nearly 60% of ever e-cigarette users in the study sample reported having tried hookah (vs 23% of never e-cigarette users), as well as an independent association between ever hookah use and openness to smoking, which suggests young adults who experiment with other tobacco products may also be at risk for future cigarette smoking.

As noted, statistically significant differences in those who were classified as being open to smoking were observed not only by e-cigarette use, but also across population subgroups of young adults. Men, young adults aged 18-24, those with lower educational attainment, those who had ever tried hookah, and those ever experimenting with conventional cigarettes were more likely to lack a firm intention not to smoke. In this study, the sample population for this analysis consisted of young adults aged 18-29 years who have not established cigarette smoking behavior. In the context of e-cigarette use and openness to cigarette smoking, this population is especially important given that this is a critical period for tobacco use experimentation and initiation of regular use to occur (DHHS, 2012). Moreover, a recent study found never-smoking middle and high school students who have used e-cigarettes are nearly twice as likely to report smoking intentions compared with youth who have never used e-cigarettes (Bunnell et al., 2014). Although previous research has shown that most smokers try their first cigarette during

childhood or adolescence (DHHS, 2012), as the diversity of tobacco products on the market expands and attracts new users, young adults who otherwise may have not initiated or established regular use of conventional tobacco products may initiate novel tobacco products, such as ENDS.

A strong association between ever e-cigarette use and the lack of a firm intention not to smoke was observed in this study among never established smokers, adjusting for ever use of other tobacco products, as well as prior experimentation with cigarettes. There are several explanations that could give rise to this association; for example, if, as the Theory of Planned Behavior suggests (Ajzen, 1991), positive attitudes towards e-cigarette use increase openness to smoke cigarettes, then e-cigarettes might indeed negatively impact population health by acting as an entry to nicotine use and to use of combustible tobacco (Fairchild, Bayer & Colgrove, 2014). A recent study of passive exposure to electronic cigarette use found that such exposure increased desire for cigarettes, as well as e-cigarettes in young adult smokers (King, Smith, McNamara, Matthews & Fridberg, 2014), and an earlier study found that watching an advertisement for e-cigarettes that emphasized they can be used anywhere resulted in increased urges to smoke (Kim, Lee, Shafer, Nonnemaker & Makarenko, 2013) suggesting that this concern is plausible. Given the recent introduction of ENDS into the marketplace and the lack of data from prospective longitudinal studies, a direct link between use of e-cigarettes and progression to use of cigarettes has not been shown (Abrams, 2014; Hitchman, McNeill & Brose, 2014). Alternative explanations are also possible, such as young adults at risk for future cigarette smoking are turning to ENDS use. As noted in this study, those with

a prior experience with other tobacco products were also more likely to report openness to smoking, which may suggest a common set of factors that put young adults at risk for future conventional cigarette smoking.

Few studies have assessed what proportion of young adults at risk for future cigarette smoking will actually go on to engage in smoking cigarettes; however, this lack of a firm intention not to smoke has been a powerful predictor of increased risk of progression to actual use (Choi et al., 2001; Wakefield et al., 2004). Future research using longitudinal studies will help determine tobacco use trajectories over time to assess whether the use of ENDS among youth and young adults is associated with future combustible tobacco smoking, what the impact of ENDS use is on young adults at risk for smoking, and if the same risk factors that put individuals at risk for smoking initiation also puts them at risk for ENDS initiation, as well as the initiation of other tobacco products.

Limitations

This study is not without limitations. The first and most important limitation arises from the cross-sectional nature of the study. While a statistically significant association was observed between young adults who have tried e-cigarettes and openness to cigarette smoking, the cross-sectional nature of the survey limits the ability to establish the temporal relationship between e-cigarette use and openness to smoking. A second limitation results from the use of observational data. While we adjusted for relevant covariates in our analyses, it is possible that the association observed between e-cigarette use and openness to smoking is the result of an unmeasured confounder. Additionally,

there are limitations inherent to relying on self-report measures of behavior (Schwarz & Oyserman, 2011). In this study, young adults reported their openness to smoke conventional cigarettes, defined as a lack of a firm intention not to smoke, which is likely influenced by many factors such as attitudes, subjective norms surrounding the behavior, and access to tobacco products. Nonetheless, self-reported data can still provide valuable insight as to their behavioral intentions, which is an important antecedent to behavior change (Ajzen, 1985; Ajzen, 1991). Next, given that the survey measures for e-cigarettes in the 2012-2013 NATS only explicitly address “e-cigarettes,” it is possible that these measures underestimate ENDS use by not also including terminology used to describe ENDS, such as “e-hookah”, “vape pens” or “e-pens” which may be growing in popularity (Richtel, 2014). Lastly, this study examined the association between e-cigarette use and openness to cigarette smoking among never established cigarette smokers who may have previously experimented with conventional cigarettes at some point in their lifetime. Due to a limited sample size of young adults who have never tried cigarette smoking, we were not able to test this association among never experimenters; however, after controlling for prior cigarette experimentation increased odds of being open to smoking among e-cigarette users remained, indicating an independent association. Future research on openness to smoke cigarettes among e-cigarette users without a prior history of cigarette use may help further explore these relationships.

Conclusions

Our findings indicate that ever use of e-cigarettes, along with ever use of other combustible products, is associated with being open to smoking cigarettes, even after adjusting for other tobacco product use, as well as demographic characteristics. Although

this study does not allow us to assess directionality of this association, longitudinal research and on-going surveillance efforts to monitor patterns of use of ENDS will help illuminate tobacco use behaviors over time, as well as provide additional insight on the relationship between ENDS use, including e-cigarettes, and conventional cigarette use in young adult populations.

Table 3.1: Characteristics of Never Established Smoking Young Adults, ^a by Ever Use of E-Cigarettes --- NATS 2012-2013

Respondent Characteristics	Among Never E-Cigarette Users (n=3,981)		Among Ever E-Cigarette Users (n=328)		<i>p</i>
	%	95% CI	%	95% CI	
Sex					<0.0001
Male	45.1	(43.0, 47.1)	61.2	(54.5, 67.9)	
Female	54.9	(52.9, 57.0)	38.8	(32.1, 45.5)	
Age					0.002
18-24	63.8	(62.0, 65.6)	73.3	(67.9, 78.7)	
25-29	36.2	(34.4, 38.0)	26.7	(21.3, 32.1)	
Race/Ethnicity					0.14
White, NH	53.1	(51.2, 55.0)	57.6	(50.9, 64.2)	
Black, NH	12.5	(11.1, 13.8)	7.2	(3.7, 10.6)	
Hispanic	22.3	(20.6, 24.0)	22.1	(16.4, 27.8)	
Other, NH	12.1	(10.8, 13.4)	13.2	(8.8, 17.5)	
Education					0.02
<12th Grade (No Diploma)	11.4	(9.8, 12.9)	***	***	
HS Diploma, GED, or Equivalent	33.1	(31.1, 35.1)	36.8	(29.8, 43.8)	
Some College or Higher	55.5	(53.4, 57.6)	58.6	(51.6, 65.6)	
U.S. Region					0.41
Northeast	17.7	(16.7, 18.6)	19.7	(14.3, 25.1)	
Midwest	20.4	(19.5, 21.4)	19.0	(14.2, 23.7)	
South	37.3	(36.1, 38.4)	32.9	(27.0, 38.9)	
West	24.6	(23.6, 25.6)	28.4	(22.7, 34.1)	
Ever Use of Smokeless Tobacco ^b					<0.0001
Yes	4.1	(3.4, 4.8)	18.1	(13.4, 22.7)	
No	95.9	(95.2, 96.6)	81.9	(77.3, 86.6)	
Ever Use of Hookah					<0.0001
Yes	22.7	(21.1, 24.3)	58.5	(51.9, 65.0)	
No	77.3	(75.7, 78.9)	41.5	(35.0, 48.1)	
Ever Use of Cigars ^c					<0.0001
Yes	3.2	(2.5, 3.9)	14.8	(10.1, 19.5)	
No	96.8	(96.1, 97.5)	85.2	(80.5, 89.9)	
Ever Experimentation with Cigarettes					<0.0001
Yes	36.7	(34.8, 38.5)	86.2	(81.7, 90.7)	
No	63.3	(61.5, 65.2)	13.8	(9.3, 18.3)	

Note. CI= confidence interval; GED= General Education Development Certificate; NH= non-Hispanic.

^a Never established smoking young adults was defined as respondents 18-29 years of age who reported never smoking 100 cigarettes in their lifetime and currently smoking cigarettes "not at all". Current, regular cigar and hookah smokers (every day or some day) were also excluded from the sample.

^b Ever use is defined as having used chewing tobacco, dip, or snuff 20 times or having ever tried snus or dissolvables.

^c Ever use of cigars was defined as having used cigars, cigarillos, or filtered little cigars 50 times during their lifetime.

***Estimate was suppressed; the RSE was >30% or denominator <50.

p value from chi-squared test.

Frequencies reflect unweighted data.

Table 3.2: Prevalence of Openness to Cigarette Smoking and Factors Associated with Openness to Smoking among Young Adults ^a --- NATS 2012-2013

Respondent Characteristics	Prevalence of Openness to Smoking			Unadjusted OR		Adjusted OR	
	%	95% CI	<i>p</i>	OR	95% CI	AOR	95% CI
Ever e-cigarette use			<0.0001				
Yes	46.1	(39.5, 52.8)		5.2	(3.9, 6.9)	2.4	(1.7, 3.3)
No	14.2	(12.8, 15.6)		(ref)	---	(ref)	---
Sex			<0.0001				
Male	22.2	(19.9, 24.6)		2.1	(1.7, 2.6)	1.8	(1.4, 2.3)
Female	11.9	(10.1, 13.6)		(ref)	---	(ref)	---
Age			<0.0001				
18-24	18.8	(16.9, 20.7)		1.6	(1.3, 1.9)	1.7	(1.3, 2.2)
25-29	12.9	(11.0, 14.9)		(ref)	---	(ref)	---
Race/Ethnicity			0.06				
White, NH	16.1	(14.1, 18.0)		(ref)	---	(ref)	---
Black, NH	13.5	(9.5, 17.5)		0.8	(0.6, 1.2)	1.0	(0.7, 1.5)
Hispanic	20.2	(16.7, 23.7)		1.3	(1.0, 1.7)	1.3	(0.9, 1.7)
Other, NH	17.6	(13.5, 21.6)		1.1	(0.8, 1.5)	1.4	(1.0, 1.9)
Education			0.01				
<12th Grade (No Diploma)	21.5	(15.6, 27.4)		(ref)	---	(ref)	---
HS Diploma, GED, or Equivalent	18.6	(15.6, 21.5)		0.8	(0.6, 1.2)	0.7	(0.4, 1.1)
Some College or Higher	14.7	(13.1, 16.3)		0.6	(0.4, 0.9)	0.5	(0.3, 0.8)
U.S. Region			0.62				
South	18.5	(14.7, 22.2)		(ref)	---	(ref)	---
Midwest	17.3	(14.1, 20.5)		1.1	(0.8, 1.5)	1.2	(0.9, 1.6)
Northeast	15.8	(13.5, 18.0)		1.2	(0.9, 1.6)	1.3	(0.9, 1.8)
West	16.6	(13.8, 19.3)		1.1	(0.8, 1.4)	1.0	(0.7, 1.3)
Ever Use of Smokeless Tobacco ^b			<0.0001				
Yes	34.9	(28.1, 41.8)		2.9	(2.1, 4.0)	1.0	(0.7, 1.5)
No	15.7	(14.3, 17.2)		(ref)	---	(ref)	---
Ever Use of Hookah			<0.0001				
Yes	28.2	(25.0, 31.5)		2.7	(2.2, 3.3)	1.6	(1.3, 2.1)
No	12.8	(11.3, 14.3)		(ref)	---	(ref)	---
Ever Use of Cigars ^c			<0.0001				
Yes	38.5	(29.2, 47.8)		3.3	(2.2, 5.0)	1.6	(1.0, 2.6)
No	15.8	(14.4, 17.2)		(ref)	---	(ref)	---
Ever Experimentation with Cigarettes			<0.0001				
Yes	29.0	(26.3, 31.7)		4.5	(3.6, 5.6)	3.5	(2.7, 4.5)
No	8.4	(7.0, 9.8)		(ref)	---	(ref)	---

Note. Statistically significant estimates noted in bold. CI= confidence interval; GED=General Education Development Certificate; NH= non-Hispanic; OR=Odds Ratio.

^a Never smoking young adults was defined as respondents 18-29 years of age who reported never smoking 100 cigarettes in their lifetime and currently smoking cigarettes "not at all". Current, regular cigar and hookah smokers (every day or some day) were also excluded from the sample.

^b Ever use of smokeless tobacco was defined as having used chewing tobacco, dip, or snuff 20 times or having ever tried snus or dissolvables.

^c Ever use of cigars was defined as having used cigars, cigarillos, or filtered little cigars 50 times during their lifetime.

p value from chi-squared test.

CHAPTER FOUR: STUDY 2: UNDERSTANDING THE RELATIONSHIP BETWEEN E-CIGARETTE USE AND CIGARETTE SMOKING AMONG YOUNG ADULTS: FINDINGS FROM A QUALITATIVE STUDY²

INTRODUCTION

Electronic nicotine delivery systems (ENDS) such as electronic cigarettes (e-cigarettes) are battery-operated devices that typically deliver nicotine and other additives to the user in an aerosol form. Since entering the U.S marketplace in 2007, e-cigarette use has markedly increased among adults (King, Alam, Promoff, Arrazola & Dube, 2013; Pearson, Richardson, Niaura, Vallone & Abrams, 2012). An analysis of the 2012-2013 National Adult Tobacco Survey found that U.S. young adults aged 18-24 reported higher prevalence of e-cigarette use (every day, some day, or rarely) compared to the overall adult population (8.3% vs. 4.2%, respectively) (Agaku et al. 2014). Another study by Ramo and colleagues compared data from three online surveys of young adults smokers from 2009-2013, respectively, and found notable increases in prevalence of past 30 use of e-cigarettes with 6% in 2009-2010, 19% in 2010-2011, and 41% in 2013 (Ramo, Young, Wolff & Prochaska, 2014). Understanding the potential uptake of e-cigarette products among young adults in the U.S. is particularly important as this is a distinct period of identity development, exploration, and establishment of health behaviors (Arnett, 2000) and has also been shown to be a time ripe for adoption of regular tobacco use (Ling & Glantz, 2002).

² Manuscript to be submitted

As e-cigarettes continue to grow in popularity in the U.S., the public health community remains divided regarding the balance of potential benefits—and potential harms— associated with e-cigarette use. Given that cigarette smoking is the primary driver of preventable mortality attributable to tobacco use in the US (USDHHS, 2014), proponents of e-cigarettes champion the value as a tool for harm reduction (Cobb et al., 2010). Indeed, a small number of studies have demonstrated promise of e-cigarette products as a smoking cessation aid (Caponnetto et al., 2013; Polosa et al. 2013). On the other hand, there are concerns that e-cigarette use among youth and young adults could potentially lead to initiation and adoption of conventional cigarettes (Grana, 2013)—including among those who might otherwise not have begun smoking conventional cigarettes. Despite the growing body of literature on e-cigarette use in the U.S., still little is known about the nature of the relationship between e-cigarette use and conventional cigarette smoking behavior. In other words, in the midst of an increasingly heated debate, there is no conclusive evidence regarding the impact e-cigarettes will have on smoking initiation and cessation.

In the absence of longitudinal data to assess patterns of use of e-cigarettes and other tobacco products over time, an important first step is to characterize e-cigarette users' attitudes about e-cigarettes as well as conventional cigarettes, and to explore the relationship between the two. Qualitative data is well suited to provide this insight; however the extant literature applying qualitative methodologies to explore attitudes and patterns of use among young adult e-cigarette users is limited. One recent study by Kong et al. (2014) conducted focus groups among middle school, high school and college

students to explore reasons for e-cigarette experimentation and discontinuation and found that reasons for e-cigarette initiation included curiosity, availability of flavors, and ability to do “smoke tricks” (Kong, Morean, Cavallo, Camenga & Krishnan-Sarin, 2014). Another study by Choi and colleagues (2012) explored young adults’ (18-26 years old) perceptions of snus, dissolvable tobacco products, and e-cigarettes using focus groups and generally found positive reactions to e-cigarette products; although many of the participants in this study were not current users of the products. These studies have been useful to better understand attitudes and beliefs surrounding e-cigarette products among users and non-users; however, in light of the critical questions about the impact of e-cigarettes on smoking behavior, a critical gap in the literature remains examining individuals’ beliefs and attitudes about the relationship between e-cigarette use and conventional cigarette smoking among young adults.

Thus, the primary aim of this study is to use qualitative focus group data to contextualize findings from a recently published quantitative study on the relationship between e-cigarette use and openness to cigarette smoking (Coleman et al., 2015), including how using e-cigarette products relates to their thoughts and feelings about conventional cigarette smoking. Among those who use e-cigarettes in combination with other tobacco products, we sought to explore if and in what ways e-cigarette use relates to their perceptions—and use—of conventional cigarettes. Drawing on constructs known to influence behavior according to the Theory of Planned Behavior (Ajzen, 1991), such as attitudes, subjective norms, and behavioral intention; specific research questions of interest included: 1) How do young adult e-cigarette users describe their attitudes and

beliefs about conventional cigarettes, including their openness to try conventional cigarette smoking *soon* or *in the next year*?; 2) How do young adults describe change in their beliefs about conventional cigarettes as a result of their e-cigarette use?; and 3) How do young adult e-cigarette users, particularly non-exclusive e-cigarette users, describe patterns of use between e-cigarettes and conventional cigarettes?

METHODS

Study Design

To address this gap in the literature on the relationship between young adults' e-cigarette use and conventional cigarette smoking, this study employed 10 focus groups ($N=80$) with young adult current e-cigarette users. This qualitative study was conceived as part of a convergent parallel mixed methods study design, which included qualitative investigation of the relationship between e-cigarette use and conventional cigarette smoking through focus groups as well as a quantitative analysis of the 2012-2013 National Adult Tobacco Survey (NATS) assessing the association between e-cigarette use and openness to cigarette smoking among young adults (Coleman et al., 2015). Qualitative and quantitative study components were conducted concurrently using the same study aims, thus prioritizing the two methodological approaches equally (Creswell & Plano Clark, 2011). The primary focus of this paper is on the qualitative study component.

Setting and Participants

Focus group participants were recruited as a part of a broader qualitative study focusing on language, beliefs, and behaviors related to “other tobacco products” (e-cigarettes, hookah, and cigars). The focus for this study—to explore the relationship between e-cigarette use and conventional cigarette smoking—utilized data from the e-cigarette focus groups, which were segmented by age group (young adults aged 18-29 and older adults aged 30+) and by their e-cigarette use status (exclusive e-cigarette use and non-exclusive e-cigarette use). More specifically, the sample for this study was comprised of participants in the young adult focus groups who were current e-cigarette users (they have used an e-cigarette product in the past 30 days) and were considered either exclusive e-cigarette users (have used only e-cigarettes in the past 30 days) or non-exclusive users (have used e-cigarettes and at least one other tobacco product in the past 30 days). All groups were comprised of a mix of individuals in terms of gender, race/ethnicity, and education level.

Local market research firms provided facilities and recruitment services for the focus groups, which were conducted in five U.S. cities, including: Washington, District of Columbia; Orlando, Florida; Providence, Rhode Island; Richmond, Virginia; and Los Angeles, California. Across all five study site locations, the number of focus groups ranged from 1 to 4 groups per city. Selection of the five study sites was based on national prevalence data to determine locations where prevalence was high across all three products of interest in the broader study (i.e. e-cigarettes, hookah, and cigars). Additionally, market scanner data was used to confirm study site locations indicating high market share for e-cigarette products. Using convenience sampling, the market

research companies recruited study participants from their databases who met the requirements for inclusion in the specific study segments (i.e. 18-29 year old male and female current e-cigarette users) using a screener developed by study investigators. To be eligible to participate in the focus groups, respondents had to be able to read, understand, and speak English. In addition, individuals were ineligible if they had other characteristics that could potentially bias responses (e.g., connections to the tobacco industry; employed by the federal government; or employed in the public health, advertising, or marketing industries), or if they had participated in market research in the past 6 months. All study procedures were approved by the Institutional Review Boards (IRBs) at the FDA, Research Triangle International (RTI) (the study contractor) and by the Office of Management and Budget (OMB).

Focus group procedures

Once participants arrived at the facility, they were provided an informed consent form to read and sign and were rescreened to confirm eligibility. Experienced moderators conducted the focus group discussions using a moderator guide that included specific items to probe the relationship between their e-cigarette use and their use of other tobacco products, including conventional cigarettes. Specifically, young adult e-cigarette users were asked to discuss if and how their beliefs about conventional cigarettes had changed as a result of their e-cigarette use, and if they intended to smoke cigarettes soon or in the next year. Young adult exclusive e-cigarette users were asked, “*Before using an e-cigarette, what did you think about traditional cigarettes— how did you feel about them?*” Follow-up probing questions, such as: “*Has your opinion changed since you*

started using e-cigarettes?” were used to elicit a detailed description of young adults’ opinions and attitudes about the relationship between their e-cigarette use and conventional cigarette smoking. At the end of the focus groups, participants received a monetary incentive of \$75 for their participation. All focus groups lasted approximately one hour in length and were audio-recorded and professionally transcribed by an independent subcontractor.

Data Analysis

Verbatim transcripts from the young adult e-cigarette focus group sessions were coded and organized using NVivo version 9 software (QSR International) by a primary and secondary coder / reviewer. An initial set of codes and subtopics were created corresponding to each topic of interest for this study guided by the Theory of Planned Behavior (Ajzen, 1991), including attitudes about e-cigarettes and conventional cigarettes (positive and negative), subjective norms, and behavioral intention (operationalized as openness to smoking *soon* or *in the next year*). Using a phenomenological approach (Giorgi, 1997), additional codes were created for emergent themes and patterns identified after review of the transcripts, and codes were then consolidated as necessary. All codes in the dictionary were given operational definitions to enhance reliability and validity as well as aid in the coding process. A primary and secondary coder on the research team conducted a pilot test of the coding dictionary on a randomly selected transcript and compared coding decisions. Based on results from the pilot, coders revised the coding dictionary and re-ran the pilot procedure to enhance reliability in coding process. After finalizing the coding dictionary, the primary coder completed all coding for the focus

group transcripts, and a secondary coder coded a random sample of three transcripts to ensure at least 80% agreement, thus, strengthening the reliability of the coding process (Creswell, 2012). Any changes to the coding dictionary were discussed between the primary and secondary coders, and disagreements were debated until consensus was reached. Data were coded across all young adult focus groups, as well as separately by e-cigarette use status (exclusive vs. non-exclusive e-cigarette use) to identify potential group differences.

RESULTS

Sample Characteristics

Focus group characteristics are provided in Table 4.1 by city. Overall, the focus group sample of young adult e-cigarette users had an average age of 25.7 ($SD= 2.1$, range 18-29), and was nearly evenly split by gender (54% female and 46% male). Most participants had some college experience, either a 2-year degree (50%) or a college degree (29%). The majority of participants identified as White (66%); 13% identified as Hispanic, 11% Black, 10% Asian and 3% other. Lastly, 67% of the focus groups were conducted among exclusive e-cigarette users based on the sampling frame developed by study investigators.

Presented below are findings for each of the two research questions further organized by theme. Differences by segment (age; exclusive or nonexclusive use) are presented where appropriate. Throughout the findings, quotations from participants are displayed. These quotations were not chosen to represent equally each participant segments or focus group location; rather, the quotes are intended to illustrate a belief,

attitude, or experience held by a representative subset of participants. As we did not have access to transcripts linking participants' responses at the individual level, we instead provide information on how many focus groups endorsed a particular idea or concept. A summary of key themes are detailed in Table 4.2.

Attitudes and beliefs about conventional cigarettes—including openness to smoking

Contrast in Attitudes between E-Cigarettes and Conventional Cigarettes

The discussion surrounding the relationship between e-cigarette use and conventional cigarettes among exclusive and non-exclusive users most frequently elicited negative attitudes towards cigarette smoking as compared to e-cigarettes, such as: the smell, price, and health risk of conventional cigarettes. For example, many participants (in all 10 focus groups) when prompted to think about whether using e-cigarettes has made them think differently about conventional cigarettes noted the things that are not present with e-cigarette use: for instance, the lack of secondhand smoke, and no need for ashtrays. Specifically, the smell left behind on clothing, hands, hair, and fabrics in the home or car from conventional cigarettes appeared to become more salient among participants through their experience with e-cigarettes, once they initiated e-cigarettes and noticed the lack of smell produced by the latter. For example, one participant said, *“Well, I think [conventional cigarettes] are disgusting now. I can’t stand the smell of it. When somebody even walks by me with the smell of it on them, I hate it”*. Another participant said, *“Yeah, the smell [of cigarettes] is terrible. I mean, it’s like the biggest thing because I don’t like my clothes to smell like smoke and then my car smells like smoke and then everything smells like smoke...”* Regarding price, participants discussed

how purchasing e-cigarettes often entails a great cost upfront, but the upkeep of the product and e-liquid was relatively inexpensive in comparison to purchasing cigarette packs. When asked about how using e-cigarettes affects their thoughts about conventional cigarettes one participant said, *“Just about the price, I guess, and also the flavor... you’re paying less for something better and like this is much better than the cigarettes”*.

Sense of Control

Young adults also described a sense of control over the formulation e-cigarettes that they felt as though did not exist with conventional cigarettes, which was a theme endorsed in 60% of the focus groups. For example, many participants described positive aspects of e-cigarette formulation over which they could exhibit control, such as the ability to choose flavors and adjust nicotine content, which is not possible with conventional cigarettes. Among non-exclusive users, some participants also discussed how e-cigarettes allowed them to control the “fix” that they needed—that is, they could control the amount, or concentration, of nicotine they received with their e-cigarette. One participant described this sense of control as follows: *“Because I think you can choose the flavors, you can choose the amount of nicotine. Depending where you get it from, it will specifically tell you what’s in it versus like everything that’s in a regular cigarette... For me, it just gives me more control, I feel.”* Another participant said, *“I think e-cigarettes allow you to have more control over like what you’re, you know, smoking.”*

Openness to Cigarette Smoking

When prompted if they intended to use conventional cigarettes either *soon* or *in the next year*, participants were more likely to say they did not plan to smoke cigarettes in the future. Although a few young adults said there was a possibility that they would smoke cigarettes in the future, the majority (across all focus group) said they were not open to cigarette smoking, and moreover—they were less interested in smoking conventional cigarettes now that they use e-cigarettes. For example, one participant shared, “[I’m] less interested in normal cigarettes.” Another participant said, “Definitely lessened my desire to smoke traditional cigarettes.” On the other hand, among exclusive e-cigarette users who had used the e-cigarette to quit smoking, some reported that there was a possibility they would relapse and use cigarettes again in the future. “...I don’t want to be a parent and a smoker, so I tried the e-cigarette to quit, but it’s not the same. So I’ll probably fall off the wagon.”

Change in beliefs about conventional cigarettes as a result of e-cigarette use

Shift in Social Norms

In comparing their e-cigarettes to conventional cigarettes, one theme that emerged among young adult participants in all focus groups was how these two products relate to one another in terms of social norms. Participants described how e-cigarette use is popular in social settings, such as bars and parties, and on college campuses, and generally more socially acceptable compared to conventional cigarettes. For example, several participants described e-cigarette use as “trendy” and “fashionable looking”; whereas conventional cigarette smoking was described as “outdated” and associated with greater social stigma. As an illustration of this point, one participant said, “...When I was

in college, everybody was smoking cigarettes and now they're going to smoke e-cigarettes and whatever they come up with next, it's just a routine." Another participant said, *"I just have a feeling that sooner or later e-cigs are going to take over like and regular cigarettes are not going to be as popular anymore."*

Health Effects

Young adults also discussed different attitudes/ beliefs about e-cigarettes and conventional cigarettes in terms of their health effects. Here again they often contrasted e-cigarettes with cigarettes, and vice versa. For example, one participant said, *"You don't have carcinogens... You don't have tar."* Several participants in all focus groups described feeling healthier while using e-cigarettes compared to the past experiences with cigarette smoking, for example: *"...I said to myself, because I never, I didn't smoke cigarettes too often, so I'm like, there's a chance that this is healthier [so] why don't I just stick with it?;"* while others expressed ambivalence about e-cigarettes being a healthier alternative to conventional cigarettes since they were unaware of studies or reports to support the notion that e-cigarettes are healthier alternative to smoking. *"That's the most off-putting thing about them, to me, is that it could possibly be worse than cigarettes."*

Patterns of E-Cigarette Use Compared to Conventional Cigarettes

Differences in the patterns of use between the two products were also discussed when comparing e-cigarettes to conventional cigarettes. Specifically, participants noted how with a conventional cigarette it was intuitive when to stop smoking (i.e., when the

cigarette was fully burned), but with e-cigarettes it was easy to continue to use it for longer periods. The lack of restrictions about where to use it was also conducive for some to use sporadically throughout the day. Among non-exclusive e-cigarette users, many participants discussed how using an e-cigarette has (or has not) impacted their cigarette smoking patterns. For example, some participants described how using an e-cigarette has facilitated a reduction in the amount of cigarettes they smoke. One participant said: “*I don’t smoke like a pack of cigarettes a day anymore... I smoke [cigarettes] when I’m like out drinking now but honestly, e-cigs really helped me wean off it during the day at work.*” In contrast, others talked about how e-cigarettes had been ineffective in helping them cut down or quit smoking. “*When I try to replace [smoking] with my e-cigarette use, I felt like it didn’t work at all...I felt like it had no effect absolutely on my cigarette smoking, the desire to smoke cigarettes is still there.*”

Lastly, among non-exclusive e-cigarette users, several participants discussed situations or occasions when smoking a conventional cigarette was preferable to using their e-cigarette. Many of these situations included times when drinking alcohol, socializing with other smokers, and under stressful situations. “*I’ll still smoke cigarettes if friends are out or, you know, things are getting especially stressful and the e-cigarette is not quite cutting it, and—you know—I still kind of prefer having actual cigarette breaks.*”

DISCUSSION

In this focus group study, young adult e-cigarette users—both exclusive and non-exclusive users—discussed their attitudes and beliefs about conventional cigarettes in relation to their e-cigarette use as well as their openness to cigarette smoking in the future. To our knowledge, this is the first published study to qualitatively explore the relationship between e-cigarette use and cigarette smoking behavior among current young adult e-cigarette users. Findings from this study suggest that in general, young adults who use e-cigarette products view e-cigarettes as “*cool*” or “*trendy*” whereas conventional cigarettes were viewed as “*outdated*” and associated with greater social stigma. These young adults discussed a greater sense of control over the formulation of their e-cigarette products compared to conventional cigarettes in terms of the availability of flavors and nicotine concentrations. Although attitudes surrounding e-cigarettes were generally positive, some non-exclusive e-cigarette users described scenarios or occasions where conventional cigarette smoking was preferable to e-cigarette use; such as while consuming alcohol, while in social settings, and during high-stress situations.

Perhaps the most striking and noteworthy finding was the strong negative attitudes towards conventional cigarettes in comparison to their e-cigarette products, given that many participants discussed previous (or concurrent) experience with cigarettes. That is, when prompted to discuss how using an e-cigarette has impacted their attitudes and beliefs about conventional cigarettes, young adults (both exclusive and non-exclusive e-cigarette users) overwhelmingly described negative aspects to cigarette smoking (e.g. the smell, presence of secondhand smoke, ash produced) that appeared to become more salient as a result of their e-cigarette use. One potential explanation for this

finding can be found by considering the processes by which these attitudes are formed. In particular, psychological theories suggest that when two target objects are presented simultaneously (e.g. two tobacco products), the evaluation of the product will depend, in part, on whether the comparison evokes assimilation or contrast effects (Schwarz & Bless, 1992; Wanke, Bless & Schwarz, 1999). Which process occurs—assimilation or contrast—will, in turn, affect how positively or negatively the objects are evaluated (Schwarz & Blass, 1992; Wanke, Bless & Schwarz, 1999). In the present study, when conventional cigarettes were directly compared to e-cigarettes, rather than being assimilated (i.e. the “transfer” hypothesis), the two products were judged in contrast to each other, resulting in stronger negative attitudes towards conventional cigarettes. In particular, in the face of an alternative (e-cigarettes) that was free of the smell, secondhand smoke, and ash produced by conventional cigarettes (to name a few), such features came to be viewed much more negatively.

This qualitative study sought to contextualize findings from previous literature which found that compared to those who have not tried e-cigarettes, non-cigarette smoking young adults who *have* tried e-cigarettes were more likely to report openness to cigarette smoking in the future (Coleman et al., 2015). In the present study, young adult exclusive e-cigarette users generally described not being open to cigarette smoking in the future. Moreover, some participants suggested that they were “*less interested in normal cigarettes*” since initiating use of e-cigarettes. This would suggest that positive attitudes towards e-cigarettes may not lead to positive attitudes toward cigarette smoking, thus not increasing young adults’ openness to future cigarette smoking. It should be noted,

however, that Coleman et al. (2015) compared e-cigarette users to non-users in terms of their openness to cigarette smoking; whereas in the present study, the purpose was to examine this relationship amongst users. Despite these differences, study findings suggest that instead of e-cigarette use promoting progression to conventional cigarettes as has been suggested (Choi, Babian, Mottey, Corbett & Forster, 2012; Grana, 2013), this notion may not be appropriate in the context of e-cigarette use and future cigarette smoking behavior (Abrams, 2014; Bell & Keane, 2014). Indeed there may be other factors involved in explaining this relationship such as a common set of factors that put young adults at risk for both e-cigarette use and future conventional cigarette smoking (e.g. socioeconomic status, sensation seeking tendencies, and peer-influence) (CDC, 2011).

A small number of participants in the present study who were trying to quit smoking or reduce their cigarette consumption using e-cigarettes did describe settings where they would still be likely to smoke conventional cigarettes, such as in social settings or while drinking or during high stress situations—which suggests a set of internal and external factors may increase the desire for cigarette smoking among e-cigarette users, such as social cues, product availability, and tobacco dependence. Taken together with findings from Coleman et al. (2015), these findings suggest the relationship between e-cigarette use and future cigarette smoking is complex. Indeed, these negative attitudes and feeling about not being open to smoke conventional cigarettes does not necessarily imply young adult e-cigarette users will not engage in future cigarette smoking behavior, especially since many of the participants in the study have had some

prior experience with cigarette smoking and—among non-exclusive users—expressed situations where conventional cigarette use would be preferable to e-cigarettes.

As the prevalence of e-cigarette use continues to rise among young adult populations (King, Alam, Promoff, Arrazola & Dube, 2013; Pearson, Richardson, Niaura, Vallone & Abrams, 2012; Regan, Promoff, Dube & Arrazola, 2011), the public health community remains divided as to their views of e-cigarette products. Some argue potential benefits of e-cigarettes as a tool for harm reduction or as a smoking cessation aid for smokers who would otherwise not have quit (Wagener, Siegel, & Borrelli, 2012), while others argue potential harms exist if e-cigarettes were to delay or deter smokers from quitting or appeal to young persons who might not have otherwise tried tobacco products (Grana, 2013). Indeed, a direct link between e-cigarette use and progression to cigarette smoking has not been shown (Abrams, 2014). However, it is possible that some young adults who were already open to cigarette smoking are turning to e-cigarette products instead—and alternatively—some young adults might be initiating e-cigarettes because they are “trendy” and positive attitudes towards e-cigarettes might increase openness to cigarette smoking. Importantly, patterns of e-cigarette use will differ among individuals; how e-cigarette products are used by the majority individuals will ultimately determine their net impact on population health.

This focus group study uniquely contributes to the scientific literature by examining how consumers talk about their e-cigarette products, and how the use of these products relates to attitudes and beliefs about conventional cigarettes, including openness

to future cigarette smoking. While this study focused on exclusive and non-exclusive e-cigarette users, future qualitative research should examine different types of users (e.g. users of different ENDS products and device types, dual/poly tobacco users, etc.), which may have an impact on consumer attitudes about the products. More broadly, future research—especially longitudinal studies—will be important to determine tobacco use trajectories over time and provide additional insight as to the relationship between e-cigarette use and conventional cigarette smoking.

Limitations

As with all qualitative research, limitations exist in terms of generalizability of study findings as this study did not aim to recruit a nationally representative sample of young adult e-cigarette users. While representativeness was strengthened by recruitment of e-cigarette users across five different geographic locations in the U.S., future studies should explore attitudes and beliefs about e-cigarette use among young adults residing in other geographic regions, including more rural locations. Additionally, the vast majority of this study sample reported having some college education or higher—thus, follow-up work would also want to enhance representation of those with lower levels of education. Timing of data collection is also an important limitation to consider in comparing findings from this qualitative study to the quantitative analysis by Coleman et al. (2015). Specifically, data collection from this focus group study occurred during early to mid-2014; whereas Coleman et al. (2015) used data from the National Adult Tobacco Survey conducted towards the end of 2012 through early 2013. Finally, the U.S. marketplace for ENDS products is rapidly changing, as are state and local policies for e-cigarettes which

may influence consumers' attitudes, beliefs, and knowledge about the products. This research was collected during one snapshot in time and therefore this focus group data precludes us from making causal inferences.

Conclusions

The relationship between e-cigarette use and conventional cigarette smoking among young adults is complex and multifaceted. The young adult participants in this study were generally not open to cigarette smoking in the future, and moreover, found negative attributes associated with cigarette smoking (e.g. smell, ash produced) more salient as a result of their experience with e-cigarettes, which is inconsistent with the concern that e-cigarettes may lead to cigarette smoking. These findings may be explained, in part, by the cognitive processes that elicit a contrasting of the two products, resulting in stronger negative attitudes towards conventional cigarettes (Schwarz & Bless, 1992; Wanke, Bless & Schwarz, 1999). Efforts to understand how e-cigarette use impacts cigarette smoking behavior and the nature of this relationship are critical to develop public health interventions to prevent initiation of tobacco products, particularly among young adult populations.

Table 4.1: Characteristics of Young Adult E-Cigarette Participants by City (N=80)

	Overall		DC		LA		Orlando		Providence		Richmond	
	n	%	n	%	n	%	n	%	n	%	n	%
Overall	80	100%	17	22%	32	40%	9	12%	4	1%	18	25%
Age												
Average Age (SD)	25.7 (2.10)		26.6 (2.18)		24.8 (3.07)		27.3 (1.22)		27.5 (3.00)		22.5 (2.71)	
Sex												
Female	43	54%	8	47%	16	50%	6	67%	2	50%	11	61%
Male	37	46%	9	53%	16	50%	3	33%	2	50%	7	39%
Race/ ethnicity												
White	53	66%	12	71%	21	66%	8	89%	3	75%	9	50%
Black or African American	9	11%	2	12%	2	6%	0	0%	1	25%	4	22%
Hispanic	10	13%	2	12%	5	16%	1	11%	0	0%	2	11%
Asian	8	10%	2	12%	3	9%	0	0%	0	0%	3	17%
Other	2	3%	0	0%	2	6%	0	0%	0	0%	0	0%
Education												
Less than high school	3	4%	1	6%	1	3%	0	0%	0	0%	1	6%
High school or GED	4	5%	1	6%	1	3%	1	11%	1	25%	0	0%
Some college or 2- year degree	40	50%	6	35%	9	28%	8	89%	2	50%	15	83%
College degree	24	29%	5	29%	16	50%	0	0%	1	25%	2	11%
Postgraduate degree	9	11%	4	24%	5	16%	0	0%	0	0%	0	0%
E-cigarette use status												
Exclusive ^a	54	67%	7	41%	25	78%	0	0%	4	100%	18	100%
Non- Exclusive ^b	26	33%	10	59%	7	22%	9	100%	0	0%	0	0%

Note. SD= Standard Deviation; DC= Washington, District of Columbia.

^a Has only used e-cigarettes in the past 30 days.

^b Has used e-cigarettes as well as at least one other tobacco product in the past 30 days.

Table 4.2: Summary of Key Findings by Theme

Theme	Key Findings
Contrast in Attitudes between E-Cigarettes and Conventional Cigarettes	<ul style="list-style-type: none"> • Discussing the relationship between e-cigarettes and conventional cigarettes elicited negative attitudes towards cigarette smoking, such as: <ol style="list-style-type: none"> 1) smell left behind on clothes 2) the high price of cigarette packs 3) adverse health risks of smoking
Sense of Control	<ul style="list-style-type: none"> • Many participants described a sense of control over the formulation of e-cigarettes that did not exist with conventional cigarettes, such as: <ol style="list-style-type: none"> 1) ability to control their “fix” by altering nicotine concentrations 2) ability to choose flavors
Openness to Cigarette Smoking	<ul style="list-style-type: none"> • Majority of participants were not open to cigarette smoking • Many were less interested in conventional cigarettes as a result of their e-cigarette use
Shift in Social Norms	<ul style="list-style-type: none"> • Young adults considered e-cigarettes to be “trendy” and “fashionable” • Conventional cigarettes were considered “outdated” and associated with social stigma
Health Effects	<ul style="list-style-type: none"> • Many described feeling healthier while using e-cigarettes compared to past experiences with cigarettes • A small number of participants expressed ambivalence about e-cigarettes as a healthier alternative to conventional cigarettes given the limited information on their long-term health effects
Patterns of Use	<ul style="list-style-type: none"> • Many described differences in the patterns of use between e-cigarettes and conventional cigarettes, including ability to use e-cigarettes for longer periods compared to conventional cigarettes • A subset of participants described how using an e-cigarettes facilitated a reduction in the amount of cigarettes smoked per day; others found e-cigarettes ineffective in helping them cut down or quit smoking

CHAPTER FIVE: STUDY 3: “*IT’S NOT SMOKE. IT’S NOT TAR. IT’S NOT 4,000 CHEMICALS. CASE CLOSED*”: EXPLORING ATTITUDES, BELIEFS, AND PERCEIVED SOCIAL NORMS OF E-CIGARETTE USE AMONG ADULT USERS³

INTRODUCTION

Electronic cigarettes (e-cigarettes), a form of battery-operated electronic nicotine delivery systems (ENDS), belong to a heterogeneous class of products that typically deliver nicotine and other additives to the user in an aerosol form. The diversity of e-cigarette products available to consumers on the Internet and in stores is rapidly increasing, with an estimated 460 brands and 7,700 flavors available as of January 2014 (Zhu et al., 2014). Although e-cigarette products were originally invented to mimic conventional cigarette smoking as much as possible, including in appearance (Cahn & Siegel, 2011; Etter & Bullen, 2011), the products now vary in shape and size, ranging from the cigarette-like devices (“cigalikes”), which are models resembling conventional cigarettes; to “Tanks” or “Mods”, which are larger and usually include a refillable “tank” for e-liquid (Farsalinos, Romagna, Tsiapras, Kyrzopoulos & Voudris, 2014).

In recent years, awareness and use of e-cigarette products has surged among adults (King, Patel, Nguyen & Dube, 2014; Pepper & Brewer, 2014). From 2010 to 2013, awareness of e-cigarettes doubled from 40.9% to 79.7%, and ever use of e-cigarettes among U.S. adults increased from 3.3% to 8.5%, respectively (King et al., 2014). Similarly, e-cigarette advertising expenditures have increased nearly three-fold across

³ Manuscript to be submitted

media channels from \$6.4 million in 2011 to \$18.3 million in 2012 (Kim, Arnold & Makarenko, 2014). Despite this marked increase in e-cigarette advertising and use, currently e-cigarette products that do not make therapeutic claims remain unregulated by the U.S. Food and Drug Administration (FDA). However, in April 2014 the FDA released a proposed rule to extend its jurisdictional authorities to other tobacco products, including e-cigarettes (Government Printing Office [GPO], 2014). Under the current proposed rule, FDA would have the authority to regulate the manufacturing, marketing, and distribution of e-cigarettes. When evaluating new tobacco products, FDA is required to assess the impact of the product and its marketing on population health, which includes understanding what consumers understand about the products and how they are being used. Therefore, to assess the potential public health impact of e-cigarette products, research is needed to understand consumer perceptions about e-cigarettes, such as attitudes about the products, reasons for use, knowledge of ingredients and health effects, and relationship between e-cigarette use and conventional cigarette smoking.

The extant literature on consumer perceptions of e-cigarette is limited; however, in recent years several studies have examined reasons for e-cigarette use among adults (Adkinson et al., 2013; Dawkins, Turner, Roberts, & Soar, 2014; Farsalinos et al., 2014; Goniewicz, Lingas & Hajek, 2013; Pepper, Ribisl, Emery & Brewer, 2014; Richardson, Pearson, Xiao, Stalgaitis & Vallone, 2014; Vickerman, Carpenter, Altman, Nash & Zbikowski, 2013; Zhu, Gamst, Lee, Cummings, Yin & Zoref, 2013;), which is one important piece in understanding consumer perceptions about the products. Frequently reported reasons for e-cigarette use in the current literature include: aiding in cessation

for conventional cigarette smoking (Dawkins et al., 2014; Farsalinos et al., 2014; Pepper et al., 2014; Zhu et al., 2013); the ability to use e-cigarettes anywhere (Dawkins et al., 2014; Pepper et al., 2014;) and limited amount of secondhand “smoke” produced (Farsalinos et al., 2014); and perception of less harm than conventional cigarettes by consumers (Etter & Bullen, 2011; Pepper et al., 2014; Zhu et al., 2013). A small number of studies have examined harm perceptions of e-cigarettes and have found e-cigarettes are often perceived to be less addictive, as well as less harmful in general, as compared to conventional cigarettes (Adkinson et al., 2013; Choi & Forster, 2013; Pearson, Richardson, Niaura, Vallone & Abrams, 2012; Richardson, Pearson, Xiao, Stalgaitis & Vallone, 2014). However, there is a dearth of qualitative studies in the scientific literature that focus on how consumers talk about the products, and what they know or think about the health effects and ingredients in e-cigarettes. Moreover, research is needed to qualitatively explore social norms surrounding e-cigarettes as well as what e-cigarette users’ future plans are for use of the product.

Thus, the primary aim of this study was to explore attitudes, beliefs, and perceived social norms surrounding e-cigarette use among adults, as well as how perceptions of e-cigarettes compare to those associated with conventional cigarettes. Understanding e-cigarette users’ attitudes, beliefs, and perceived social norms surrounding the products is of primary interest given that these constructs have been shown to be important predictors of tobacco use behavior (Ajzen, 1991; Choi, Gilpin, Farkas & Pierce, 2001; Wakefield et al., 2004). That is, the extent to which these constructs impact ENDS use and use of other tobacco products is important in

understanding the potential population health impact of e-cigarette products. To explore these constructs as they relate to e-cigarettes, this study conducted a series of focus groups with adult current e-cigarette users to address the following research questions: 1) What are adult e-cigarette users' attitudes towards e-cigarette use?; 2) What do adult e-cigarette users know about the ingredients of e-cigarettes?; 3) What are adult e-cigarette users' beliefs about the health risks associated with e-cigarette use?; 4) To what extent do adult e-cigarette users report friends and family members' use of e-cigarettes, as well as how their friends and family view their use of e-cigarettes?; and 5) How do adult e-cigarette users describe their plans for future use of e-cigarettes?

METHODS

Setting and Participants

Focus group participants were recruited as a part of a broader qualitative study focusing on language, beliefs, and behaviors related to “other tobacco products” (e-cigarettes, hookah, and cigars). The focus for this study—to explore attitudes, knowledge, beliefs, and social norms of e-cigarette use among adult users of the product—utilized data from the e-cigarette focus groups, which were segmented by age group (young adults aged 18-29 and older adults aged ≥ 30) and by their e-cigarette use status (exclusive e-cigarette use and non-exclusive e-cigarette use). All participants who were recruited to participate in the e-cigarette focus groups were considered to be current e-cigarette users (they have used an e-cigarette product in the past 30 days). More specifically, participants were considered either exclusive e-cigarette users (have used only e-cigarettes in the past 30 days) or non-exclusive users (have used e-cigarettes and at least one other tobacco

product in the past 30 days). All groups comprised a mix of individuals in terms of gender, race/ethnicity, and education levels.

Local market research firms provided facilities and recruitment services for the focus groups, which were conducted in five U.S. cities, including: Washington, District of Columbia; Orlando, Florida; Providence, Rhode Island; Richmond, Virginia; and Los Angeles, California. Selection of the five study sites was based on national prevalence data to determine locations where prevalence was high across all three products of interest in the broader study (e-cigarettes, hookah, and cigars). Additionally, data were obtained from market scanner data to further identify study site locations indicating high market share for e-cigarette products. Using convenience sampling, the market research companies recruited study participants from their databases who met the requirements for inclusion in the specific study segments using a screener developed by study investigators. To be eligible to participate in the focus groups respondents had to be able to read, understand, and speak English. In addition, individuals were ineligible if they had other characteristics that could potentially bias responses (e.g. connections to the tobacco industry; employed by the federal government; or employed in the public health, advertising, or marketing industries), or if they had participated in market research in the past 6 months. All study procedures were approved by the Institutional Review Boards (IRBs) at FDA, Research Triangle International (RTI) (the study contractor) and by the Office of Management and Budget (OMB).

Focus group procedures

Once participants arrived at the facility, they were provided an informed consent form to read and sign and were rescreened to confirm eligibility. Participants also had the opportunity to ask any questions they might have related to their participation before entering the focus group session. Experienced moderators conducted the focus group discussions using a moderator guide that included specific items to probe attitudes about e-cigarettes, knowledge about the ingredients, beliefs about the health risks associated with e-cigarettes, and perceived social norms surrounding e-cigarette use. More specifically, adult e-cigarette users were asked to discuss if/how their attitudes, beliefs, and norms surrounding e-cigarettes compared to other tobacco products, including conventional cigarettes. The moderator guide included specific items attitudes about e-cigarettes, including why they used e-cigarette products, benefits to using them, and similarities/ differences between e-cigarettes and other tobacco products. Knowledge about ingredients and beliefs of harm of e-cigarettes were discussed and comparisons were made to other tobacco products. Lastly, adult e-cigarette users were asked questions regarding their friends and families' opinions and use of e-cigarettes, "*Do your friends/ family members use e-cigarettes—what do they think about them?*" Follow-up probing questions, such as: "*Tell me about your friends who don't use e-cigarettes; why don't they use them?*" were used to elicit a detailed description of adults' perceptions of the social norms surrounding use of e-cigarettes. At the end of the focus groups, participants received a monetary incentive of \$75 for their participation. All focus groups lasted approximately one hour in length and were audio-recorded and professionally transcribed by an independent subcontractor.

Data Analysis

Verbatim transcripts from the focus group sessions were coded and organized using NVivo version 9 software (QSR International) by a primary and secondary coder. An initial set of codes and subtopics were created corresponding to each topic of interest for this study guided by the Theory of Planned Behavior (Ajzen, 1991), including attitudes about e-cigarettes (positive and negative), as well as perceived social norms surrounding e-cigarettes (e.g. friends' and family members' opinions about their use of e-cigarettes). Using a phenomenological approach (Giorgi, 1997), additional codes were created for emergent themes and patterns identified after review of the transcripts, and codes were then consolidated as necessary. All codes in the dictionary were given operational definitions to enhance reliability and validity, as well as aid in the coding process. Primary and secondary coders on the research team conducted a pilot test of the coding dictionary on a randomly selected transcript and compared coding decisions. Based on the pilot, coders revised the coding dictionary and re-ran the pilot procedure to enhance reliability in coding process. Following the coding pilot, the primary coder completed all coding for the focus group transcripts, and the secondary coder coded a random sample of three of the 14 transcripts to ensure at least 80% agreement (Creswell, 2012), thus, strengthening the reliability of the coding process. Any changes to the coding dictionary throughout the process were discussed between the primary and secondary coders, and disagreements were discussed until consensus was reached. Results were examined across all adult focus groups, as well as by age group (young adults vs. adults) and by e-cigarette use status (exclusive vs. non-exclusive e-cigarette use).

RESULTS

Sample Characteristics

We conducted 14 focus groups (n=116) with young adult (aged 18-29) and older adult e-cigarette users (aged ≥ 30), with a range of 7 to 10 participants per group. There were two focus groups in Orlando, four focus groups in Los Angeles, two in Providence, three in Richmond, and three in Washington DC. Of the 14 focus groups, seven were comprised of exclusive e-cigarette users while the other seven contained those who currently use e-cigarettes along with at least one other tobacco product. Lastly, per the sampling frame for this study, the majority of focus groups (n=10; 71%) were comprised of young adult e-cigarette users compared to older adult e-cigarette users (n=4; 29%).

Participant characteristics are provided in Table 5.1 by city. Overall, the focus group sample of adult e-cigarette users had an average age of 30.4 ($SD= 3.4$, range 18-64), and was nearly evenly split by gender (49% female and 51% male). Most participants had some college experience, either a 2-year degree (46%), a college degree (28%), or postgraduate degree (12%). The majority of participants identified as White (66%); 15% identified as Black, 11% Hispanic, 7% Asian and 2% other.

A summary of key findings is detailed in Table 5.2. These findings are organized by construct.

Attitudes about E-Cigarette Products

Across all focus groups (exclusive and non-exclusive), attitudes towards e-cigarettes were mostly positive. In particular, participants described several benefits to using an e-cigarette, such as: the ability to use e-cigarettes as a method to reduce or completely quit smoking, ability to augment conventional cigarette smoking in situations where smoking is not permitted, the perception of e-cigarettes as more socially acceptable than conventional cigarettes, and availability of a variety of flavors. As an example of availability of e-cigarette flavors, one older adult participant noted, *“There’s flavors. I like the idea that there’s flavors.”*

Several adults discussed their positive experiences using an e-cigarette to help them reduce or completely quit smoking. For example, one young adult said, *“Well, I just enjoy [e-cigarettes] as a hobby, and a way to quit smoking, you know. It’s kept me off of cigarettes for a while.”* An older adult described additional benefits to using an e-cigarette, including health benefits and the absence of smell from conventional cigarettes. These factors contributed to this adult’s success in quitting cigarette smoking, which was noted by saying, *“I feel better breath-wise. I feel better; I can smell things...The cigarette smell is nasty—I didn’t realize how bad I stunk, you know. It was bad. So that’s all the positives that I’ve seen [and] is what keeps me going with this, already in the last five, six months that I haven’t had a cigarette.”*

When negative attitudes towards e-cigarettes were discussed, however, it was typically among adults who were experiencing dissatisfaction with an e-cigarette as replacement for conventional cigarette smoking. For example, one older adult said, *“I*

would rather not have to, to not have cigarettes in my life. I'd rather vape instead but they still don't quite do what cigarettes do for me, for some reason." Several young adults also echoed this notion of dissatisfaction in substituting e-cigarettes for conventional cigarettes. For example, *"When I try to replace it, my cigarette use with my e-cigarette use, I felt like it didn't work at all...So I felt like it had absolutely no effect on my cigarette smoking, the desire to smoke cigarettes is still there."*

Among non-exclusive users (60% of the focus group sample), many described benefits to using e-cigarettes in places or situations where it was inconvenient to smoke cigarettes, such as at work or during inclement weather. For example, one young adult said, *"I use mine just when I'm somewhere that I can't smoke. So like I keep it in my purse and if I'm somewhere that I can't smoke or I know I'm not going to be able to smoke for hours then I'll just keep it in my bag."*

The majority of participants described how using e-cigarettes allowed them to continue to enjoy the social aspects of smoking with using conventional cigarettes, and frequently discussed the lack of stigma surrounding e-cigarette use in direct comparison to conventional cigarette smoking. For example, one participant said, *"Yeah, because when you drink I got to have [it], it's like drinking and smoking, it goes together. I can't drink without smoking, and I'm just trying to find a healthier way to still smoke."*

Additionally, young adults often described e-cigarette use as being more socially acceptable compared to conventional cigarette smoking. One young adult said, *"...If you want to smoke, you know, [an e-cigarette] is more like a trendy way versus*

[conventional] cigarettes, which I think these days are very like—taboo.” This statement highlights the sentiment often described by young adult participants who reported conventional cigarette smoking as “*outdated*” compared to e-cigarette use.

While not the majority of opinion, a smaller number of adults discussed how they still feel some stigma associated with e-cigarette use, and described a lack of comfort using e-cigarettes in places or setting where cigarette smoking is not allowed. This idea was endorsed among a small number of participants in 7 out of 14 focus groups. As an illustration of this point, one older adult said, “...*It’s very uncomfortable trying to use it, you don’t know where you can smoke, you know, where you can’t. It’s very frustrating and, you know, [you] feel like an outcast but you’re not.*”

Knowledge about E-Cigarette Ingredients and Beliefs about Health Effects

Generally, across all focus groups adults were unaware of the ingredients in their e-cigarette products. Most participants acknowledged e-cigarette products (commonly) contain nicotine, and many reported they choose to use e-cigarettes for this reason (to deliver nicotine in a way that they perceive as healthier than conventional cigarettes). Indeed, a small number of participants discussed knowledge of varying concentrations of nicotine and flavorings in e-cigarette liquid, a few adults mentioned specific ingredients in e-cigarettes, such as propylene glycol or vegetable glycerin; however, the vast majority of adults described a general lack of knowledge as to the specific ingredients in e-cigarettes (with the exception of nicotine). For example, when prompted to discuss ingredients in e-cigarettes, one older adult user said, “*Water and I believe oil, like some*

kind of, maybe like vegetable oil or something like that.” Another older adult said, “I know that some people use like glycerin in them, you know, nicotine additives, I’m not sure exactly what. Some of them don’t have the ingredients labeled, so it’s hard to tell.”

For those who were currently or have used e-cigarettes to quit smoking, there was an overall agreement that e-cigarette ingredients were less harmful than ingredients in conventional cigarettes.

Adults also discussed a lack of knowledge when it came to the health effects of e-cigarette use, but expressed interest in increasing their knowledge in this area. As an illustration of this point, one older adult said, *“...I’m always skeptical when something first starts coming out, we don’t know all the side effects or all the problems with it until later on, like you know, 20 years from now, we’re going to find out that we all have this new cancer because we’ve been smoking [an e-cigarette].”* When prompted to discuss the health effects associated with e-cigarettes, participants primarily described short-term health effects such as throat irritation, coughing, and lightheadedness. For example, one older adult said, *“[E-cigarettes] can make you vomit and lightheaded.”* Long-term effects of e-cigarette use was less known, but when prompted to discuss long-term health effects participants often compared potential long-term health effects of e-cigarettes to those associated with conventional cigarette smoking. For example, one young adult noted, *“I mean, I think it could still lead to cancer, possibly.”* Another young adult said, *“I don’t know if they’re any better for you than cigarettes because I feel like there’s a lot of mystery behind them, but I hope [they are better for you than cigarettes].”*

Despite the lack of knowledge surrounding ingredients and health effects associated with e-cigarettes, adults overwhelmingly felt as though e-cigarettes are less harmful than conventional cigarettes. One young adult said, *“I mean, I hear [an e-cigarette] is healthier than a regular cigarette, so that’s the benefit.”* Additionally, one older adult said, *“I have thought of the long-term effects and I weighed it out and I’m like, ‘You know what? It’s not smoke. It’s not tar. It’s not 4,000 chemicals.’ Case closed.”*

Perceived Social Norms Surrounding E-Cigarette Use

Adults were prompted to discuss whether their friends and family used e-cigarettes, and how their friends and family viewed their use of e-cigarettes. The majority of participants in all 10 focus groups said that they have both friends who use and do not use e-cigarettes, but frequently their first time trying e-cigarettes was with friends. A smaller number of adults also discussed having family members who use e-cigarettes, but this was less common compared to those who reported friends’ use. Generally, participants described positive reactions from friends and family members about their e-cigarette use—particularly when used to reduce or quit smoking. A small number of participants discussed friends and family members being wary of their e-cigarette use, and associated their e-cigarette use with conventional cigarette smoking. For example, one young adult said, *“...Most of my friends are still pretty skeptical of it. I mean, it’s still putting nicotine and vapor in your lungs one way or the other.”*

Plans for Future E-Cigarette Use

Lastly, adult participants were prompted to discuss their plans for future e-cigarette use. Adults who reported using e-cigarettes to reduce or quit conventional cigarette smoking were less likely to forecast they would stop using e-cigarettes in the near or long-term, whereas those who use e-cigarettes “socially” report that they may stop using in the next 1 to 5 years. For example, one young adult participant said, *“Now I do it because I’m in college and like everybody around me is doing it. If like people aren’t doing it later then I probably won’t be doing it.”* Many participants across all focus groups said they could envision a time in the future when they may stop using e-cigarettes for specific reasons, including: if they start having children, if the popularity of e-cigarettes decreases, if studies are released suggesting adverse health effects of e-cigarettes, and if they are able to progressively wean off all tobacco products. One young adult participant said, *“I mean, hopefully I can get to the point where I don’t need cigarettes or e-cigarettes, so I’ll just eventually stop everything—but we’ll see.”*

DISCUSSION

This study explored adult e-cigarette users’ attitudes, knowledge, beliefs, and perceived social norms surrounding e-cigarettes in five U.S. geographic regions. Qualitative analysis suggests that e-cigarette users generally have positive attitudes about e-cigarettes, and simultaneously report a lack of information and knowledge about the products. Consistent with previous studies (Dawkins et al., 2014; Farsalinos et al., 2014; Pepper et al., 2014), adults in this study described three main reason for using e-cigarettes: 1) as a way to reduce or quit smoking conventional cigarettes, 2) to augment cigarette use, and 3) because the products are trendy. There only appeared to be one

notable difference between age groups or e-cigarette use status segments. Young adult participants appeared to be more likely to use e-cigarettes because they were considered to be “cool” or “trendy” compared to older adults, who primarily described using e-cigarettes as a mechanism to reduce or quit smoking.

Overwhelmingly, adult participants across all focus groups described a lack of knowledge surrounding the ingredients and health effects of e-cigarettes, and expressed interest in learning about what was in e-cigarettes. Despite the lack of knowledge about the ingredients or health effects, the majority of adults still believed e-cigarettes were less harmful than conventional cigarettes. Similarly, one study by Sanders-Jackson and colleagues (2014) examined young adults’ knowledge of e-cigarette constituents in a U.S. web panel and found the majority of participants (57.3%) responded “Don’t know/Refused” to whether they believe e-cigarettes contain any toxic chemicals. Further, although many adult participants in the present study concluded that e-cigarettes were less harmful than conventional cigarettes, they were often wary of the lack of information available about the health effects of e-cigarette use—and at times—were unsure as to whether or not e-cigarettes would ultimately be better for their health in the long-term. These findings are important to note in the context of recent studies using survey data that reported e-cigarette users and non-users believed e-cigarettes are less harmful than to conventional cigarettes (Adkinson et al., 2013; Choi & Forster, 2013; Farsalinos et al., 2014; Pearson et al., 2012; Richardson et al., 2014). The qualitative responses provided by participants in this study support these survey findings, but also provide additional insight of participants’ skepticism. Moreover, adult e-cigarette users expressed great

interest in learning about ingredients and health effects of e-cigarette products once this information becomes available, which is an important role for public health professionals to play.

Participants in the present study generally described positive reactions from their friends and family members surrounding their e-cigarette use, particularly when participants were using e-cigarettes to reduce or quit use of conventional cigarettes. Adult e-cigarette users reported having friends and family members who both do and do not use e-cigarettes, and typically discussed how friends and family members who do use e-cigarettes start doing so as a way to quit conventional cigarette smoking. Young adults in particular often discussed using e-cigarettes with friends in social settings while drinking alcohol. These are similar to the findings from one study by Pepper et al. (2014), which found that among a national sample of U.S. adults, the second most common reason for e-cigarette use was influence from friends or family members. Taken together, these findings suggest that social norms surrounding e-cigarette use play a substantial role in use and attitudes towards the products.

As the diversity of e-cigarette products available in the U.S. marketplace continues to grow (Zhu et al., 2014), understanding consumers' attitudes, beliefs, and perceived social norms surrounding the products is critical. Behavioral theory, such as the Theory of Planned Behavior (Ajzen, 1991) posits that these factors are important antecedents to behavior, and exploring attitudes and beliefs surrounding e-cigarettes can shed light on how these factors influence tobacco use behavior. Qualitative responses

from adult e-cigarette users in this study suggest a combination of experiences that lead to positive attitudes about the products, including: satisfying a need for nicotine among current or former cigarette smokers, and experiencing social benefits of e-cigarette use with friends—particularly among young adults. Given that many participants expressed a lack of knowledge surrounding the ingredients and health effects associated with e-cigarette products, future health communications should seek to address these knowledge gaps as more information becomes available. To date, limited data are available on the impact of e-cigarette vapor on health, but early studies suggest trace amounts of toxic substances have been detected in e-cigarette vapor; although levels of these toxicants was significantly lower for e-cigarettes than for conventional cigarettes (Goniewicz et al., 2013) Lastly, the sample of adult e-cigarette users in this study provided diverse narratives as to their experience with e-cigarette products, which highlight individual differences in terms of attitudes and beliefs surrounding the products. This heterogeneity among e-cigarette users in terms of their attitudes and beliefs is particularly important to consider for researchers and regulators in order to assess the population impact of e-cigarettes as well as target public health interventions. Future research should track how attitudes, beliefs, and perceived social norms surrounding e-cigarettes evolve over time, and provide additional insight as to their relationship to e-cigarette use behavior and use of other tobacco products—including, conventional cigarettes.

Limitations

The findings of this study should be interpreted in light of several limitations. First, this research has limited generalizability due to its qualitative nature. However,

diverse perspectives were gathered by recruitment of e-cigarette users across five different geographic locations in the U.S. Future studies should explore attitudes, beliefs, and social norms about e-cigarette use among adults residing in other geographic regions, including more rural regions. Next, study participants constitute a convenience sample of adult e-cigarette users in the cities selected for data collection, and primarily represented college educated adults. Finally, the U.S. marketplace for ENDS products is rapidly changing, as are state and local policies for e-cigarettes which may influence consumers' attitudes, beliefs, and knowledge about the products. Indeed, this research was collected during one snapshot in time so longitudinal research could provide additional insight into how attitudes, beliefs, and social norms surrounding e-cigarettes are changing over time and track how these constructs influence tobacco product use behavior and health.

Conclusion

Few studies have qualitatively explored attitudes, beliefs, and perceived social norms surrounding e-cigarette among adults. This study detected several unique themes and provided insight as to reasons why adults use e-cigarettes and their experience using the products. Overall, we found positive attitudes towards e-cigarettes as a mechanism to reduce or quit conventional cigarettes and benefits of use such as in social settings and while drinking alcohol—particularly among young adults. This study also demonstrated a general lack of knowledge among adult e-cigarette users as to the ingredients of health effects of e-cigarette products. Despite this lack of knowledge, adult e-cigarette users overwhelmingly believed e-cigarettes were less harmful than conventional cigarettes. Findings from this research, which provide valuable insight for understanding e-cigarette

users' attitudes, beliefs, and social norms, are important to inform FDA's regulation of these products.

Table 5.1: Adult E-Cigarette Focus Group Participant Characteristics by City (N=116)

	Overall		DC		LA		Orlando		Providence		Richmond	
	n	%	n	%	n	%	n	%	n	%	n	%
City												
Total	116		26	22%	32	28%	17	15%	14	12%	27	23%
Age Group												
18-29	80	69%	17	65%	32	100%	9	53%	4	29%	18	67%
≥30	36	31%	9	35%	0	0%	8	47%	10	71%	9	33%
<i>Average Age(SD)</i>	<i>30.4</i>	<i>(3.4)</i>	<i>33.4</i>	<i>(12.1)</i>	<i>24.8</i>	<i>(3.1)</i>	<i>29.7</i>	<i>(7.3)</i>	<i>32.7</i>	<i>(11.9)</i>	<i>31.3</i>	<i>(13.0)</i>
Gender												
Female	57	49%	13	50%	16	50%	6	35%	8	57%	14	52%
Male	59	51%	13	50%	16	50%	11	65%	6	43%	13	48%
Hispanic												
No	99	85%	22	85%	26	81%	14	82%	14	100%	23	85%
Yes	17	15%	4	15%	6	19%	3	18%	0	0%	4	15%
Race												
White	76	66%	18	69%	21	66%	14	82%	11	79%	12	44%
Black or African American	17	15%	5	19%	2	6%	0	0%	2	14%	8	30%
Hispanic	13	11%	2	8%	4	13%	3	18%	0	0%	4	15%
Asian	8	7%	2	8%	3	9%	0	0%	0	0%	3	11%
American Indian - Native Alaskan	1	1%	0	0%	0	0%	0	0%	1	7%	0	0%
Other	2	2%	0	0%	2	6%	0	0%	0	0%	0	0%
Education												
Less than high school	3	3%	1	4%	1	3%	0	0%	0	0%	1	4%
High school or GED	13	11%	1	4%	1	3%	2	12%	5	36%	4	15%
Some college or 2-year degree	53	46%	8	31%	9	28%	13	76%	6	43%	17	63%
College degree	33	28%	9	35%	16	50%	2	12%	2	14%	4	15%
Postgraduate degree	14	12%	7	27%	5	16%	0	0%	1	7%	1	4%
E-cigarette use status												
Exclusive ^a	54	47%	7	27%	25	78%	0	0%	4	29%	18	67%
Non-Exclusive ^b	62	53%	19	73%	7	22%	17	100%	10	71%	9	33%

Note. SD= Standard Deviation; DC= Washington, District of Columbia.

^a Has only used e-cigarettes in the past 30 days.

^b Has used e-cigarettes as well as at least one other tobacco product in the past 30 days.

Table 5.2: Summary of Key Findings by Construct

Construct	Key Findings
Attitudes towards E-cigarettes/E-cigarette Use	<ul style="list-style-type: none"> • Attitudes were mostly positive. • Benefits included: <ol style="list-style-type: none"> 1) the ability to use e-cigarettes to reduce/quit smoking or in places where smoking is not allowed, 2) lack of social stigma compared to conventional cigarettes, and 3) availability of flavors. • Disadvantages included: <ol style="list-style-type: none"> 1) dissatisfaction using an e-cigarette as a replacement for conventional cigarettes, and 2) a small number of adults described social stigma using an e-cigarette and/or lack of comfort using the product in places where smoking was not allowed.
Knowledge about E-cigarette Ingredients	<ul style="list-style-type: none"> • Lack of knowledge about the ingredients in e-cigarettes. • This lack of knowledge made them uneasy about using the products.
Beliefs about Health Effects	<ul style="list-style-type: none"> • Generally unaware of the health effects of e-cigarette use. • The majority of adults believed e-cigarettes are less harmful than conventional cigarettes.
Perceived Social Norms	<ul style="list-style-type: none"> • The majority of participants have both friends who use and do not use e-cigarettes. • For several adults, their first time trying e-cigarettes was with friends. • When used in place of conventional cigarettes, friends and family members were generally being supportive of their e-cigarette use. • A small number of adults had friends and family members who were wary of their use of the products.
Future Intentions for E-cigarette Use	<ul style="list-style-type: none"> • Many planned to continue using e-cigarettes in the future. • Those using e-cigarettes to reduce or quit smoking intended to continue to use the products in the next 1 to 5 years. • Those using the products socially hoped to stop using e-cigarettes in the long-term.

CHAPTER SIX: SUMMARY

6.1 Overview & Summary

The extant literature on electronic cigarette (e-cigarette) use among young adults is limited, yet rapidly growing. Since entering the U.S. marketplace in 2007, e-cigarettes have surged in popularity—particularly among young adults (Agaku et al., 2014). As more data becomes available as to the harmful or potentially harmful constituents, such as tobacco-specific nitrosamines, aldehydes, metals, and volatile organic compounds, which have been documented at lower levels compared to conventional cigarettes (Cheng, 2014), significant questions still remain regarding e-cigarettes' impact on population health. E-cigarettes have sparked a debate within the public health community as to the potential benefits as a tool for cessation and/or harm reduction (Wagener, Siegel, & Borrelli, 2012)—and the potential harms if young people who otherwise would have not initiated tobacco products initiate e-cigarettes, which some would argue may increase young peoples' susceptibility to conventional cigarettes and subsequently lead to conventional cigarette smoking (Grana, 2013). This dissertation sought to 1) examine the association between e-cigarette use and openness to cigarette smoking among young adults, and 2) identify attitudes, knowledge, beliefs, and perceived social norms of e-cigarettes among young adult e-cigarette users, and 3) identify how young adult perceptions of e-cigarettes compare to those associated with conventional cigarettes. Each study conducted as a part of this dissertation provided findings that can be used to inform public health practitioners and researchers on consumer perceptions of e-cigarette products, and provides insight into the complex relationship between e-cigarette use and conventional cigarette smoking.

In study 1, characteristics of young adults aged 18-29 from a nationally representative sample of U.S. adults were examined by ever use of e-cigarettes, demographic characteristics, and ever use of other tobacco products (smokeless tobacco, cigars, hookah, and cigarettes). Among young adults who had never established cigarette smoking behavior and who were not current smokers of cigarettes or other combustible tobacco products (unweighted N=4,310), 7.9% (95% CI= 6.9-8.9) reported lifetime use of e-cigarettes—14.6% of whom reported current use of the product. Multivariate logistic regression was used to examine the relationship between e-cigarette use and openness to cigarette smoking among young adults who had never established cigarette smoking behavior. Findings indicated that ever use of e-cigarettes was positively associated with being open to cigarette smoking (AOR= 2.4; 95% CI= 1.7-3.3), as was being male, aged 18-24, less educated, and having ever used hookah or experimented with conventional cigarettes. One potential explanation for these findings, according to the Theory of Planned Behavior (TPB), could suggest that positive attitudes towards e-cigarettes may increase openness to smoke cigarettes; however longitudinal research is needed to examine how these behaviors change over time and whether openness to smoking leads to behavior change.

Study 2 qualitatively explored the relationship between e-cigarette use and conventional cigarette smoking, including young adults' openness to smoking cigarettes “soon” or “in the next year.” Interestingly, findings from this study did not support the notion that most young adults who have used e-cigarettes, and are not current cigarette smokers, are at high risk to transition to conventional cigarette smoking. Instead, the majority of participants discussed being less interested in conventional cigarettes since

using e-cigarettes, and overwhelmingly described negative aspects to cigarettes smoking (e.g. the smell, presence of secondhand smoke, ash produced) that appeared to become more salient as a result of their e-cigarette use. Therefore, these findings would suggest that positive attitudes towards e-cigarettes may not transfer to conventional cigarette smoking as young adults generally did not express positive attitudes towards cigarette smoking. However, it is unclear how this negative perception of conventional cigarettes will actually prevent e-cigarette users from transitioning at some point in the future, as Study 1 suggests e-cigarette users are more open to future conventional cigarette smoking than nonusers. Indeed, the 2012-2013 NATS does not provide information about how openness to smoking may have changed after using e-cigarettes, which should be explored in longitudinal studies.

Finally in study 3, qualitative focus groups with both adult and young adult e-cigarette users explored attitudes, knowledge, beliefs, and perceived social norms of e-cigarettes use. Across focus groups, participants expressed many positive attitudes towards e-cigarettes, and simultaneously reported a lack of information about the products. Many expressed interest in knowing more about what is in the products when the information becomes available. Among those who are, or have used e-cigarettes as a strategy to quit smoking, there was consensus in the belief that ingredients were less harmful than conventional cigarettes, even though the ingredients were unknown. Additionally, participants discussed the lack of stigma around e-cigarettes compared to conventional cigarettes, and many also described positive reactions from friends and family about their e-cigarette use, especially when an e-cigarette was used in place of a conventional cigarette.

Overall, young adults in the focus group study provided thoughtful and insightful descriptions of their attitudes, beliefs, and social norms surrounding their e-cigarette use, as well as how the attitudes and beliefs related to conventional cigarette smoking. Quantitative findings from the National Adult Tobacco Survey found a strong association between e-cigarette use and openness to cigarette smoking; yet it was not possible to determine the directionality of this relationship or why the association exists. However, focus groups with young adult e-cigarette users were able to provide additional insight into the nature of this relationship, which revealed this relationship to be a complex one—given that focus group participants (who may have previously smoked conventional cigarettes) described negative aspects to conventional cigarette smoking as being more salient as a result of their e-cigarette use. Across the major themes and constructs explored in the qualitative focus group discussions, saturation was achieved within study sites and overall. In particular, we reached a point in each study site location where no new information was being identified. However, each of the five cities were important for data collection given how rapidly the e-cigarette market is evolving—and thus, differences in language and use patterns were important to investigate across cities. Future research using longitudinal studies will ultimately be needed to evaluate if/how the attitudes and beliefs evolve over time as well as determine individual tobacco use trajectories.

6.2 Implications

This dissertation research has implications for future research and public health messaging, as well as for informing the debate surrounding e-cigarette products. First,

this research plays an important role in the regulatory environment surrounding e-cigarettes as FDA's Center for Tobacco Products is held to the population health standard when considering future policy options related to e-cigarettes—meaning CTP will need to weigh the impact of e-cigarettes on users and nonusers as well as address this complexity among different types of e-cigarette users (e.g. those using e-cigarettes to quit, those experimenting with tobacco for the first time). A critical piece in understanding the potential public health impact of e-cigarettes is to understand how e-cigarettes appeal to nonusers of tobacco products. A chief concern related to nonusers of other tobacco products is the potential to renormalize smoking behavior and potentially erode public health gains over the past decade through clean indoor air/smoke-free policies. Indeed, more work is needed to determine what the impacts of e-cigarettes are among both users and nonusers of tobacco products but this current work provides a first step in understanding the relationship between e-cigarette use and conventional cigarette smoking, as well as attitudes towards e-cigarettes among users of the products.

Additionally, this dissertation research highlights the value of mixed methods approaches given that by themselves—findings from the quantitative or qualitative studies could lead to very different conclusions. For example, based on the NATS data analysis, we might not expect e-cigarette users would highlight negative aspects of cigarette smoking as a result of their e-cigarette use. Moreover, in NATS e-cigarette users (compared to nonusers) were more likely to report openness to smoking; however the qualitative focus groups did not find any evidence that e-cigarette use positively influenced e-cigarette users' attitudes towards conventional cigarettes. Therefore, an important implication of this research is that on-going surveillance efforts should

continue to be complimented by qualitative work to understand the nuance of why and how people use tobacco products, and how they are related.

Lastly, participants in the qualitative focus group study reported a lack of information about e-cigarette products in terms of ingredients and health effects, which highlights the importance of public health information campaigns to disseminate information about the products. In the absence of conclusive evidence as to the long-term health effects of e-cigarettes, public health messaging surrounding e-cigarettes could focus on the known health risks of nicotine, particularly on pregnant women as well as the deleterious effects of nicotine on the developing adolescent brain. The addictive nature of nicotine should also be communicated.

6.3 Strengths & Limitations

There are several strengths and limitations of this dissertation that are important to acknowledge. With respect to the quantitative study, a pivotal strength was the ability to explore the relationship between e-cigarette use and openness to smoking using a nationally representative sample of U.S. adults from the 2012-2013 National Adult Tobacco Survey (NATS). However, the most important limitation arises from the cross-sectional nature of NATS. While an association can be tested between young adults who have tried e-cigarettes and self-reported openness to conventional cigarette smoking, the cross-sectional nature of the survey limits the ability to establish the temporal relationship between e-cigarette use and openness to conventional cigarette smoking. Another limitation in the NATS analysis results from the use of observational data. That is, while it is possible to adjust for relevant covariates in this analysis, it is possible that the

association observed between e-cigarette use and openness to conventional cigarette smoking is the result of unmeasured confounders.

Additionally, there are limitations inherent to relying on self-report measures of behavior (Schwarz & Oyserman, 2011). Both lifetime e-cigarette use and conventional cigarette smoking were self-reported. Given that the survey measures for e-cigarettes in the 2012-2013 NATS only explicitly address “e-cigarettes,” it is possible that these measures underestimate ENDS use by not also including terminology used to describe ENDS, such as “e-hookah”, “vape pens” or “e-pens,” which may be growing in popularity. Moreover, in this study, young adults’ openness to conventional cigarette smoking is assessed, which is likely influenced by many factors such as attitudes, subjective norms surrounding the behavior, and access to tobacco products. Nonetheless, self-reported data still provide valuable insight as to intentions, which is an important antecedent to behavior change (Ajzen, 1985; Ajzen, 1991). Lastly, although information was obtained from NATS respondents on the state in which they currently reside (which is used to categorize respondents based on U.S. Census regions), more nuanced detail about geographic information, such as zip codes, were unavailable to examine any geographic differences. Despite these limitations, this study was the first to examine the relationship between e-cigarettes use and openness to cigarette smoking in a nationally representative sample of young adults who had never established cigarette smoking behavior.

In the qualitative study, limitations exist that are inherent to that of all focus group studies, such as limited ability to generalize findings to other people or settings. Representativeness was strengthened in this study by recruitment of adult e-cigarette

users across five different geographic locations in the U.S.; however, the study is still limited in that all of the five locations were situated on either the east or west coast of the United States, and therefore missed the opportunity to collect data among those living in other regions of the U.S. or from more rural locations. However, the study sample was strengthened by the ability to contract with local market research firms with extensive databases for recruiting focus group participants. It should also be noted the vast majority of this study sample reported having some college education or higher and were also comprised mostly younger adults (average age was 30.4)—thus, follow-up work would also want to enhance representation of those with lower levels of education with a wider age distribution. Lastly, due to anticipated difficulties with recruitment of never established cigarette smokers, e-cigarette focus groups were segmented by current use of the product (i.e. exclusive use or dual use) and not by those who have never met the 100 threshold for ever use of cigarette smoking as defined by NATS.

6.4 Future Research Directions

Findings from this dissertation speak to the complex and multifaceted relationship between e-cigarette use and cigarette smoking behavior among young adults. Undoubtedly, future work will be needed—particularly longitudinal studies—to determine how individual trajectories vary over time and whether consumer perceptions about the products change as the marketplace for ENDS, specifically e-cigarettes, continues to evolve. Findings from this dissertation provide unique insight into the relationship between e-cigarette use and cigarette smoking behavior, as well as consumer perceptions about the products that warrant further investigation. For example, focus

group participants described a lack of knowledge as to the ingredients and health effects surrounding e-cigarette products, but expressed interest in learning more information as it becomes available. This suggests the need for communications to disseminate information about e-cigarettes to the public as new information is gleaned through scientific research. Furthermore, more research is needed regarding product characteristics, including understanding device characteristics and how those characteristics affect consumer use and product appeal.

As noted above, one challenge in recruiting e-cigarette users to participate in focus groups was segmenting e-cigarette users by their use status (exclusive vs. non-exclusive e-cigarette user). Moreover, during focus group discussions cigarette smoking behavior was not easily categorized—such that even those who said they had switched from conventional cigarettes to e-cigarettes at times still described smoking occasionally under certain circumstances (e.g. under stressful situation). This limitation suggests the need to recruit e-cigarette users based on a different set of characteristics. For example, future work could examine differences in attitudes and beliefs of e-cigarettes by users of different device types, for example, those who use products that closely resemble cigarette products (“cigalikes”) versus those who use more customizable devices (“Tank systems” or “Mods”). These device types can differ in significant ways that affect the users’ experience (e.g., availability of flavors; effective delivery of nicotine), which, in turn, might affect behavior, attitudes, and beliefs about the product. The existence of multiple user groups may have implications for the public health impact of e-cigarette use and marketing. For instance, hypothetically, users of tank system devices (vs. “cigalikes”) may be less (or more) likely to engage in dual use with conventional

cigarettes; likewise, tank system devices and cigalikes may present differential risk for initiation and experimentation with conventional cigarettes among non-users. Further qualitative investigation is needed with adults (both young adults and older adults) representing a mix of sex, race/ethnicity, and educational levels who currently use these two different device types to better understand these devices and how their respective characteristics relate to the users' experience of the product, as well as their use, beliefs, and attitudes about e-cigarettes.

APPENDICES

Appendix I: Methods

This section includes the study overview, conceptual model, study design, measures and instrumentation. A data analysis plan is also presented.

Study Overview

The public health community remains at a divide as to the potential benefits versus harms associated with the advent of e-cigarettes. Thus, in the absence of longitudinal data to monitor potential consequences of e-cigarette use among vulnerable populations over time, exploratory research is critically needed to determine if an association exists between e-cigarette use and openness to try cigarette smoking as well as to identify perceptions of these products compared to conventional cigarettes. Therefore, the main purpose of this study was two-fold: 1) to examine the association between e-cigarette use and openness to cigarette smoking among young adults and 2) to identify attitudes, beliefs, and perceived social norms of e-cigarettes among young adult e-cigarette users, as well as how young adult perceptions of e-cigarettes compare to those associated with conventional cigarettes. Using a mixed methods study design, this research examines complementary data on young adults' e-cigarette use and cigarette smoking behavior using both quantitative and qualitative findings. Quantitative data was obtained from a large, nationally representative survey of U.S. adults, and qualitative data was obtained from a focus group study with young adult e-cigarette users in five geographic locations across the U.S.

Study Design

This dissertation research employed a mixed methods study design to provide complementary data on this topic and triangulate data sources to develop a more complete understanding of the relationship between e-cigarettes and conventional cigarette smoking, as well as young adults' attitudes, beliefs, and perceived social norms of these two products. A mixed methods approach to address the study aims for this research was selected given this method's unique ability to provide multiple forms of evidence to document and inform the research investigation (Creswell & Plano Clark, 2011). In recent years mixed methods approaches have evolved and are now recognized as a legitimate form of inquiry in the social and human science research (Denzin & Lincoln, 2005). Although strengths and limitations exist for both quantitative and qualitative study designs, mixed methods research provides strengths that offset the weaknesses of both quantitative and qualitative methods. For example, although quantitative research offers the ability to control for confounding influence of many variables and can be used to generalize to a population of interest, it is weak in understanding the context or setting in which people talk; and in the case of this study, is also limited by the cross-sectional nature of the available quantitative data and thus cannot establish a temporal relationship between e-cigarette use and openness to smoke cigarettes. On the other hand, qualitative methods offer depth and breadth to individuals' experience of a phenomena, but are seen as deficient because of the personal interpretations made by the researcher and limited generalizability due to small sample sizes (Creswell & Plano Clark, 2011). Thus, mixed methods approaches have the unique ability to answer questions that cannot be answered with quantitative or qualitative

methods on their own. Several research studies have been successful in implementing a mixed methods research design where the combination of strengths of one approach (either quantitative or qualitative) makes up for the weaknesses of the other approach (Jick, 1979; Knodel & Saengtienchai, 2005; Weine et al., 2005).

In this study, a convergent parallel mixed method study design was employed where implementation of the quantitative and qualitative components of the study occurred during the same phase of the research process, thus prioritizing both methods equally (Creswell & Plano Clark, 2011). Moreover, the quantitative and qualitative components of this study were independently analyzed and then during final interpretations of the study findings were triangulated to present an overall interpretation of the study results (Figure 2).

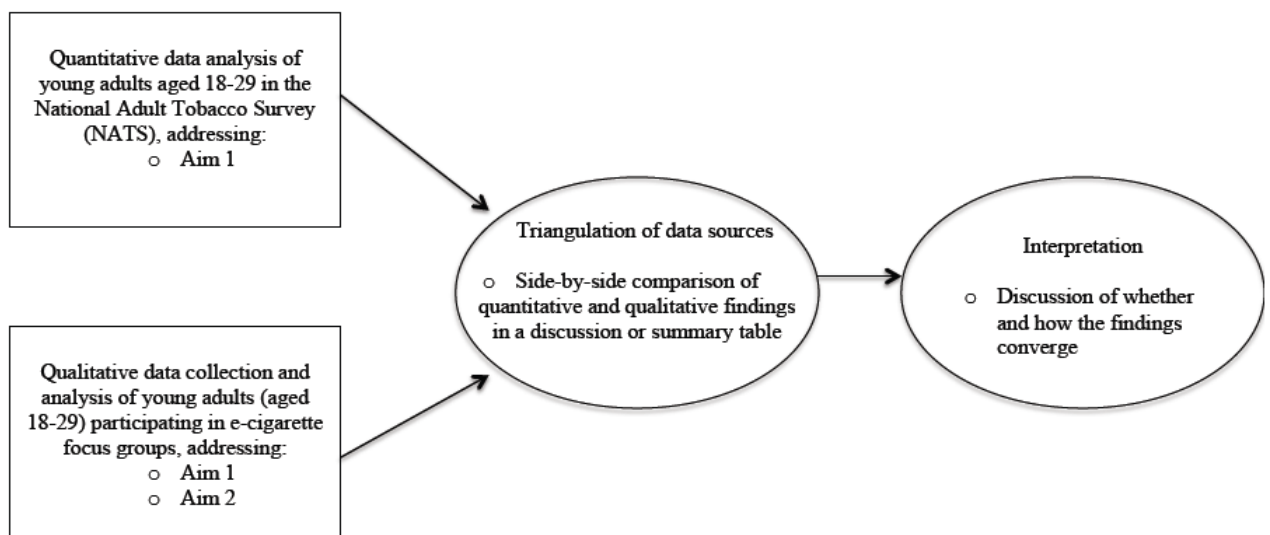


Figure 2: Overall Design to Address Study Aims 1 and 2

Quantitative Investigation

The quantitative component of this dissertation research involved a secondary data analysis of the 2012-2013 National Adult Tobacco Survey (NATS), which is a nationally representative cross-sectional survey of U.S. adults ≥ 18 years of age. The purpose of this analysis was to examine the association between e-cigarette use and openness to cigarette smoking among U.S. young adults who have never established cigarette smoking behavior. A conceptual framework (Figure 1) developed for examining the hypothesized relationship between e-cigarette use and openness to cigarette smoking was the guiding framework for this analysis. Moreover, the goals of this analysis were to:

- 1) identify characteristics of never smoking young adults by ever use of e-cigarettes, including sex, age, race/ ethnicity, educational attainment, U.S. Census region, ever use of other tobacco products (e.g., smokeless tobacco, hookah, and cigars), and experimentation with conventional cigarettes
- 2) determine the prevalence of self-reported openness to cigarette smoking by ever use of e-cigarettes as well as demographic characteristics and other tobacco product use
- 3) identify whether e-cigarette smoking is associated with future intentions to smoke cigarettes among young adults in the U.S. who have never established cigarette smoking behavior
- 4) examine other factors associated with intentions to smoke cigarettes among never established smoking young adults in the U.S.

The primary outcome variable of this study was self-reported openness to try cigarette smoking, which is examined as a binary composite variable of two measures assessing openness to smoke *soon* or *in the next year*. The relationship between e-cigarette use and

openness to smoke cigarettes was examined, as was the association between other socio-demographic factors and other tobacco products (smokeless tobacco, hookah, cigars, and experimentation with cigarettes) and openness to smoke. Even though various predictors of openness to cigarette smoking (e.g., socio-demographic factors and other tobacco product use) was examined and compared with e-cigarette use, the primary focus of this study was on the relationship between e-cigarette use and openness to smoke cigarettes.

National Adult Tobacco Survey (NATS)

The 2012-2013 National Adults Tobacco Survey is a stratified, nationally representative random-digit dialed telephone (RDD) survey of non-institutionalized adults 18 years of age and older. The sampling design was a dual frame RDD sample, comprised of independent samples drawn from 75% landline and 25% cell phone-only households in the 50 U.S. states and District of Columbia. The 2012-2013 NATS was a collaborative partnership between FDA's Center for Tobacco Products (CTP) and CDC's Office on Smoking and Health (OSH). A total of 57,994 completed interviews and 2,198 eligible partial interviews (at least 60% complete) were obtained between October 2012 and July 2013, yielding a total sample of 60,192 qualified interviews and a corresponding response rate of 44.9%. Participation in the NATS survey is voluntary, and respondents are not compensated for their time/ participation in the survey.

Study Population

This analysis was restricted to the 4,310 respondents in the 2012-2013 NATS between 18-29 years of age and met the definition of an adult never established smoker. Young adult respondents were determined to be 'never established smokers' if they respond "no" to the question: "Have you smoked at least 100 cigarettes in your entire

life?”, and also responded “not at all” to the question: “Do you now smoke cigarettes every day, some days, or not at all?”. Young adults who reported current, regular (every day or some days) use of other combustible products, including cigars and hookah, were excluded from the sample due to the potential for current use of other combusted tobacco products to confound the relationship between e-cigarette use and openness to smoke cigarettes. Current users of non-combustible products, including traditional smokeless tobacco, snus and dissolvable tobacco products, were not excluded from the sample, but non-combustible product use was included as a covariate in the analysis.

Measures

Primary Dependent Measure- Openness to cigarette smoking

Openness to future cigarette smoking was assessed among young adults in the study population using two questions: “Do you think you will smoke a cigarette soon?” and “Do you think you will smoke a cigarette in the next year?” Response options were: “Definitely yes”, “Probably yes”, “Probably not”, and “Definitely not”. A binary composite variable was created, and those who responded with any response option other than a firm intention not to smoke (“Definitely not”) were categorized as being open to smoking cigarettes and, therefore, considered at risk for future smoking. This definition draws on previous research on susceptibility measures classifying susceptibility/ high-risk intentions as the lack of firm intention not to smoke (Choi et al., 2001; Mowery, Farrelly, Haviland, Gable & Wells, 2004; Pierce et al., 1996; Wakefield et al., 2004). A sensitivity analysis was also conducted classifying only “Definitely yes” and “Probably yes” as being open to smoking and “Probably not” and “Definitely not” as not being open to smoking cigarettes.

Primary Independent Measure- Ever Use of E-Cigarettes

All survey respondents were asked the question “Before today, had you ever heard of electronic cigarettes, or e-cigarettes?” Those who answered “yes” were then asked “Have you ever used an electronic cigarette, even just one time in your entire life?” Ever e-cigarette users were defined as those who responded “yes”, while those responding “no” were defined as never e-cigarette users. Individuals who indicated never having heard of e-cigarettes prior to interview were treated as never e-cigarette users in the analysis as they were not asked the e-cigarette use question. Given that the survey measures for e-cigarettes in the 2012-2013 NATS only explicitly addressed “e-cigarettes”, it is possible that these measures underestimated the number of ENDS users by not also including other product types, such as “e-hookah”, “vape pens” or “e-pens,” which is a limitation of this survey measure.

Demographic variables

- *Sex*- Defined as Male vs. Female
- *Age*- Young adults 18-29 in the study population will be stratified by those 18-24 years of age and those 25-29 years of age in the quantitative analysis to examine differences within this broader group of young adults (Green et al., 2007)
- *Race/ Ethnicity*- Defined as non-Hispanic White, non-Hispanic Black, Hispanic, or non-Hispanic other
- *Education*- Defined as less than 12th grade (no diploma); high school diploma, GED, or equivalent; or some college or higher
- *U.S. Census Region*- This variable is defined based on self-report data on what state the respondent current resides in (at the time of data collection). Based on

U.S. Census data, state information was categorized into the following four regions: Northeast, Midwest, South, and West.

Other Tobacco Product Use

- *Ever Cigarette Experimentation*-Ever cigarette experimentation is assessed using the question, “Have you ever tried cigarette smoking, even one or two puffs?”. Respondents who select “yes” are considered to have experimented with cigarettes at some point in their lifetime.
- *Ever Use of Smokeless Tobacco*-A binary variable (yes/no) for ever use of smokeless tobacco was created based on respondents’ self-report of having used of traditional smokeless tobacco (chewing tobacco, dip, or snuff) 20 times or having ever tried snus or dissolvable tobacco products. If respondents reported having tried any of the smokeless products (or having used traditional smokeless at least 20 times) they were classified as having ever tried smokeless tobacco. This measure for assessing ever use of traditional smokeless tobacco in NATS (≥ 20 times in their lifetime) is derived from other national surveys also using this measure to assess ever established smokeless use in adults (USDHSS, 2014).
- *Ever Use of Hookah*-Ever use of hookah was defined based on the following question, “Have you ever smoked tobacco in a hookah in your entire life?”. Response options were categorized as a binary variable (yes/no) with yes representing use at least once in their lifetime.
- *Ever Use of Cigars*- Ever use of cigars was defined based on the following questions, “Have you smoked cigars, cigarillos, or little filtered cigars at least 50 times in your entire life?”. Response options were categorized as a binary variable

(yes/no). This measure for assessing ever use of cigars in NATS (≥ 50 times in their lifetime) is derived from other national surveys also using this measure to assess ever established cigar, cigarillo, or little filtered cigar use in adults (USDHSS, 2014).

Quantitative Analysis

All quantitative analyses were conducted using SAS 9.3 controlling for the complex survey design in NATS. Additionally, final survey weights were applied to reflect national adult population estimates. All variables included in the analysis were first examined in a univariate analysis to explore frequency distributions for the discrete categorical variables and identify any outliers, as well as the proportion of missing responses for each variable.

Bivariate Analysis

Bivariate analyses were conducted to assess associations between the primary dependent variable and each independent variable and covariates. First, sample characteristics of young adults, including sex, age group, race/ethnicity, educational attainment, U.S. Census region, ever use of smokeless tobacco (chewing tobacco, snuff, dip, snus, or dissolvables), ever use of hookah, ever use of cigars, and ever experimentation with cigarettes were examined by ever use of e-cigarettes. Next, national prevalence estimates and 95% confidence intervals (CIs) of self-reported openness to cigarette smoking were calculated, stratified by demographic characteristics, as well as ever use of other tobacco products (e.g., smokeless tobacco, hookah, cigars, and experimentation with cigarettes). Differences between estimates were considered statistically significant if results from a bivariate Rao-Scott chi-square test, which

incorporates a correction to account for the survey design effects, were <0.05 . Bivariate logistic regression analyses were employed to estimate unadjusted odds ratios (ORs) of openness to cigarette smoking by e-cigarette use, demographic characteristics, and other tobacco product use.

Multivariate Analysis

To address study Aim 1, this quantitative analysis assessed the association between e-cigarette use among young adults and openness to smoke cigarettes. More specifically, this analysis employed multivariate logistic regression to estimate adjusted odds ratios (AORs) and 95% confidence intervals (CIs). The adjusted regression model included the following covariates: sex, age group, race/ethnicity, educational attainment, U.S. Census region, ever use of e-cigarettes, ever use of smokeless tobacco, ever use of hookah, ever use of cigars, and ever experimentation with cigarettes. This analysis did not have the ability to identify what proportion of young adults that report openness to cigarette smoking actually go on to engage in smoking behavior; however, based on TBP and other previous studies on openness to smoke/intention measures, this measure of openness to use cigarettes has been a powerful predictor of increased risk of progression to actual use (Ajzen, 1991; Choi et al., 2001; Wakefield et al., 2004).

Qualitative Investigation

The qualitative component of this study was conducted as a part of a larger research effort by FDA's Center for Tobacco Products (CTP). The primary aim of the larger study was to conduct a series of focus groups across the U.S. to inform current and future education and communication efforts as well as survey development for FDA-

funded surveillance systems related to “other tobacco products”. These other tobacco products included e-cigarettes, hookah, and cigar products (little filtered cigars, cigarillos, and premium cigars). Moreover, this broader study sought to ascertain the diversity of knowledge, attitudes, and awareness related to these other tobacco products held by adults across the U.S who use the products. Given the limited surveillance data and increased prevalence in awareness and use of these other tobacco products, this formative study design employed a number of focus groups with adult tobacco users from five geographic markets nationwide. Selection of the five study sites was based on prevalence data from the National Adult Tobacco Survey and National Health Interview Survey to determine locations where prevalence of use was high across all three products of interest (e-cigarettes, hookah, and cigars). Additionally, data were obtained from Nielsen scanner data to further identify study site locations indicating high market share for all products of interest in the broader study. The study sites selected for data collection included: Orlando, Florida; Los Angeles, California; Providence, Rhode Island; Richmond, Virginia; and Washington, District of Columbia. Focus groups with e-cigarette users in the broader study were segmented by age (young adults aged 18-29 and adults aged 30 or older) and by experience with the product (exclusive use versus non-exclusive use).

For this dissertation research, data was analyzed from the e-cigarette focus groups in all five study site locations, including specific items incorporated into the moderator guides to address study Aims 1 and 2 (see Appendix A).

Qualitative Research Questions

To support study Aims 1 and 2 for this dissertation research, four research and related sub-questions questions have been developed for exploration in the qualitative data:

Research question 1: How has using e-cigarettes affected young adults' attitudes and beliefs about conventional cigarettes, including their openness to trying conventional cigarettes soon or in the next year?

Research question 2: How do young adult e-cigarette users compare e-cigarettes to other tobacco products, including conventional cigarettes?

RQ 2.1: How do young adult e-cigarette users compare e-cigarettes to other tobacco products in terms of ingredients and nicotine content?

RQ 2.2: How do young adult e-cigarette users compare e-cigarettes to other tobacco products in terms of use patterns?

Research question 3: What do young adults believe are the health risks associated with e-cigarette use?

RQ 3.1: How do young adults describe the risks of e-cigarettes compared to those associated with conventional cigarettes?

Research question 4: How do young adults describe their friends' and family members' use of e-cigarettes?

***RQ 4.1:** How do young adult e-cigarette users describe their friends' opinions about their use of the product?*

***RQ 4.2:** How do young adult e-cigarette users describe family members' opinions about their use of the products?*

Study Population

The sample for this qualitative study was a non-probability purposive convenience sample of young adults and older adults residing in one of the five study locations. Participants were targeted for recruitment to this study based on their age and e-cigarette use status. Moreover, study participants under study Aim 1 were young adults aged 18-29 years and reported current use (past 30 day use) of e-cigarettes. 80 young adult e-cigarette users were recruited to participate in an e-cigarette focus group in one of the five study site locations (total N=116). To ensure homogeneity in terms of familiarity with e-cigarettes, focus group participants were segmented in terms of their current e-cigarette use. That is, focus group participants were segmented in to either a non-exclusive use group (those who reported having used e-cigarettes as well as another tobacco product in the past 30 day) or exclusive e-cigarette use group (those who reported only having used an e-cigarette in the past 30 days). Additionally, all focus groups included a mix of races/ethnicities, sex, and education levels.

Recruitment Plan & Screening Procedure

Recruitment for the focus groups was conducted by the study contractor to implement the focus groups according to the e-cigarette screener developed for this

project (see Appendix B). As mentioned above, each of the five different study locations were selected based on prevalence of e-cigarette use, but are also uniquely situated in disparate regions of the country to ensure that individuals from a range of demographic backgrounds will have the opportunity to be recruited. The contractors primarily drew from their own existing databases of individuals interested in research participation who met the specified criteria for participation in the e-cigarette focus groups. Individuals were contacted by telephone and screened for eligibility.

In addition to items related to tobacco use, the recruitment screener included questions related to education and race/ethnicity. These questions were used to ensure representation of different backgrounds among recruited participants for this study. The recruitment screener also included questions related to English proficiency, which is included for the purposes of recruiting individuals who are both capable and comfortable participating in a group discussion conducted in English. Individuals were ineligible for participation if they had other characteristics that could potentially bias responses (e.g., connections to the tobacco industry; employed by the federal government; or employed in the public health, advertising, or marketing industries), or if they have participated in market research in the past 6 months. Participants who met the eligibility criteria, and who were willing and able to attend an in person focus group session, were scheduled to participate in this study and given information about the time and place of their participation, where they were required to provide informed consent.

The contractor recruited approximately 12 individuals for each focus group discussion, for a desired anticipated turnout of 8-9 participants per group. Focus groups conducted for this study achieved a range of 7 to 10 participants in each focus group

session. Respondents were offered a monetary incentive of \$75.00 to participate in this study, which was provided at the conclusion of the focus group session. Participants had the right to terminate their participation in the focus groups at any point during the study, without penalty.

Study Procedures

When participants arrived at the facility, they were first rescreened to ensure they meet the criteria for the e-cigarette focus groups, and were then given an informed consent form to read through, ask questions as needed, and sign. The focus group discussion lasted approximately 60 minutes, and was led by a trained moderator who used a script developed by the study PI (Blair Coleman) and co-investigators to guide the discussion on e-cigarettes (see Moderator Guide in Appendix A). Before beginning the focus group discussions, the moderator briefly went over a set of “ground rules” with the study participants to encourage everyone in the group to create an respectful environment where everyone could openly share their opinions, and reassured the group there are no right or wrong answers to the questions presented. Participants were also informed a note taker, as well as the study PI (Blair Coleman), were seated behind a two-way mirror (or joining via webcast) observing all focus group discussions.

After a brief warm-up exercise, the discussion covered the following topics: (a) past use, behaviors, and terminology associated with e-cigarettes, (b) relationship between e-cigarettes and other tobacco product use, including openness to conventional cigarette smoking soon or in the next year; and, (c) attitudes, beliefs, and perceived social norms surrounding e-cigarette use. At the end of the focus group discussion, the

moderator closed the focus groups by thanking participants for their time and insights on the topic of e-cigarettes. Lastly, upon exiting the facility participants received a monetary incentive of \$75 cash for their time and participation in the study.

Qualitative Analysis/ Organization

All focus group sessions were audio recorded and transcribed verbatim to create Microsoft word transcripts of each focus group discussion, which were then stored in a password protected file to keep the information confidential. Transcriptions of the focus group discussions did not include names or any other identifying information that could be linked back to the study participants. Focus group data was coded and organized using NVivo version 9 Software (QSR International) by Ms. Coleman, the primary coder and reviewer. An initial set of codes and subtopics was created by Ms. Coleman corresponding to each topic of interest described above, including past use of e-cigarettes, behaviors, and terminology associated with e-cigarette use, the relationship between e-cigarettes and other tobacco product use, openness to smoke conventional cigarettes, and attitudes, beliefs, and perceived social norms surrounding e-cigarette use. Additional codes were created for emergent themes and patterns identified during analysis, and codes were then consolidated as necessary. Finally, detailed codes to use for analysis of specific topics (e.g., the relationship between e-cigarette use and openness to engage in cigarette smoking behavior) were developed by Ms. Coleman.

To ensure reliability of the data, a pilot test of the coding dictionary was employed to ensure consistency of coding between the primary and secondary coders/reviewers. Next, the primary reviewer analyzed and interpreted the data, and a secondary reviewer coded a random sample of transcripts; any discrepancies were discussed until

consensus was reached. Additionally, statements were compared within and across groups to ensure consistency within all of the major themes. Lastly, after Ms. Coleman completed all coding for the focus group transcripts, a secondary coder coded a random sample of three of the 14 transcripts to ensure at least 80% agreement (Creswell, 2012), thus, strengthening the reliability of the coding process. Characteristics of the study sample were presented using frequencies and percentages for categorical variables and means and standard deviations continuous variables of interest.

Triangulation of Data Sources

Following independent analysis of both the quantitative and qualitative components of this research study, triangulation of data sources was crucial to obtaining a complete understanding of the proposed research questions and study aims. Both approaches to data collection in this study provided valuable insight into the association between e-cigarette use and cigarette smoking behavior; however, without integration of these data sources, significant limitations would have remained. That is, although an association between e-cigarette use and openness to smoke cigarettes was observed, the cross-sectional nature of the survey limits the ability to establish a temporal relationship between e-cigarette use and openness to conventional cigarette smoking. Thus, comparing results of the quantitative analysis to the qualitative data from the focus group study provided the opportunity to contextualize study findings and identify whether results of both analyses converge and how they converge.

According to the mixed methods literature on strategies for comparing results across quantitative and qualitative data, three primary options exist for merged data

analysis comparisons, including: side-by-side comparisons in a discussion or summary table, joint display comparisons in the results or interpretation, and data transformation in the results (Creswell & Plano Clark, 2011). The most widely applied method for comparing results in mixed methods studies is the side-by-side comparison for merged data analysis, which involves presenting the quantitative results and qualitative findings together in discussion or summary table, whereby the presentation of the findings alongside each other becomes the means for conveying the merged results (Creswell & Plano Clark, 2011). For example, published studies (Mizrahi & Rosenthal, 2011) have used this approach and presented the quantitative results followed by qualitative results in the form of quotes in a discussion section accompanied by a statement describing how the qualitative quotes either confirm or disconfirm the quantitative results. This side-by-side comparison method for merging findings has received support in the scientific literature as an approach for data analysis in mixed methods studies, particularly for convergent study designs, and therefore was the data analysis approach employed for this study to triangulate study findings.

Using the side-by-side comparison approach to analyze the two data sources together in this study under the convergent mixed methods study design (see Figure 2), after each component of the research was independently analyzed there was a process for merging the two sets of results based on previous research (Bazeley, 2009). That is, once the quantitative and qualitative findings were independently analyzed, a side-by-side comparison was presented in Study 2 in order to merge the results by comparing both the quantitative and qualitative data findings under study Aim 1. That is, the side-by-side comparison presented in the discussion of the Study 2 manuscript describes the

quantitative findings from the NATS quantitative investigation, as well as the qualitative responses from the focus groups, includes a discussion on how the findings from these two forms of data collection converge or diverge. Thus, triangulation of these findings from both study components in the form of a discussion provided a more in-depth understanding of the relationship between e-cigarette use and openness to cigarette smoking among young adults. The approach to merging the data sources through a discussion in Study 2—as opposed to a summary table; another common approach for merging data sources under the convergent parallel design—was employed due to differences between the study samples in the quantitative and qualitative studies. That is, young adults in the NATS analysis were all never established smokers who have used e-cigarettes at least once in their lifetime; whereas young adult e-cigarette users in the focus group study were not excluded based on prior cigarette smoking status—and thus, may have had previous experience with cigarettes. If this study had been designed using the same study population for both quantitative and qualitative data collection—or if the exact same selection criteria had been employed for quantitative and qualitative data collection—merging the results in a summary table may have been a more suitable option as opposed using a discussion as a vehicle for merging study findings.

Lastly, triangulation of these two data sources using the side-by-side comparison method is important in the context of the theoretical framework of this study. The Theory of Planned Behavior posits that behavioral intentions (i.e. openness to smoking) depend on a combination of a person's attitudes and subjective norms about the behavior as well as their perceived behavioral control (Ajzen, 1991). Qualitative findings under study Aim 2 provided additional insight as to young adults' attitudes and perceived social norms

surrounding e-cigarette use, which according to TPB, positive attitudes and social norms coupled with the behavioral similarities of e-cigarette use to that of conventional cigarette smoking (e.g., nicotine delivery via inhalation, hand-to-mouth delivery) may lead to intentions to smoke cigarettes among e-cigarette users. Alternatively, it is possible that positive attitudes surrounding e-cigarettes may in fact reinforce negative attitudes towards cigarette smoking (e.g. due to the smell of conventional cigarettes, ash produced, etc.). Additionally, under study Aim 1 triangulation of study findings from both the quantitative and qualitative investigations provide unique insight as to young adults' openness to cigarette smoking, which according to TPB is the most proximal antecedent to behavior change (Ajzen, 1991), and thus an important finding to consider in the context of public health.

Human Subjects Protection

The focus group study as well as data collection for the 2012-2013 National Adults Tobacco Survey received approval from the Office of Management and Budget (OMB) prior to data collection. Additionally, IRB approval was obtained for the 2012-2013 NATS by the Centers for Disease Control and Prevention, Office on Smoking and Health as well as the contractor administering the survey (Westat). According to the U.S. Department of Health and Human Services' Code of Federal Regulations on Human Subjects Research (Title 45 Part 46), research involving existing, de-identified data made publically available is subject to exempt status. IRB approval for the broader focus group study had already been obtained through the FDA's Center for Tobacco Product's IRB as well as the study contractor's (RTI International) IRB, and was determined not to be

subject to review by the University of Maryland's IRB as it did not meet the criteria for human subjects research (see Appendix V).

Further, to ensure confidentiality among all focus group participants, the following measures were taken: 1) last names of the participants were not used on any focus group materials (typed lists of participants, name tags, transcripts, reports, or during the audio recorded discussion); 2) transcripts do not contain any personally identifying information and are stored securely on a password-protected computer; 3) quotes that may have been used in the final manuscripts or presentations of the study findings to illustrate a discussion-derived theme were not be attributed to the individual; and 4) before the groups began, the moderator obtained verbal consent from the participants to audiotape the sessions.

Appendix II: Moderator Guide

I. Introduction and Ground Rules (5 minutes)

MODERATOR: Welcome and thank you for participating in tonight's discussion. My name is _____. Tonight, I am interested in hearing your opinions about tobacco products. You have been asked to participate in tonight's discussion because you use (or have used) some of the various tobacco products that we are going to discuss tonight.

Before we begin, I want to go over a few ground rules for our discussion tonight, which will last about an hour.

- Your participation is voluntary and you have the right to not answer any question or withdraw from the study at any time.
- If at any time you are uncomfortable with my questions, you can choose not to answer. Just let me know that you prefer not to answer.
- Everything we discuss today will be kept private to the extent allowable by law. Your name and contact information, which only the study staff knows, will not be given to anyone else, and no one will contact you after this discussion is over.
- Tonight's discussion will be audio-recorded. The recordings will help me write the final report and will be kept in a secure location and then destroyed at the end of the study. No names will be mentioned in the final report created from these interviews.
- Behind me is a one-way mirror. Behind that are some of my colleagues. We are also videostreaming our group. They're watching to make sure that I ask you all of the questions I have for you today. Near the end of our conversation, I'm going to go into the back and see if they have any last minute questions for you.
- Most importantly, there are no right or wrong answers. I want to know your opinions. I do not work for the people sponsoring this research and I didn't write the questions we're going to look at, so don't hold back on giving me your honest opinions.
- I'm not a medical doctor or an expert on smoking or tobacco, so I can't answer specific questions. At the end of our discussion, however, I have some materials that you can take with you if you'd like.
- Please silence your cell phones.
- Do you have any questions before we begin?

II. General Discussion about Tobacco Products

Let's talk about your experiences with cigarettes and other types of tobacco products. What tobacco products do you currently use or have you used or tried?

(Whiteboard)

III. E-cigarettes – Use and behavior, access, and language

Ok, now let's talk a little more about your experiences with electronic cigarettes (e-cigarettes)

Initiation

1. How did you first hear about e-cigarettes?
2. Describe your first experience using e-cigarettes that you can remember:
 - When was it?
 - Where were you?
 - Who were you with?
 - How did you get e-cigarettes? (Purchase? Friends?)
 - What made you try it?
 - What were your reactions to it? (Positive or negative; physical and non-physical)
 - What do you remember most about your first experience using e-cigarettes?
3. Was the first e-cigarette you tried flavored?
 - Was it flavored to taste like menthol (mint)?
 - Was it flavored to taste like alcohol, candy, fruit or other sweets?
4. Was this your first experience using any type of tobacco product?

Recent History of Use/Reason for Continued Use

5. For those of you who still use them, why have you continued using them?

Language/Nomenclature

6. Let's talk about the words you use when you talk about e-cigarettes, or talk about using e-cigarettes:
 - What do you call the act of using an e-cigarette?
 - What do you call the "smoke" that comes out when you use an e-cig?
 - Have you ever heard of a [what are they? How are they different?]:
 - Vape pen
 - E-hookah
 - Portable hookah
 - Electronic delivery device
 - E-pen
7. What do you call people who use e-cigarettes regularly? (Is there a name for them?)
 - Do you consider yourself a {person who uses e-cigarettes regularly}?
 - What would you consider "regular use" of e-cigarettes? (How much? How often?)

- Do you consider people who use e-cigarettes “smokers”? Why or why not?

Current use setting and frequency

8. Describe your use of e-cigarettes now: What products do you use? What is the typical situation when you’d be using them? How often?
 - Where are you? What are you doing?
 - Are you with other people? (Who are you with?)
9. What type of e-cigarettes do you use (disposable? rechargeable?); are they flavored? Do they have nicotine? Are they refillable? Do you feel comfortable using the e-cigarette in public places?
 - Have you ever used e-cigarettes in places where cigarette smoking is not allowed?
 - Have you ever been approached by anyone wanting to know what you were smoking?

Access to Product

10. How do you usually get e-cigarettes?
 - Do you buy e-cigarettes (them) yourself? If so, where?
 - How often? How much/many at a time?
 - Do you try different types [disposable/rechargeable]? What makes you try something different?

Additional Tobacco Use/Combined Effect

11. How is using e-cigarettes related to your use of other tobacco products?

Ask during e-cig exclusive use groups:

12. Were you curious about trying traditional cigarettes before you started using e-cigarettes?
 - Are you curious about trying cigarettes now?
13. Before using an e-cigarette, what did you think about traditional cigarettes? How did you feel about them?
 - Has your opinion changed since you started using an e-cigarette?
14. Do you think you will try cigarette smoking?
 - Soon?
 - In the next year?

Ask during e-cig dual use groups:

15. If you started smoking cigarettes before using e-cigarettes, did using an e-cigarette impact your cigarette smoking; if so how?
16. If you started using e-cigarettes before you started smoking cigarettes, were you curious about cigarette smoking?

17. How has your experience with e-cigarettes affected how you feel or what you think about traditional cigarettes?

Planned Continued Use

18. Do you see yourself using e-cigarettes a year from now? What about five years from now? Why or why not?
19. Is there a point in time when you no longer see yourself using e-cigarettes? When would that be? Why?

IV. OTP – Attitudes and beliefs (risk)

Reason for Use

20. Why do you think people use e-cigarettes? Are there benefits to using them? What are the benefits?

Similarity to other tobacco products

21. How are e-cigarettes like other tobacco products and how are they different?
- How are e-cigarettes like cigarettes and how are they different?
 - What do you know about the ingredients of e-cigarettes?
 - What about nicotine? What do you know about nicotine in e-cigarettes vs. in other tobacco products?

Knowledge/perception of relative negative health outcomes

22. How can using e-cigarettes affect your health?
23. What have you heard about how using e-cigarettes can affect your health?
24. How do e-cigarettes compare to other tobacco products [or other substances] in terms of the health risks?
- How do they compare to cigarettes?
25. Can someone get addicted to e-cigarettes?
- Do you consider yourself addicted to e-cigarettes? Why/Why not?
 - In terms of addiction, how does it compare with cigarettes?
 - In terms of addiction, how does it compare with other tobacco products? Other products (like alcohol, drugs)?

Perceived Social Norms

26. Do your friends use e-cigarettes? What do they think about them? What do they think about you using it?
- Tell me about your friends who don't use e-cigarettes: Why don't they use them?
27. Do any of your other family members use e-cigarettes? Who? What do they think of e-cigarettes?
28. Where have you seen or heard about e-cigarettes? (probe: websites [what websites?], TV, magazines, newspaper, etc.)
- What do you think about what you've seen/heard?

V. Closing

I would like to thank you for coming here today and participating in this discussion. This research was sponsored by the Food and Drug Administration also known as the FDA. FDA would like to thank you for sharing your opinions as they will be very useful in helping them to understand people's reactions and thoughts about the tobacco products we have talked about. The FDA wants you to know that there is no safe tobacco product, including the products we talked about today. Here is a pamphlet with information from FDA on how users can quit. Feel free to share this pamphlet with tobacco users you might know.

Appendix III: Focus Group Screener

FDA Tobacco Focus Groups Screening Questionnaire *E-Cigarette*

Hello, this is _____ from [FACILITY NAME], a local market research firm. May I please speak to _____?

(Hello, this is _____ from [FACILITY NAME], a local market research firm.) We are working with RTI International, a nonprofit research organization, and the Food and Drug Administration (FDA) on a research study about tobacco products, and would like to include your opinions. I want to assure you that we are not from a tobacco company or a company that sells quit-smoking aids.

We are holding a group discussion on [DATE] with approximately 9 other people like you. The discussion group starts at [TIME] and will last about 60 minutes. For study purposes, the group discussion will be audio recorded, and FDA project team members may observe the discussion.

In appreciation for your participation, you will be reimbursed for your time, effort, and travel expenses. Participation in the groups is completely voluntary. Would it be OK if I ask you a few questions now in order to see if you are eligible to be in one of the groups?

- ☐ Yes – *Continue.*
- ☐ No – *Thank and end call.*

What is your age?
_____ [Record age and group into category]

- ☐ <18 → **TERMINATE**
- ☐ 18-29 → **CONTINUE FOR 18-29 YEAR OLD YOUNG ADULT GROUP**
- ☐ 30 and older → **CONTINUE FOR 30 AND OLDER ADULT GROUP**

1. Have you ever smoked cigarettes or used smokeless tobacco products, even just one time?

☐ Yes

If yes: Which tobacco products have you (ever) used? And how often? [Check all that apply]

☐ Cigarettes

- ☐ Every day
 ☐ Occasionally
- ☐ Cigars
 - ☐ Every day
 - ☐ Occasionally
- ☐ Cigarillos
 - ☐ Every day
 - ☐ Occasionally
- ☐ Pipes
 - ☐ Every day
 - ☐ Occasionally
- ☐ Hookahs or water pipes
 - ☐ Every day
 - ☐ Occasionally
- ☐ Snus
 - ☐ Every day
 - ☐ Occasionally
- ☐ Chewing tobacco/dip/snuff
 - ☐ Every day
 - ☐ Occasionally
- ☐ Dissolvable tobacco products
 - ☐ Every day
 - ☐ Occasionally
- ☐ Other: _____
 - ☐ Every day
 - ☐ Occasionally
- ☐ No

2. Have you ever heard of an electronic or e-cigarette?

- ☐ Yes ***Continue.***
- ☐ No ***Terminate.***

3. Have you ever tried electronic or e-cigarettes, even just one time?

- ☐ Yes

If yes: Do you currently (in the past 30 days) use e-cigarettes?

 - ☐ Yes
 - ☐ No
- ☐ No ***Terminate.***

4. In the past 5 years, have you or any member of your household worked for any of the following? (*Read list. If yes to any, thank the respondent and terminate.*)

- ☐ A tobacco or cigarette company
- ☐ A public health or community organization involved in communicating the dangers of smoking or the benefits of quitting
- ☐ A marketing, advertising, or public relations agency or department
- ☐ The Federal Government (***Read list. If yes to any, thank the respondent and terminate.***)
 - ☐ The U.S. Food and Drug Administration (FDA)
 - ☐ The National Institutes of Health (NIH)
 - ☐ The Centers for Disease Control and Prevention (CDC)
 - ☐ The Substance Abuse and Mental Health Services Administration (SAMHSA)
 - ☐ The Centers for Medicare & Medicaid Services (CMS)

5. Have you or any member of your household ever lobbied on behalf of the tobacco industry?

- ☐ Yes ***Thank the respondent and terminate.***
- ☐ No ***Continue.***

6. Have you or any member of your household personally represented or worked on behalf of a tobacco company in connection with a tobacco lawsuit?

- ☐ Yes ***Thank the respondent and terminate.***
- ☐ No ***Continue.***

7. Have you participated in any paid market research in the past 6 months?

- ☐ Yes ***Thank the respondent and terminate.***
- ☐ No ***Continue.***

8. For study purposes, if you participate, the discussion group will be recorded. The interviewer will not ask any sensitive questions. Are you okay with us recording your group discussion?

- ☐ Yes ***Continue.***
- ☐ No ***Thank the respondent and terminate.***

9. What is your sex?

- ☐ Male
- ☐ Female

10. What is the highest level of education that you have completed? (*Read list.*)

- ☐ Less than high school diploma ***Continue.***
- ☐ High school graduate or GED ***Continue.***
- ☐ Some college or 2-year degree ***Continue.***
- ☐ College degree ***Continue.***
- ☐ Postgraduate degree ***Continue.***

11. Are you of Hispanic or Latino origin?

- ☐ Yes
- ☐ No

12. What is your race? (*Read list. Recruit a mix to show per group.*)

- ☐ White
- ☐ Black or African American
- ☐ Asian
- ☐ Native Hawaiian or other Pacific Islander
- ☐ American Indian or Alaskan Native
- ☐ **[DON'T READ]** Hispanic
- ☐ **[DON'T READ]** Other

13. Finally, during the focus group discussion, you will be asked to review written materials and offer your opinions; therefore, I need to ask whether you have a medical or nonmedical condition that affects your ability to read and/or understand written materials in English?

- ☐ Yes ***Thank the respondent and terminate.***
- ☐ No ***Continue.***

Great! You qualify for our study. The discussion group will be held on [DATE] at [TIME] and will last about 60 minutes. For your time and opinions, you will receive \$75 at the end of the session.

13. Would you like to participate in the group discussion at [TIME] on [DATE]?

- ☐ Yes ***Continue.***
- ☐ No ***Thank the respondent and terminate.***

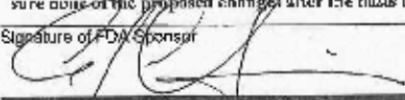
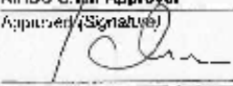
Great! May I please have your mailing and/or e-mail address to send you a confirmation letter with directions? [***Verify address and phone number.***]

Appendix IV: Focus Group Coding Dictionary

Code	Definition	Source
Attitudes (parent node)	The degree to which a person has favorable or unfavorable evaluation of an object or behavior	Glantz, Rimer & Viswanath, 2008; Eagly & Chaiken (1993)
Positive attitudes	Favorable evaluation of e-cigarettes and/or e-cigarette use	Glantz, Rimer & Viswanath, 2008
Benefits of e-cigarette use	Direct reference to benefits associated with e-cigarette use (in general)	BC
Plans for continued use	Reference to plans for continued/ future e-cigarette use	BC
Negative attitudes	Unfavorable evaluation of e-cigarettes and/or e-cigarette use	Glantz, Rimer & Viswanath, 2008
Disadvantages to e-cigarette use	Direct reference to disadvantages associated with e-cigarettes use (in general)	BC
Plans to discontinue use	Reference to plans to discontinue e-cigarette use, including if/when there would be a time when they would no longer use e-cigarettes	BC
Beliefs (parent node)	All thoughts towards the attitude object; or relation between the object of the belief and some other object, value, concept, or attribute	Fishbein & Ajzen (1975); Eagly & Chaiken (1993)
Knowledge about the ingredients and/or health risks	Direct reference to having knowledge (or a lack thereof) about the ingredients (including nicotine) in e-cigarette products and/ or health risks associated with e-cigarette use	BC
Beliefs about the ingredients and/or health risks	Beliefs about specific ingredients (including nicotine) in e-cigarette products and/ or health risks associated with e-cigarette use	BC
Comparative beliefs about ingredients and nicotine content in e-cigarettes compared to conventional cigarettes	Direct reference to beliefs about the ingredients and nicotine content in e-cigarette use compared to conventional cigarettes	BC
Comparative beliefs about the health risks compared to conventional cigarettes	Direct reference to beliefs about the health risks associated with e-cigarette use compared to conventional cigarettes	BC

Code	Definition	Source
Comparative beliefs about addictiveness of e-cig compared to conventional cigarettes	Direct reference to beliefs about the addictiveness of e-cigarette use compared to conventional cigarettes	BC
Perceived social norms (parent node)	Belief about whether most people approve or disapprove of behavior (e-cigarette use)	Glantz, Rimer & Viswanath, 2008
Friends' use	Belief about whether their friends use e-cigarettes	Glantz, Rimer & Viswanath, 2008
Friends' positive opinions about e-cigarette use	Belief about whether friends have positive attitudes/ opinions about e-cigarettes/ e-cigarette use	Glantz, Rimer & Viswanath, 2008
Friends' negative opinions about e-cigarette use	Belief about whether friends have negative attitudes/ opinions about e-cigarettes/ e-cigarette use	Glantz, Rimer & Viswanath, 2008
Family members' use	Belief about whether their family members use e-cigarettes	Glantz, Rimer & Viswanath, 2008
Family members' positive opinions about e-cigarette use	Belief about whether family members have positive attitudes/ opinions about e-cigarettes/ e-cigarette use	Glantz, Rimer & Viswanath, 2008
Family members' negative opinions about e-cigarette use	Belief about whether family members negative attitudes/ opinions about e-cigarettes/ e-cigarette use	Glantz, Rimer & Viswanath, 2008
Relationship between e-cigarette use and openness to conventional cigarette smoking (parent node)	Reference to the relationship between e-cigarette use and conventional cigarette smoking; including if/how e-cigarette use affects thoughts, feelings, and use of conventional cigarette smoking	BC
Openness to try to cigarette smoking	Reference to openness to trying conventional cigarette smoking, which lacks a firm intention not to smoke (i.e. will definitely not smoke)	Pierce et al. (1996); Mowery et al. (2004)
Change (if any) in opinion about conventional cigarettes	Direct mention of any change in opinions about conventional cigarettes as a result of e-cigarette use	BC
Impact (if any) e-cigarettes have on patterns of use of conventional cigarettes	Direct mention of any impact e-cigarette use has had on their patterns of use of conventional cigarettes	BC

Appendix V: Human Subjects Protection

DEPARTMENT OF HEALTH AND HUMAN SERVICES Food and Drug Administration	
REQUEST FOR EXEMPTION FROM IRBSC REVIEW UNDER 45 CFR 46.101(b)(2)	
IRBSC Number 14-015CTP	
Study Title Oral Tobacco Products: A Focus Group Study	
FDA Sponsor Smith E. Johnson	Principal Investigator Elizabeth Adams, RIT
My project involves only ADULTS: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, then indicate the State and the age of majority in that State:</i> State: _____ Age of majority: _____	
AND <input type="checkbox"/> Project uses only survey procedures <input checked="" type="checkbox"/> Project uses only interview procedures <input type="checkbox"/> Project involves only observation of public behavior	
AND <input checked="" type="checkbox"/> Information is recorded in such a manner that subjects can not be identified, directly or through identifiers	
OR <input type="checkbox"/> Although subjects can be identified, disclosure of information obtained could not place subjects at risk of civil/criminal liability or be damaging to the subject's financial standing, employability, or reputation	
Please attach the following information, if applicable:	
<ul style="list-style-type: none"> Completed and Signed IRBSC Waiver Transmittal Form Study protocol, including either focus group or survey questions Documentation that all subjects are adults (18 or older) Recruitment and/or Advertisement information Text of oral consent of subjects Information on who will be conducting the interview/focus group testing including documentation that the person(s) has been trained Information on who will have access to the study data and how it will be kept confidential Discussion of either how the subject's identity will be protected and/or why this is not needed 	
I understand that if any changes are proposed for this study, I will need to resubmit the materials to the IRBSC to make sure none of the proposed changes alter the basis for the above exemption.	
Signature of FDA Sponsor 	Date (mm/dd/yyyy) 2/28/2014
IRBSC Chair Approval Approved (Signature) 	Date (mm/dd/yyyy) 2/28/2014
FORM FDA 3547a (8/11)	



UNIVERSITY OF MARYLAND

INSTITUTIONAL REVIEW BOARD

1204 Marie Mount Hall
College Park, MD 20742-5125
TEL 301.405.4212
FAX 301.314.1475
irb@umd.edu
www.umresearch.umd.edu/IRB

DATE: September 8, 2014

TO: Blair Coleman, MPH
FROM: University of Maryland College Park (UMCP) IRB

PROJECT TITLE: [655399-1] The Association between Electronic Cigarette Use and Cigarette Smoking Behavior among Young Adults in the United States

SUBMISSION TYPE: New Project

ACTION: DETERMINATION OF NOT HUMAN SUBJECT RESEARCH
DECISION DATE: September 8, 2014

Thank you for your submission of New Project materials for this project. The University of Maryland College Park (UMCP) IRB has determined this project does not meet the definition of human subject research under the purview of the IRB according to federal regulations.

We will retain a copy of this correspondence within our records.

If you have any questions, please contact the IRB Office at 301-405-4212 or irb@umd.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within University of Maryland College Park (UMCP) IRB's records.

REFERENCES

- Abrams, D. B. (2014a). Promise and peril of e-cigarettes. *JAMA Pediatrics*, 311, 135-136.
- Abrams, D. B. (2014b). Potential and pitfalls of e-cigarettes--reply. *JAMA: The Journal of the American Medical Association*, 311, 1922.
- Adkison, S. E., O'Connor, R. J., Bansal-Travers, M., Hyland, A., Borland, R., Yong, H. H. et al. (2013). Electronic nicotine delivery systems: International tobacco control four-country survey. *American Journal of Preventive Medicine*, 44, 207-215.
- Ajzen, I. (1985). *From intentions to actions: A theory of planned behavior*. In J. Khuhl & J. Beckmann (Eds.), *Action Control: from cognition to behavior*. New York: Springer-Verlang.
- Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behavior and Human Decision Processes*, 50, 179-211.
- Arnett, J. J. (2000). Emerging adulthood: a theory of development from the late teens through the twenties. *American Psychologist*, 55, 469.
- Arnett, J. J. (2005). The developmental context of substance use in emerging adulthood. *Journal of Drug Issues*, 35(2), 235-254.
- Backinger, C. L., Fagan, P., O'Connell, M. E., Grana, R., Lawrence, D., Bishop, J. A. & Gibson, J.T. (2008). Use of other tobacco products among US adult cigarette smokers: Prevalence, trends and correlates. *Addictive Behaviors*, 33, 472-489.
- Barbeau, A. M., Burda, J., & Siegel, M. (2013). Perceived efficacy of e-cigarettes versus nicotine replacement therapy among successful e-cigarette users: a qualitative approach. *Addiction Science & Clinical Practice*, 8(1), 5.
- Bazeley, P. (2009). Integrating data analyses in mixed methods research [Editorial]. *Journal of Mixed Methods Research*, 3(3), 203-207.
- Bell, K. & Keane, H. (2014). All gates lead to smoking: The 'gateway theory', e-cigarettes and the remaking of nicotine. *Social Science & Medicine*, 119, 45-52.
- Bullen, C., Howe, C., Laugesen, M., McRobbie, H., Parag, V., Williman, J. & Walker, N. (2013). Electronic cigarettes for smoking cessation: a randomised controlled trial. *The Lancet*, 382, 1629-1637.

- Cahn, Z. & Siegel, M. (2011). Electronic cigarettes as a harm reduction strategy for tobacco control: A step forward or a repeat of past mistakes? *Journal of Public Health Policy*, 32, 16-31.
- Caponnetto, P., Auditore, R., Russo, C., Cappello, G. C., & Polosa, R. (2013a). Impact of an electronic cigarette on smoking reduction and cessation in schizophrenic smokers: A prospective 12-month pilot study. *International Journal of Environmental Research and Public Health*, 10, 446-461.
- Caponnetto, P., Campagna, D., Cibella, F., Morjaria, J. B., Caruso, M., Russo, C. & Polosa, R. (2013b). Efficiency and safety of an eElectronic cigAreTte (ECLAT) as tobacco cigarettes substitute: A prospective 12-month randomized control design study. *PloS One*, 8(6), 1-12.
- Centers for Disease Control and Prevention, Morbidity and Mortality Weekly Report (2011). Vital Signs: Current Cigarette Smoking Among Adults Aged ≥ 18 Years— United States, 2005–2010. 60(35); 1207-1212.
- Centers for Disease Control and Prevention, Morbidity and Mortality Weekly Report (2012). Consumption of Cigarettes and Combustible Tobacco — United States, 2000–2011. 61(30): 565-569.
- Centers for Disease Control and Prevention, Morbidity and Mortality Weekly Report (2014). Tobacco Product Use Among Adults— United States, 2012-2013; 63(25): 1-6.
- Chaloupka, F. J. (2014). Tobacco control policy and electronic cigarettes. *JAMA Pediatrics*, 168(7), 601-602.
- Chen, I. L. & Husten, C. G. (2014). Introduction to tobacco control supplement. *Tobacco Control*, 23, ii1-ii3.
- Cheng, T. (2014). Chemical evaluation of electronic cigarettes. *Tobacco Control*, 23, ii11-ii17.
- Choi, K., Fabian, L., Mottey, N., Corbett, A., & Forster, J. (2012). Young adults favorable perceptions of snus, dissolvable tobacco products, and electronic cigarettes: Findings from a focus group study. *American Journal of Public Health*, 102, 2088-2093.
- Choi, K. & Forster, J. (2013). Characteristics associated with awareness, perceptions, and use of electronic nicotine delivery systems among young US Midwestern adults. *American Journal of Public Health*, 103, 556-561.
- Choi, W. S., Gilpin, E. A., Farkas, A. J., & Pierce, J. P. (2001). Determining the probability of future smoking among adolescents. *Addiction*, 96, 313-323.

- Cialdini, R. B., & Goldstein, N. J. (2004). Social influence: Compliance and conformity. *Annual Review of Psychology*, 55(1), 591-621.
- Cobb, N. K., Byron, M. J., Abrams, D. B., & Shields, P. G. (2010). Novel nicotine delivery systems and public health: The rise of the "e-cigarette". *American Journal of Public Health*, 100, 2340-2342.
- Cobb, N. K. & Abrams, D. B. (2011). E-cigarette or drug-delivery device? Regulating novel nicotine products. *The New England Journal of Medicine*, 365, 193.
- Cobb, N. K., Brookover, J., & Cobb, C. O. (2015). Forensic analysis of online marketing for electronic nicotine delivery systems. *Tobacco Control*, 24, 128-131.
- Coleman, B.N., Apelberg, B.J., Ambrose, B.K., Green, K.M., Choiniere, C., Bunnell, R. & King, B.A. (2015). The association between electronic cigarette use and openness to cigarette smoking among young adults. *Nicotine & Tobacco Research*, 17(2), 212-218.
- Corey, C., Wang, B., Johnson, S. E., & et al. (2013). Notes from the field: Electronic cigarette use among middle and high school students: US, 2011-2012. *Morbidity and Mortality Weekly (MMWR)*, 62, 729-730.
- Creswell & Plano Clark. (2011). *Designing and Conducting Mixed Methods Research* (2nd ed.). Thousand Oaks, CA: Sage Publications, Inc.
- Dawkins, L., Turner, J., Roberts, A., & Soar, K. (2013). 'Vaping' profiles and preferences: An online survey of electronic cigarette users. *Addiction*, 108, 1115-1125.
- Delnevo, C.D., Giovenco, D.P., Ambrose, B.K., Corey, G.C. & Conway, K.P. (2014). Preference for flavoured cigar brands among youth, young adults and adults in the USA. *Tobacco Control*, 0, 1-6.
- Denzin, N. K. & Lincoln, Y.S.. (2005). *The SAGE Handbook for Qualitative Research* (3rd ed.). Thousand Oaks, CA: SAGE Publications, Inc.
- Dutra, L. M. & Glantz, S. A. (2014). Electronic cigarettes and conventional cigarette use among us adolescents: A cross-sectional study. *JAMA Pediatrics*.
- Etter, J. F., Bullen, C., Flouris, A. D., Laugesen, M., & Eissenberg, T. (2011). Electronic nicotine delivery systems: a research agenda. *Tobacco Control*, 20, 243-248.
- Etter, J. F. & Bullen, C. (2014). A longitudinal study of electronic cigarette users. *Addictive Behaviors*, 39, 491-494.
- Etter, J. F. & Bullen, C. (2011). Electronic cigarette: Users profile, utilization, satisfaction and perceived efficacy. *Addiction*, 106, 2017-2028.

- Fairchild, A.L. & Bayer, R. (2015). Smoke and fire over e-cigarettes. *Science*, 347(6220), 375-376.
- Fairchild, A. L., Bayer, R., & Colgrove, J. (2014). The renormalization of smoking? E-cigarettes and the tobacco “endgame.” *New England Journal of Medicine*, 370(4), 293-295.
- Farsalinos, K. E., Romagna, G., Tsiapras, D., Kyrzopoulos, S., & Voudris, V. (2014). Characteristics, perceived side effects and benefits of electronic cigarette use: A worldwide survey of more than 19,000 consumers. *International Journal of Environmental Research and Public Health*, 11(4), 4356–4373.
- Federal Trade Commission (2013). Federal Trade Commission smokeless tobacco report for 2012. Washington, DC: Author. Retrieved from: www.ftc.gov/os/2013/05/130521smokelesstobaccoreport.pdf
- Fielder, R. L., Carey, K. B., & Carey, M. P. (2012). Prevalence, frequency, and initiation of hookah tobacco smoking among first-year female college students: A one-year longitudinal study. *Addictive Behaviors*, 37(2), 221-224.
- Fishbein, M. & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*. Reading MA: Addison-Wesley.
- Flouris, A. D. & Oikonomou, D. N. (2010). Electronic cigarettes: miracle or menace? *British Medical Journal*, 340, 215.
- Foulds, J., Veldheer, S., & Berg, A. (2011). Electronic cigarettes (e-cigs): views of aficionados and clinical/public health perspectives. *International Journal of Clinical Practice*, 65, 1037-1042.
- Giorgi, A. (1997). The theory, practice, and evaluation of the phenomenological method as a qualitative research procedure. *Journal of Phenomenological Psychology*, 28(2), 235.
- Glanz, K., Rimer, B. K., & Viswanath, K. (2008). *Health behavior and health education: Theory, research, and practice*. San Francisco, CA: John Wiley & Sons, Inc.
- Goniewicz, M. L., Kuma, T., Gawron, M., Knysak, J., & Kosmider, L. (2013). Nicotine levels in electronic cigarettes. *Nicotine & Tobacco Research*, 15, 158-166.
- Goniewicz, M. L., Knysak, J., Gawron, M., Kosmider, L., Sobczak, A., Kurek, J., ... Benowitz, N. (2013). Levels of selected carcinogens and toxicants in vapour from electronic cigarettes. *Tobacco Control*, 23, 133-139.
- Goniewicz, M.L., Lingas, E.O. & Hajek, P. (2013) Patterns of electronic cigarette use and users beliefs about their safety and benefits: An Internet survey. *Drug & Alcohol Review*, 32(2), 133-140.

- Grana, R. A. (2013). Electronic cigarettes: A new nicotine gateway? *Journal of Adolescent Health, 52*, 135-136.
- Grana, R. A., Popova, L., & Ling, P. M. (2014). A longitudinal analysis of electronic cigarette use and smoking cessation. *JAMA Internal Medicine, 174*(5), 812-813.
- Grana, R. A. & Ling, P. M. (2014). "Smoking revolution": A content analysis of electronic cigarette retail websites. *American Journal of Preventive Medicine, 46*, 395-403.
- Green, M. P., McCausland, K. L., Xiao, H., Duke, J. C., Vallone, D. M., & Healton, C. G. (2007). A closer look at smoking among young adults: Where tobacco control should focus its attention. *American Journal of Public Health, 97*, 1427.
- Hafez, N. & Ling, P. M. (2005). How Philip Morris built Marlboro into a global brand for young adults: Implications for international tobacco control. *Tobacco Control, 14*, 262-271.
- Henningfield, J. E. & Zaatari, G. S. (2010). Electronic nicotine delivery systems: Emerging science foundation for policy. *Tobacco Control, 19*, 89-90.
- Hitchman, S. C., McNeill, A., & Brose, L. S. (2014). Electronic cigarettes: Time for an accurate and evidence-based debate. *Addiction, 109*, 867-868.
- Ho, D. E., Imai, K., King, G., & Stuart, E. A. (2007). Matching as nonparametric preprocessing for reducing model dependence in parametric causal inference. *Political Analysis, 15*, 199-236.
- Jick, T.D. (1979). Mixing qualitative and quantitative methods: Triangulation in action. *Administrative Science Quarterly, 24*, 602-611.
- Johnston, L.D., O'Malley, P.M., Miech, R.A., Bachman, J.G. & Schulenberg, J.E. (2015). *Monitoring the Future national results on adolescent drug use: Overview of key findings, 2014*. Ann Arbor Mich: Institute for Social Research, University of Michigan.
- Kandel, E.R. & Kandel, D.B. (2014). A molecular basis for nicotine as a gateway drug. *New England Journal of Medicine, 371*(10), 932-943.
- Knodel, J. & Saengtienchair, C. (2005). Older-aged parents: The final safety net for adult sons and daughters with AIDS in Thailand. *Journal of Family Issues, 26*(5), 665-698.
- Kim, A. E., Lee, Y. O., Shafer, P., Nonnemaker, J., & Makarenko, O. (2013). Adult smokers' receptivity to a television advertising for electronic nicotine delivery systems. *Tobacco Control, 1-4*.

- Kim, A. E., Arnold, K. Y., & Makarenko, O. (2014). E-cigarette advertising expenditures in the US, 2011–2012. *American Journal of Preventive Medicine*, 46, 409-412.
- King, A. C., Smith, L. J., McNamara, P. J., Matthews, A. K., & Fridberg, D. J. (2014). Passive exposure to electronic cigarette (e-cigarette) use increases desire for combustible and e-cigarettes in young adult smokers. *Tobacco Control*. Epub ahead of print. doi: 10.1136/tobaccocontrol-2014-051563
- King, B. A., Alam, S., Promoff, G., Arrazola, R., & Dube, S. R. (2013). Awareness and ever-use of electronic cigarettes among U.S. adults, 2010-2011. *Nicotine & Tobacco Research*, 15, 1623-1627.
- King, B.A., Patel, R., Nguyen, K., Dube, S.R. (2014). Trends in awareness and use of electronic cigarettes among U.S. adults, 2010-2013. *Nicotine & Tobacco Research*. Epub ahead of print. doi: 10.1093/ntr/ntu191
- Kong, G., Morean, M.E., Cavallo, D.A., Camenga, Krishnan-Sarin, S. (2014). Reasons for electronic cigarette experimentation and discontinuation among adolescents and young adults. *Nicotine & Tobacco Research*. Epub ahead of print. doi:10.1093/ntr/ntu257
- Latimer, L. A., Batanova, M., & Loukas, A. (2013). Prevalence and harm perceptions of various tobacco products among college students. *Nicotine & Tobacco Research*, 26(5), 519-526.
- Lee, S., Grana, R. A., & Glantz, S. A. (2013). Electronic cigarette use among Korean adolescents: A cross-sectional study of market penetration, dual use, and relationship to quit attempts and former smoking. *Journal of Adolescent Health* 54(6), 684-690.
- Lee, Y. O., Hebert, C. J., Nonnemaker, J. M., & Kim, A. E. (2014). Multiple tobacco product use among adults in the United States: Cigarettes, cigars, electronic cigarettes, hookah, smokeless tobacco, and snus. *Preventive Medicine*, 62, 14-19.
- Li, J., Bullen, C., Newcombe, R., Walker, N., & Walton, D. (2013). The use and acceptability of electronic cigarettes among New Zealand smokers. *Journal of the New Zealand Medical Association*, 126.
- Ling, P. M. & Glantz, S. A. (2002). Why and how the tobacco industry sells cigarettes to young adults: evidence from industry documents. *American Journal of Public Health*, 92, 908-916.
- Maziak, W., Ward, K. D., Afifi Soweid, R. A., & Eissenberg, T. (2005). Standardizing questionnaire items for the assessment of waterpipe tobacco use in epidemiological studies. *Public Health*, 119(5), 400-404.

- Mead, E.L., Rimal, R.N., Ferrence, R.B., & Cohen, J.E. (2014). Understanding the sources of normative influence on behavior: The example of tobacco, *Social Science & Medicine*, 115, 139-143.
- Mizrachi, T., & Rosenthal, B.B. (2001). Complexities of coalition building: Leaders' successes, strategies, struggles, and solutions. *Social Work* 46(1), 63-78.
- McMillen, R., Maduka, J., & Winickoff, J. (2012). Use of emerging tobacco products in the United States. *Journal of Environmental and Public Health*, 2012, 1-8.
- McQueen, A., Tower, S., & Sumner, W. (2011). Interviews with "vapers": Implications for future research with electronic cigarettes. *Nicotine & Tobacco Research*, 13(9), 860-867.
- Mowery, P.D., Farrelly, M.C., Haviland, M.L., Gable, J.M., & Wells, H.E. (2004). Progressions to established smoking among US youths. *American Journal of Public Health*, 94(2), 331-337.
- Pearson, J. L., Richardson, A., Niaura, R. S., Vallone, D. M., & Abrams, D. B. (2012). E-cigarette awareness, use, and harm perceptions in US adults. *American Journal of Public Health*, 102, 1758-1766.
- Pepper, J. K. & Brewer, N. T. (2013). Electronic nicotine delivery system (electronic cigarette) awareness, use, reactions and beliefs: a systematic review. *Tobacco Control*, 23(5), 1-10.
- Pepper, J.K., Ribisl, K.R., Emery, S.L. & Brewer, N.T. (2014). Reasons for starting and stopping electronic cigarette use. *International Journal of Environmental and Public Health*, 11, 10345-10367.
- Pierce, J. P., Choi, W. S., Gilpin, E. A., Farkas, A. J., & Merritt, R. K. (1996). Validation of susceptibility as a predictor of which adolescents take up smoking in the United States. *Health Psychology*, 15, 355.
- Polosa, R., Caponnetto, P., Morjaria, J. B., Papale, G., Campagna, D., & Russo, C. (2011). Effect of an electronic nicotine delivery device (e-Cigarette) on smoking reduction and cessation: a prospective 6-month pilot study. *BMC Public Health*, 11, 786.
- Ramo, D. E., Young-Wolff, K. C., & Prochaska, J. J. (2015). Prevalence and correlates of electronic-cigarette use in young adults: Findings from three studies over five years. *Addictive Behaviors*, 41, 142-147.
- Rath, J. M., Villanti, A. C., Abrams, D. B., & Vallone, D. M. (2012). Patterns of tobacco use and dual use in US young adults: The missing link between youth prevention and adult cessation. *Journal of Environmental & Public Health*, 2012, 1-9.

- Regan, A. K., Promoff, G., Dube, S. R., & Arrazola, R. (2013). Electronic nicotine delivery systems: Adult use and awareness of the "e-cigarette" in the USA. *Tobacco Control*, 22, 19-23.
- Richardson, A., Ganz, O., Stalgaitis, C., Abrams, D., & Vallone, D. (2013). Noncombustible tobacco product advertising: How Companies are selling the new face of tobacco. *Nicotine & Tobacco Research*, 16(5), 606-614.
- Richardson, A., Pearson, J., Xiao, H., Stalgaitis, C. & Vallone, D. (2014). Prevalence, harm perceptions, and reasons for using noncombustible tobacco products among current and former smokers. *American Journal of Public Health*, 104(8), 1437-1444.
- Richtel M. (2014, March 4). E-cigarettes, by Other Names, Lure Young and Worry Experts. *The New York Times*. Retrieved from http://www.nytimes.com/2014/03/05/business/e-cigarettes-under-aliases-elude-the-authorities.html?_r=0. Accessed May 17, 2014.
- Rigotti, N. A., Lee, J. E., & Wechsler, H. (2000). US college students' use of tobacco products: Results of a national survey. *JAMA: The Journal of the American Medical Association*, 284, 699-705.
- Rosenbaum, P. R. & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70, 41-55.
- Sanders-Jackson, A., Tan, A., Bigman, C., Henriksen, L. (2014). Knowledge about e-cigarette constituents and regulation: Results from a national survey of US young adults. *Nicotine & Tobacco Research*. [epub ahead of print]. doi: 10.1093/ntr/ntu276
- Schripp, T., Markewitz, D., Uhde, E., & Salthammer, T. (2013). Does e-cigarette consumption cause passive vaping? *Indoor Air*, 23, 25-31.
- Schwarz, N. & Bless, H. (1992). Assimilation and contrast effects in attitude measurement: An inclusion/ exclusion model. *Advances in Consumer Research*, 19, 72-77.
- Schwarz, N. & Oyserman, D. (2001). Asking questions about behavior: Cognition, communication, and questionnaire construction. *American Journal of Evaluation* 22(2), 127-160.
- Siegel, M. B., Tanwar, K. L., & Wood, K. S. (2011). Electronic cigarettes as a smoking-cessation tool: Results from an online survey. *American Journal of Preventive Medicine*, 40, 472-475.
- Sutfin, E. L., McCoy, T. P., Morrell, H. E., Hoepfner, B. B., & Wolfson, M. (2013). Electronic cigarette use by college students. *Drug and Alcohol Dependence*, 131, 214-221.

- Trumbo, C. W. & Harper, R. (2013). Use and perception of electronic cigarettes among college students. *Journal of American College Health*, 61, 149-155.
- U.S. Department of Health and Human Services. (2010). *How Tobacco Smoke Causes Disease: The Biology and Behavioral Basis for Smoking-Attributable Disease: A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.
- U.S. Department of Health and Human Services. (2012). *Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.
- U.S. Department of Health and Human Services. (2014). *The Health Consequences of Smoking- 50 Years of Progress: A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.
- Vickerman K.A., Carpenter K.M., Altman T., Nash C.M. Zbikowski S.M. (2013). Use of electronic cigarettes among state tobacco cessation quitline callers. *Nicotine & Tobacco Research*, 15, 1787-1791
- Vansickel, A. R. & Eissenberg, T. (2013). Electronic cigarettes: Effective nicotine delivery after acute administration. *Nicotine & Tobacco Research*, 15, 267-270.
- Vickerman, K. A., Carpenter, K. M., Altman, T., Nash, C. M., & Zbikowski, S. M. (2013). Use of electronic cigarettes among state tobacco cessation quitline callers. *Nicotine & Tobacco Research*, 15, 1787-1791.
- Vries, H. D., Backbier, E., Kok, G., & Dijkstra, M. (1995). The impact of social influences in the context of attitude, self-efficacy, intention, and previous behavior as predictors of smoking onset. *Journal of Applied Social Psychology*, 25, 237-257.
- Wagener, T. L., Siegel, M., & Borrelli, B. (2012). Electronic cigarettes: Achieving a balanced perspective. *Addiction*, 107, 1545-1548.
- Wakefield, M., Kloska, D. D., O'Malley, P. M., Johnston, L. D., Chaloupka, F., Pierce, J. et al. (2004). The role of smoking intentions in predicting future smoking among youth: Findings from monitoring the future data. *Addiction*, 99, 914-922.
- Wang, B., King, B.A., Corey, C.G., Arrazola, R.A. & Johnson, S.E. (2014). Awareness and use of non-conventional tobacco products among U.S. students, 2012. *American Journal of Preventive Medicine*, 47(2S1), S36- S52.

- Wanke, M., Bless, H., & Schwarz, N. (1999). Assimilation and contrast in brand and product evaluation: Implications for marketing. *Advances in Consumer Research*, 26, 95-98.
- Weine, S., Knafl, K., Feetham, S., Kulauzovic, Y., Klebic, A., Scolve, S., ... Spahovic, D. (2005). A mixed methods study of refugee families engaging in multiple-family groups. *Family Relations*, 54, 558-568.
- Wills, T.A., Knight, R., Williams, R.J., Pagano, I. & Sargent, J.D. (2014). Risk factors for exclusive e-cigarette use and dual e-cigarette use and tobacco use in adolescents. *Pediatrics*, 135(1), e41-e51.
- World Health Organization Study Group on Tobacco Regulation. (2009). Tobreg scientific recommendation: Devices designed for the purpose of nicotine delivery to the respiratory system in which tobacco is not necessary for their operation. In: *Report on the Scientific Basis of Tobacco Product Regulation: Third Report of a WHO Study Group*. Geneva: World Health Organization.
- Yamin, C. K., Bitton, A., & Bates, D. W. (2010). E-cigarettes: A rapidly growing Internet phenomenon. *Annals of Internal Medicine*, 153, 607-609.
- Zhu, S-H., Gamst, A., Lee, M., Cummins, S., Yin, L., & Zoref, L. (2013). The use and perception of electronic cigarettes and snus among the US population. *PloS One*, 8(10), 1-12.
- Zhu, S-H., Sun, J.Y., Bonnevie, E., Cummins, S.E., Gamst, A., Yin, L. & Lee, M. (2014). Four hundred and sixty brands of e-cigarettes and counting: Implications for product regulation. *Tobacco Control*, 23, iii3-iii9.