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## ABSTRACT

### FACTORS ASSOCIATED WITH E-CIGARETTE USE: ANALYSIS OF THE POPULATION ASSESSMENT OF TOBACCO AND HEALTH (PATH) STUDY

By

NANNAN ZHANG

August 15, 2017

**INTRODUCTION:** Smoking is the leading cause of preventable death in the United States and has been shown to be harmful to human health. Among alternative tobacco products, e-cigarettes have been widely regarded as the safest substitute to the traditional cigarette. However, debate remains about their safety and possible ill effects.

**AIM:** The purpose of this study was to assess characteristics associated with e-cigarette use (everyday/some days/no use) and examine factors related to former smokers replacing a traditional smoking habit with e-cigarette use (yes/no).

**METHODS:** A secondary data analysis was conducted with the Public Use Files (PUFs) for the Population Assessment of Tobacco and Health (PATH) Study, a nationally representative, longitudinal cohort study of tobacco use. Bivariate and multivariable unweighted and weighted generalized linear models were developed for value and comparative purposes, as well as multilevel models to account for within geographical region clustering. Ordinal logistic regression was used to analyze the ordinal e-cigarette use outcome, and logistic regression with the e-cigarette smoking status of former smokers outcome.

**RESULTS:** Covariates associated with e-cigarette use included having rules that allowed smoking non-combustible tobacco inside the home (everyday vs no use: OR = 0.33, CI = 0.27-0.41; somedays vs no use: OR = 0.58, CI = 0.53-0.64), older than 35 years old (everyday vs no use: OR = 0.63, CI = 0.52-0.75; somedays vs no use: OR = 0.86, CI = 0.76-0.96), and positive or neutral self-opinion on tobacco (everyday vs no use: OR = 0.88, CI = 0.73-1.05; somedays vs no use: OR = 1.38, CI = 1.22-1.55). Factors related to e-cigarette use in former smokers included rules allowing non-combustible tobacco products inside the home (Weighted: OR = 0.19, CI = 0.15-0.24; Unweighted: OR = 0.15, CI = 0.12-0.19; Mixed: OR = 0.19, CI = 0.15-0.24), aged 18-35 years (Weighted: OR = 1.45, CI = 1.16-1.80; Unweighted: OR = 2.91, CI = 2.27-3.72; Mixed: OR = 1.45, CI = 1.16-1.80), and not having any health insurance (Weighted: OR = 0.57, CI = 0.44-0.75; Unweighted: OR = 0.47, CI = 0.34-0.64; Mixed: OR = 0.57, CI = 0.44-0.75).

**DISCUSSION:** Family tolerance of smoking and one's self-opinion on tobacco were factors found to be strongly associated with e-cigarette use. The prevalence of e-cigarette use among young adults raises concerns and necessitates a multi-disciplinary approach to monitor and intervene. Further study is needed to better understand e-cigarette smoking consumption behavior and effects.

FACTORS ASSOCIATED WITH E-CIGARETTE USE: ANALYSIS OF THE POPULATION ASSESSMENT OF  
TOBACCO AND HEALTH (PATH) STUDY

by

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APPROVAL PAGE

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### Author's Statement Page

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Nannan Zhang  
Signature of Author

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## Introduction

Smoking is the leading cause of preventable death (CDC, n.d.) in the United States and has been shown, along with secondhand smoke, to be harmful to human health. After decades of sustained efforts to curb smoking, including institutional bans on public smoking and increased costs, smoking in the United States is increasingly restricted in public places (Martell, Garrett, & Caraballo, 2016). Rates of smoking have declined, from 20.9% of adults in the general population smoking in 2005, down to about 15.1% in 2015 (CDC, n.d.). Many active smokers have knowledge of its adverse effects, yet continue to engage in this behavior. These active smokers are more likely to be identified as male, older than 25 years old, lower educational level, and below poverty level, based on data from the Morbidity and Mortality Weekly Report 2016 of Centers for Disease Control and Prevention. The decades of public health research into the ill effects of tobacco have resulted in targeted interventions aimed at smoking cessation (Velicer et al., 1993). However, as a result of increased awareness about the ill effects of smoking, accompanied with a drop in smoking rates, substitutes for cigarettes have appeared. Alternative tobacco products that have grown in popularity include e-cigarettes, hookah, cigar, pipe, and smokeless tobacco (Bashirian, Barati, Mohammadi, & Mostafaei, 2016). Former cigarette smokers have alternatives, and some replace old smoking habits with newer substitute products.

Among alternative tobacco products, e-cigarettes have been widely regarded as the safest substitute of traditional cigarette with a most harmless health effect (Maron, 2014). E-cigarettes, devices that typically deliver nicotine, flavorings, and other additives to users through an inhaled aerosol, are also referred to by a variety of names, including "e-cigs", "e-hookahs", "mods", "vape pens", "vapes", and "tank systems" (CDC, 2017). Unlike cigarettes (TV commercial advertisements on cigarettes have been banned since 1970s), advertisements on e-cigarette devices are widely broadcast (Maron, 2014). To date, there are no regulations put out by the U.S. Food and Drug Administration (FDA) on e-cigarettes. As a result, e-cigarette use has spread rapidly, and is especially popular among young adults. Based on a previous study, nearly

60% the general public are familiar with an e-cigarette device and can describe how the device looks like (Maron, 2014).

The effects of e-cigarettes and other alternative tobacco products on human health have not undergone rigorous scientific scrutiny (Poznański, Pietras, & Antczak, 2017). Proponents of e-cigarettes argue a similar smoking experience is possible, without the harmful effects of traditional cigarettes (Benowitz & Fraiman, 2017; Anthérieu et al., 2017). On the other side of the argument is concern about the intake of nicotine, exposure to adolescents, and uncertainty of health effects from e-cigarette use. The question of whether e-cigarettes are safe is still open to debate. There seems to be a consensus that e-cigarettes can lead to addiction (Polosa, Caponnetto, Niaura, & Abrams, 2017). E-cigarettes can also be used to deliver other drugs besides nicotine, such as marijuana (CDC, 2017). It may not be surprising to discover an association between e-cigarette use and substance abuse.

It is of interest to understand e-cigarette use and smoking behavior. It is desirable to evaluate factors associated with e-cigarette use. Although some studies have been done, few have made use of a nationally representative sample of the United States population (Okagua, Opara, & Alex-Hart, 2016; Liao et al., 2016). Based on a literature review of e-cigarette use, studies of smoking behavior appear to have been focused on young adolescents.

The purpose of this work is to study e-cigarette use in an adult population and assess factors associated with smoking behavior. Two aspects will be studied, including frequency of e-cigarette use, and adults who switched from traditional tobacco products to e-cigarette consumption. Statistical modeling techniques will be compared and contrasted for quantifying associations between e-cigarette smoking and demographics, social characteristics, and psychological factors.

## **Literature Review**

### **Debate on Harms and Benefits**

There is considerable debate within the public health community about the health risks e-cigarette use as a substitute for traditional tobacco products. Unger et al (2016) collected data on tweets (messages sent using Twitter) about exposure to secondhand e-cigarette aerosol over a 6-week period in 2015 and found 531 (35%) pro-e-cigarette tweets, 392 (26%) anti-e-cigarette tweets, and 596 (39%) neutral tweets from the 1519 total tweets. They also found that social-focused tweets were predominantly pro-e-cigarette, whereas health-focused tweets were predominantly anti-e-cigarette.

A systematic review on e-cigarette use and health effects was recently published (Poznański et al., 2017). They performed a systematic review to address the clinical question “Can we recommend electronic cigarettes to our patients?”. Their work suggested that e-cigarette use is not as beneficial and safe as portrayed by the media. Concerns were expressed about toxicity effects on health from chemical compounds and elements delivered with the vapor. In addition, the authors reviewed published works on possible adverse effects, as well as infrequent fatalities.

**Harm.** Several publications reported negative views of e-cigarette use. With the exception of the Poznański et al (2017) study previously mentioned, other systematic reviews illuminated different aspects of the toxicity of e-cigarettes. Bourke et al (2017) examined the relationship between e-cigarettes and urologic health and found potential harm of toxicity on the urologic system. Shields et al (2017) conducted a review on pulmonary toxicity of electronic cigarettes focusing on inflammation and reported on pulmonary inflammation related to smoking as well as e-cigarette use. They emphasized that product and e-liquid design features of e-cig devices such as nicotine content and delivery, voltage, e-liquid formulations, and flavors can all impact pulmonary toxicity, and recommended these products be regulated by the FDA. To screen the different toxicant profiles from different flavored e-liquid, a cell level toxicity test was conducted by Rowell et al (2017) with nicotine and propylene glycol/vegetable glycerin (PG/VG) serving as controls. Thirteen flavored e-liquids were tested on a lung epithelial cell line (CALU3). Among all flavors, a group of four flavors consistently showed greater toxicity compared to the control group, suggesting that the harmful effects may vary among flavors. Individual chemical

constituents for all 13 flavors using gas chromatography-mass spectrometry were also examined, showing that all the flavors exhibited some degree of toxicity and a diverse array of chemical constituents. Another study mentioned the potential toxic impact of e-cigarette vaping on the cerebrovascular system and stroke injury (Kaisar et al., 2017). *In vivo* experimental design was used in this study using male mice. Although the main purpose was to find evidence for Metformin (MF) treatment for reducing stress and inhibits inflammatory responses, the researchers also showed that nicotine (the principal e-liquid's ingredient used in e-cigarettes) can play a major role in e-cig toxicity since it can increase the cellular oxidative stress.

**Benefit.** Although there is research to suggest harmful effects of e-cigarettes, there is also a body of scientists that advocate for e-cigarettes to replace traditional tobacco products. The risk of e-cigarettes is thought to be less than that of cigarette smoking based on both qualitative and quantitative comparisons of e-cigarette aerosol versus cigarette smoke constituents (Benowitz & Fraiman, 2017). Anthérieu et al (2017) adopted *in vitro* toxicological experiments to compare cellular and transcriptomic effects between e-cigarette vapor and cigarette smoke (CS) in human bronchial epithelial cells. The results strongly suggested a lower toxicity of e-cigarette vapors compared to CS in the BEAS-2B cell line, which supported e-cigarette use as a preferred tobacco product.

### **E-cigarette Smoking Prevalence**

In the United States, the prevalence of current use among adults (18 years old or older) was 3.3% in 2013-2014 (Bourke et al., 2017). Coleman et al (2017) reported results based on the Population Assessment of Tobacco and Health (PATH) Study, 2013–2014 that 5.5% of adult are current e-cigarette users. Compared to cigarette smoking prevalence, which was still high at 26.4% in the 2014 Eurobarometer survey, the percentage of regular e-cigarette use was at about 2% (Polosa et al., 2017).

The recent US Surgeon General's report gave a warning that in 2014, current use of e-cigarette by young adults aged 18-24 years old surpassed that of adults aged over 25 years old.

Krishnan-Sarin et al (2017) carried out a survey on e-cigarette use among high-school youth from 8 Connecticut high schools in the spring of 2015 (n = 7045). 1080 (15.3%) of those students were reported as ever e-cigarette users. The limited sample size in that study may explain the potential bias of observed e-cigarette prevalence being reported at higher levels as compared to national data. A similar cross-sectional study with a larger sample size was conducted to find out prevalence of electronic cigarette use among Canadian students (Montreuil et al., 2017). In total, 42 094 students participated in the survey. Results showed 17.7% of students in grades 6-12 reported ever using e-cigarettes, and 5.7% reported past 30-day use. In light of the frequent use of e-cigarettes among high-school students, the authors reported concern with exposure to middle-school students. According to a recent study, approximately 6547 (4.3%) of participants selected from 15 middle schools in 3 counties in West Virginia of the United States had used e-cigarettes (Kristjansson, Mann, & Smith, 2017).

The substantial gap in prevalence of e-cigarette use between youth or young adults and adults over 25 years old has been reported. Some explanations have included campus cigarette bans, commercial media influence, and interests in flavors. Harrell et al (2017) surveyed youth about flavor preferences and found youth groups reported flavors as an attractive motivating force in trying e-cigarettes. The majority of e-cigarette users reported that at first use, e-cigarette flavors tasted like something other than tobacco. Participants reported their first e-cigarette was flavored 98%, 95%, and 71.2% of the time for Texas school-going youth, Texas young adult college students, and young adults, respectively as compared to 44.1% of older adults (>25 years old) nationwide.

### **Factors Related to E-cigarette Use/Initiation**

Ashford et al (2017) conducted a cross-sectional study to explore the relationship between exposure to e-cigarette advertising and e-cigarette use among female current or former tobacco users. The results showed that younger age, white non-Hispanic race, and greater exposure to e-cigarette advertising were associated with a higher likelihood of ever using e-cigarettes. One interesting finding in this article is that younger age was associated with use of flavored e-cigarettes, which is consistent with the findings of Harrell et al (2017). Since flavors

have been found to be related to first e-cigarette use at younger ages, restricting the range of e-cigarette flavors (e.g., eliminating sweet flavors, like fruit and candy) may serve as preventive measures with youth and young adults. The study sample was limited to female current or former tobacco users.

Like Ashford et al (2017), Hébert et al (2017) also studied exposure and engagement with e-cigarette-related social media. Unlike Ashford's study, the study population was focused on sixth, eighth, and 10<sup>th</sup> graders (n = 3907). The authors used weighted logistic regression models and found about 50% of adolescents in Texas are exposed to tobacco-related social media. A significant association between exposure and engagement with tobacco-related social media and susceptibility of adolescents to e-cigarettes has been reported (Hébert et al., 2017).

In addition to social media, attitudes about e-cigarettes is a very important determinant of e-cigarette use (Waters, Mueller-Luckey, Levault, & Jenkins, 2017). To better understand the perceived harms and social norms in the use of electronic cigarettes, Waters et al (2017) conducted a cross-sectional survey of 309 individuals from central Illinois. Participants were asked about their perceptions of e-cigarettes, including preferences about being for or against them. They found that e-cigarette perceptions of harm were consistent across all demographic characteristics. However, e-cigarette social norms were less favorable among non-whites. Hammig, Daniel-Dobbs, and Blunt-Vinti (2017) reported on minority students in US-based middle schools and high schools with the 2014 National Youth Tobacco Survey (NYTS) (weighted N = 27,294,454). They found that e-cigarette initiation was associated with perceptions of harm and addiction potential, as well as exposure to e-cigarette advertising, among minority youth.

Lanza, Pittman, and Batshoun (2017), explored the relationship between obesity and e-cigarette use. Survey data were collected from a convenience sample of 452 (59% female) undergraduates attending a large, public university during the 2015-2016 academic year. The results showed that obesity or greater deviation from one's group body mass index (BMI) norm were associated with a higher likelihood of using e-cigarettes. However, generalizability was a challenge with the use of a convenience sample.

The relationship between sensation seeking and a spectrum of e-cigarette use behaviors was studied by Case et al (2017). This study utilized two waves of data collected 6 months apart through the Texas Adolescent Tobacco and Marketing Surveillance System (TATAMS) in 2014-2015 (n = 2,488). Result of this study showed that higher sensation seeking scores were consistently and significantly associated with experimentation with e-cigarette use among Texas sixth, eighth, and 10<sup>th</sup> adolescents.

Coleman et al (2017) utilized the Population Assessment of Tobacco and Health (PATH) Study, 2013–2014, to assess patterns of current e-cigarette use among daily and non-daily adult users, to find out factors that contribute to daily usage. They found a link between cigarette cessation in the past year and daily e-cigarette use, compared with current smokers. Moreover, those who reported using rechargeable or refillable devices were more likely to report daily use compared with those who did not use these devices.

### **Smoking Abstinence/Cessation & E-cigarette Vaping**

Literature was found about e-cigarettes use as a tool/aid of cigarette smoking abstinence. Polosa et al (2017) supported the preventive effect of e-cigarettes as a substitute smoking product. They conducted a cross-sectional study of a representative sample of 27,801 respondents from 28 EU member states. As one would expect, daily e-cigarette use is highly prevalent among current and former smokers, but rare in never smokers. Data in this study showed that current and former smokers are at least 50 times more likely to use e-cigarette daily compared to never smokers, which would indicate that daily e-cig users are usually dual users of both traditional cigarettes and e-cigarettes, with or without a smoking cessation attempt. They also suggested that e-cigarette devices themselves are very unlikely to generate nicotine addiction, and instead could be regarded as a tool to support successful smoking cessation.

There was also literature to argue that electronic cigarette use has nothing to do with smoking abstinence. Zawertailo et al (2017) found that although some youth use e-cigarettes for cessation purposes, e-cigarette use was not associated with smoking reduction with

baseline smokers. In this study, 6526 participants were recruited through 187 primary care clinics across Ontario, Canada, to examine the association between concurrent e-cigarette use and smoking abstinence at 3- and 6-month follow-ups. 78.2% of e-cigarette users reported using an e-cigarette for smoking cessation. A negative association was found between e-cigarette use and successful abstinence at both 3- and 6-month follow-up, after adjusting for covariates such as severity of tobacco dependence, gender, and age. These findings suggest that concurrent use of e-cigarettes may have a harmful effect on quitting attempts.

A Japanese cross-sectional study was conducted to assess the relationship between smoking cessation and quitting methods used, including e-cigarettes, smoking cessation therapy, and unassisted (Hirano, Tabuchi, Nakahara, Kunugita, & Mochizuki-Kobayashi, 2017). 798 eligible participants were recruited into the study aged 20-69 years who smoked within the previous five years. They also found a negative association between e-cigarette and smoking cessation (OR = 0.632; 95% CI = 0.414–0.964) after adjusting for gender, age, health-related factors, and other quitting methods.

Gorini et al (2017) conducted another similar research study in Italy on 6112 adults who smoked and had quitting attempts at least once in the past year. Participants were divided into three groups based on most recent quitting method: e-cigarette only, no aid, other quitting methods (medications; programs delivered in smoking cessation services; other unspecified methods). Smoking abstinence was reported among 9% of those using no aid; 8% of e-cigarette users; 15% of those using other methods. No significant differences in abstinence were observed for e-cigarette users compared with those reporting no aid (adjusted Prevalence Ratio [aPR] = 0.81; 95%Confidence Interval (CI) = 0.58-1.14). Changing the reference group to e-cigarette users, those using other quitting methods were significantly more likely to report abstinence than e-cigarette users (aPR = 1.76; 95%CI = 1.07–2.88). The conclusion of this study based on a representative Italian population was that e-cigarettes use is equally helpful on smoking abstinence as no aid, and is less useful in the smoking cessation process as compared to other established quitting methods.



Wang, Li, Wu, Lam, and Chan (2017) conducted a longitudinal study on Hong Kong residents to investigate the association between electronic cigarette use and smoking cessation behavior among current youth smokers who called the Youth Quitline (n = 189). An association was not found between e-cigarette use and self-reported past 7-day point prevalence of abstinence (PPA) at the 6-month follow-up (odds ratio[OR]: 0.56, 95% Confidence Interval [CI]: 0.24 to 1.35). However, an association was found with more cessation attempts (unstandardized beta= 1.26, 95% CI: -0.13 to 2.66). The authors reported they did not find an association between successful smoking abstinence among Youth Quitline smokers.

### **E-cigarette Use & Smoking Initiation**

There are several schools of thought about e-cigarettes. Some believe e-cigarette use could lead to higher likelihood of successful smoking cessation among current cigarette smokers. However, another group supports e-cigarette devices as a replacement product for traditional tobacco-based cigarettes. Adolescents and young adults who have never smoked traditional cigarettes are now connecting to e-cigarettes, and these individuals may be at risk for subsequent progression to traditional cigarette smoking (Leventhal et al., 2016; Primack et al., 2015; Soneji et al., 2017). Since this issue has received much attention in the public health field, studies have been conducted to illustrate the relationship between e-cigarette contact and future smoking initiation.

Leventhal et al (2016) recruited students from 10 public high schools in Los Angeles County, California into a longitudinal study approved by the University of Southern California institutional review board and detailed elsewhere. Their study proved the association between baseline vaping and follow-up frequency or heaviness of smoking. E-cigarette vaping was reported by 37% of US 10<sup>th</sup> grade adolescents, and was associated with subsequent initiation of combustible cigarette smoking.

Primack, Soneji, Stoolmiller, Fine, and Sargent (2015) designed and conducted a longitudinal cohort study with a national US sample of 694 participants aged 16 to 26 years who were never cigarette smokers and were attitudinally nonsusceptible to smoking cigarettes, to

determine whether baseline use of e-cigarettes among nonsmoking and nonsusceptible youths and young adults was associated with subsequent progression along an established trajectory to traditional cigarette smoking. The results based on this national sample of US adolescents and young adults showed that use of e-cigarettes at baseline was associated with subsequent progression to traditional cigarette smoking.

In addition to the longitudinal studies described, a systematic review and meta-analysis of longitudinal studies that assessed initial use of e-cigarettes and subsequent cigarette smoking was also published (Soneji et al., 2017). Strong and consistent evidence of an association was reported between initial e-cigarette use and subsequent cigarette smoking initiation, as well as between past 30-day e-cigarette use and subsequent past 30-day cigarette smoking.

## **Methods**

### **Data Source**

A secondary data analysis was conducted using the Public Use Files (PUFs) for the Population Assessment of Tobacco and Health (PATH) Study. The PATH study is a nationally representative, longitudinal cohort study of tobacco use and how it affects the health of people in the United States. It covered the 50 states and Washington D.C. and sampled over 150,000 mailing addresses, using a four-staged stratified sampling design, yielded a sample of 45971 respondents (32,320 adults included) who completed a Wave 1 interview from 2013 to 2014. The Wave 1 target population in the PATH study is the civilian household population 12 years of age or older. We will limit the population studied here to only include adults (18 years old or older). Youth who turned 18 years old by the next wave of data collection were considered "aged-up adults" and invited to complete the Adult Interview (United States Department of Health and Human Services. National Institutes of Health. National Institute on Drug Abuse, 2016).

The PATH study used a four-stage stratified area probability sample design. At the first stage, a stratified sample of geographical primary sampling units (PSUs) was selected, in which a PSU is a county or group of counties. For the second stage, within each selected PSU, smaller

geographical segments were formed and then a sample of these segments was drawn. At the third stage, the sampling frame consisted of the residential addresses located in these segments. The fourth stage selected adults and youth from the sampled households identified at these addresses, with varying sampling rates for adults by age, race, and tobacco use status. Adults were sampled in two phases - Phase 1 sampling used information provided in the household screener and Phase 2 sampling used information provided by the adult in the Phase 2 screener at the beginning of the adult instrument. The complex probability sampling was performed to yield a nationally representative sample.

### **Dependent Variables**

Dependent variables in the PATH Study included tobacco products, smoking status, and smoking frequency. Different tobacco-related products were covered, each listed as a separate part, including cigarettes, e-cigarettes/electronic nicotine products, cigars (traditional, cigarillos, filtered), pipes, hookah, smokeless tobacco (snus pouches and other forms of smokeless tobacco), and dissolvable tobacco. Bidis and kreteks were additional types asked about on the Youth Interview, but were not asked on the Adult Interview. Although each section of tobacco products had unique questions, the majority of the questions fit into one of the following categories: ever use, recency of use, frequency of use, amount of use, brands used, and purchase details. Most questions asked in the questionnaires were categorical. Other questions included age at which something occurred or the person's body measurements. The responses to these were typically numerical. Progressive questions were designed in the questionnaire, with skip patterns and some sequences. Our interest here is focusing on e-cigarettes consumption. The first question for “e-cigarettes” in the tobacco product section was “Have you ever used e-cigarettes?”. If the answer was yes, the participant progressed to the second question, which was “Are you using e-cigarettes every day, somedays, or not at all?”. If the answer was every day, then the participant progressed to the third question, which was about frequency of use (past hour, today, yesterday, day before yesterday, or 3 or more days ago). If the answer was among the first four categories, the participant was asked the last question in the sequence: “How many e-cigarettes do you use every day?”.

Based on the layout of dependent questions in the PATH data, and in order to explore the possible rules of electronic cigarette smoking behavior from the demographic characteristics and social and psychological perspective, two categorical dependent variables were generated in this project:

- The first dependent variable is the frequency of e-cigarette smoking behavior with three levels - 'every day', 'somedays', and 'not at all' among those who have ever used an electronic cigarette, even if only once.
- The second dependent variable is a dichotomous variable defined on former cigarette smokers, as persons who became e-cigarette users, and persons who did not become e-cigarette users. By exploring the difference between those who became current e-cigarette users and those who did not among the population who are former regular cigarette smoker but not smoke cigarette anymore, we aim to determine factors related with people's decision to convert from e-cigarette smoking from traditional products.

### **Independent Variables (Covariates)**

Covariates were selected based on both literature and items of interest. According to a report of the Centers for Disease Control and Prevention (CDC) , factors related to e-cigarette using behavior can be categorized into five major parts: sociodemographic factors (socioeconomic status [SES], gender, and race/ethnicity); environmental factors (acceptability and availability of tobacco products, interpersonal variables, perceived environmental variables); behavioral factors (academic achievement, problem behaviors, influence of peer groups, participation in activities, and behavioral skills); personal factors (knowledge of the long-term health consequences of using tobacco, functional meanings of tobacco use, subjective expected utility of tobacco use); and current behavior relative to tobacco use (intentions to smoke and smoking status).

A total of 28 covariates were selected from the PATH dataset for each of the two dependent variables. SAS 9.4 was used for all statistical analyses. Two steps were used to

determine covariates associated with our outcomes. The first step was to find covariates that were associated with each dependent variable, and include each in a bivariate logistic regression model. Frequency tables were created displaying crosstabs between covariates and each dependent variable. Based on the counts/percentages of frequency tables and significance test results as reference, covariates were selected based on adequate sample sizes to test for an association with the outcome. A total of 22 covariates were selected to analyze for the 1<sup>st</sup> dependent variable and 28 covariates for the 2<sup>nd</sup> dependent variable. Some of the discrete variable categories were collapsed to ensure adequate counts and reasonable balance. The second step in the analysis was to select covariates to include in a multivariable model (one for each dependent variable). Based on the contingency table of each dependent table and its covariates, maximum differences of weighted percentage for each covariate were calculated. A clinically meaningful effect size was defined as a 10% difference in outcome categories.

For frequency of e-cigarette use as the dependent variable, covariates taken into consideration included:

- age at first time smoking, sex, Hispanic/non-Hispanic race, white/other race, age at interview, highest education, household Income past year, poverty level, health insurance, emergency room visit past year, current employment status, smoker(s) around you at work, live with smoker during childhood, rules of combustible tobacco inside home, rules of non-combustible tobacco inside home, loved ones' opinion on tobacco, self-perspective quality of life, self-opinion on tobacco, if used alcohol/drugs regularly during past year, region.

For the convert to e-cigs dependent variable, covariates were consisted of:

- age at first time smoking, sex, Hispanic/non-Hispanic race, white/other race, age at interview, highest education, household Income past year, poverty level, health insurance, self-perceptive of physical health, self-perceptive of mental health, self-perceptive of overall health, emergency room visit past year, current employment status, if working indoors, if working outdoors, if working in a vehicle, smoker(s)

around you at work, live with smoker during childhood, rules of combustible tobacco inside home, rules of non-combustible tobacco inside home, loved ones' opinion on tobacco, self-perspective quality of life, self-opinion on tobacco, if believe nicotine the main substance for tobacco addiction, if used alcohol/drugs regularly during past year, region.

Data analysis was conducted with two analytic processes, one for each dependent variable. As a result, the covariates for each dependent variable differed. Both single-variable and multi-variable logistic regression models as well as Generalized Linear Mixed Models (GLMMs) were developed to assess the relationships between the two dependent variables and the selected covariates.

### **Statistical Methodology**

Each dependent variable was modeled with a statistical framework that enabled a comparison of statistical methods. The types of models fit included: unweighted logistic regression, weighted logistic regression, and unweighted logistic regression with a random effect for region. Analyses included use of unweighted and weighted statistical measures, enabling an opportunity to compare the impact of sample weights on the results. Additional advanced statistical models (Multilevel Models) were considered for clustering of responses by region of the country, as smoking habits differed by geography.

**Descriptive Statistics.** Tables with summary statistics were created that included unweighted counts, unweighted percents, and weighted percents. Missing values were quantified for each covariate.

**Logistic Regression Modeling.** Logistic Regression Model, a member of the Generalized Linear Model (GzLM) family, is useful when the dependent variable is categorical. Unlike the General Linear Model (GLM), it does not assume normality on the outcome. An assumption in the GzLM is a linear relationship between the independent variable(s) and the log odds (a function of the dependent variable). Binary distributions are especially common in use of logistic models with a dependent variable that has only two levels. For a dependent variable

with more than two levels, ordinal or multinomial logistic regression can be used, with a cumulative logit link function (clogit) or general logit link function (glogit) function, respectively.

The first dependent variable about e-cigarette smoking status consisted of three levels – “every day”, “somedays”, “not at all”. For each regression model, an ordinal logistic regression model was first fit. Since this measure is ordinal in nature, this is the appropriate statistical modeling framework to use. However, an assumption in reporting of the ordinal logistic regression model is that of proportional odds. The score test was used to test for this assumption. If the proportional odds assumption was not fulfilled, the more general multinomial logistic regression modeling framework was used.

**Sampling Weights.** The PATH data was collected with the implementation of a complex probability sample in order to obtain a nationally representative sample (Andale, n.d.). There were variables provided in the PATH data file that allowed me to account for the sampling weights in my analysis. The weighting procedures applied in SAS adjusted for oversampling of certain population groups and non-responses via the sampling weights. Comparisons were made with weighted and unweighted results.

**Multilevel Modeling.** The multilevel model (MLM) here was developed as an extension of logistic regression to include a random effect for region. Participants in some regions may share similar characteristics to others in the same region, including exposure to media about smoking, etc. Such correlation would result in a violation of the independence assumption necessary in a traditional logistic regression modeling framework.

Assumptions of the MLM are similar to the classic regression framework (e.g. linearity, normality, and homoscedasticity), with the exception of the independence assumption. In the PATH study, four regions– Northeast, Midwest, South, and West- were included in the sampling process. It is reasonable to suspect that observations are nested within geographical region. To account for this within region correlation, region was treated as a random effect in the MLM model. A challenge faced was the decrease in frequencies within table cells. This resulted in estimation problems for the multi-category dependent variable since a necessary assumption is

to have expected cell counts of adequate size. Thus, MLMs were unestimable in some cases for the first dependent variable. As a result, for the 1<sup>st</sup> dependent variable we only compare results from four models (unweighted unadjusted logistic model, weighted unadjusted logistic model, unweighted adjusted logistic model, and weighted adjusted logistic model), whereas we have six models to consider for the 2<sup>nd</sup> dependent variable (unweighted unadjusted logistic model, weighted unadjusted logistic model, unadjusted logistic with a random effect for region, unweighted adjusted logistic model, and weighted adjusted logistic model, and adjusted logistic with a random effect for region).

## Results

This study looked at two dimensions of e-cigarette use outcome: frequency of e-cigarettes consumption (three level included: every day, somedays, and no use) and decision-made behavior to convert from traditional cigarette to e-cigarette use (yes or no).

### Frequency of E-cigarettes Consumption

Among the 32320 total participants in the PATH study, 11515 (35.7%) reported ever used e-cigarettes. Among those ever-users, 734 (6.4%) are every day users, 2908 (25.3%) are somedays users, and 7873 (68.4%) are people who no longer use e-cigarettes. With the 10% cutoff as our effect size of interest, 3 of the total 22 (13.6%) covariates for the first dependent variable were retained in the analysis for the multivariable model: Rules of non-combustible tobacco inside home (not allowed vs allowed), Age at interview (18-34 vs 35+), and Self-opinion on tobacco (positive/neutral vs negative). The unweighted unadjusted multinomial logistic model and weighted unadjusted multinomial logistic model each showed a strong and statistically significant association between the depth of e-cigarette smoking and each of these four covariates. However, when including all four in a multivariable model, race was no longer statistically significant.

**Unweighted Unadjusted Multinomial Logistic Model.** Results of modeling also indicated that family rules allowing non-combustible tobacco products inside home (everyday vs no use: OR = 0.35, CI = 0.29-0.41; somedays vs no use: OR = 0.58, CI = 0.53-0.63), aged 35 years old or



older (everyday vs no use: OR = 0.53, CI = 0.45-0.61; somedays vs no use: OR = 0.84, CI = 0.77-0.91) were statistically significant and related to a higher frequency of e-cig consumption ( $p < .0001$ ). Positive or neutral attitude towards tobacco (OR = 1.39, CI = 1.28-1.52) was also found to distinguish somedays e-cigarette user and non-e-cigarette users compared to negative attitudes, but not between every day user and non-users.

**Weighted Unadjusted Multinomial Logistic Model.** Similar results were showed in weighted results as the unweighted model. Allowed to smoke non-combustible tobacco inside home (everyday vs no use: OR = 0.32, CI = 0.26-0.40; somedays vs no use: OR = 0.57, CI = 0.52-0.62;  $p < .0001$ ), aged over 35 (everyday vs no use: OR = 0.58, CI = 0.49-0.70; somedays vs no use: OR = 0.84, CI = 0.75-0.94;  $p < .0001$ ), and positive/neutral self-opinion on tobacco (everyday vs no use: OR = 0.88, CI = 0.73-1.06; somedays vs no use: OR = 1.39, CI = 1.23-1.56;  $p < .0001$ ) were significantly related to a relatively higher frequency of e-cigarette consumption behavior.

**Unweighted Adjusted Multinomial Logistic Model.** Rules that allowed to smoke non-combustible tobacco inside home (everyday vs no use: OR = 0.36, CI = 0.31-0.43; somedays vs no use: OR = 0.60, CI = 0.55-0.65;  $p < .0001$ ), aged over 35 (everyday vs no use: OR = 0.57, CI = 0.49-0.67; somedays vs no use: OR = 0.85, CI = 0.78-0.93;  $p < .0001$ ), and positive/neutral self-opinion on tobacco (everyday vs no use: OR = 0.89, CI = 0.76-1.04; somedays vs no use: OR = 1.39, CI = 1.27-1.51;  $p < .0001$ ) were significantly related to a relatively higher frequency of e-cigarette consumption behavior.

**Weighted Adjusted Multinomial Logistic Model.** Rules that allowed to smoke non-combustible tobacco inside home (everyday vs no use: OR = 0.33, CI = 0.27-0.41; somedays vs no use: OR = 0.58, CI = 0.53-0.64;  $p < .0001$ ), aged over 35 (everyday vs no use: OR = 0.63, CI = 0.52-0.75; somedays vs no use: OR = 0.86, CI = 0.76-0.96;  $p < .0001$ ), and positive or neutral self-opinion on tobacco (everyday vs no use: OR = 0.88, CI = 0.73-1.05; somedays vs no use: OR = 1.38, CI = 1.22-1.55;  $p < .0001$ ) were significantly related to a relatively higher frequency of e-cigarette consumption behavior.

## Conversion to E-cigarette Users

There were in total 4374 participants who reported being a former regular cigarette smoker but not smoking cigarette any longer. Thus, for this second dependent variable, we are considering a total of 4374 participants out of the larger population of 32320 individuals ( $4374/32320 = 13.5\%$ ). Among these participants, 451 (10.31%) reported currently being an e-cigarette user (every day or somedays), and 3923 (89.69%) did not acquire e-cig use behavior. With the 10% cutoff percentage as criteria for a covariate being retained in the multivariable model, 7 of the total 28 (25%) covariates for the second dependent variable were included in the adjusted model: Rules of non-combustible tobacco inside home (not allowed vs allowed), Age at interview (18-34 vs 35+), Rules of combustible tobacco inside home (not allowed vs allowed), Current employment status (employed for pay vs don't currently work for pay), Self-opinion on tobacco (positive/neutral vs negative), Health insurance coverage (yes vs no), and Believe that nicotine is the main substance to use tobacco (Not at all/Somewhat vs Very much).

**Unadjusted Binary Logistic Model (Weighted, Unweighted, and with A Random Effect for Region).** The results suggested that all seven covariates included in the three models listed above were statistically significantly associated with the dichotomous outcome: converted to e-cigarette smoking behavior or not. Family rules allowing non-combustible tobacco products inside home (Weighted: OR = 0.18, CI = 0.14-0.22; Unweighted: OR = 0.12, CI = 0.10-0.15; Mixed: OR = 0.18, CI = 0.15-0.23), aged 18-34 years old (Weighted: OR = 1.85, CI = 1.51-2.25; Unweighted: OR = 4.24, CI = 3.38-5.30; Mixed: OR = 1.83, CI = 1.50-2.24), combustible tobacco tolerance at home (Weighted: OR = 0.52, CI = 0.41-0.65; Unweighted: OR = 0.38, CI = 0.29-0.51; Mixed: OR = 0.52, CI = 0.41-0.65), employed for pay from full- or part-time job (Weighted: OR = 1.36, CI = 1.10-1.67; Unweighted: OR = 1.78, CI = 1.36-2.34; Mixed: OR = 1.37, CI = 1.11-1.69), neutral to positive self-opinion on tobacco (Weighted: OR = 1.40, CI = 1.14-1.72; Unweighted: OR = 1.95, CI = 1.50-2.53; Mixed: OR = 1.39, CI = 1.13-1.71), not having health insurance (Weighted: OR = 0.47, CI = 0.37-0.61; Unweighted: OR = 0.33, CI = 0.25-0.42; Mixed: OR = 0.48, CI = 0.37-0.62), not or somewhat believing that nicotine is the main substance to use tobacco (Weighted: OR = 1.28, CI = 1.05-1.57; Unweighted: OR = 1.65, CI = 1.28-2.13; Mixed: OR = 1.27,

CI = 1.04-1.55) were significantly more likely to start using e-cigarette as substitute after their smoking cessation compared to those who are not allowed to use combustible or non-combustible tobacco products inside home, older than 35, do not currently work for pay, holding negative opinions on tobacco, very much believing nicotine is the main substance leading to tobacco addiction, and with no health insurance.

**Adjusted Binary Logistic Model (Weighted, Unweighted, and with A Random Effect for Region).** After adjusting for other covariates in the model, the results of weighted, unweighted, and the adjusted logistic model with a random effect for region showed similar change: rules of combustible tobacco inside home (Weighted: OR = 1.10, CI = 0.86-1.42; Unweighted: OR = 1.04, CI = 0.75-1.45; Mixed: OR = 1.10, CI = 0.86-1.42), current employment status (Weighted: OR = 1.15, CI = 0.92-1.44; Unweighted: OR = 1.24, CI = 0.93-1.64; Mixed: OR = 1.15, CI = 0.92-1.44), self-opinion on tobacco (Weighted: OR = 1.04, CI = 0.83-1.30; Unweighted: OR = 1.30, CI = 1.00-1.68; Mixed: OR = 1.04, CI = 0.83-1.30), and belief that nicotine is the main substance that caused tobacco addiction (Weighted: OR = 1.08, CI = 0.87-1.34; Unweighted: OR = 1.14, CI = 0.85-1.53; Mixed: OR = 1.08, CI = 0.87-1.34) were no longer showing a statistically significant association with the conversion to e-cigarette use outcome.

Covariates with strong associations with converting to e-cigarette use behavior, such as rules of non-combustible tobacco use inside home (73.17% of e-cig users, 32.89% of quitters are allowed), age at interview (41.46% of e-cig switchers, 27.74% of quitters are 18-34 years old), and health insurance (20.59% of e-cig starters, 10.88% of quitters are with no insurance coverage), remained statistically significant in the adjusted models after controlling for other factors. The modeling results suggested that family rules allowing non-combustible tobacco products inside home (Weighted: OR = 0.19, CI = 0.15-0.24; Unweighted: OR = 0.15, CI = 0.12-0.19; Mixed: OR = 0.19, CI = 0.15-0.24), aged 18-35 years old (Weighted: OR = 1.45, CI = 1.16-1.80; Unweighted: OR = 2.91, CI = 2.27-3.72; Mixed: OR = 1.45, CI = 1.16-1.80), not having any health insurance (Weighted: OR = 0.57, CI = 0.44-0.75; Unweighted: OR = 0.47, CI = 0.34-0.64; Mixed: OR = 0.57, CI = 0.44-0.75) were significantly more likely to start using e-cigarette as substitute after their smoking cessation compared to those who are not allowed to use

combustible or non-combustible tobacco products inside home, older than 35, and with no health insurance.

## **Discussion**

E-cigarettes has been used as a popular substitute device for the purpose of reducing potential harm from cigarette smoking behavior and facilitating smoking cessation. This study also explored possible indicators related to e-cigarette use or transitioning behaviors for former smokers by targeting a sub-population in the PATH study. Strong et al (2017) carried out basic statistical summary based on PATH Study, and showed similar results in the number of e-cigarette only users as our statistical analysis of this study (n=437). The main findings of associated factors can be divided into two dimensions, with respect to frequency of e-cigarette using, and transitioning from traditional cigarettes to e-cigarettes. Considering the overall results, it appears that family tolerance of smoking and one's self-perspective on tobacco were the most important factors related to e-cigarette use and also on transitioning to e-cigarettes from traditional tobacco. Interestingly, age was inversely related to each of the dependent variables. Older age was significantly related to more frequent e-cigarette use. Financial status and higher incomes may be related to this finding. However, older adults were less likely to switch to e-cigarette use after quitting traditional smoking. Consistent with recent findings, the prevalence of e-cigarette use among young adults was considerably higher compared to older adults (Primack et al., 2015; Harrell et al., 2017; Soneji et al., 2017). With regards to e-cigarette use as a substitute for traditional tobacco, results suggested the most important factors were age, home tolerance, financial status, and self-consciousness on tobacco.

This study provides information and fills a gap with respect to previous studies in this area with the use of a nationally representative sample. Research into e-cigarette use can be challenging due to the relative low frequency of use as compared to traditional tobacco. Only 35.7% and 13.5% of the PATH data was utilized to study each of the two dependent variables, respectively. Defining the second dependent variable necessitated a subgroup of the original study sample, resulting in a smaller sample size and potential sampling bias. Missing data resulted in removing some covariates from consideration. Estimation was an issue with fitting

multilevel models to a multi-category outcome, due to the sparseness of frequency for some levels of some covariates.

The safety of e-cigarettes is under debate in the United States. The prevalence of e-cigarette consumption among adults, especially young adults, raises concerns and may necessitate a multi-disciplinary approach to monitor and possibly intervene. These results may be used by policy-makers as further evidence to build and develop population appropriate interventions. More work needs to be done to explore and understand the potential effects of e-cigarette smoking. The analyses presented here were on a cross sectional data set. It will be beneficial to consider longitudinal cohort data to better understand e-cigarette consumption behavior and effects.

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## Appendix

Table 7.1 Descriptive Statistics of Study Variables by Frequency of E-cigarette Use (n=11515)

Covariate	Level	# of Missing	Everyday			Some Days			No Longer Using			Total			Everyday vs Some days		Everyday vs No longer		Some vs No longer		Max Difference	
			Unweig	Unweig	Weight	Unweig	Unweig	Weight	Unweig	Unweig	Weight	Unweig	Unweig	Weight	Unweig	Weight	Unweig	Weight	Unweig	Weight	Unweig	Weight
			hted	hted	ed	hted	hted	ed	hted	hted	ed	hted	hted	ed	hted	hted	Percent	Percent	Percent	Percent	Percent	Percent
Rules of non-combustible tobacco inside	Not allowed	109	195	26.60	25.25	1087	37.65	37.30	3969	50.98	51.26	5251	46.04	46.08	11.05	12.05	24.38	26.01	13.33	13.96	24.38	26.01
	Allowed		538	73.40	74.75	1800	62.35	62.70	3817	49.02	48.74	6155	53.96	53.92	11.05	12.05	24.38	26.01	13.33	13.96	24.38	26.01
Age at Interview		1																				
	18 - 34		327	44.55	40.20	1629	56.04	49.26	4757	60.42	53.58	6713	58.30	51.63	11.49	9.06	15.87	13.38	4.38	4.32	15.87	13.38
	35+		407	55.45	59.80	1278	43.96	50.74	3116	39.58	46.42	4801	41.70	48.37	11.49	9.06	15.87	13.38	4.38	4.32	15.87	13.38
Self-opinion on tobacco	Positive or neutral	31	345	47.13	45.39	1699	58.61	56.77	3959	50.41	48.60	6003	52.27	50.40	11.48	11.38	3.28	3.21	8.20	8.17	11.48	11.38
	Negative		387	52.87	54.61	1200	41.39	43.23	3894	49.59	51.40	5481	47.73	49.60	11.48	11.38	3.28	3.21	8.20	8.17	11.48	11.38
Used alcohol/drugs regularly during past year	Yes	62	288	39.45	38.94	1394	48.25	47.47	3857	49.23	48.52	5539	48.36	47.62	8.80	8.53	9.78	9.58	0.98	1.05	9.78	9.58
	No		442	60.55	61.06	1495	51.75	52.53	3977	50.77	51.48	5914	51.46	52.38	8.80	8.53	9.78	9.58	0.98	1.05	9.78	9.58
Rules of combustible tobacco inside	Not allowed	52	474	64.84	65.82	1649	56.96	56.42	4895	62.46	62.86	7018	61.22	61.47	7.88	9.40	2.38	2.96	5.50	6.44	7.88	9.40
	Allowed		257	35.16	34.18	1246	43.04	43.58	2942	37.54	37.14	4445	38.78	38.53	7.88	9.40	2.38	2.96	5.50	6.44	7.88	9.40
Live with smoker during childhood	Yes	1389	425	66.61	68.16	1638	64.41	64.84	4098	59.01	60.15	6161	60.84	61.83	2.20	3.32	7.60	8.01	5.40	4.69	7.60	8.01
	No		213	33.39	31.84	905	35.59	35.16	2847	40.99	39.85	3965	39.16	38.17	2.20	3.32	7.60	8.01	5.40	4.69	7.60	8.01
Hispanic Race	Hispanic	0	66	8.99	7.68	468	16.09	13.82	1293	16.42	14.15	1827	15.87	13.64	7.10	6.14	7.43	6.47	0.33	0.33	7.43	6.47
	Non-Hispanic		668	91.01	92.32	2440	83.91	86.18	6580	83.58	85.85	9688	84.13	86.36	7.10	6.14	7.43	6.47	0.33	0.33	7.43	6.47
Poverty 2-level	Below poverty level	982	231	34.17	30.75	1095	40.93	36.84	2804	39.04	35.15	4130	39.21	35.28	6.76	6.09	4.87	4.40	1.89	1.69	6.76	6.09
	At or above poverty level		445	65.83	69.25	1580	59.07	63.16	4378	60.96	64.85	6403	60.79	64.72	6.76	6.09	4.87	4.40	1.89	1.69	6.76	6.09
Poverty 3-level	Below poverty level	982	231	34.17	30.75	1095	40.93	36.84	2804	39.04	35.15	4130	39.21	35.28	6.76	6.09	4.87	4.40	1.89	1.69	6.76	6.09
	At or near poverty level		178	26.33	26.62	662	24.75	25.39	1830	25.48	25.69	2670	25.35	25.68	1.58	1.23	0.85	0.93	0.73	0.30	1.58	1.23
	At or above twice poverty level		267	39.5	42.63	918	34.32	37.76	2548	35.48	39.16	3733	35.44	39.04	5.18	4.87	4.02	3.47	1.16	1.40	5.18	4.87
Household Income past year	Less than \$50,000	982	458	67.75	65.53	1979	73.98	71.61	5180	72.12	69.24	7617	72.32	69.58	6.23	6.08	4.37	3.71	1.86	2.37	6.23	6.08
	\$50,000 or more		218	32.35	34.47	696	26.02	28.39	2002	27.88	30.76	2916	27.68	30.42	6.33	6.08	4.47	3.71	1.86	2.37	6.33	6.08
Region	Northeast	0	80	10.90	11.99	349	12.00	13.57	1229	15.61	17.67	1658	14.40	16.28	1.10	1.58	4.71	5.68	3.61	4.10	4.71	5.68
	Midwest		184	25.07	23.50	734	25.24	22.84	1973	25.06	23.12	2891	25.11	23.07	0.17	0.66	0.01	0.38	0.18	0.28	0.18	0.66
	South		296	40.33	40.92	1147	39.44	40.23	2897	36.80	36.81	4340	37.69	37.92	0.89	0.69	3.53	4.11	2.64	3.42	3.53	4.11
	West		174	23.71	23.59	678	23.31	23.36	1774	22.53	22.40	2626	22.81	22.72	0.40	0.23	1.18	1.19	0.78	0.96	1.18	1.19
White/Other Race	White	0	599	81.61	83.91	2256	77.58	79.12	6028	76.57	78.59	8883	77.14	79.08	4.03	4.79	5.04	5.32	1.01	0.53	5.04	5.32
	Other		135	18.39	16.09	652	22.42	20.88	1845	23.43	21.41	2632	22.86	20.92	4.03	4.79	5.04	5.32	1.01	0.53	5.04	5.32

(Continued)

<b>Health Insurance</b>		134																					
	Yes		576	79.45	80.41	2147	74.81	75.42	5914	75.96	77.03	8637	75.89	76.86	4.64	4.99	3.49	3.38	1.15	1.61	4.64	4.99	
	No		149	20.55	19.59	723	25.19	24.58	1872	24.04	22.97	2744	24.11	23.14	4.64	4.99	3.49	3.38	1.15	1.61	4.64	4.99	
<b>Current Employment Status</b>		70																					
	Employed for pay FULL+PART		449	61.42	62.36	1882	65.08	65.62	5140	65.71	67.31	7471	65.28	66.56	3.66	3.26	4.29	4.95	0.63	1.69	4.29	4.95	
	Don't currently work for pay		282	38.58	37.64	1010	34.92	34.38	2682	34.29	32.69	3974	34.72	33.44	3.66	3.26	4.29	4.95	0.63	1.69	4.29	4.95	
<b>Loved ones' opinion on tobacco</b>		59																					
	Positive or neutral		272	37.06	35.90	1220	42.16	40.40	3050	39.02	37.51	4542	39.69	38.12	5.10	4.50	1.96	1.61	3.14	2.89	5.10	4.50	
	Negative		462	62.94	64.10	1674	57.84	59.60	4766	60.98	62.49	6902	60.31	61.88	5.10	4.50	1.96	1.61	3.14	2.89	5.10	4.50	
<b>Age at first time smoking</b>		368																					
	<18		574	78.95	79.18	2224	78.17	77.34	5689	75.10	74.75	8487	76.14	75.70	0.78	1.84	3.85	4.43	3.07	2.59	3.85	4.43	
	18+		153	21.05	20.82	621	21.83	22.66	1886	24.90	25.25	2660	23.86	24.30	0.78	1.84	3.85	4.43	3.07	2.59	3.85	4.43	
<b>Self-perspective Quality of Life</b>		20																					
	Good to Excellent		624	85.01	85.99	2423	83.49	83.17	6674	84.92	84.69	9721	84.57	84.41	1.52	2.82	0.09	1.30	1.43	1.52	1.52	2.82	
	Fair to Poor		110	14.99	14.01	479	16.51	16.83	1185	15.08	15.31	1774	15.43	15.59	1.52	2.82	0.09	1.30	1.43	1.52	1.52	2.82	
<b>Highest Education</b>		68																					
	High School Graduate or under		328	45.05	45.89	1414	48.91	48.64	3656	46.70	46.72	5398	47.16	47.14	3.86	2.75	1.65	0.83	2.21	1.92	3.86	2.75	
	Some College or higher		400	54.95	54.11	1477	51.09	51.36	4172	53.30	53.28	6049	52.84	52.86	3.86	2.75	1.65	0.83	2.21	1.92	3.86	2.75	
<b>Sex</b>		0																					
	Male		397	54.09	55.60	1486	51.10	52.92	4107	52.17	54.31	5990	52.02	54.05	2.99	2.68	1.92	1.29	1.07	1.39	2.99	2.68	
	Female		337	45.91	44.40	1422	48.90	47.08	3766	47.83	45.69	5525	47.98	45.95	2.99	2.68	1.92	1.29	1.07	1.39	2.99	2.68	
<b>Smoke around you at work</b>		14																					
	No		422	57.57	57.94	1648	56.71	56.60	4640	59.02	58.12	6710	58.34	57.74	0.86	1.34	1.45	0.18	2.31	1.52	2.31	1.52	
	Somewhat/Yes		311	42.43	42.06	1258	43.29	43.40	3222	40.98	41.88	4791	41.66	42.26	0.86	1.34	1.45	0.18	2.31	1.52	2.31	1.52	
<b>Emergency Room Visit past year</b>		24																					
	Yes		249	33.92	33.70	1001	34.53	33.66	2618	33.32	32.39	3868	33.66	32.79	0.61	0.04	0.60	1.31	1.21	1.27	1.21	1.31	
	No		485	66.08	66.30	1898	65.47	66.34	5240	66.68	67.61	7623	66.34	67.21	0.61	0.04	0.60	1.31	1.21	1.27	1.21	1.31	

Table 7.2 Bivariate Modeling Results for Frequency of E-cigarette Use (n=11515)

Covariate	Level	# of Missing	Unweighted Unadjusted Multinomial Logistic						Weighted Unadjusted Multinomial Logistic							
			Everyday vs Not at all			Some days vs Not at all			P-value	Everyday vs Not at all			Some days vs Not at all			P-value
			OR	95% CI		OR	95% CI			OR	95% CI		OR	95% CI		
<b>Rules of non-combustible tobacco inside</b>	Not allowed Allowed	109	0.35	0.29	0.41	0.58	0.53	0.63	<.0001	0.32	0.26	0.40	0.57	0.52	0.62	<.0001
<b>Age at Interview</b>		1							<.0001							<.0001
	18 - 34		0.53	0.45	0.61	0.84	0.77	0.91		0.58	0.49	0.70	0.84	0.75	0.94	
	35+															
<b>Self-opinion on tobacco</b>	Positive or neutral Negative	31	0.88	0.75	1.02	1.39	1.28	1.52	<.0001	0.88	0.73	1.06	1.39	1.23	1.56	<.0001
<b>Used alcohol/drugs regularly during past year</b>	Yes No	62	0.67	0.58	0.78	0.96	0.88	1.05	<.0001	0.68	0.57	0.81	0.96	0.87	1.06	0.0002
<b>Rules of combustible tobacco inside</b>	Not allowed Allowed	52	1.11	0.95	1.30	0.80	0.73	0.87	<.0001	1.14	0.94	1.38	0.77	0.70	0.84	<.0001
<b>Live with smoker during childhood</b>	Yes No	1389	1.39	1.17	1.65	1.26	1.14	1.38	<.0001	1.42	1.16	1.73	1.22	1.10	1.36	<.0001
<b>Hispanic Race</b>	Hispanic Non-Hispanic	0	0.50	0.39	0.65	0.98	0.87	1.10	<.0001	0.50	0.38	0.66	0.97	0.86	1.10	<.0001
<b>Poverty 2-level</b>	Below poverty level At or above poverty level	982	0.81	0.69	0.96	1.08	0.99	1.19	0.0050	0.82	0.70	0.96	1.08	0.98	1.18	0.0074
<b>Poverty 3-level</b>	Below poverty level At or near poverty level At or above twice poverty level	982	0.79	0.65	0.95	1.08	0.98	1.20	0.0244	0.80	0.67	0.96	1.09	0.98	1.21	0.0273
			0.93	0.76	1.13	1.00	0.89	1.13		0.95	0.76	1.19	1.03	0.90	1.17	
<b>Household Income past year</b>	Less than \$50,000 \$50,000 or more	982	0.81	0.69	0.96	1.10	0.99	1.22	0.0044	0.85	0.71	1.00	1.12	1.00	1.26	0.0039
<b>Region</b>	Northeast Midwest South West	0	0.66	0.51	0.87	0.74	0.64	0.86	<.0001	0.65	0.46	0.91	0.74	0.63	0.86	<.0001
			0.95	0.77	1.18	0.97	0.86	1.10		0.97	0.68	1.37	0.95	0.80	1.12	
			1.04	0.86	1.27	1.04	0.93	1.16		1.06	0.79	1.42	1.05	0.90	1.23	

(Continued)

<b>White/other Race</b>	0								0.0066							0.0213
White alone		1.36	1.12	1.65	1.06	0.96	1.17			1.42	1.11	1.83	1.03	0.92	1.15	
Other																
<b>Health Insurance</b>	134								0.0326							0.0189
Yes		1.22	1.01	1.48	0.94	0.85	1.04			1.22	1.02	1.47	0.92	0.82	1.02	
No																
<b>Current Employment Status</b>	70								0.0644							0.0185
Employed for pay FULL+PART		0.83	0.71	0.97	0.97	0.89	1.06			0.81	0.68	0.95	0.93	0.84	1.02	
Don't currently work for pay																
<b>Loved ones' opinion on tobacco</b>	59								0.0042							0.0666
Positive or neutral		0.92	0.79	1.08	1.14	1.04	1.24			0.93	0.77	1.14	1.13	1.01	1.26	
Negative																
<b>Age at first time smoking</b>	368								0.0009							0.0008
<18		1.24	1.03	1.50	1.19	1.07	1.32			1.28	1.09	1.52	1.15	1.05	1.27	
>=18																
<b>Self-perspective Quality of Life</b>	20								0.1802							0.1128
Good to Excellent		1.01	0.82	1.25	0.90	0.80	1.01			1.11	0.90	1.37	0.89	0.78	1.02	
Fair to Poor																
<b>Highest Education</b>	68								0.0639							0.2370
High School Graduate or under		0.94	0.80	1.09	1.09	1.00	1.19			0.97	0.81	1.16	1.08	0.99	1.18	
Some College or higher																
<b>Sex</b>	0								0.3154							0.3744
Male		1.08	0.93	1.26	0.96	0.88	1.04			1.05	0.89	1.25	0.95	0.86	1.04	
Female																
<b>Smoke around you at work</b>	14								0.0889							0.5285
No		0.94	0.81	1.10	0.91	0.84	0.99			0.99	0.83	1.19	0.94	0.84	1.05	
Somewhat/Yes																
<b>Emergency Room Visit past year</b>	24								0.4894							0.4615
Yes		1.03	0.88	1.21	1.06	0.97	1.16			1.06	0.90	1.25	1.06	0.95	1.18	
No																

Table 7.3 Descriptive Statistics of Study Variables for the Conversion to E-cigarettes Outcome (n=4374)

Covariate	Level	# of Missing	Converted to E-cigarette			Quit Smoking			Total			Covered vs Quit	
			Unweighted Count	Unweighted Percent	Weighted Percent	Unweighted Count	Unweighted Percent	Weighted Percent	Unweighted Count	Unweighted Percent	Weighted Percent	Unweighted Percent	Weighted Percent Difference
<b>Rules of non-combustible tobacco inside</b>	Not allowed	28	121	26.83	26.60	2614	67.11	74.45	2735	62.93	72.37	40.28	47.85
	Allowed		330	73.17	73.40	1281	32.89	25.55	1611	37.07	27.63	40.28	47.85
<b>Age at Interview</b>		0											
	18 - 34		187	41.46	38.97	1088	27.74	13.10	1275	29.16	14.21	13.72	25.87
	35+		264	58.54	61.03	2834	72.26	86.90	3098	70.84	85.79	13.72	25.87
<b>Smoke around you at work</b>	No	1673	112	36.60	35.90	1150	48.02	51.78	1262	46.72	50.93	11.42	15.88
	Somewhat/Yes		194	63.40	64.10	1245	51.98	48.22	1439	53.28	49.07	11.42	15.88
<b>Rules of combustible tobacco inside</b>		11											
	Not allowed		329	73.27	72.31	3295	84.18	87.17	3624	83.06	86.53	10.91	14.86
	Allowed	120	26.73	27.69	619	15.82	12.83	739	16.94	13.47	10.91	14.86	
<b>Current Employment Status</b>		17											
	Employed for pay FULL+PART		306	68.30	68.33	2398	61.35	54.79	2704	62.06	55.38	6.95	13.54
	Don't currently work for pay	142	31.70	31.67	1511	38.65	45.21	1653	37.94	44.62	6.95	13.54	
<b>Self-opinion on tobacco</b>		5											
	Positive or neutral		158	35.03	33.34	1088	27.77	20.44	1246	28.52	21.00	7.26	12.90
	Negative		293	64.97	66.66	2830	72.23	79.56	3123	71.48	79.00	7.26	12.90
<b>Health Insurance</b>		43											
	Yes		351	79.41	79.72	3466	89.12	92.37	3817	88.13	91.83	9.71	12.65
	No	91	20.59	20.28	423	10.88	7.63	514	11.87	8.17	9.71	12.65	
<b>Believe nicotine main substance to use tobacco</b>		34											
	Not at all to Somewhat		186	41.33	41.26	1379	35.45	29.87	1565	36.06	30.36	5.88	11.39
	Very much		264	58.67	58.74	2511	64.55	70.13	2775	63.94	69.64	5.88	11.39
<b>Poverty 3-level</b>		392											
	Below poverty level		78	18.89	17.49	624	17.48	13.77	702	17.63	13.94	1.41	3.72
	At or near poverty level		114	27.60	28.09	820	22.98	22.73	934	23.46	22.97	4.62	5.36
	At or above twice poverty level	221	53.51	54.42	2125	59.54	63.50	2346	58.92	63.09	6.03	9.08	

(Continued)

<b>Loved ones' opinion on tobacco</b>	733												
Positive or neutral		145	32.15	31.53	855	26.80	22.96	1000	27.46	23.49	5.35	8.57	
Negative		306	67.85	68.47	2335	73.20	77.04	2641	72.54	76.51	5.35	8.57	
<b>Self Perception of Mental Health</b>	7												
Good/Excellent		355	78.89	80.19	3374	86.14	87.69	3729	85.29	87.36	7.25	7.50	
Fair/Poor		95	21.11	19.81	543	13.86	12.31	638	14.61	12.64	7.25	7.50	
<b>Household Income past year</b>	392												
Less than \$50,000		237	57.38	56.12	1844	51.67	49.80	2081	52.26	50.08	5.71	6.32	
\$50,000 or more		176	42.62	43.88	1725	48.33	50.20	1901	47.74	49.92	5.71	6.32	
<b>Region</b>	0												
Northeast		52	11.53	13.26	656	16.72	19.12	708	16.19	18.87	5.19	5.86	
Midwest		114	25.28	21.55	970	24.73	22.65	1084	24.78	22.61	0.55	1.10	
South		179	39.69	39.08	1316	33.55	34.56	1495	34.18	34.75	6.14	4.52	
West		106	23.50	26.10	981	25.01	23.66	1087	24.85	23.77	1.51	2.44	
<b>Age at first time smoking</b>	1												
<18		355	78.71	79.83	3027	77.18	74.74	3382	77.34	74.96	1.53	5.09	
18+		96	21.29	20.17	895	22.82	25.26	991	22.66	25.04	1.53	5.09	
<b>White/Other Race</b>	0												
White		375	83.15	83.96	3284	83.71	87.76	3659	83.65	87.60	0.56	3.81	
Other		76	16.85	16.04	639	16.29	12.24	715	16.35	12.40	0.56	3.81	
<b>Poverty 2-level</b>	392												
Below poverty level		78	18.89	17.49	624	17.48	13.77	702	17.63	13.94	1.41	3.72	
At or above poverty level		335	81.11	82.51	2945	82.52	86.23	3280	82.37	86.06	1.41	3.72	
<b>Working Indoors</b>	1673												
Yes		257	84.26	84.05	2085	87.02	87.14	2342	86.71	86.97	2.76	3.09	
No		48	15.74	15.95	311	12.98	12.86	359	13.29	13.03	2.76	3.09	
<b>Self Perception of Overall Health</b>	4												
Good/Excellent		368	81.78	83.02	3367	85.89	85.64	3735	85.47	85.53	4.11	2.62	
Fair/Poor		82	18.22	16.98	553	14.11	14.36	635	14.53	14.47	4.11	2.62	
<b>Self Perception of Physical Health</b>	4												
Good/Excellent		355	78.89	79.52	3256	83.06	82.10	3611	82.63	81.99	4.17	2.58	
Fair/Poor		95	21.11	20.48	664	16.94	17.90	759	17.37	18.01	4.17	2.58	



(Continued)

<b>Used alcohol/drugs regularly during past year</b>	26												
Yes		177	39.51	39.21	1763	45.21	41.54	1940	44.62	41.44	5.70	2.33	
No		271	60.49	60.79	2137	54.79	58.46	2408	55.38	58.56	5.70	2.33	
<b>Emergency Room Visit past year</b>	9												
Yes		137	30.38	28.73	1084	27.70	26.58	1221	27.97	26.67	2.68	2.15	
No		314	69.62	71.27	2830	72.30	73.42	3144	72.03	73.33	2.68	2.15	
<b>Hispanic Race</b>	0												
Hispanic		29	6.43	5.93	405	10.32	7.92	434	9.92	7.84	3.89	1.99	
Non-Hispanic		422	93.57	94.07	3518	89.68	92.08	2940	90.08	92.16	3.89	1.99	
<b>Live with smoker during childhood</b>	590												
Yes		274	67.49	67.47	2205	65.28	69.35	2479	65.51	69.26	2.21	1.88	
No		132	32.51	32.53	1173	34.72	30.65	1305	34.49	30.74	2.21	1.88	
<b>Self-perspective Quality of Life</b>	4												
Good to Excellent		404	89.58	90.42	3581	91.38	91.56	3985	91.19	91.51	1.80	1.14	
Fair to Poor		47	10.42	9.58	338	8.62	8.44	385	8.81	8.49	1.80	1.14	
<b>Highest Education</b>	12												
High School Graduate or under		165	36.67	39.28	1255	32.08	38.22	1420	32.55	38.27	4.59	1.06	
Some College or higher		285	63.33	60.72	2657	67.92	61.78	2942	67.45	61.73	4.59	1.06	
<b>Working in a Vehicle</b>	1673												
Yes		33	10.82	11.27	272	11.35	11.90	305	11.29	11.86	0.53	0.63	
No		272	89.18	88.73	2124	88.65	88.10	2396	88.71	88.14	0.53	0.63	
<b>Sex</b>	0												
Male		226	50.11	52.96	2171	55.34	52.54	2397	54.80	52.56	5.23	0.42	
Female		225	49.89	47.04	1752	44.66	47.46	1977	45.20	47.44	5.23	0.42	
<b>Working Outdoors</b>	1673												
Yes		56	18.36	18.47	490	20.45	18.73	546	20.21	18.71	2.09	0.26	
No		249	81.64	81.53	1906	79.55	81.27	2155	79.79	81.29	2.09	0.26	

Table 7.4 Bivariate Modeling Results for the Conversion to E-cigarettes Outcome (n=4374)

Covariate	Level	# of Missing	Unweighted Unadjusted Binary Logistic			Weighted Unadjusted Binary Logistic			Unadjusted Logistic with a Random Effect for Region												
			OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value										
Rules of non-combustible tobacco inside	Not allowed	28	0.18	0.14	0.22		0.12	0.10	0.15		0.18	0.15	0.23								
	Allowed																				
Age at Interview		0																			
	18 - 34		1.85	1.51	2.25		4.24	3.38	5.30		1.83	1.50	2.24								
	35+																				
Smoke around you at work	No	1673	0.63	0.49	0.80		0.52	0.40	0.68		0.63	0.49	0.81								
	Somewhat/Yes																				
Rules of combustible tobacco inside	Not allowed	11	0.52	0.41	0.65		0.38	0.29	0.51		0.52	0.41	0.65								
	Allowed																				
Current Employment Status	Employed for pay FULL+PART	17	1.36	1.10	1.67		1.78	1.36	2.34		1.37	1.11	1.69								
	Don't currently work for pay																				
Self-opinion on tobacco	Positive or neutral	5	1.40	1.14	1.72		1.95	1.50	2.53		1.39	1.13	1.71								
	Negative																				
Health Insurance	Yes	43	0.47	0.37	0.61		0.33	0.25	0.42		0.48	0.37	0.62								
	No																				
Believe nicotine main substance to use tobacco	Not at all to Somewhat	34	1.28	1.05	1.57		1.65	1.28	2.13		1.27	1.04	1.55								
	Very much																				
Poverty 3-level		392	1.20	0.92	1.58		1.48	1.09	2.02		1.18	0.89	1.55								
	Below poverty level																				
	At or near poverty level														1.34	1.05	1.70		1.44	1.14	1.82
	At or above twice poverty level																				
Loved ones' opinion on tobacco		733	1.29	1.05	1.60		1.55	1.18	2.02		1.28	1.03	1.58								
	Positive or neutral																				
	Negative																				

(Continued)

<b>Self Perception of Mental Health</b>	7				<.0001				0.0003				<.0001
Good/Excellent		0.60	0.47	0.77		0.57	0.42	0.77		0.61	0.48	0.78	
Fair/Poor													
<b>Household Income past year</b>	392				0.0279				0.0215				0.0481
Less than \$50,000		1.26	1.03	1.55		1.29	1.04	1.60		1.23	1.00	1.51	
\$50,000 or more													
<b>Region</b>	0				0.0094				0.0412				
Northeast		0.73	0.52	1.04		0.63	0.43	0.93					
Midwest		1.09	0.82	1.44		0.86	0.59	1.25					
South		1.26	0.98	1.62		1.03	0.74	1.42					
West													
<b>Age at first time smoking</b>	1				0.4613				0.0241				0.4728
<18		1.09	0.68	1.39		1.34	1.04	1.72		1.09	0.86	1.38	
>=18													
<b>White/Other Race</b>	0				0.7595				0.0705				0.8828
White alone		0.96	0.74	1.25		0.73	0.52	1.03		0.98	0.76	1.27	
Other													
<b>Poverty 2-level</b>	392				0.4791				0.0531				0.5738
Below poverty level		1.10	0.85	1.43		1.33	1.00	1.77		1.08	0.83	1.40	
At or above poverty level													
<b>Working Indoors</b>	1673				0.1821				0.2799				0.2043
Yes		0.80	0.57	1.11		0.78	0.49	1.23		0.81	0.58	1.12	
No													
<b>Self Perception of Overall Health</b>	4				0.0192				0.1574				0.0281
Good/Excellent		0.74	0.57	0.95		0.82	0.62	1.08		0.75	0.58	0.97	
Fair/Poor													
<b>Self Perception of Physical Health</b>	4				0.0272				0.2706				0.0387
Good/Excellent		0.76	0.60	0.97		0.85	0.63	1.14		0.78	0.61	0.99	
Fair/Poor													
<b>Used alcohol/drugs regularly during past year</b>	26				0.0218				0.3402				0.0339
Yes		0.79	0.65	0.97		0.91	0.74	1.11		0.81	0.66	0.98	
No													
<b>Emergency Room Visit past year</b>	9				0.2299				0.3959				0.2610
Yes		1.14	0.92	1.41		1.11	0.87	1.43		1.13	0.91	1.40	
No													

(Continued)

<b>Hispanic Race</b>		0				0.0095				0.1823				0.0091
	Hispanic		0.60	0.40	0.88		0.73	0.46	1.16		0.59	0.40	0.88	
	Non-Hispanic													
<b>Live with smoker during childhood</b>		590				0.3757				0.5792				0.3679
	Yes		1.10	0.89	1.38		0.92	0.67	1.25		1.11	0.89	1.38	
	No													
<b>Self-perspective Quality of Life</b>		4				0.2029				0.4779				0.2304
	Good to Excellent		0.81	0.59	1.12		0.87	0.59	1.28		0.82	0.60	1.13	
	Fair to Poor													
<b>Highest Education</b>		12				0.0496				0.7269				0.0653
	High School Graduate or under		1.23	1.00	1.50		1.05	0.81	1.35		1.21	0.99	1.49	
	Some College or higher													
<b>Working in a Vehicle</b>		1673				0.7820				0.7571				0.7954
	Yes		0.95	0.65	1.39		0.94	0.63	1.40		0.95	0.65	1.39	
	No													
<b>Sex</b>		0				0.0348				0.8766				0.0321
	Male		0.81	0.67	0.99		1.02	0.82	1.26		0.81	0.66	0.98	
	Female													
<b>Working Outdoors</b>		1673				0.3923				0.9211				0.3555
	Yes		0.88	0.64	1.19		0.98	0.70	1.38		0.87	0.64	1.18	
	No													

Table 7.5 Multivariable Modeling Results for Frequency of E-cigarette Use (n=11515)

Covariate	Level	# of Missing	Unweighted Unadjusted Multinomial Logistic					Weighted Unadjusted Multinomial Logistic					Unweighted Adjusted Multinomial Logistic					Weighted Adjusted Multinomial Logistic												
			Everyday vs Not at all			Some days vs Not at all		P-value	Everyday vs Not at all			Some days vs Not at all		P-value	Everyday vs Not at all			Some days vs Not at all		P-value	Everyday vs Not at all			Some days vs Not at all		P-value				
			OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI								
Rules of non-combustible tobacco inside	Not allowed	109	0.35	0.29	0.41	0.58	0.53	0.63	<.0001	0.32	0.26	0.40	0.57	0.52	0.62	<.0001	0.36	0.31	0.43	0.60	0.55	0.65	<.0001	0.33	0.27	0.41	0.58	0.53	0.64	<.0001
	Allowed																													
Age at Interview	18 - 34	1	0.53	0.45	0.61	0.84	0.77	0.91	<.0001	0.58	0.49	0.70	0.84	0.75	0.94	<.0001	0.57	0.49	0.67	0.85	0.78	0.93	<.0001	0.63	0.52	0.75	0.86	0.76	0.96	<.0001
	35+																													
Self-opinion on tobacco	Positive or neutral	31	0.88	0.75	1.02	1.39	1.28	1.52	<.0001	0.88	0.73	1.06	1.39	1.23	1.56	<.0001	0.89	0.76	1.04	1.39	1.27	1.51	<.0001	0.88	0.73	1.05	1.38	1.22	1.55	<.0001
	Negative																													

Table 7.6 Multivariable Modeling Results for the Conversation to E-cigarettes Outcome (n=4374)

Covariate	Level	# of Missing	Unweighted Unadjusted Binary Logistic				Weighted Unadjusted Binary Logistic			Unadjusted Logistic with a Random Effect for Region			Unweighted Adjusted Binary Logistic			Weighted Adjusted Binary Logistic			Adjusted Logistic with a Random Effect for Region							
			OR	95% CI		P-value	OR	95% CI		P-value	OR	95% CI		P-value	OR	95% CI		P-value	OR	95% CI		P-value				
Rules of non-combustible tobacco inside	Not allowed	28	0.18	0.14	0.22	<.0001	0.12	0.10	0.15	<.0001	0.18	0.15	0.23	<.0001	0.19	0.15	0.24	<.0001	0.15	0.12	0.19	<.0001	0.19	0.15	0.24	<.0001
	Allowed																									
Age at Interview	18 - 34	0	1.85	1.51	2.25	<.0001	4.24	3.38	5.30	<.0001	1.83	1.50	2.24	<.0001	1.45	1.16	1.80	0.0009	2.91	2.27	3.72	<.0001	1.45	1.16	1.80	0.0010
	35+																									
Rules of combustible tobacco inside	Not allowed	11	0.52	0.41	0.65	<.0001	0.38	0.29	0.51	<.0001	0.52	0.41	0.65	<.0001	1.10	0.86	1.42	0.4472	1.04	0.75	1.45	0.8266	1.10	0.86	1.42	0.4474
	Allowed																									
Current Employment Status	Employed for pay FULL+PART	17	1.36	1.10	1.67	0.0042	1.78	1.36	2.34	<.0001	1.37	1.11	1.69	0.0035	1.15	0.92	1.44	0.2233	1.24	0.93	1.64	0.1403	1.15	0.92	1.44	0.2236
	Don't currently work for pay																									
Self-opinion on tobacco	Positive or neutral	5	1.40	1.14	1.72	0.0013	1.95	1.50	2.53	<.0001	1.39	1.13	1.71	0.0017	1.04	0.83	1.30	0.7199	1.30	1.00	1.68	0.0530	1.04	0.83	1.30	0.7200
	Negative																									
Health Insurance	Yes	43	0.47	0.37	0.61	<.0001	0.33	0.25	0.42	<.0001	0.48	0.37	0.62	<.0001	0.57	0.44	0.75	<.0001	0.47	0.34	0.64	<.0001	0.57	0.44	0.75	<.0001
	No																									
Believe nicotine main substance to use tobacco	Not at all to Somewhat	34	1.28	1.05	1.57	0.0140	1.65	1.28	2.13	0.0002	1.27	1.04	1.55	0.0177	1.08	0.87	1.34	0.4953	1.14	0.85	1.53	0.3708	1.08	0.87	1.34	0.4954
	Very much																									