ABSTRACT

Understanding Smoking Preferences:
Results from a Discrete Choice Experiment amongst U.S. Adults

E-cigarette (vaping) use has increased dramatically in recent years. While switching to vaping might benefit cigarette smokers, there is a risk of increased use by nonsmokers. Adults (N=525) aged 18 to 88 years made choices between two alternatives that differed in policy-relevant characteristics. Nonsmokers preferred e-cigarettes over all other tobacco products (WTP $1.34). Nonsmokers showed a strong aversion to the addictiveness of the products and long-term health risks. Light and heavy smokers differed in their attitudes toward health risks, with heavy smokers being relatively unsensitive to long-term health risks compared to light smokers. Cost was a particularly important factor for nonsmokers. Marginal analysis suggests smokers were relatively unsensitive to price increases alone. Vaping is attractive for nonsmokers when they perceived health risks are low, suggesting that behavior change campaigns should focus on the health risks. Results also suggest that it may be difficult to get smokers to shift to vaping.

Gilda Zarate-Gonzalez
May 2020

Copyright (or ©)

Gilda Zarate-

Gonzalez, 2021

All rights reserved

UNDERSTANDING SMOKING PREFERENCES: RESULTS FROM A DISCRETE CHOICE EXPERIMENT AMONGST U.S. ADULTS

By

Gilda Zarate-Gonzalez

A research project submitted in partial
fulfillment of the requirements for the degree of
Master of Science in Public Health Research
in the School of Social Sciences, Humanities and Arts
University of California, Merced
June 2021

UNIVERSITY OF CALIFORNIA, MERCED

Understanding Smoking Preferences: Results from a Discrete Choice Experiment amongst U.S. Adults.

A Research Project submitted in partial satisfaction of the requirements for the degree of Master of Science in Public Health (MSPH)

by

Gilda Zarate-Gonzalez

The Research Project of Gilda Yvette Zarate-Gonzalez is approved, and it is acceptable in quality:

Professor Name	Signature	Date
Paul Brown, PhD, Chair	Paul M Brown	June 14, 2021
Ricardo Cisneros, PhD, MPH,	Ricardo Cisneros	
Kurt Schnier, PhD,	Kurt Schnier Digitally signed by Kurt Schnier Date: 2021.06.14 18:31:29 -07'00'	

ACKNOWLEDGEMENTS

To Nana, Tio Alex and Tomas, your departure was a turning point toward truthfulness.

To my baby sister and brothers, whether you are near or far on another continent seeing you grow has been a joy and I revel in your curiosity to find yourselves. To my beloved friends who are my role models and my chosen family. To my nieces and nephews who inspire my work. To my Great-grandmother, to Tata, to Mama and Papa, and my aunts and uncles, the farmworkers who gave me a conscience, faith, a spirit of selfless service to others, and citizenship.

To my moon's rabbit, my heart, and my healer, and to their father who is our guardian and protector, you are my life.

TABLE OF CONTENTS

Page

LIST OF TABLES vi

Chapter

1. INTRODUCTION 1

Statement of the Problem 1

Previous Attempts to Addressing the Problem . . 2

2. LITERATURE REVIEW 3

Smoking: Unanswered Questions 7

3. METHODOLOGY 8

Data Collection and Sample 8

Study Development and Measurements. . . . 8

Experimental Design 11

Data Analysis 12

Research Questions 13

4. RESULTS 14

Sample Demographics 14

Initial Results: Conditional and Linearized Models . . 15

Willingness to Pay 16

Smoking and Nonsmoking Models 17

Willingness to Pay by Smoking Groups . . . 18

Marginal Probabilities to Model Tobacco Policy Options . 19

Market Share Elasticities 22

5. DISCUSSION AND CONCLUSION 24

Comparison to Other Discrete Choice Studies . . 24

Limitations 25

Implications for Further Research 26

REFERENCES 27

LIST OF TABLES AND FIGURES

Table Page

1. Smoking-Related Discrete Choice Experiments for Policy Relevant Factors 4

2. Discrete Choice Experiment Attributes 9

3. Demographic summary of participants 14

4. Conditional and Linearized Models 16

5. Model by Smoking Status 18

6. Market Share Elasticities 22

Figure

1. Sample Choice Set 11

2. Marginal Probabilities of Worst vs. Best Tobacco Product by Smoking Status 19

3. Marginal Probabilities of Highly Addictive Tobacco Products by Smoking Status 20

4. Marginal Probabilities of Changing Price of Cigarettes by Smoking Status 20

5. Marginal Probabilities of Highly Addictive and High Illness of e-cigarettes by Smoking Status . . 21

Chapter 1

INTRODUCTION

Tobacco accounts for approximately 10% of annual global deaths among adults (Goodchild, Nargis, & D'Espaignet, 2018). According to the World Health Organization (WHO) (2016) tobacco smoking rates vary across countries. For example: at least 20% of the adult population in 20 countries of the European Union smoke daily; over 40% in Asian regions, and smoking rates in the Pacific regions and the United States (U.S.) are slightly lower than in Europe with less than 20% of the adult population smoking daily. Current worldwide estimates indicate that US$ 1.4 trillion in healthcare costs and lost productivity each year are attributed to tobacco smoking (WHO, 2017).

Despite declining smoking trends, in the U.S. 34 million adults smoke tobacco (Centers for Disease Control and Prevention, 2018a). According to the Centers for Disease Control and Prevention (CDC) (2014a) smoking rates remain high in the following groups: 1) Men 2) 25-64 year old adults 3) Lower education level 4) Below poverty level 5) Uninsured or Medicaid 6) Disabled 7) People who report psychological distress 8) Lesbian, Gay, Bisexual, Transgender and Queer, and 9) Midwest and South regions of the U.S.

The rates of smoking in the U.S. differ by race and ethnicity (CDC, 2018; Katz, Ang, & Suro, 2012). American Indians and Alaska Natives report the highest rates of smoking (24%), non-Hispanic Whites/Caucasians report a 15.2% smoking rate, non-Hispanic Blacks 14.9%, and Hispanic/ Latino/Latina report a rate of 9.9%. The lowest rate of smoking is reported amongst non-Hispanic Asians[1] at 7.1%.

Statement of the Problem

Based on available evidence, smoking tobacco is associated with significant deleterious health outcomes such as premature mortality, lung cancer, stroke, coronary heart disease, chronic obstructive pulmonary disease, pneumonia, bladder cancer, and periodontal disease (Akl et al., 2010; Bello et al., 2014; Bergstrom, 2004; Boffetta, 2008; Centers for Disease Control and Prevention, 2018a; King, Jama, Marynak, & Promoff, 2015; Ong & Glantz, 2004; U.S. Surgeon General Office Department of Health and Human Services, 2014; van Osch, Jochems, van Schooten, Bryan, & Zeegers, 2016; Watson et al., 2013; World Health Organization, 2017).

A longitudinal study by Yang et al. (2019) indicated that cigarette smoking-associated population attributable risk (PAR) was 29.3% for all causes of death in a cohort of men born after 1930, and lung cancer mortality PAR was 68.4%. In a systematic review (Akl et al., 2010) researchers concluded that waterpipe smoking, such as smoking with hookahs, is significantly associated with periodontal disease (Odds Ratio (OR) = 3–5), respiratory illness (OR = 2.3; 95% confidence interval (CI) 1.1–5.1), low birth-weight (OR = 2.12; 95% CI 1.08–4.18) and lung cancer (OR) = 2.12; 95% CI 1.32–3.42.

---

[1] Not including Hawaiians and Other Pacific Islanders.

Involuntary smoking, also known as second-hand smoking, has also been associated with lung cancer in adults exposed to tobacco smoke and acute respiratory conditions in children (Fielding & Phenow, 1988).

Traditionally health risks are associated with the use of ubiquitous cigarette tobacco products. Nevertheless in a study by Pitard et al. (2001) the researchers sought to investigate the association of tobacco use through three products individually (cigarettes, cigars and pipes) and bladder cancer. The study demonstrated that although the OR of smoking only cigarettes was 3.5 (CI 2.9–4.2) -*the highest*-, the OR of smoking only cigars was significant at 2.3 (CI 1.6–3.5), and the bladder cancer OR for pure pipe smoking was 1.9 (95% CI 1.2–3.1). The results were demonstrative of tobacco being a carcinogen regardless of the mode of use and duration.

Previous attempts to Addressing the Problem

Based on existing body of evidence correlating smoking tobacco with early mortality and grave health effects, public health professionals have sought to curb tobacco smoking employing a wide array of measures and policies, such as imposing taxes on tobacco sales, increasing the minimum legal purchase ages, imposing tobacco-free zones, smoking bans in public places, tobacco cessation programs, etc. These public health interventions have been effective at reducing smoking rates.

Although the overall trend of tobacco smoking in the U.S. has been in decline, reaching 15.5% in 2016 from 21% in 2005 (CDC, 2018b), the advent of e-cigarettes and vaping has risen at alarming rates and our understanding of its public health implications is still developing (Aveyard, Arnott, & Johnson, 2018; Miech, Johnston, O'Malley, Bachman, & Patrick, 2019). There is more work to do in order to increase our knowledge on what variables and circumstances are important to tobacco smoking and vaping.

Vaping has been promoted to current smokers to decrease dependency on tobacco (Farrimond & Abraham, 2018). Nevertheless e-cigarettes, having risks on their own, can be attractive to nonsmokers and has promoted a surge of vaping among teens, young adults and nonsmokers (Chatterjee, Alzghoul, Innabi, & Meena, 2018). This raises questions about the extent to which vaping can: a) succeed as smoking cessation aids, b) will lead to more people being dependent on nicotine and c) whether these people might turn to tobacco use (Leventhal et al., 2016).

This compels an examination of what aspects of smoking would entice cigarette users to switch to vaping to reduce harm, and how nonsmokers view e-cigarettes. There is limited evidence on how people perceive these products, and by what means policies or interventions, such as price increases on tobacco products are likely to move smokers toward vaping to continue curbing nicotine use.

The purpose of this study is to identify what smokers and nonsmokers value about tobacco products and vaping using a discrete choice experiment to identify these preferences. Discrete choice experiments (DCEs) present a stated preference methodology that can be applied to expand our knowledge of choices, behaviors, risks, and acceptance for relevant factors involved in contemporary health issues.

Chapter 2

LITERATURE REVIEW

The application of DCEs is in expansion in the study of tobacco smoking behavior as of lately. For instance Buckell, Sindelar, Maclean, & Sindelar (2013), and Marti, Buckell, Maclean, & Sindelar (2019a) examined whether e-cigs are perceived as a healthier option and willingness to use them as cessation aids. They found that cigarette smokers valued price but did not perceive e-cigs as healthier. In addition, those who both vape and smoke cigarettes were willing to use e-cigarettes as cessation supports, perceived them as the healthier option, and an alternative to evade smoking bans.

Other studies have focused on measuring the effects of vaping and cigarettes flavors and flavor bans in the choice of either cigarettes or e-cigarettes (Pesko, Kenkel, Wang, & Hughes, 2016; Salloum, Nakkash, et al., 2018; Shang, Huang, Chaloupka, & Emery, 2018; Sindelar, Marti, & Buckell, 2017), they found that people valued flavors and menthol in their uptake of vaping as an alternative and the perception of severe health effects from smoking cigarettes. Furthermore, these experiments found that a ban on menthol would reduce the choice of cigarettes to favor vaping, and a ban on flavored e-cigarettes would likely increase the choice of cigarettes amongst smokers. Also, restricting youth from access to fruit, sweet or beverage flavors was relevant in their desire of using e-cigarettes or vaping.

A systematic review by Regmi, Kaphle, Timilsina, & Tuha (2018) examined the DCEs results in the preferences of cigarettes, waterpipes, and e-cigarettes. Their findings determined that monetary attributes were the most valued by the participants. Several other experimental studies have included health warning related attributes which in comparison to cost and flavors are less valued aspects of using tobacco (Minh et al., 2016; Salloum, Louviere, et al., 2018; Thrasher et al., 2018a).

In this study, a DCE is used to examine the relative importance of key policy-relevant attributes related to smoking and vaping from U.S. adults. The aims are: 1) to measure the preferences and tradeoffs of four tobacco products (cigarettes, cigars, hookahs and e-cigarettes) and determine which product characteristics are most important to adult smokers and nonsmokers; and 2) to examine how effective policies aimed at increasing the price of tobacco products would be in reducing smoking and vaping among adult smokers and nonsmokers.

Table 1 presents ways in which DCEs have been used in the study of tobacco use preferences and tradeoffs. Results of reviewed scientific literature which utilized discrete choice experiment modeling for policy-relevant tobacco smoking attributes are included in the table.

Table 1. Smoking-Related Discrete Choice Experiments for Policy Relevant Factors

Place, Author, Year	Date Implemented	Tobacco Product(s)	Preferred ("valued") Factors	Less Preferred ("valued") Factors
United States				
Online, National Marti, Buckell, Maclean, & Sindelar (2019)	January 2014	Cigarettes, Disposable, and Rechargeable E-Cigs	For cigarette smokers: price, older. For vapers and dual users: use e-cigs as a cessation aid, perceived as the healthier option, evade smoking bans.	For cigarette smokers: less interested in quitting, evading smoking bans, do not perceive e-cig as a healthier option. All, cost is significant but smaller magnitude.
Online, National Buckell, Marti, & Sindelar (2019)	November 2016	Cigarettes and e-cigarettes	Ban on menthol would reduce choice of cigarettes while increasing the choice of e-cig. Ban on flavored e-cigs alone would likely increase the choice of cigarettes in smokers.	Nicotine content.
Online, National Shang, Huang, Chaloupka, & Emery (2018)	September 2015	Cigalike e-cigs, e-GO/Mods/APVs	For youth: Restricting fruit/sweets/beverage flavors. Adoption of strong health warning messages.	Cigalike e-cigs.
Online, National Thrasher et al. (2018)	November 2016	Cigarette pack inserts	Inserts with imagery. Inserts with cessation resources.	Testimonial/Didactic text type of insert. Call to action on insert.

			Financial benefit messages. Well-being messages.	Cravings messages. Social support (self-efficacy) messages.
Internet-based, In-person, University-based Salloum et al. (2015)	June – October 2014	Waterpipe (hookah)	Fruit-flavors. Nicotine-free labeled products. Health warning exposed were more likely to opt-out.	Nicotine content for males and cigarette smokers.
Online, National Pesko, Kenkel, Wang, & Hughes (2016)	2014 - 2015	E-cigs as alternative to cigarettes	Flavors and menthol. Price. For adults: price increases, severe warning labels.	Reduced risk warning label.
Online, National Salloum, Louviere, et al. (2018)	2016	Cigarette pack inserts	High tar perception. Numeric HPHC information. Link HPHC to disease to encourage quitting.	Disease link for harm perception.
Online, National Buckell & Sindelar (2019)	November 2016 – May 2017	Cigarettes, and e-cigs	Prefer smoking group: price and health harms. Prefer vaping group: health and fruit/candy flavors.	Prefer vaping group: less price sensitive.
International				
Vietnam Minh et al. (2016)	1st Round June 2014 2nd Round January 2015	Cigarettes with graphic or text Health Warnings	Diseased lung graphic warning. Rural. Low income.	Text health warning. Damaged teeth.

Canada, Online Thrasher et al. (2018)	2017	Cigarette pack inserts with health benefits/tips to quit smoking messages	Imagery type. Imagery type and message topic (combined). Healthy mom and baby (real people). Healthy mom, dad and baby (real and combined). For females, pregnant woman. For males, imagery with a dad. For older, imagery on message.	Message topic (by itself). Symbolic figure of a pregnant woman. For males, pregnant woman. Younger, unaffected by imagery.
Canada, Online Kotnowski, Fong, Gallopel-Morvan, Islam, & Hammond (2016)	November 2013	Cigarettes targeting women	For intention to try: pack structure, taste and harm perceptions.	For intention to try: warning label size, brand.
Lebanon, In Person AUB campus Salloum et al. (2015)	June 2012	Smoking cessation treatments	Aversion to pill. Reduced distance to pharmacy. Cessation support.	Nicotine patch. Heavy smokers and males had the lowest demand elasticity.
Jordan, Oman, Palestine, UAE, Online Salloum, Nakkash et al. (2018)	2016	Waterpipe (shisha, hookah)	Fruit-flavored varieties. Lower prices. Lower nicotine content.	Health warnings.
Systematic Review	2000-2016	Cigarettes, e-cigs, waterpipes	Monetary attributes	NA

Regmi, Kaphle, Timilsina & Tuha (2018)

Smoking: Unanswered Questions

To date, most studies that utilized experimental designs of discrete choice to assert preferences and trade-offs focused on people who are tobacco users. Furthermore, the attention on factors which could facilitate cessation were prevalent in most of the research. Only one study included nonsmokers and the factors that may entice them to join the ranks of tobacco smokers.

This study evaluates the likely impact of price increases and bans on smoking and vaping in public settings. Studies that attempt to elicit these factors under hypothetical scenarios in order to emulate a rapid-changing tobacco marketplace and existing tobacco control measures are needed. This study seeks to fill that gap.

Chapter 3

METHODOLOGY

Data Collection and Sample

The study was designed to elicit the smoking preferences of a sample of adults in the U.S. A total of 525 adults ages 18 to 88 years of age were engaged utilizing the survey software Qualtrics (Qualtrics, 2018). Qualtrics distribution service was employed to reach a national survey audience. The distribution service includes an incentive to participants for each completed survey. The survey was available in English only.

The study was approved by the Institutional Review Board.

Study Development and Measurements

The attributes were developed during face-to-face interviews with smokers and vapers in order to identify the factors they consider when using a nicotine or tobacco product. These interviews were recorded, transcribed and analyzed to incorporate in the experimental survey design.

During the development phase respondents were presented with different combinations of smoking relevant attributes. Pilot respondents were asked to make repeated choices among: 1) cigarettes, 2) cigars, 3) hookahs, and 4) e-cigarettes. We are most concerned with the trade-offs between cigarettes and e-cigarettes as a group, but we include both hookahs and cigars in the choice sets as these two popular products have different pricing schemes. Due to the inclusion of nonsmokers, the intention was to reveal preferences and conditions were contingent to latent casual or chronic use of tobacco products.

The experimental design included seven attributes, called “features” during the online survey session for each participant. The attributes were: 1) what tobacco product they smoked or would prefer to use, 2) the place where they can smoke and the people who are around, 3) kick or satisfaction from smoking, 4) cost of smoking, 5) addictiveness, 6) smell of smoke, and 7) expected long-term health risks. Indicator variables were constructed for the six (6) non-price attributes of all the tobacco products. Attributes that were studied for their impact on the enjoyment that people get from smoking and their levels are presented in table 2.

Table 2. Choice Attributes

Feature (*Attribute*)	Options
1. What are you smoking	- Cigarettes - Cigars - Hookahs - E-cigarettes Respondents may not have tried all of these, but we would like you to answer the questions based upon what you know about each of these types of smoking.
2. The place where you can smoke and the people who are around you	- Pleasant place to smoke - Okay place to smoke - Uncomfortable place to smoke The place and people who you are around can influence the respondents' choice.
3. Kick or satisfaction from smoking	- Very bad - Somewhat bad - Neutral - Somewhat good - Very good
4. Cost of the smoking	- No cost (free) - $ 0.25 per smoke - $ 0.50 per smoke - $ 1.50 per smoke - $ 5.00 per smoke Assumption: what participant has to pay for the cost of the tobacco or nicotine only. Options may be more or less than participant usually pays. This allows to know willingness to pay under different situations.
5. Addictiveness	- Not at all addictive/able to quit at any time - Moderately addictive/would be somewhat difficult to quit - Highly addictive/would be very difficult to quit Interested in understanding how important of a consideration this attribute is while many factors

	play a role in individual tobacco product addiction.
6. The smell of smoke	- Pleasant smell that quickly goes away - Odorless, no smell - Strong odor that lingers and stays on clothes
7. Long-term health risks	- No or minimal long-term health risks - Some chance (20%) of getting serious illness in the future - Moderate chance (60%) of getting serious illness in the future - High chance (90%) of getting serious illness in the future Health risks associated to the decision of whether participants engage in smoking or not.

The price of cigarettes and cigars are well described by their marginal price (i.e., price for a pack of cigarettes or for a single cigar). However, for hookahs and e-cigarettes, consumers must purchase the tobacco dose or a kit, which includes a battery package and a charger also buy bottles of e-cigarette liquid. Thus, a marginal price and a fixed price range to capture the full price of using or recharging these tobacco products, and not any additional or start up costs.

Prior to commencing the choice task of the experiment, participants were provided with an example of a fictitious completed choice set to assist respondents in understanding the choice task element. At the conclusion of the survey, participants were asked for demographic information and questions about their desire to quit, worry of cancer development and concern to becoming addicted were asked additional questions were also included.

Dependent Variables

This study investigates stated preferences of tobacco smoking by three (3) types of smoker and the nonsmoker groups and four (4) tobacco products: cigarettes, cigar, hookah, and e-cigarettes.

During the discreet choice experiment, participants successively make choices among two alternatives $(j = 1, 2)$ in hypothetical scenarios. This is abiding with the random utility theory (Mangham, Hanson, & McPake, 2009).

The classification of smokers and nonsmokers occurred in two phases. The original question during the prescreening section of the survey asked participants: Have you

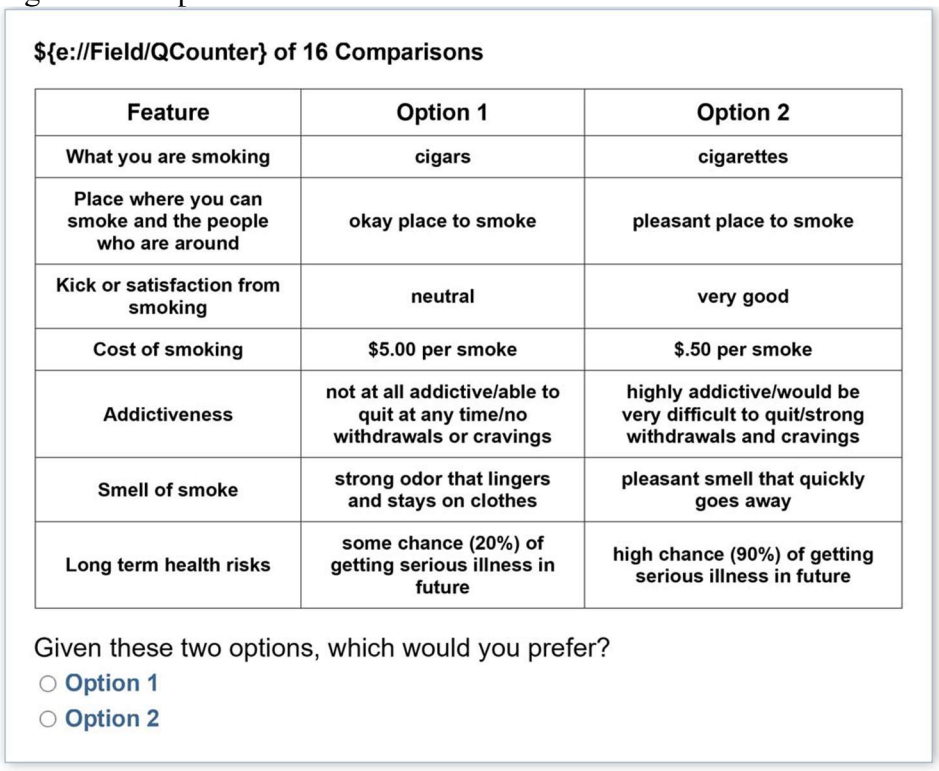
smoked in the past 30 days; survey participants were given the option of answering yes or no to having smoked cigarettes, cigars, hookahs, or e-cigarettes. Based on the smoking status prescreening question the proportion of smokers of any product was 40%, sixty percent were nonsmokers.

The survey included a post-experiment set of questions designed to elicit information about current experience and duration of smoking status. Two questions were designed for this purpose: How often do you smoke any of the following (cigarette, cigar, hookah, e-cig) now? With the answer categories of never, less than once a month, a couple of times a month, at least once a week, nearly every day. The second question was: Have you smoked 100 or more times in your life? With the options yes or no as answers.

Experimental design

Using Sawtooth Software (v 8.2.4) a total of 16 choice set designs, each with seven (7) attributes, were created. In each choice set version, respondents were asked to choose from 'Option 1' or 'Option 2'. Appendix A provides an example choice set. The full factorial design gave rise to 160 possible combinations of attributes. Participants were randomly allocated to mutually exclusive blocks of choice sets. The choices were confined to sixteen (16) per participant to prevent respondent fatigue. A sample choice set is presented in figure 1.

Figure 1. Sample choice set



${e://Field/QCounter} of 16 Comparisons

Feature	Option 1	Option 2
What you are smoking	cigars	cigarettes
Place where you can smoke and the people who are around	okay place to smoke	pleasant place to smoke
Kick or satisfaction from smoking	neutral	very good
Cost of smoking	$5.00 per smoke	$.50 per smoke
Addictiveness	not at all addictive/able to quit at any time/no withdrawals or cravings	highly addictive/would be very difficult to quit/strong withdrawals and cravings
Smell of smoke	strong odor that lingers and stays on clothes	pleasant smell that quickly goes away
Long term health risks	some chance (20%) of getting serious illness in future	high chance (90%) of getting serious illness in future

Given these two options, which would you prefer?

○ Option 1

○ Option 2

Data Analysis

Using the statistical software package Stata (v.15) descriptive statistics were obtained from the wide data imported from Qualtrics.

To first analyze the discrete choice data in which dependent variables are binary and independent variables are categorical, we will use the conditional logistic regression (CLR) model. CLR is a type of logistic regression better suited to match and create comparison groups of interest for the study (NCSS, 2018), such as eliciting preferences by priming conditions (graphic & text, text only, none) and smoking status (nonsmoker, very light smoker, light smoker heavy smoker). To accomplish this, the original dataset will be transformed into long format.

The CLR model will yield utility coefficients for each level of the attributes. The marginal utility of engaging and continuing to smoke a tobacco product is assumed to decrease as the level of coding increases, thus, the expected sign for each attribute is negative.

A second analysis will include most categorical independent variables and it will substitute the original fixed cost levels and risk with linearized continuous variables for cost and long-term health risk perception. This type of analysis will allow us to study the fixed-effects logit for this kind of panel data (StataCorp LLC, 2016) in which attribute level predictors and person level characteristics are incorporated.

Building on the linearized and smoking status models, willingness to pay (WTP) will be estimated using utility coefficients resulting from the regression. WTP will be represented in United States Dollars (USD$) and is included in the models to reflect monetary estimates by the entire sample regardless of the prime condition, and by the nonsmokers, light, and heavy smokers.

The results were analyzed for the entire sample and subsequently by smoking status. The following criteria was used to build the categories of smokers and nonsmokers:

Nonsmoker: Never smoked any tobacco product

Light Smoker: Smoked 100 or more in lifetime & Smoked in the past 30 days & Smokes Less than once per month now & Smokes a couple of times per month now

Heavy Smoker: Smoked 100 or more in lifetime & Smoked in the past 30 days & Smokes at least once per week now & Smokes nearly every day now.

Marginal Probabilities and Price Elasticity

Marginal probabilities between two choices will be calculated using the regression utility coefficients. This will assist us to asserting how the study population values comparable alternatives of tobacco products with their use and consumption attributes.

The equation to compute the marginal probabilities for tobacco product (TP) scenario comparisons (a and b) is as follows:

$$\text{TP a, b marginal probability} = \frac{\exp\ (TP\ a, b\ utility)}{\exp\ (TP\ a, b\ utility) + \exp\ (TP\ b, a\ utility)}$$

Each tobacco product elasticity based on their market share for each tobacco product will be estimated using the following (Islam, 2006):

$$\varepsilon_{ij} = \beta_p \bar{X}_p \left(\delta_{ij} - P_j\right)$$

where $\delta_{ij} = 1, when\ i = j$

$\delta_{ij} = 0, when\ i \neq j$

Research Questions

The research questions of the study are:

1. Will increasing the price of cigarettes raise the demand of e-cigarettes amongst smokers?

2. Will nonsmokers be more likely to chose vaping e-cigarettes due to the perceived addictiveness and health risks as compared to smokers?

Chapter 4

DATA ANALYSIS AND RESULTS

Sample Demographics

The Smoking Preference Discreet Choice Experiment was designed to elicit the smoking preferences of a sample of adults in the U.S. A total of 525 adults ages 18 to 88 years of age participated in the national survey.

The mean age of the participants was 46 years old (+/-16 years). Fifty-two percent (52%) of the respondents were women, and 79% were Caucasian. Most of the participants were employed and had at least some college. Table 3 includes the demographic characteristics of the study participants.

Table 3. Demographic summary of participants.

Characteristics	n	%
Sex		
Male	250	48%
Female	275	52%
Race and Ethnicity		
White	415	79%
African American	51	10%
Asian	29	6%
Latino/Latina	33	6%
Other	10	2%
Age categories		
18 - 29	102	19%
30 - 49	200	38%
50 - 64	128	24%
65 or older	95	18%
Education		
HS Diploma/GED or lower	95	19%
Some College, 2-year College Degree	197	37%
4-year College Degree	165	31%
Professional or Graduate Degree	68	13%
Household Income		
$0 to $29,999	139	27%
$30,000 to $44,999	94	18%
$45,000 to $59,999	64	12%
$60,000 to $74,999	55	10%
$75,000 to $89,999	55	10%
$90,000 or more	118	22%
Employment Status		
Employed, full time	241	46%

Employed, part time	59	11%
Unemployed	49	10%
Student, full/part time	23	4%
Retired/Disabled, Other	153	29%

Most of the participants reported having some college, and 44% have a 4-year college degree or higher. The mean household income was included in the category between $45,000 and $59,999 annually. Lastly, 46% of the sample study participants were employed full-time.

Initial Results: Conditional and Linearized Models

The first model conditional logistic regression provides the coefficient results for each attribute included in the experiment. As expected, all results had negative slopes with different degrees of magnitude. However, model 1 which includes all participants yielded positive results for somewhat and very good kicks/satisfaction, yet they were not statistically significant. Among the type of products, both cigars and hookahs were significantly the least preferred. Participants valued less uncomfortable places to smoke, very bad kicks, highly addictive tobacco products, strong odor, and tobacco products with high health risks. The cost category in model 1 was significantly valued less at the higher levels of $1.50 and $5.00 per smoke.

The results of the conditional model 1 and the linearized model 2 for all participants are reported in table 4.

Table 4. Conditional and Linearized Models for All Participants

	Model 1. Conditional β (SE)	Model 2. Linearized β (SE)	WTP
Type of Product			
Cigarette	*omitted*	*omitted*	
Cigar	-.314***(.04)	-.312***(.04)	-$2.86
Hookah	-.313***(.04)	-.303***(.04)	-$2.78
E-cigarette	-.029 (.04)	-.026 (.04)	-$0.24
Place to Smoke			
Pleasant	-.029 (.03)	-.028 (.03)	-$0.26
Okay	*omitted*	*omitted*	
Uncomfortable	-.104**(.03)	-.110**(.03)	-$1.01
Kick or Satisfaction			
Very bad	-.163***(.04)	-.160***(.04)	-$1.47
Somewhat bad	-.140**(.05)	-.145**(.04)	-$1.33
Neutral	*omitted*	*omitted*	
Somewhat good	.032 (.05)	.023 (.05)	$0.21
Very good	.035 (.05)	.027 (.04)	$0.25
Cost			
No cost (free)	*omitted*		
$0.25	-.078 (.05)		
$0.50	-.065 (.05)		
$1.50	-.231***(.04)		
$5.00	-.569***(.05)		
Linear		-.109***(.01)	-$1.00
Addictiveness			
Not at all addictive	*omitted*	*omitted*	
Moderately addictive	-.053 (.03)	-.053 (.03)	-$0.49
Highly addictive	-.201***(.03)	-.204***(.03)	-$1.87
Smell			
Pleasant	-.017 (.03)	-.019 (.03)	-$0.17
Odorless	*omitted*	*omitted*	
Strong odor that lingers	-.175***(.03)	-.171***(.03)	-$1.57
Long-term Health Risks			
No or minimal	*omitted*		
Some chance (20%)	-.286***(.04)		
Moderate chance (60%)	-.918***(.04)		
High chance (90%)	-1.33***(0.4)		
Linear		-0.14***(.00)	-$0.13

*Levels of significance: *p<.05; **p<.01; ***p<.001*

Willingness to Pay

By linearizing cost and long-term health risks in model 2, the marginal analysis was performed for each additional unit of tobacco product consumption. Preferences and

tradeoffs remained similar in slope compared to model 1 for all participants. Participants are least willing to pay (WTP) for cigars and hookahs at a -$2.86 and -$2.78 respectively, and e-cigarettes had the lowest WTP aversion with only 24 cents compared to cigarettes. As per satisfaction obtained from smoking tobacco, participants are willing to pay 21 cents and 25 cents more for 'somewhat good' and 'very good' kicks or satisfaction.

In the long-term health risks attribute, participants will be willing to pay 13 cents less for each single point increase in the chance of getting a serious illness from smoking. Thus, if the risk of getting a serious illness in the future due to smoking was to increase from 0% to 50% the willingness to pay would decrease $6.50.

Marginal Probability

We performed a marginal probability analysis between two smoking products in a worst- and best-case scenario based on the preferences stated by the entire sample of DCE participants. Using the utility coefficients from the CLR, the 81% of the study participants will prefer vaping over cigarettes (19%). The choice of this selection by the sample is attained in combination with same price to cigarettes, reduced health risks, moderately addictive, a very good kick, and no odor for vaping. See figure 2.

Smoking and Nonsmoking Models

Most tobacco use-related discrete choice experiment available literature include the preferences and tradeoffs of current smokers, very few include nonsmokers. As previously discussed, this study includes nonsmokers in its sample to assist policy and decision-makers in staving off tobacco use.

Model 3 compares the preferences and tradeoffs between nonsmokers, light smokers and heavy smokers. The conditional logistic regression for the linearized model results are included in table 5.

All groups of smokers and nonsmokers reported cigars and hookahs as their least preferred tobacco smoking option. Nonsmokers however reported a statistically significant affinity for e-cigarettes. Heavy and light smokers have a significant aversion for uncomfortable places to smoke. Light smokers dislike very bad kick or satisfaction and are less concerned with cost compared to nonsmokers and heavy smokers. Heavy smokers dislike strong tobacco odors that lingers and are the least concerned with long-term health risks.

Nonsmokers state to prefer pleasant places to smoke and somewhat and very good kicks, although the results are not statistically significant. This group reports disliking highly addictive tobacco products, as well as those with strong odors that linger and a bad kick. Nonsmokers are the most concerned with long-term health risks compared to light and heavy smokers and are more concerned with cost.

Table 5. Model by Smoking status

	Model 3.					
	Nonsmokers		Light smokers		Heavy smokers	
	β (SE)	WTP	β (SE)	WTP	β (SE)	WTP
Type of Product						
Cigarette	*omitted*		*omitted*		*omitted*	
Cigar	-.036 (.06)	-$0.30	-.742***(.09)	-$8.25	-.849***(.07)	-$7.26
Hookah	-.026 (.06)	-$0.21	-.640***(.09)	-$7.12	-.840***(.07)	-$7.18
E-cig	.163***(.06)	$1.34	-.202* (.09)	-$2.25	-.351***(.07)	-$3.00
Place to Smoke						
Pleasant	.04 (.05)	$0.33	-.132 (.08)	-$1.47	-.092 (.06)	-$0.79
Okay	*omitted*		*omitted*		*omitted*	
Uncomfortable	.02 (.05)	$0.16	-.176* (.08)	-$1.96	-.250***(.06)	-$2.14
Kick or Satisfaction						
Very bad	-.176**(.06)	-$1.44	-.233* (.10)	-$2.59	-.145 (.08)	-$1.24
Somewhat bad	-.145**(.04)	-$0.99	-.049 (.11)	-$0.55	-.096 (.16)	-$1.12
Neutral	*omitted*		*omitted*		*omitted*	
Somewhat good	.032 (.07)	$0.26	.029 (.11)	$0.32	.038 (.08)	$0.32
Very good	.060 (.07)	$0.49	-. 010 (.11)	-$0.11	.041 (.08)	$0.35
Cost						
Linear	-.122***(.01)	-$1.00	-.099***(.01)	-$1.00	-.117***(.01)	-$1.00
Addictiveness						
Not at all addictive	*omitted*		*omitted*		*omitted*	
Moderately addictive	-0.91 (.05)	-$0.75	.056 (.08)	$0.62	.009 (.060)	$0.08
Highly addictive	-.363***(.05)	-$2.98	.057 (.08)	$0.63	-.071 (.06)	-$0.61
Smell						
Pleasant	-0.86 (.05)	-$0.70	.089 (.08)	$0.99	.035 (.06)	$0.30
Odorless	*omitted*		*omitted*		*omitted*	
Strong odor	-.254***(.05)	-$2.08	-.107 (.08)	-$1.19	-.133* (.06)	-$1.14
Long-term health risks						
Linear	-.021***(.00)	-$0.17	-.009***(.00)	-$0.10	-.008***(.00)	-$0.07

*Levels of significance: *p<.05; **p<.01; ***p<.001*

Willingness to Pay by Smoking Status

As mentioned in the findings, nonsmokers prefer e-cigarettes from the other three options included in the experiment. Their willingness to pay for smoking e-cigarettes is $1.34. Nonsmokers are willing to pay $2.98 less for products that are highly addictive or very difficult to quit and will pay $2.08 less for strong odor that lingers.

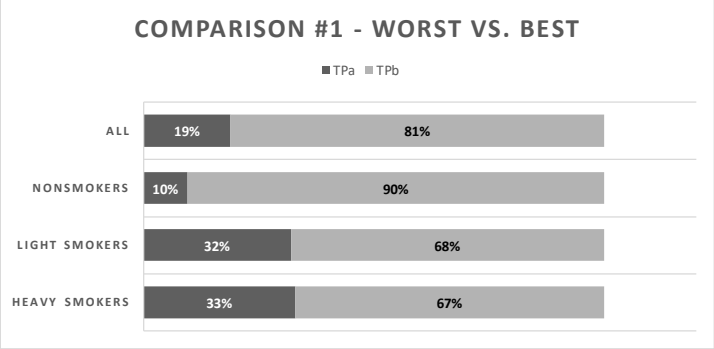
For each increase in the risk of getting a serious illness from smoking tobacco heavy smokers are willing to pay 7 cents less, light smokers 10 cents less, and nonsmokers 17 cents.

The groups of light and heavy smokers are willing to pay less for uncomfortable places to smoke at -$1.96 and -$2.14 respectively.

Marginal Probabilities to Model Tobacco Policy Options

Figure 2 shows the marginal probability of choosing between two smoking products based on preferences stated by the entire sample of DCE participants and by smoking status (nonsmokers, light smokers and heavy smokers). Comparison 1 shows that nonsmokers are the group that are the least likely to prefer cigarettes (10%) and 90% will choose to vape.

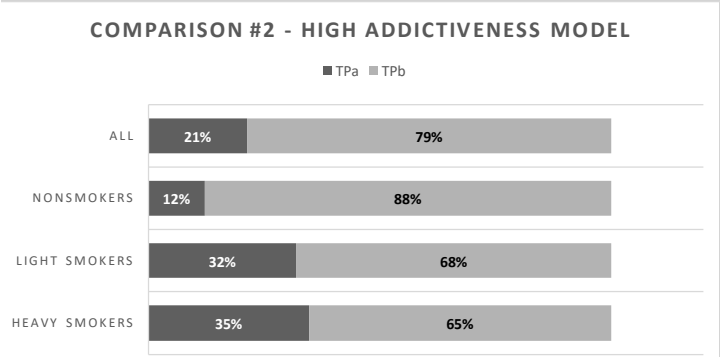
Figure 2. Marginal Probabilities of Worst vs. Best Tobacco Product by Smoking Status



Comp1. Attribute	Tobacco Product A	Tobacco Product B
Product	Cigarette	e-cigarette
Place	Uncomfortable place to smoke	Okay place to smoke
Kick	Very good	Very good
Addictiveness	Highly addictive	Moderately addictive
Odor	Strong odor that lingers	No odor
Cost	$1.00 per smoke	$1.00 per smoke
Risk of Illness	80% risk of serious illness in the future	5 % risk of serious illness in the future

We conducted further marginal analysis to explore if increasing the addictiveness perception of vaping would affect the participants' choices. Figure 3 shows comparison 2 which suggests that light smokers were relatively insensitive to highly addictive e-cigarettes, and only 2% of more nonsmokers and heavy smokers would prefer cigarettes as compared to comparison 1.

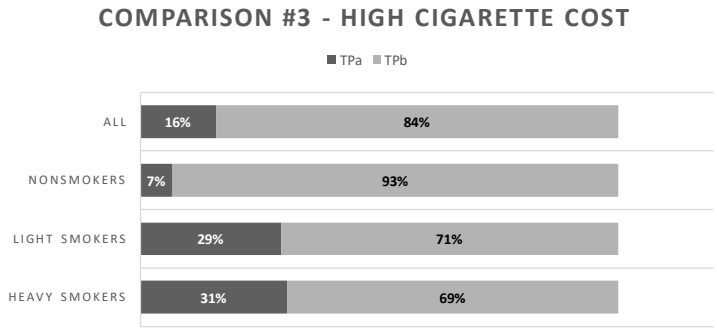
Figure 3. Marginal Probabilities of Highly Addictive Tobacco Products by Smoking Status



Comp2. Attributes	Tobacco Product A	Tobacco Product B
Product	Cigarette	e-cigarette
Place	Uncomfortable place to smoke	Okay place to smoke
Kick	Very good	Very good
Addictiveness	Highly addictive	Highly addictive
Odor	Strong odor that lingers	No odor
Cost	$1.00 per smoke	$1.00 per smoke
Risk of Illness	80% risk of serious illness in the future	5 % risk of serious illness in the future

The third comparison gets to core of the research question which seeks to test if increases in the price of cigarettes will drive people to vape. The results in figure 4 indicate that the number of study participants choosing vaping increases to 84%, suggesting that increasing the price from $1 to $4, while keeping all the other attributes the same, only decreases the probability of choosing the cigarette option by 3%.

Figure 4. Marginal Probabilities of Changing Price of Cigarettes by Smoking Status

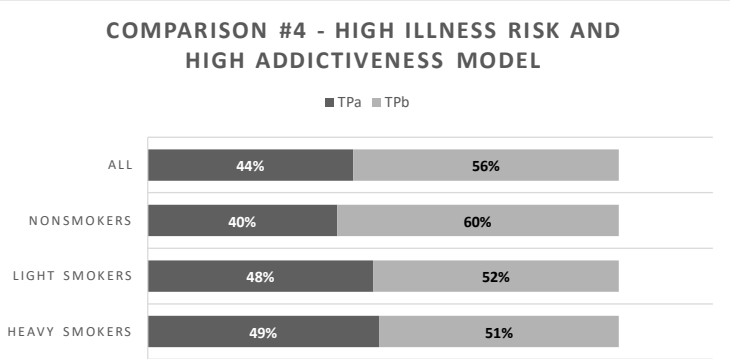


Comp3. Attributes	Tobacco Product A	Tobacco Product B
Product	Cigarette	e-cigarette
Place	Uncomfortable place to smoke	Okay place to smoke
Kick	Very good	Very good
Addictiveness	Highly addictive	Moderately addictive
Odor	Strong odor that lingers	No odor
Cost	$4.00 per smoke	$1.00 per smoke
Risk of Illness	80% risk of serious illness in the future	5 % risk of serious illness in the future

Lastly, comparison 4 (figure 5) demonstrates that changing the perception of vaping as highly addictive and as very risky to health significantly reduces the likelihood of

choosing e-cigarettes from 81% in comparison 1 to 56% for all participants, 30% reduction for nonsmokers, 16% for both light smokers and heavy smokers.

Figure 5. Marginal Probabilities of Highly Addictive and High Illness of e-cigarettes by Smoking Status



Comp4. Attributes	Tobacco Product A	Tobacco Product B
Product	Cigarette	e-cigarette
Place	Uncomfortable place to smoke	Okay place to smoke
Kick	Very good	Very good
Addictiveness	Highly addictive	Highly addictive
Odor	Strong odor that lingers	No odor
Cost	$1.00 per smoke	$1.00 per smoke
Risk of Illness	80% risk of serious illness in the future	80% risk of serious illness in the future

Market Share Elasticities

For the model which includes all study participants, the market share of cigarettes is 29%, the largest. In the same model, cigars' market share is 21.2%, hookah is 21.4%, and e-cigarettes have a share of 28.2%. At a price of $4.00 per smoke, the market share and elasticity of each tobacco product is presented in table 6 and estimated by smoking status.

Table 6. Market Share Elasticities per Tobacco Product and Smoking Status

	Cigarette	Cigar	Hookah	e-cigarette
All				
Share	29%	21%	24%	28%
Own elasticity	-.309	-.343	-.342	-.312
Nonsmokers				
Share	24%	23%	24%	29%
Own elasticity	-.369	-.373	-.372	-.348
Light Smokers				
Share	35%	17%	19%	29%
Own elasticity	-.255	-.329	-.321	-.281
Heavy Smokers				
Share	39%	17%	17%	27%
Own elasticity	-.285	-.389	-.389	-.339

At any 1% increase in the price of cigarettes would result in a decrease of .309% in own market share. Similarly, at the same percentage rate of price increase for e-cigarettes would reduce its own market share .312%. In comparison, price increases in cigars and hookahs would result in sharper percentage decreases in their own market share.

Summary

Models 1 and 2 represented both conditional logistic regression models designed to elicit the stated preferences of all participants from a national sample. Model 2 was linearized for continuous variables cost and long-term health risks. As expected, all regression coefficients were negative except for the 'somewhat good' and 'very good' levels of the kick/satisfaction attribute, yet they were not statistically significant.

Model 3 investigated the stated preferences and tradeoffs of the discrete choice experiment participants by smoking status. These included nonsmokers, light smokers and heavy smokers.

Furthermore, this study explored the marginal probability of selecting tobacco products given specific levels of attributes for best and worst scenarios, increase in prices, addictiveness, and different levels of health risks.

Chapter 5

DISCUSSION AND CONCLUSION

The goals of this study were to understand what policy-relevant tobacco smoking factors are more relevant to adult smokers and nonsmokers in the U.S. and to examine how effective policies aimed at increasing the price of tobacco products would be in reducing smoking and vaping.

Cigars and hookahs are the least preferred tobacco product. Also, the model inclusive of all participants showed that they least preferred uncomfortable places to smoke, very bad kicks or satisfaction, strong odors, and highly addictive tobacco products. Cost and long-term health risks were found to be statistically significant attributes influencing tobacco smoking in this nationwide sample participants.

When stratifying by smoking status, nonsmokers reported a strong affinity for e-cigarettes and a willingness to pay $1.34 more for smoking this type of tobacco product. Nevertheless, nonsmokers dislike strong odors, bad kicks, and tobacco products that are presented as highly addictive. When it comes to long-term health risks, the nonsmoker group stated the highest concern for getting a serious illness in the future compared to light and heavy smokers and are more concerned with cost.

Light smokers are the least concerned by cost. The group of light smokers value less cigars and hookahs thus is willing to pay less for cigars (-$8.25) and hookahs (-$7.12) compared to nonsmokers and heavy smokers. Their willingness to pay for e-cigarettes is $2.25 less.

Heavy smokers stated a significant dislike for uncomfortable places to smoke, and strong odors that linger. The group of heavy smokers are the least concerned with long-tern health risks compared to light smokers and nonsmokers. Conversely, cost is a significant attribute for heavy smokers.

Marginal analysis indicate that smokers were relatively insensitive to price increases alone, with a $3 price surge only increases the probability of vaping by 3%. This finding suggests that a combination of policies and interventions, rather than stand alone strategies, are needed to effect smoking.

Comparison to other Discrete Choice studies

Consistent with prior DCE studies e-cigarettes are perceived as the ‘least harmful’ option. This was represented in the examination of the entire sample participants and during the analysis by smoking status. Nonsmokers in this study stated a positive preference to the option of smoking e-cigarettes.

Also, presenting addictiveness as an attribute to value in tobacco products yielded results resembling past studies in which participants demonstrate a significant dislike for highly addictive products.

Although this study participants were exposed to priming conditions similar to the innate environment, interactions with the warnings were tested and did not significantly affect

the results. The reviewed literature also showed mixed results regarding the influence of warning labels that are graphic and text, text only or none.

Other DCE studies have included marginal analysis willingness to pay, however this study also included the marginal probability of selecting a tobacco product over another given specific levels of attributes related to smoking tobacco.

Significance of work

This research has taken steps forward to advancing existing knowledge of tobacco smoking stated preferences and tradeoffs for not only current smokers but also for nonsmokers. The inclusion of the latter group was intended to help advance the downward trend of tobacco use in the U.S. and remain up-to-date with the factors that may be of relevance for individuals who are not current smokers and who may be the target of new waves of tobacco products.

This is one of the very few DCEs that include people who are currently not using tobacco products. Thus, policy makers may find this analysis useful to the process of creating and implementing new policies as the results elicit the preferences and compromises that individuals are willing to make related to tobacco smoking and experimentation with tobacco products.

This study suggests that increasing the price of cigarettes would lead to an increase in the probability light and heavy smokers to switch to vaping, though the elasticities differ between heavy and light smokers. Also, these results indicate that isolated strategies may be less effective at changing smoking behavior compared to integrating a list of policies and interventions.

To conclude, these results advance our understanding about the views of current nonsmokers toward cigarettes and vaping, suggesting that price increases and increased knowledge of addiction would likely deter nonsmokers from vaping.

Limitations

This study has several limitations. First, the participant sample only included two participants who identified as Native Americans and Alaska Natives. The CDC (2018) reports that the highest rates of tobacco use are in this population. Future studies should include a larger sample of Native American populations.

Second, the study included the general category of e-cigarettes and did not differentiate between disposable and refillable products. This limitation is mitigated by the findings in existing literature that study the general category unless is to study the preferences before each individual type of e-cigarettes or vaping devices.

Third, DCEs are studies based on stated survey responses and there are studies (Pesko et al., 2016) that address research contending the results of these type of analyses as not useful to policy-making if poorly designed or relevant. This study was designed with strong internal validity checks which included pilot testing the policy-relevant attributes and levels. Furthermore, the theories formulated during the design and pilot phases were

confirmed by the regression coefficients that resulted from analyzing the experimental data.

Implications for further research

This study produced current and policy-relevant evidence useful in the design and implementation of tobacco use policies and interventions. Findings examine the preferences of individuals that are a representative sample of the U.S. population and the tradeoffs they are willing to make, thus providing significant policy insights.

Furthermore, the results of this discrete choice experiment increase the body of knowledge available to public health professionals concerned with developing evidence-based patient and community-centered interventions to address current tobacco use and prevention.

In a fast-transforming tobacco product market, public health professionals and decision makers are challenged by the limited availability of information exposing preference shifts for smokers and those considering experimentation with new tobacco products.

One of the main findings in the study points at the direction in which future DCEs could contribute to expand our understanding in the introduction of flavors in vaping. The perception that e-cigarettes are the least harmful product amongst the study participants urges to research how variations of e-cigarettes flavors affect tobacco consumption and evaluate its dynamic relevance in influencing tobacco use.

REFERENCES

Akl, E. A., Gaddam, S., Gunukula, S. K., Honeine, R., Jaoude, P. A., & Irani, J. (2010). The effects of waterpipe tobacco smoking on health outcomes: a systematic review. *International Journal of Epidemiology*, *39*(3), 834–857. https://doi.org/10.1093/ije/dyq002

Aveyard, P., Arnott, D., & Johnson, K. C. (2018). Should we recommend e-cigarettes to help smokers quit? *BMJ (Online)*, *361*. https://doi.org/10.1136/bmj.k1759

Bello, S., Menéndez, R., Antoni, T., Reyes, S., Zalacain, R., Capelastegui, A., … Ruiz-Manzano, J. (2014). Tobacco Smoking Increases the Risk for Death From Pneumococcal Pneumonia. *Chest*, *146*(4), 1029–1037. https://doi.org/10.1378/CHEST.13-2853

Bergstrom, J. (2004). Tobacco smoking and chronic destructive periodontal disease. *Odontology*, *92*(1), 1–8. https://doi.org/10.1007/s10266-004-0043-4

Boffetta, P. (2008). Tobacco smoking and risk of bladder cancer. *Scandinavian Journal of Urology and Nephrology*, *42*(sup218), 45–54. https://doi.org/10.1080/03008880802283664

Buckell, Joachim, John, M., Sindelar, J., Maclean, C., & Sindelar, J. L. (2013). *To 'Vape' or Smoke? a Discrete Choice Experiment Among U.S. Adult Smokers*. *NBRE* (Vol. 53). https://doi.org/10.1017/CBO9781107415324.004

Buckell, John, Marti, J., & Sindelar, J. L. (2019). Should flavours be banned in cigarettes and e-cigarettes? Evidence on adult smokers and recent quitters from a discrete choice experiment. *Tobacco Control*, *28*(2), 168–175. https://doi.org/10.1136/tobaccocontrol-2017-054165

Buckell, John, & Sindelar, J. L. (2019). The impact of flavors, health risks, secondhand smoke and prices on young adults' cigarette and e-cigarette choices: a discrete choice experiment. *Addiction (Abingdon, England)*, *114*(8), 1427–1435. https://doi.org/10.1111/add.14610

Centers for Disease Control and Prevention. (2018a). Current Cigarette Smoking Among Adults in the United States. Retrieved May 4, 2019, from https://www.cdc.gov/tobacco/data_statistics/fact_sheets/adult_data/cig_smoking/index.htm

Centers for Disease Control and Prevention. (2018b). Smoking is down, but almost 38 million American adults still smoke. Retrieved December 30, 2019, from https://www.cdc.gov/media/releases/2018/p0118-smoking-rates-declining.html

Chatterjee, K., Alzghoul, B., Innabi, A., & Meena, N. (2018). Is vaping a gateway to smoking: A review of the longitudinal studies. *International Journal of Adolescent Medicine and Health*. Walter de Gruyter GmbH. https://doi.org/10.1515/ijamh-2016-0033

Farrimond, H., & Abraham, C. (2018). Developing E-cigarette friendly smoking cessation services in England: Staff perspectives. *Harm Reduction Journal*, *15*(1). https://doi.org/10.1186/s12954-018-0244-8

Fielding, J., & Phenow, K. (1988). Health Effects of Involuntary Smoking. *The New England Journal of Medicine*, *319*(22), 1452–1460. Retrieved from https://www.nejm.org/doi/pdf/10.1056/NEJM198812013192205

Goodchild, M., Nargis, N., & D'Espaignet, E. T. (2018). Global economic cost of smoking-attributable diseases. *Tobacco Control*, *27*(1), 58–64. https://doi.org/10.1136/tobaccocontrol-2016-053305

Islam, T. (2006). Conjoint Analysis and Discrete Choice Experiments - Market Share Based Price Elasticity. In *Institute for Advanced Studies, Special Invited Talk* (p. 41). Vienna. Retrieved from http://statmath.wu.ac.at/people/tislam/Vienna

Katz, V. S., Ang, A., & Suro, R. (2012). An Ecological Perspective on U.S. Latinos' Health Communication Behaviors, Access, and Outcomes. *Hispanic Journal of Behavioral Sciences*, *34*(3), 437–456. https://doi.org/10.1177/0739986312445566

King, B. A., Jama, A. O., Marynak, K. L., & Promoff, G. R. (2015). Attitudes Toward Raising the Minimum Age of Sale for Tobacco Among U.S. Adults. *American Journal of Preventive Medicine*, *49*(4), 583–588. https://doi.org/10.1016/j.amepre.2015.05.012

Kotnowski, K., Fong, G. T., Gallopel-Morvan, K., Islam, T., & Hammond, D. (2016). The Impact of Cigarette Packaging Design Among Young Females in Canada: Findings From a Discrete Choice Experiment. *Nicotine & Tobacco Research*, *18*(5), 1348–1356. https://doi.org/10.1093/ntr/ntv114

Leventhal, A. M., Stone, M. D., Andrabi, N., Barrington-Trimis, J., Strong, D. R., Sussman, S., & Audrain-McGovern, J. (2016). Association of e-cigarette vaping and progression to heavier patterns of cigarette smoking. *Journal of the American Medical Association*, *316*(18), 1918–1920. https://doi.org/10.1001/jama.2016.14649

Mangham, L. J., Hanson, K., & McPake, B. (2009). How to do (or not to do)...Designing a discrete choice experiment for application in a low-income country. *Health Policy and Planning*, *24*(2), 151–158. https://doi.org/10.1093/heapol/czn047

Marti, J., Buckell, J., Maclean, J. C., & Sindelar, J. (2019a). TO "VAPE" OR SMOKE? EXPERIMENTAL EVIDENCE ON ADULT SMOKERS. *Economic Inquiry*, *57*(1), 705–725. https://doi.org/10.1111/ecin.12693

Marti, J., Buckell, J., Maclean, J. C., & Sindelar, J. (2019b). TO "VAPE" OR SMOKE? EXPERIMENTAL EVIDENCE ON ADULT SMOKERS. *Economic Inquiry*, *57*(1), 705–725. https://doi.org/10.1111/ecin.12693

Miech, R., Johnston, L., O'Malley, P. M., Bachman, J. G., & Patrick, M. E. (2019). Trends in Adolescent Vaping, 2017–2019. *New England Journal of Medicine*, *381*(15), 1490–1491. https://doi.org/10.1056/NEJMc1910739

Minh, H. Van, Chung, L. H., Giang, K. B., Duc, D. M., Hinh, N. D., Mai, V. Q., … Yang, J.-C. (2016). Potential Impact of Graphic Health Warnings on Cigarette Packages in Reducing Cigarette Demand and Smoking-Related Deaths in Vietnam. *Asian Pacific Journal of Cancer Prevention : APJCP*, *17*(S1), 85–90. https://doi.org/10.7314/apjcp.2016.17.s1.85

NCSS. (2018). Conditional Logistic Regression. In *NCSS Statistical Software* (p. 1). NCSS. Retrieved from https://ncss-wpengine.netdna-ssl.com/wp-content/themes/ncss/pdf/Procedures/NCSS/Conditional_Logistic_Regression.pdf

Ong, M. K., & Glantz, S. A. (2004). Cardiovascular health and economic effects of smoke-free workplaces. *The American Journal of Medicine*, *117*(1), 32–38. https://doi.org/10.1016/j.amjmed.2004.02.029

Pesko, M. F., Kenkel, D. S., Wang, H., & Hughes, J. M. (2016). The effect of potential electronic nicotine delivery system regulations on nicotine product selection. *Addiction*, *111*(4), 734–744. https://doi.org/10.1111/add.13257

Pitard, A., Brennan, P., Clavel, J., Greiser, E., Lopez-Abente, G., Chang-Claude, J., … Boffetta, P. (2001). Cigar, pipe, and cigarette smoking and bladder cancer risk in European men. *Cancer Causes and Control*, *12*(6), 551–556. https://doi.org/10.1023/A:1011291015233

Qualtrics. (2018). Qualtrics Online Survey Software. Retrieved December 8, 2018, from https://www.qualtrics.com/research-core/survey-software/

Regmi, K., Kaphle, D., & Timilsina, S. et al. (2018). Application of Discrete-Choice Experiment Methods in Tobacco Control: A Systematic Review. *PharmacoEconomics Open*, *2*, 5–17. https://doi.org/https://doi.org/10.1007/s41669-017-0025-4

Regmi, K., Kaphle, D., Timilsina, S., & Tuha, N. A. A. (2018). Application of Discrete-Choice Experiment Methods in Tobacco Control: A Systematic Review. *PharmacoEconomics - Open*, *2*(1), 5–17. https://doi.org/10.1007/s41669-017-0025-4

Salloum, R. G., Abbyad, C. W., Kohler, R. E., Kratka, A. K., Oh, L., & Wood, K. A. (2015). Assessing Preferences for a University-Based Smoking Cessation Program in Lebanon: A Discrete Choice Experiment. *Nicotine & Tobacco Research*, *17*(5), 580–585. https://doi.org/10.1093/ntr/ntu188

Salloum, Ramzi G, Louviere, J. J., Getz, K. R., Islam, F., Anshari, D., Cho, Y., … Thrasher, J. F. (2018). Evaluation of strategies to communicate harmful and potentially harmful constituent (HPHC) information through cigarette package inserts: a discrete choice experiment. *Tobacco Control*, *27*(6), 677–683. https://doi.org/10.1136/tobaccocontrol-2016-053579

Salloum, Ramzi G, Maziak, W., Hammond, D., Nakkash, R., Islam, F., Cheng, X., & Thrasher, J. F. (2015). Eliciting preferences for waterpipe tobacco smoking using a

discrete choice experiment: implications for product regulation. *BMJ Open*, *5*(9), e009497. https://doi.org/10.1136/bmjopen-2015-009497

Salloum, Ramzi G, Nakkash, R., Abu-Rmeileh, N. M. E., Hamadeh, R. R., Darawad, M. W., Kheirallah, K. A., … Thrasher, J. F. (2018). Individual-level determinants of waterpipe smoking demand in four Eastern-Mediterranean countries. *Health Promotion International*. https://doi.org/10.1093/heapro/day084

Shang, C., Huang, J., Chaloupka, F. J., & Emery, S. L. (2018). The impact of flavour, device type and warning messages on youth preferences for electronic nicotine delivery systems: evidence from an online discrete choice experiment. *Tobacco Control*, *27*(e2), e152–e159. https://doi.org/10.1136/tobaccocontrol-2017-053754

Sindelar, J. L., Marti, J., & Buckell, J. (2017). *Should flavors be banned in E-cigarettes?*

StataCorp LLC. (2016). Conditional (fixed-effects) logistic regression. Retrieved from https://www.stata.com/manuals13/rclogit.pdf

Thrasher, J. F., Anshari, D., Lambert-Jessup, V., Islam, F., Mead, E., Popova, L., … Lindblom, E. N. (2018a). Assessing Smoking Cessation Messages with a Discrete Choice Experiment. *Tobacco Regulatory Science*, *4*(2), 73–87. https://doi.org/10.18001/TRS.4.2.7

Thrasher, J. F., Anshari, D., Lambert-Jessup, V., Islam, F., Mead, E., Popova, L., … Lindblom, E. N. (2018b). Assessing Smoking Cessation Messages with a Discrete Choice Experiment. *Tobacco Regulatory Science*, *4*(2), 73–87. https://doi.org/10.18001/TRS.4.2.7

Thrasher, J., Islam, F., Davis, R., Popova, L., Lambert, V., Cho, Y., … Hammond, D. (2018). Testing Cessation Messages for Cigarette Package Inserts: Findings from a Best/Worst Discrete Choice Experiment. *International Journal of Environmental Research and Public Health*, *15*(2), 282. https://doi.org/10.3390/ijerph15020282

U.S. Surgeon General Office Department of Health and Human Services. (2014). *Chapter 12 Smoking-Attributable Morbidity, Mortality, and Economic Costs*. Retrieved from https://www.surgeongeneral.gov/library/reports/50-years-of-progress/sgr50-chap-12.pdf

van Osch, F. H., Jochems, S. H., van Schooten, F.-J., Bryan, R. T., & Zeegers, M. P. (2016). Quantified relations between exposure to tobacco smoking and bladder cancer risk: a meta-analysis of 89 observational studies. *International Journal of Epidemiology*, *45*(3), 857–870. https://doi.org/10.1093/ije/dyw044

Watson, D., Glover, M., McCool, J., Bullen, C., Adams, B., & Min, S. (2013). Impact of national smokefree environments laws on teachers, schools and early childhood centres. *Health Promotion Journal of Australia*, *22*(3), 166. https://doi.org/10.1071/HE11166

World Health Organization. (2016). *The economic burden of lung disease*. *European Respiratory Society*.

World Health Organization. (2017). Tobacco control economics. *WHO*. Retrieved from https://www.who.int/tobacco/economics/background/en/

Yang, J. J., Yu, D., Wen, W., Shu, X.-O., Saito, E., Rahman, S., … Zheng, W. (2019). Tobacco Smoking and Mortality in Asia. *JAMA Network Open*, *2*(3), e191474. https://doi.org/10.1001/jamanetworkopen.2019.1474