EFFECT OF INTERNET AND CONVENTIONAL ADVERTISEMENT EXPOSURE ON ELECTRONIC CIGARETTE USE AMONG ADOLESCENTS:
FINDINGS FROM THE NATIONAL YOUTH TOBACCO SURVEY

by

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A DISSERTATION

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ABSTRACT

**Background:** The use of e-cigarettes has increased dramatically among American adolescents since 2011 and has become a major public health concern. About 2.4 million middle and high students were current (past 30 days) users of electronic cigarettes or e-cigarettes in 2014 (CDC, 2017a). Exposure to e-cigarette advertisements may be a contributing factor to the sharp rise in e-cigarette use among adolescents, as 69% of middle and high school students reported to have exposure to e-cigarette advertisements on the Internet, in convenience stores, in magazine or newspapers, and on television (CDC, 2017a). **Purpose:** To examine the impact of Internet and conventional advertisement exposure on use of e-cigarettes among American adolescents. To investigate the individual, interpersonal, community and policy factors associated with e-cigarette use. **Methods:** This study is a secondary data analysis of data originating from the 2017 National Youth Tobacco Survey (NYTS). This database is an annual, school-based, cross-sectional survey that collects information on major tobacco use indicators from middle school (grade 6-8) to high school (from grade 9 to 12) students. **Results:** Out of the 17,872 adolescents included in the analysis, most participants were White (44.1%). A sample of racial and ethnic minority youths also participated: 25.8% Hispanic, 16.7% African American, and 10.9% other. Approximately 20% of the youths in the study reported e-cigarette use. The relationships between e-cigarette use and current cigarette smoking status, age, race, grade in school, perceived harmfulness, perceived addictiveness, presence of tobacco user in household, Internet advertisement exposure, access to tobacco products and warning label exposure were all significant (p<0.001). Specifically, Internet advertisement exposure was significantly associated
with e-cigarette use (p<0.001). Participants who were “always” exposed to Internet e-cigarette advertisements were 2.15 times more likely to use e-cigarettes than those who were never exposed (OR=2.15; 95% CI [1.72, 2.70]; p<0.001). **Conclusion:** Internet advertisement exposure exerts a greater impact on e-cigarette use than other conventional advertisement methods. Health educators and health professionals should educate the target population about the harms of e-cigarette use at an early stage of adolescence, and serve as advocates for policy changes regarding tighter regulations on e-cigarette advertisements, especially on the Internet.
DEDICATION

I would like to dedicate my dissertation to my parents, Henry and Tammy Leung. This project would have been impossible without their unconditional love and support. Even though you are halfway across the globe, you are always on my mind. Thank you for supporting my pursuit of a new life and a new career in the United States.

I would also like to dedicate this project to my husband, James, who is the love of my life. Thank you for being so patient and understanding throughout the process. Whenever I was down, you were always there to lift me up. When I stumbled over obstacles in my research, you encouraged me to find ways to solve the problems. When I was tired and frustrated, you were the best cheerleader who motivated me to persevere and to never give up. I love you forever babe.

To Connie, thank you for being the sister I never had. Thank you for all the advice and encouragement throughout the years. It was not easy for me to reboot my whole life and career in a different country, and I could not have made it without our daily texting and endless laughs. I am truly blessed to have a sister to keep me sane. Lastly, to all my friends who have helped me along the way (Terence, Mala, Hewa, Sara, Becca), I dedicate my dissertation to you as well. Thank you for your friendship and support.
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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>AA</td>
<td>African American</td>
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<tr>
<td>ALA</td>
<td>American Lung Association</td>
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<td>CDC</td>
<td>Centers for Disease Control and Prevention</td>
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<td>E-cigarette</td>
<td>Electronic cigarette</td>
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<td>NCI</td>
<td>National Cancer Institute</td>
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<td>NIH</td>
<td>National Institutes of Health</td>
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<td>NYTS</td>
<td>National Youth Tobacco Survey</td>
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<tr>
<td>SAS</td>
<td>Statistical Analysis System</td>
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<td>SEM</td>
<td>Socio-ecological Model</td>
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<tr>
<td>SPSS</td>
<td>Statistical Package for the Social Sciences</td>
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<tr>
<td>USDHHS</td>
<td>United States Department of Health &amp; Human Services</td>
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<td>WHO</td>
<td>World Health Organization</td>
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<tr>
<td>df</td>
<td>Degree of Freedom</td>
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<td>N</td>
<td>Participants in the total sample</td>
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<td>n</td>
<td>Participants in a portion of the sample</td>
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<tr>
<td>p</td>
<td>P-value: probability associated with the occurrence under the null hypotheses of a value of extreme as or more extreme than the observed value</td>
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<td>SD</td>
<td>Standard Deviation</td>
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<td>Less than</td>
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ACKNOWLEDGMENTS

“That who always have a sense of appreciation and gratitude never reach an impasse in life.”

– Daisaku Ikeda

This inspiring quote from President Ikeda of Soka Gakkai is one of my favorites about gratitude. Nichiren Buddhism teaches us that each person has within one self the courage, wisdom and compassion to face and surmount all challenges in life and we should always be grateful for the help we received. There are many people that have my eternal gratitude for their contribution to my time in graduate school at the University of Alabama. To Dr. Birch, thank you for meeting with me, a girl from Hong Kong who knocked on your office door in the summer of 2015, when I expressed my interest in earning a Ph.D. Your wisdom, love of teaching and passion for health education truly inspired me. Thank you for giving me the opportunity to further my studies and discover my passion for teaching.

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CHAPTER 1
INTRODUCTION

Electronic cigarettes are devices that produce an aerosol by heating up a liquid that usually contains nicotine, which is the addictive drug found in regular cigarettes, cigars and other tobacco products (CDC, 2018). Flavorings and other chemicals could be added to produce the aerosol, which is inhaled by the user. Electronic cigarettes are also commonly called “e-cigarettes”, “vapes”, “tank systems” and “electronic nicotine delivery system” (ENDS). E-cigarettes come in many shapes and sizes, and may be shaped as a cigarette, pen, USB stick and other everyday items (CDC, 2018).

The use of e-cigarettes has increased dramatically among American adolescents since 2011 and has become a major public health concern. About 2.4 million middle and high students were current (past 30 days) users of electronic cigarettes, or e-cigarettes in 2014 (CDC, 2017a). E-cigarettes have surpassed other tobacco products and emerged as the most popular tobacco/nicotine product used by high school (13.4%) and middle school (3.9%) students (Arrazola et al., 2015). While electronic cigarettes could be considered less harmful than combustible cigarettes due to the lack of tar, the e-cigarette aerosol still contains harmful substances like nicotine, diacetyl, ultrafine particles, carcinogens and heavy metals such as nickel, tin and lead (CDC, 2018). Nicotine is highly addictive and can harm adolescent brain development, while the ultrafine particles and carcinogenic chemicals can cause damage to the lungs (CDC, 2018). Moreover, recent research found that E-cigarette use is associated with sustained cigarette use later in life (Bold, K. W., 2018). E-cigarette advertising expenditures have
increased rapidly from approximately $6.4 million in 2011 to $115 million in 2014 in the United States (Singh, T., 2016). Approximately 18.3 million American middle and high school students were exposed to at least one source of e-cigarette advertising in 2014 (Singh, 2016). Exposure to e-cigarette advertisements may be a contributing factor to the sharp rise in e-cigarette use among adolescents, as 69% of middle and high school students reported to have exposure to e-cigarette advertisements on the internet, in convenience stores, in magazine or newspapers, and on television (CDC, 2017a). The 2016 National Youth Tobacco Survey (NYTS) indicated this worrying trend is actually worsening, with 78.2% of youth – 20.5 million middle and high school students – reported exposure to e-cigarette advertisements from at least one source (Marynak, Gentzke, Wang, Neff & King, 2018).

Tobacco product advertisements may entice youth to experiment with tobacco products. E-cigarette manufacturers are using various tactics to reach their target youth consumers including placing advertisements using conventional methods via newspaper, magazines, in stores and on television (Marynak et al., 2018). A randomized trial has shown that e-cigarette advertisements on television are very effective. In this study, exposure of adolescent e-cigarette non-users to TV ads led to a 50 percent higher intentions to use e-cigarettes than those who were not exposed (Farelly, 2015). A study published in Pediatrics estimated e-cigarette advertisements may be able to permeate an audience up to 24 million youth. This same study found that exposure of youth to e-cigarette advertisements increased by 256 percent from 2011 to 2013 (Duke, 2014).

E-cigarette manufacturers are also using online marketing as their latest tool to reach youths. The congressional report published in 2014 found that many e-cigarette manufacturers market their products extensively using social media and websites like Facebook, YouTube,
Instagram and Twitter (Gateway to Addiction, 2014). E-cigarette companies are placing ads on search engines and websites that specialize in entertainment, music and sports to ensure their visibility to youth and young adult audience. A study found that during a two-onth period, nearly 74,000 tweets were made about e-cigarettes, most being tweeted by a few commercial enterprises to maintain a strong presence on social media (Jidong Huang, 2014). According to the 2016 NYTS, it was found that 40.6% of high school students have been exposed to online e-cigarette advertisements (Marynak et al., 2018).

The Healthy People 2020 initiative specifically calls for attention in the reduction in the proportion of adolescents in grade 6 through 12 who are exposed to tobacco marketing on the internet (Healthy People 2020, 2018). In 2009, the baseline of 36.8% of adolescents in grades 6 through 12 were exposed to tobacco marketing on the Internet, which is higher than the 33.1% target set by the Healthy People 2020 initiative (Healthy People 2020, 2018). One of the main objectives is the reduction in the initiation of tobacco products in adolescents. In 2015, about 5% of adolescents aged 12 to 17 who had not previously used tobacco products first initiated use in the past 12 months. The Healthy People 2020 target is set at 3% and it has yet to be achieved (Healthy People 2020, 2018). This shortcoming highlights the importance of examining the effects of online advertising on non-smoker adolescents’ use of e-cigarettes.

**Statement of Problem**

The 2016 Surgeon General report stated that continued research is warranted to examine the pattern and reasons of initiation in smoking e-cigarettes among adolescents (*E-cigarette use among youth and young adults: a report of the Surgeon General*, 2016). Strong evidence has established that advertising for conventional cigarettes increases initiation among never users, discourages quit attempts in current users, and encourages relapse in those trying to quit (NCI,
2008; USDHHS, 2012). However, very few studies have focused on e-cigarette advertising in particular and additional research is recommended (E-cigarette use among youth and young adults: a report of the Surgeon General, 2016).

There is an apparent lack of recent research which focus specifically on the impact of Internet advertisements on the use of e-cigarette among US adolescents. Previous studies have examined data from the 2014 National Youth Tobacco Survey (NYTS) and found a strong association between exposure to e-cigarette advertising and youth susceptibility to use e-cigarettes (CDC 2016a; Mantey et al., 2016). One study investigated the combined effect of advertisement exposure on intention to use e-cigarette using the 2014 dataset but did not analyze the effect of Internet advertisements (Stroup & Branstetter, 2018). The combined effect included tobacco marketing via Internet, newspaper or magazine, inside stores and on television (Stroup & Branstetter, 2018). The impact of Internet e-cigarette advertisements require further investigation as e-cigarette companies market their products extensively online and maintain a strong visible presence on social media sites that are popular among American youths (Campaign for Tobacco-Free Kids, 2018). The present study aims to fill the gap in knowledge by focusing on the effect of online marketing on the actual use of e-cigarettes among middle and high school adolescents, based on data from the recent 2017 National Youth Tobacco Survey.

**Purpose of the study**

The purpose of this study was to examine the effect of Internet and conventional (via newspaper/magazines, stores and television) advertisement exposure on e-cigarette use among a national sample of American adolescents. Using the socio-ecological model as framework, other factors from the NYTS survey were examined for their relationship with e-cigarette use.
Theoretical framework

Socio-ecological model. This theoretical model originated from the work of a developmental psychologist, Urie Bronfenbrenner who asserted that the entire ecological system must be considered in order to understand human development (Bronfenbrenner, U., 1974). The five subsystems or layers of this ecological model include the microsystem, mesosystem, exosystem, macrosystem and chronosystem (Sharma, 2017).

The concept of ecological approach has been applied in many health promotion program planning where multiple factors could influence health behavior and these various factors also interact among themselves. The generic social-ecological model consists six levels. The first level is the Individual level, which includes factors like knowledge, attitudes, beliefs, personality traits, skills, perceptions and self-efficacy (McLeroy et al., 1988). The second set of factors is the Interpersonal level, which include external factors like relationships with family, friends and peers. These relationships shape our social identity and support systems, and define our role within the social structure (McLeroy et al., 1988).

In some but not all ecological models, there are factors at the Institutional level that affect certain health behaviors. These are often the rules, regulations and policies of informal structures or organizations (McLeroy et al., 1988). Examples include rules within school, worksites and healthcare systems.

The Community level factors include the social norms and networks, or standards of behavior that exist among individuals, groups, or organizations (McLeroy et al., 1988). Examples of community level factors related to tobacco control include mass media and advertising, accessibility to tobacco products in the local stores in the community, restriction of tobacco use and local reinforcement of such restrictions in public places, worksites and schools.
(Corbett, 2001). The *Policy level* factors are broader factors that encourage or discourage specific health behaviors in the society (Hayden, 2014). Examples of policy level factors related to tobacco prevention include warning labels on tobacco products, smoke-free laws, taxes and restriction of sales to minors (Corbett, 2001; Kalkhoran, 2018).

Several studies have used the socio-ecological model (SEM) to examine factors that are associated with tobacco use initiation among youths (Corbett, 2001; Kalkhoran, 2018). Other studies have also used the SEM to study nicotine replacement therapy use (King, 2018), tobacco, drug and alcohol use among youths (Williams, R. D., 2012). According to Kalkhoran (2018), multiple factors influence the initiation and maintenance of tobacco use among adolescents and the SEM provided a framework to assess factors at each level, organized in ascending order of individual, interpersonal, community and policy level (Kalkhoran, 2018). Additionally, Corbett et al. found that a social ecological approach to tobacco prevention calls for interventions at multiple levels of the model and promising results have been experienced in large-scale programs (e.g., ASSIST; California, Florida state programs) (Corbett, 2001). Therefore, the SEM was selected as the theoretical framework for the present study to identify which individual, interpersonal, community and policy level factors are associated with e-cigarette use among a national sample of adolescents.

The analytic approach that was used in the current study involved the identification of factors at each of the four levels of the SEM. Individual, interpersonal, community and policy factors were selected from the NYTS survey and the factors would serve as independent variables in the statistical analyses. The outcome variable of interest was *e-cigarette use*, which was defined as having used electronic cigarettes for more than one day among the adolescents surveyed.
Independent variables

**Moderating factors.** Individual factors included demographic information such as age (9 to 19 years old or older), gender (male, female), self-reported ethnicity (Hispanic or Non-Hispanic) and self-reported race (African-American [AA], White, Asian, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander).

**Individual factors.** Individual factors included individual knowledge, attitudes and beliefs. Predictor variables included perceived harmfulness (no harm, little, some or a lot of harm) and perceived addictiveness (less addictive, equally addictive or more addictive than cigarettes).

**Interpersonal factor.** Interpersonal factors included the presence of tobacco user in household (Yes or No).

**Community factors.** Community factors included Internet advertisement exposure (Never/I do not use the internet, Rarely, Sometimes, Most of the time, Always), conventional advertisement exposure (Never/ I have not been exposed, Rarely, Sometimes, Most of the times, Always), and accessibility to tobacco products in a store (Easy, somewhat easy, not easy at all).

**Policy factors.** Policy factors included e-cigarette warning label exposure (Never/I did not see an e-cigarette package, Rarely, Sometimes, Most of the time, Always).

Dependent variables

The outcome variable of interest is the behavior of e-cigarette use, which is measured as a dichotomous variable derived from item 30 in the 2017 NYTS, which asked “In total, on how many days have you used e-cigarettes in your entire life?” Response options included 0 days which was recoded as no e-cigarette use. Responses of e-cigarette use for 1 days or more were recoded as yes for e-cigarette use.
Research Questions

The research questions in this study include:

1) What is the relationship between Internet advertisement exposure and e-cigarette use?

2) What is the relationship between conventional advertisement exposure and e-cigarette use?
   a. Via newspaper or magazines
   b. Via stores
   c. Via television
   d. Via combination of Internet, newspaper/magazines, stores and television

3) What moderating factors (e.g., age, sex, race/ethnicity, grade) and individual factors (e.g. perceived harmfulness, perceived addictiveness) are associated with e-cigarette use?

4) Is the presence of a tobacco user in the household associated with e-cigarette use? (interpersonal level factor)

5) Is the accessibility to tobacco products in stores associated with e-cigarette use? (community level factor)

6) Is the exposure to warning labels associated with e-cigarette use? (policy level factor)

7) What is the relationship between all the significant factors identified and e-cigarette use?

8) What are the top three self-reported reasons for using e-cigarettes among adolescents?
Significance of the Study

Electronic cigarettes have replaced conventional cigarettes as the most popular tobacco product used by high school and middle school students since 2014 (Arrazola, 2015). Therefore, the future of tobacco use prevention lies in the deeper understanding of the various factors that are associated with initiation of e-cigarettes use. Using the socio-ecological model as a framework, various factors at each level were investigated.

This is the first documented study to analyze data from the 2017 National Youth Tobacco Survey (NYTS) with special focus placed on Internet e-cigarette advertisement instead of conventional advertisement methods. Due to the lack of regulation on marketing of e-cigarettes in the U.S. and the increasing availability of e-cigarette related information online, it is crucial to investigate the effect of online advertising on the use of e-cigarettes (E-cigarette use among youth and young adults: a report of the Surgeon General, 2016). Initiation of e-cigarette use among adolescent non-smokers is an important public health issue as it could be associated with future sustained tobacco use. This study would have great impact to the field of health education and promotion in providing valuable insights to the future considerations in tobacco prevention, at both the national and global level.

Scope of the Study

This study employed a cross-sectional survey design and utilized data from the 2017 National Youth Tobacco Survey (NYTS). This national survey was an annual, school-based survey that collected information on major tobacco use indicators from middle school (grade 6-8) to high school (grade 9 to 12) students (CDC/NYTS, National Youth Tobacco Survey, 2017). Specific questions were tailored to measure various objectives aimed to reduce tobacco use and initiation of use among adolescents. The socio-ecological model provided a robust theoretical
framework and factors at each level were examined. The outcome variable of interest would be the behavior of e-cigarette use.

**Delimitations**

Delimitations of this study were as follows

1) This study population included all the students currently enrolled at the middle (grade 6-8) or high school (grade 9-12) level. We chose to use the NYTS database in its entirety and not used a subset of the sample. All of the individuals surveyed and provided valid responses were included.

2) The use of the socio-ecological model as the theoretical framework for this study.

   Although it is a broad and widely used model for tobacco control, our analysis is limited to factors included in this particular model.

3) The focus on exposure to advertisement may have limited our analysis and we may have overlooked other variables that may impact e-cigarette use in the dataset as a result.

**Assumptions**

1) The NYTS provides data that are representative of all middle school and high school students in the 50 states and the District of Columbia.

2) Participation in the NYTS was voluntary at both the school and student levels.

   Participants were assumed to understand the purpose, procedures and questions in the NYTS.

3) For the NYTS questionnaire, individuals provided accurate and honest self-reported responses to questions.
Limitations

Limitations of this study were as follows:

1) The NYTS is a cross-sectional survey. Causal associations cannot be made.

2) This study used data collected in 2017; hence, the data may not reflect the current extent of e-cigarette use in United States.

3) Participants were asked to recall the use of tobacco products in the past 30 days or in their entire lifetime, which can introduce some recall bias.

4) As the NYTS was performed in a school setting, participants may provide socially acceptable answers or report more desirable behaviors they thought the researcher prefer, which could lead to social desirability bias.

5) Participants may have difficulty in understanding the terminology or vocabulary used in the survey, which could lead to question bias.

Definition of Terms

E-cigarettes: Short form for Electronic cigarettes, which are also known by many different names. These devices are sometimes called “e-cigs,” “e-hookahs,” “mods,” “vape pens,” “vapes,” “tank systems,” and “electronic nicotine delivery systems (ENDS).” Most of the devices consist of a battery, a heating element and a place to hold a liquid. E-cigarettes produce an aerosol by heating the liquid, which usually contains the addictive drug nicotine and flavorings such as diacetyl. As a result, the aerosol produced that users breathe from the device contain harmful substances such as nicotine, flavoring, volatile organic compounds, ultrafine particles, carcinogens and heavy metals such as nickel, tin and lead (CDC, 2018).
**E-cigarette use:** The behavioral construct of e-cigarette use refers to the ever use of electronic cigarettes for one day or more. For our study, the outcome variable of e-cigarette use is derived from item 30 of the NYTS, which asked “In total, on how many days have you used e-cigarettes in your entire life?”. Responses of 1 day to over 100 days were redefined as *yes* for e-cigarette use. Responses of 0 days were redefined as *no* for e-cigarette use.

**Internet advertisement:** Also referred to as online advertisement, online marketing or web advertising. Advertising aims to disseminate information to affect a buyer-seller transaction. Internet advertising uses the Internet as a medium and differs from other mediums by enabling consumers to directly interact with the advertisement (Zeff, 1999). A consumer could click on an ad for more information, or take the next step and purchase the product online in the same session. Internet advertising enables the manufacturers to precisely target an audience, allowing them to deliver advertisements that are customized to the user’s interest and preferences (Internet Advertising Revenue Report (1999), Internet Advertising Bureau). For the purpose of our study, Internet advertisement is defined as any kind of ads or promotions seen on the Internet.

**Conventional advertisement:** Also referred to as traditional advertising or conventional marketing. Conventional advertisements reach their audience via a variety of mediums such as newspaper, radio, cable or broadcast television, in shops or outdoor billboards (Chao, 2012). For the purpose of our study, conventional advertisement is defined as advertisements seen in newspaper or magazine, at a convenience store, supermarket, or gas station and on television.
Socio-ecological Model: A theoretical framework for categorizing internal and external factors into levels of influence organized into individual, interpersonal, community and policy level (Kalkhoran, 2018).
CHAPTER 2
LITERATURE REVIEW

This chapter is a review of existing literature on the prevalence and pattern of electronic cigarettes use among adolescents. The current trends and regulations in e-cigarette advertisements were summarized. Additionally, the various health effects of e-cigarette use and the economic impact of e-cigarette use were discussed. The current study used the SEM as the theoretical framework and the determinants for the use of e-cigarettes were discussed. For this literature review, the SCOUT search engine of the University of Alabama library system, along with other electronic databases including EBSCO Host, PubMed, Google Scholar and Medline were used.

Definition of Electronic Cigarettes and Associated Products

E-cigarette is defined as a device that has the shape of a pen, cigar, cigarettes, USB sticks or everyday items and does not contain tobacco (NCI, 2018). E-cigarettes are known by many names which are sometimes used interchangeably, such as “e-cigs,” “e-hookahs,” “vape pens,” “vapes,” “mods,” “tank systems,” and “electronic nicotine delivery systems (ENDS)” (CDC, 2018). E-cigarettes usually consist of three components: a battery, a heating element and a place that hold a liquid (CDC, 2018). The e-cigarette produces an aerosol by heating up the liquid that usually contain nicotine- the addictive substance found in other tobacco products such as cigarettes and cigars (CDC, 2018). E-cigarettes could be used to smoke a variety of substances such as alcohol, marijuana, synthetic THC (tetrahydrocannabinol), powdered cocaine, heroin, ecstasy, hallucinogen and misused prescription drugs (Kenne, D. R., Fischbein, R. L., Tan, A. S.,
& Banks, M. (2017). The act of using an e-cigarette is commonly referred to as “vaping” or “juuling” (CDC, 2018). The word “vaping” could be misleading as the devices produce an aerosol, not a vapor (Truth Initiative, 2018). Unlike vapor, which is defined as a substance in its gaseous form, aerosol is in fact a mixture of nicotine, ultrafine particles, flavorings, volatile organic compounds, carcinogens and heavy metals (CDC, 2018). The term “juuling” is derived from the e-cigarette brand JUUL, which is a device shaped like a USB flash drive and it is equipped with a rechargeable battery with a USB dock for recharging (CDC, 2018).

JUUL is currently the top selling brand in the United States (CDC, 2018) and it has taken 68% of e-cigarette market share as measured by Nielsen (Truth Initiative, 2018). All JUUL products contain high levels of nicotine. The nicotine refill cartridges are called “pods”, which are available in many flavors including Cool Cucumber, Fruit Medley, Mango and Mint (CDC, 2018) . One single JUUL pod contains as much nicotine as 20 cigarettes according to the manufacturer of JUUL (Willett, J. G., 2019). JUUL has established itself as a leader in the market of e-cigarettes and its sleek, high tech design has inspired many copycat products. The Sourin Drop and myblu™ follow JUUL’s high tech look (Truth Initiatives, 2018); also the MarkTen, a nicotine delivery device and the PAX Era, a marijuana delivery device closely resemble the JUUL device (CDC, 2018).

Most e-cigarettes contain nicotine, the addictive substance found in cigarettes, cigars and smokeless tobacco (ALA, 2018). Nicotine is highly addictive and research suggest it is as addictive as alcohol, nicotine, heroin and cocaine (ALA, 2018). According to the 2014 U.S. Surgeon General’s report, nicotine exposure during pregnancy could harm the development of the brain and lung function in the fetus. Nicotine exposure during pregnancy is linked to low birthweight, preterm delivery and stillbirth (Surgeon General’s report, 2014). Nicotine not only
has negative impacts on brain development in children but also in adolescents and young adults (ALA, 2018). Up till age of 25, the human brain is still developing and nicotine use has been linked with lasting behavioral and cognitive impairments including working memory and inattention (ALA, 2018).

The aerosol liquid is known as “e-liquid,” “vape juice,” or “e-juice” and it typically contains water, nicotine, flavorings and a humectant, such as propylene glycol, which retain the moisture and aid the production of aerosol when heated (Truth Initiative, 2018). Propylene glycol and vegetable glycerin are common flavorings carriers in food products and medications, and they act to hold the nicotine and flavorings in suspension (The Chemical Composition Found in the Liquid Refill Cartridge, 2018). Exposure to propylene glycol can cause irritations to the respiratory tract and eyes; prolonged exposure in industrial settings can cause effect on the central nervous system and the spleen (Laino, T., 2018). Propylene glycol, when heated and vaporized, can produce a carcinogen called propylene oxide (Electronic Smoking Devices and Second hand Aerosol, 2018).

The use of flavorings in e-cigarette fluid is a major focus for e-cigarette marketing strategies (Richtel, M., 2014). A previous report stated that flavored e-cigarettes sales are occurring under 466 brands, with 7764 unique flavor names available online since 2014, with new addition of 242 new flavors per month (Shu-Hong Zhu, 2014). E-cigarette companies tend to use confectionary related flavor names, for example, chocolate raspberry, cherry cheesecake, cotton candy, banana cream pie, vanilla, butter crumble, apple and watermelon menthol (Richtel, M., 2014). Some manufacturers claim the flavored chemicals are certified as “food grade” or “generally recognized as safe”. However these certifications often refer only to ingestion and not inhalation (Flavor Extracts Manufacturers Association FEMA, 2018). A study measured 30
different e-cigarette fluids reported sufficiently high concentrations of flavored chemicals for inhalation exposure to be of toxicological concerns (Tierney, 2016).

While it is correct to state that electronic cigarettes are less harmful than cigarettes (CDC, 2018), it is by no means safe. E-cigarette aerosol generally contains less toxic chemicals than the deadly mix of 7000 chemicals found in conventional cigarettes, however, its aerosol still contains harmful and potentially harmful substances like nicotine, flavorings, organic compounds and carcinogens (CDC, 2018).

E-cigarettes are currently not approved by the U.S. Food and Drug Administration (FDA) as a smoking cessation aid (CDC, 2018). A group of health experts at the U.S Preventive Task Force responsible for making preventive medicine recommendations concluded that there is insufficient evidence to recommend e-cigarettes as a smoking cessation aid in adults, including pregnant women (Patnode, C. D., 2015). There are mixed views regarding the use of e-cigarettes to help non-pregnant adult smokers if used as a complete substitute for cigarettes or other smoked tobacco products (CDC, 2018). A recent Centers for Disease Control and Prevention (CDC) study found that e-cigarettes were used by adults in an attempt to quit smoking. However, most adult e-cigarette users did not stop smoking but instead continued to use both products, known as “dual use” (Caraballo, 2017). A Cochrane review found two randomized controlled trials with evidence that e-cigarettes with nicotine can help can help smokers in the long term compared with placebo non-nicotine e-cigarettes. However, these trials have limitations such as small sample size, small number of trials and wide margin of errors around the estimates. (McRobbie H, Bullen C, Hartmann-Boyce J, & Hajek P., 2014).

More evidence is emerging to suggest e-cigarette use is not associated with successful cessation and that e-cigarette users were not more likely to give up smoking when compared
with non-e-cigarette users. A prospective cohort study among adult smokers found no evidence that ENDS help adult smokers quit at a higher rate than non-ENDS users despite ENDS users were more likely to make a quit attempt. The authors even stated that ENDS use in real world conditions may have delayed or suppressed smoking cessation among adult smokers (Weaver et al., 2018). Similar findings were seen in a meta-analysis of 37 studies that investigated the association between e-cigarette use and cessation among adult smokers in which the odds of quitting was actually less in adults who used e-cigarettes (Kalkhoran, S., & Glantz, S. A., 2016).

**Prevalence of E-cigarette Use**

In 2018, the U.S Surgeon General issued an advisory emphasizing the importance of protecting children and adolescents from a lifetime of nicotine addiction and associated health risks by immediately addressing the epidemic of e-cigarette use among youths (U.S. Department of Health and Human Services, 2018). According to data from the CDC and FDA’s National Youth Tobacco Survey, the e-cigarette use among youths has dramatically increased to epidemic proportion in the last year. The percentage of high school students reporting e-cigarette use has risen by more than 75% between 2017 and 2018. Use among middle school students also rose by 50% within one year (U.S. Department of Health and Human Services, 2018).

The National Institute of Drug Abuse (NIDA), part of the National Institute of Health (NIH), announced important findings from Monitoring The Future (MTF), which is an annual survey of a nationally representative sample of 8th, 10th and 12th graders (NIDA, 2018). The study revealed that teens reported a dramatic increase in their use of any vaping devices in a single year, with 37.3% of 12 graders reported “any vaping” in the past 12 months, compared to 27.8% in 2017. Use of nicotine in vaping devices almost doubled among high school seniors from 11% to 20.9% in 2018 (NIDA, 2018). The MTF team leader, Dr. Richard Miech, wrote in a
letter to the editor in *New England Journal of Medicine*, that the one-year increase in the prevalence of nicotine vaping translate into approximately 1.3 million additional adolescents who vaped in 2018, as compared with 2017. He observed the increase in vaping rates within one year also aligns with the recently released CDC/ FDA funded NYTS (Miech, R., 2018).

When comparing e-cigarette use between adults and youth in the United States, youth are more likely than adults to use e-cigarettes (CDC, 2018). More than 3.6 million middle and high school students used e-cigarettes in the past 30 days, including 4.9% of middle school students and 20.8% of high school students (Cullen, 2018). In 2017, 2.8% of U.S. adults were current e-cigarette users (Wang, T. W., 2018). In 2015, data showed that among adult e-cigarette smokers, 58.8% were also current cigarette smokers and 29.8% were former cigarette smokers, and 11.4% had never been regular cigarette smokers. In contrast, among the younger e-cigarette smokers aged 18 to 25 years, 40% had never been regular cigarette smokers (CDC, 2015).

About 70 percent of U.S middle and high school students who used tobacco products in the past 30 days have used a flavored product (CDC Newsroom, 2018). This emphasized the preference of flavored tobacco products among the adolescents. Data from the 2014 NYTS showed that among the current (past 30 days) tobacco users, 63.3% (1.58 million) had used a flavored e-cigarette, 60.6% (1.02 million) had used flavored hookah, 63.5% (910,000) had used a flavored cigar, 58.8% (690,000) had used menthol flavored cigarettes, and 42.3% (120,000) had used flavored tobacco in pipes (CDC Newsroom, 2018).

**Pattern of E-cigarette Use**

The 2017 National Youth Tobacco Survey (NYTS) reported 11.7% of high school students and 3.3% of middle school students were current (past 30 days) smoker of e-cigarettes (Jamal, 2017). E-cigarette use among youths has increased in recent years more than other age
groups and there is increasing concern that e-cigarettes are acting as entry nicotine products as it has been shown to increase the likelihood of smoking cigarettes later on in life (Truth Initiative, 2018). There is substantial evidence in the 2018 NASEM report that e-cigarette use increases risk of ever using combustible cigarettes among youth and young adults (Stratton, K. R., 2018). Findings from another longitudinal study add to a growing body of evidence that e-cigarette use increases subsequent cigarette use in young people (Dunbar, M. S., 2018). In this study, 2039 youths completed three Web-based survey between 2015 to 2018, analyses revealed reciprocal associations between e-cigarette and cigarette use, meaning more frequent e-cigarette use at one time predicted more frequent cigarette use subsequently (Dunbar, M. S., 2018).

In a recent study, researchers examined the correlates of e-cigarettes use and susceptibility among adolescents not susceptible to using cigarettes (Kowitt, 2018). Using data from the 2015 North Carolina Youth Tobacco Survey (n=1627), results revealed increased perceived harm of e-cigarettes and increased perceived harm of secondhand e-cigarettes vapor were associated with lower odds of susceptibility to using e-cigarettes (Kowitt, 2018).

Also, many youths do not know what is in the e-cigarette product they are using. A recent study showed that although vast majority (98.7%) of e-cigarette products sold at convenience stores, supermarkets contain nicotine, 60% of respondents surveyed incorrectly reported e-cigarettes as being comprised of mostly flavorings (Institute for Global Tobacco Control, 2018; Marynak et al., 2018) . Flavoring in e-cigarette products was a main reason youth reported to the initiation of e-cigarette use. In a previous study, 43% of youths who ever used e-cigarettes tried them because of the appeal of different flavors (The health consequences of smoking--50 years of progress : a report of the Surgeon General, 2014)
**Dual use of tobacco products.** In general, among all age groups, e-cigarettes are commonly used by people who use another tobacco product concurrently, such as combustible cigarettes. This phenomenon is called “dual use” or “poly tobacco use” (Truth Initiatives, 2018). The majority (58.8%) of e-cigarette smokers were current smokers in a 2015 study (Morbidity and Mortality Weekly Report [MMWR], 2017). Among adults, it has been suggested that some smokers are supplementing with e-cigarettes instead of replacing it totally and this may repress efforts to completely quit smoking. This is difficult to monitor because for cigarette smokers who use e-cigarettes to help quit would have a period of overlapping use as they switch products (Truth Initiatives, 2018).

Among youths, the pattern of dual use is more complex. Youths who use other nicotine products may also be more prone to use e-cigarettes due to shared character traits – like risk taking and sensation seeking behaviors. Another possibility is that the initial e-cigarette is an entry-level product for subsequent use of other nicotine products (Truth Initiatives, 2018). The 2018 NASEM report stated that there is “substantial evidence that e-cigarette use increases risk of ever using combustible tobacco cigarettes among youth and young adults” (Stratton, K. R., Kwan, L. Y., & Eaton, D. L., 2018). In 2015, 5.2% of youth who were past-30 days e-cigarette users also reported concurrently using another tobacco product (Lauren K, C. et al, 2017). One study found that e-cigarettes are likely to be gateway devices for nicotine addiction among youths because e-cigarette use were associated with more cigarette smoking (Dutra & Glantz, 2014). In another report, 25.3% of high school students currently used any tobacco products, but only 5.9% of high school students smoked e-cigarettes exclusively (Surgeon General Report, 2016).
Health Effects of E-cigarettes

**Nicotine.** Nicotine is a naturally occurring toxic chemical found in tobacco plants and is found in tobacco products like cigarettes, cigar and other tobacco products (CDC, 2011). Nicotine is highly addictive and the mode of delivery can affect its level of addictiveness. Nicotine delivered by direct combustion of tobacco is the most addictive form and using e-cigarette or ENDS devices can also deliver similar levels of nicotine, hence, causing serious concern about its potential risks of addiction (Truth Initiatives, 2018).

Nicotine levels in e-cigarette can vary depending on the way it is used or modified by the user. Some e-cigarettes have nicotine levels approaching combustible cigarettes, for example, according to the JUUL product website, a single JUUL pod cartridge is equivalent to one pack of cigarettes or 200 cigarette puffs. JUUL pods are sold in both 3% and 5% strengths in the United States. Each 5% pod is designed to contain approximately 0.7ml of 5% nicotine by weight (approximately 40mg per pod based upon 59 mg/ml). The 3% version is designed also be 0.7ml with 3% nicotine by weight (approximately 23 mg per pod based upon 35 mg/ml) (JUUL basics FAQ, 2018).

The Surgeon General concluded that the “use of products containing nicotine poses dangers to youth, pregnant women, and fetuses. The use of products containing nicotine in any form among youth, including in e-cigarettes, is unsafe.” (Surgeon General Report, 2016). Nicotine is particularly dangerous among youths as it has been shown to have an effect on key brain receptors, making youths more prone to nicotine and other substance addictions (Truth Initiatives, 2018). Nicotine also impact the cardiovascular system by increasing heart rate and diastolic blood pressure in users shortly after use. The National Academies of Sciences, Engineering, and Medicine (NASEM) report concluded that nicotine in e-cigarettes could

Nicotine can alter the nerve cell function in developing organisms; therefore it can have negative effect on brain development in fetus, children and youths. Pregnant women are advised not to use nicotine as it increases the risk of preterm delivery and stillbirth (Truth Initiatives, 2018).

Nicotine can be lethal if delivered in high doses and nicotine in E-liquid could be harmful with the potential risk of accidental poisoning or injuries (Campaign of Tobacco-Free Kids, 2018). According to the 2016 Surgeon General’s report and the NASEM report, both noted that contact with e-liquids caused negative health effects and ingestion of e-liquids can lead to death (Surgeon General Report, 2016). The number of calls to poison control centers with poisoning of liquid nicotine has increased in recent years, with a peak of in 4023 cases of E-liquid poising seen in 2014 (American Association of Poison Control Centers, 2018).

Chemical. While e-cigarette does contain less toxins than combustible cigarettes, more than 60 chemical compounds have been found in e-liquids and more are found in the aerosol it produce (Truth Initiatives, 2018). There is insufficient evidence on the long-term health effects of e-cigarette use, which involves the inhalation of nicotine, glycerin and additives in the aerosol produced (Campaign for Tobacco-Free Kids, 2018). However, researchers have identified several potentially harmful substances, such as delivery solvents and propylene glycol, to cause dry mouth and respiratory tract infections (Stratton, K. R., Kwan, L. Y., & Eaton, D. L., 2018).

Flavorings found in e-cigarette, even those labelled as safe for ingestion by the FDA, have not been studied extensively for toxicity if inhaled over a period of time. Many flavorings are known to be cause irritation to the respiratory tract (Truth Initiatives, 2018). An article
published in the *Journal of the American Medical Association* stated that when e-cigarette users inhale the aerosol deeply into the lungs, the chemical flavorings could cause damage to the pulmonary cells (Barrington-Trimis, J. L., Sarnet, J. L., & McConnell, R., 2014).

One recent study found that exposure to increased level of cinnamon flavoring caused significant cell death and other flavoring like pentanedione and O-vanillin also showed significant cell toxicity (Muthumalage et al., 2018). Researchers of this study concluded that the data provided insights into the potential respiratory toxicity and pulmonary cell damage in e-cigarette users (Muthumalage et al., 2018). The chemical diacetyl is often used to give foods a buttery and creamy flavor and is deemed safe for ingestion by the FDA. However, high doses of diacetyl have been linked to cause acute-onset bronchiolitis obliterans, an irreversible form of obstructive lung disease (Barrington-Trimis et al., 2014). Bronchiolitis obliterans is also referred to as “popcorn lung”, because of an outbreak among workers at a microwave popcorn factory who were exposed to the inhaled diacetyl butter flavorings (Kreiss, K., 2014).

**Unintended injuries.** There have been reports of injuries resulting from explosions from poorly designed or manufactured e-cigarette devices. There is no known data for the exact number of explosions with e-cigarette use. Accidental exposure and ingestion of e-liquids can also be harmful (Truth Initiatives, 2018).

**Second hand aerosol exposure.** The e-cigarette aerosol exhaled from a user contain a mixture of ultrafine particles, nicotine, propylene glycol, flavorings, heavy metals and other chemicals compounds (CDC, 2018). The ultrafine particle concentration found in the aerosol is actually at a higher than combustible cigarette smoke and exposure to these fine or ultrafine particles may worsen respiratory conditions like asthma (Wieslander, G., Norbäck, D., & Lindgren, T., 2001). Long term exposure to inhaled propylene glycol can lead to development of
asthma in children (Electronic Smoking Devices and Second hand Aerosol, 2018). One primary component of the aerosol is propylene glycol, which acts as the base for the e-liquid. Short term exposure to propylene glycol is associated with eye, throat, airway irritation (Electronic Smoking Devices and Second hand Aerosol, 2018).

**E-cigarette marketing**

The emergence of e-cigarette has allowed companies to advertise through conventional advertisement outlets that have been tightly regulated to reduce combustible cigarette marketing to children. For example, e-cigarettes advertising has appear on television and radio, while cigarette advertisements had been heavily banned since the Congress passed the Public Health Cigarette Smoking Act in 1970 (Truth Initiative, 2018b). As for flavor ban, the FDA banned all flavors except menthol in cigarettes in an attempt to lower the appeal to youth since 2009; however, there are more than 7000 unique flavors available e-cigarettes (Shu-Hong Zhu, 2014).

Youth are widely exposed to e-cigarette advertisements and they have high awareness of e-cigarette products (Truth Initiative, 2018). An estimated 4 in 5 middle and high school students (20.5million) were exposed to e-cigarette advertisements from at least one source, a significant increase over 2014 and 2015 (Marynak et al., 2018). About seven in ten youths (17.7 million) were exposed to e-cigarette advertisements in stores in 2016, two in five were exposed on the Internet or on television, and nearly one in four were exposed through newspaper and magazine. (Marynak et al., 2018).

E-cigarette marketing continues to mirror cigarette-marketing tactics, and these include magazine ads, celebrity endorsements, sponsorship of concerts and auto races and sweet flavors (Campaign for Tobacco free kids, 2018). One new marketing strategy include offering scholarships, ranging from $250 to $5,000 that requested students to write essays detailing how
e-cigarette could minimize negative effects of smoking and the potential benefits of e-cigarettes (Binkley, C., 2018). Another marketing tactic that is evading the restrictions for cigarettes and smokeless products advertisement is the sponsorship of music festival events. Blu eCig® sponsored a music festival back in 2013, with vapor lounge with samples of Blu products and celebrity surprise appearances and interactive social media booth and electronic device charging booths (Truth Initiatives, 2018b). JUUL also sponsored a “Music in Film Summit” recently at the Sundance Film Festival at Utah (Truth Initiatives, 2018b).

Youth are exposed to e-cigarette advertisements from four major sources; at retail stores, via Internet, through television and through newspaper or magazines (CDC, 2018c). According to the CDC, 14.4 million youths are exposed to e-cigarette advertisement at retail stores, 10.5 million youths are exposed via the Internet, 9.6 million youths are exposed via television or movies and 8 million youths are exposed via newspaper or magazines (CDC, 2018c). Similarly, in order of likelihood, youth are most likely to be exposed to e-cigarette advertisement at retail store (68%), followed by Internet (41%), television (38%) and newspaper or magazines (24%) (Marynak et al., 2018).

**Effect of e-cigarette advertising.** In a randomized controlled trial among a convenience sample of 3655 adolescents who had never used e-cigarettes, those who viewed four e-cigarette television ads reported a great intention to use e-cigarette in the future when compared with the control group (Farrelly, 2015). In this study, the treatment group who were exposed to e-cigarette television ads also showed high odds of agreeing to try an e-cigarette if a best friend offered on (OR 1.29, p=0.02). Researchers concluded that exposure to e-cigarette advertising had relatively large and consistent effects on persuading adolescents to try this novel product (Farrelly, 2015).
In another randomized controlled trial conducted among young adults aged 18 to 34, researchers assessed the impact of brief exposure to print e-cigarette advertisements on perception, intention and subsequent use of e-cigarettes (Villanti et al., 2016). Results showed that ad exposures was associated with greater curiosity to try e-cigarettes among never users of e-cigarettes ($AOR = 1.63$, 95% CI $= 1.18$, 2.26) and greater likelihood of e-cigarette trial at 6 months follow-up among never users of cigarettes and e-cigarettes ($AOR = 2.85$; 95% CI $= 1.07$, 7.61) (Villanti et al., 2016).

**Internet advertisements.** E-cigarette companies have utilized the Internet to promote their product and to increase brand awareness. These online platforms have the advantages of cost-effectiveness, unique technological features and user demographics for selective marketing (Chu, K. H., 2015). One study found that Twitter was the most frequently used social networking site which interacts directly with its user (Chu, K. H., 2015). According to one study, JUUL spent more than $1$ million for the launch of its products on the Internet in 2015. The company paid for campaigns on Twitter, Instagram and YouTube to promote the image that associate the brand with being cool, having fun, having freedom and sex appeal (Huang, J., 2018). This study also stated that the number of JUUL related tweets are “highly correlated” with JUUL sales. The number of JUUL related tweets soared from a monthly average of 765 in 2015 to a monthly average of 30,565 in 2017 (Huang, J., 2018).

E-cigarette products continue to gain users and popularity by maintaining a presence on social media (Truth Initiative, 2018). Researchers found approximately 30,000 videos on YouTube which were related to e-cigarettes. These videos were posted from 10,000 unique accounts and the accumulated views of these videos were more than 100 million (Huang, J., Kornfield, R., & Emery, S. L., 2016). A recent study investigated the effectiveness of
Researchers found 108 of the leading tobacco companies maintained sponsored pages on Facebook and their results showed there were purchase links (e.g. ‘shop now’ button) in 74% of e-cigarette related pages, additionally, sales promotion (e.g. discount coupon) was found in 76% of e-cigarette related pages. Also, the requirement of excluding minor viewers age less than 18 was absent in 62% of e-cigarette brand sponsored pages (Jackler, R. K., 2019).

**Retail environment for E-cigarettes.** E-cigarettes products can be purchased in conventional retail outlets like convenience stores, pharmacies, gas stations and tobacco stores; and also sold in non-traditional outlets like online retail and vape shops (Truth Initiatives, 2018). The market for e-cigarettes is estimated to reach more than $6 billion in the U.S in 2018 (Campaign for Tobacco free kids, 2018). Altria, the major tobacco company behind well-known cigarette brand like Marlboro, recently made a $12.8 billion investment in JUUL and would own 35% of the company (Brodwin, E., 2018).

E-cigarette sales are often hard to track and analyze, as common sales tracking methods like scanner data do not take into account non-traditional sales outlets like online sales and vape shops (Truth Initiatives, 2018). Recent report estimated that e-cigarette sales are divided among vape shops (36.4%), convenience shops and food, drug retail outlets (31.8%) and online sales (31.8%) (Truth Initiatives, 2018).

**Policies for E-cigarettes**

**FDA regulations.** In 2016, the FDA announced its “deeming” regulation claiming the agency has authority to regulate electronic cigarettes and any other products meeting the criteria of “tobacco product” under the Family Smoking Prevention and Tobacco Control Act. The FDA is responsible for regulations for the product standards, importing, manufacturing, advertising,
labeling, sales and promotion of e-cigarettes (FDA, 2016). In 2017, the FDA further declared that it would extend the timeline to submit tobacco review applications to newly-regulated non-combustible products, which include e-cigarettes to 2022. This would mean an entire generation of youths would have passed through their teen years and more than 13 years would have passed before there would be full regulation of e-cigarettes (Center for Tobacco Products, 2018). There are currently no federal restrictions on flavoring in e-cigarettes (Truth Initiatives, 2018).

**Marketing policies.** Unlike traditional combustible cigarettes, e-cigarettes can be advertised on television and radio. There are few federal restrictions regarding e-cigarette marketing, for example, products cannot make claims that it exposes users to fewer toxins or reduces harm unless the FDA grants allowance. Also e-cigarette products with misleading labeling or advertising that imitates food and beverages can be considered misbranded under the Tobacco Control Act (Truth Initiatives, 2018).

At the state level, there are varying e-cigarette marketing regulations. In California and Delaware, it is prohibited to have e-cigarettes marketing websites and mobile applications directed at minors. California also has a restriction to having ads for tobacco products, including e-cigarettes, on any outdoor billboard at 1,000 feet proximity of a school or playground (Truth Initiatives, 2018).

**Taxation.** There is no federal excise taxation on e-cigarettes. There are 10 states that imposed special or excise tax on e-cigarettes; which include California, Delaware, District of Colombia, Kansas, Louisiana, Minnesota, New Jersey, North Carolina, Pennsylvania and West Virginia (Public Health Law Center, 2018).

**Warning labels.** In the FDA deeming regulations, all tobacco products, including e-cigarettes must have a warning label that reads “WARNING: This product contains nicotine.
Nicotine is an addictive chemical.” The warning label should be 30% of the two principal display panels and be in a large, legible font (Center for Tobacco Products, 2018).

**Access and minimum age of sales.** Under the FDA’s deeming regulation, the federal minimum age for sales of any tobacco products, including e-cigarettes, is 18 years of age. It is required for retailers to check photo identification of an individual under age of 27 who attempts a purchase of any tobacco product, including e-cigarettes. Vending machines and free samples of e-cigarettes are also prohibited (Truth Initiatives, 2018).

The Tobacco Control Act was signed into law in 2009 and gives the FDA authority to regulate manufacture, distribution and marketing of tobacco products (Center for Tobacco Products, 2018b). The Tobacco Control Act prohibits the FDA from raising the minimum age of sales, but some states have established a higher age of sales beyond the federal regulations for tobacco products. For example, as of 6th December, 2018, six states (California, New Jersey, Massachusetts, Oregon, Hawaii and Maine) – have raised the tobacco age to 21 (Campaign for Tobacco free kids, 2018b).

The Tobacco Control Act required the FDA to regulate the age verification for the online and other non-face-to-face sales of tobacco products, however, FDA has not yet implemented such regulations. In a 2015 study, researchers found that 61.4% of online sites required users to self-verify the permitted age of e-cigarette use by simply clicking a pop-up or dialog box, and 35.1% of sites had no age verification at any point of the online purchase process (Mackey, T. K., Miner, A., & Cuomo, R. E., 2015)

**Clean indoor air policies.** There are no federal restrictions on using e-cigarettes indoor except individual policies placed on federal buildings. As of October 2018, there are 14 states
that restrict use of e-cigarettes in 100% smoke free venues (Americans Nonsmokers’ Rights Foundation, 2018).

**Global policies.** E-cigarette policies varied widely across the world with ongoing changes. The Institute for Global Tobacco Control at the Johns Hopkins Bloomberg School of Public Health runs a database of country-level laws that regulate e-cigarettes and other ENDS (Institute for Global Tobacco Control, 2018). In a 2016 study which surveyed 90 countries, 22 countries regulate e-cigarettes using existing regulations and 25 countries banned e-cigarettes completely. Also, thirty-five countries allowed sales of e-cigarette products but restricted e-cigarette advertisements (Kennedy, R. D., Awopegba, A., De León, E., & Cohen, J. E., 2017). According to the Institute for Global Tobacco Control database, at present, 13 countries tax e-cigarettes and a total of 29 countries banned all types of e-cigarette products (Argentina, Bahrain, Brazil, Brunei Darussalam, Cambodia, Colombia, Gambia, Iran, Jordan, Kuwait, Lebanon, Mauritius, Nepal, Nicaragua, Oman, Panama, Qatar, Saudi Arabia, Seychelles, Singapore, Suriname, Syria, Thailand, Timor-Leste, Turkey, Turkmenistan, Uganda, United Arab Emirates and Uruguay). (Institute for Global Tobacco Control, 2018).

**Economic impact of E-cigarette use**

According to the CDC (2018d), smoking related diseases in the United States costs more than $300 billion per year, including approximately $170 billion for direct medical care and $156 billion in lost productivity, including $5.6 billion due to lost productivity as a result of second hand smoke exposure. A rough estimation is that if current smoking rates continue, 5.6 million Americans who are currently younger than 18 years of age will die prematurely from a smoking-related disease (Singh, T et al., 2016). The exact financial burden of e-cigarette use cannot be
established because scientists have not yet established the long-term health effect of e-cigarette and second hand exposure of e-cigarette vapor (National Institute on Drug Abuse, 2018b).

To address the public health problem of tobacco use, the FDA launched its first tobacco prevention campaign “The Real Cost” in 2014 aimed to educate at risk teens about the health risks of cigarette use (Center for Tobacco Products, 2018c). In 2018, the campaign extended to e-cigarette use with the “The Real Cost - Youth E-cigarette Campaign”, with education and prevention materials disseminated where teens spend most of their time – both in school and online. This campaign used online ads, digital and social media contents, posters in schools to deliver the message about the harms of e-cigarettes (Center for Tobacco Products, 2018c). A 2015 report by the World Health Organization pointed out that the e-cigarette industry has turned from a single manufacturer in China in 2005 to a huge global business with 466 brands which is worth billions. The WHO advocate for stricter control of e-cigarette, specifically on advertising. The WHO (2015) called for appropriate government body to take action to restrict e-cigarette advertising, promotion and sponsorships, to ensure that youths and non-smokers are not targeted by these advertisements.

The economic cost of a regular JUUL user is estimated to be similar to that of a 1 pack per day cigarette smoker (Thorndike, A. N., 2018). A starter kit of JUUL including the JUUL device, an USB charging dock, and four pods in 5% nicotine strength with four flavors (Virginia tobacco, mint, mango and crème) cost $49.99 and on average, a JUUL user spend $180 per month on JUUL pods (The Cost of JUUL: Is This Product Saving Smokers Money?, 2018). There have been claims that e-cigarettes are cheaper than combustible cigarettes and could possibly move current smokers to use e-cigarettes. A study compared the price of combustible cigarettes, rechargeable e-cigarettes and disposable e-cigarettes in a sample of 45 countries
Their results found that actually comparable units of combustible cigarettes cost less than disposable e-cigarettes in almost every country in the sample. In the rechargeable e-cigarettes where the e-liquids might cost less per comparable unit than combustible cigarettes, the initial cost of the purchase of the device presents a significant cost barrier to switching to vaping (Liber, A. C., Drope, J. M., & Stoklosa, M., 2017).

There are different population models that attempt to estimate the public health effect of the advent of e-cigarettes. In contrast to several earlier models, the Warner and Mendez model found population benefits; “with base-case assumptions, the population gains almost 3.3 million life-years by 2070.” (Warner, K. E., & Mendez, D., 2018). Dr. Stanton A. Glantz, the director of Center for Tobacco Control and Education, wrote in a blogpost that this model is flawed by conservative assumptions. For example, the model assumes that vaping increase cession by 10%; while the overall literature showed that e-cigarette depress smoking cessation by 20%. Also, the model assumed e-cigarette is harmless (Glantz, S. A., 2018).

One of important model is by Soneji et al, which even with some optimistic assumptions about the effect of e-cigarettes on smoking cessation, stated that substantial negative population effects would be expected as for every smoker who quit smoking, 8 youths start e-cigarettes. They concluded the availability of e-cigarettes is associated with net population harm (1.5 million years of life lose based on e-cigarette use pattern in 2014) (Soneji et al., 2018).

There is still ongoing debate over whether e-cigarettes are an effective cessation tool or harm reduction strategy and about the harmful effects of long-term e-cigarette use. Emerging evidence raised concerns about dual use of e-cigarettes and cigarettes and how this may undermine the efforts of complete cessation (Weaver et al., 2018). Furthermore, the evidence of
benefits of e-cigarettes have never been proven yet, and the long-term harms of e-cigarette use still take time to manifest.

**Theoretical framework**

The socio-ecological model (SEM) is a theoretical framework useful for tobacco control and organizing tobacco prevention approaches. There are existing literature that support the use of the SEM as a theoretical framework for the study of e-cigarette use among adolescents.

**Socio-ecological Model (SEM)**

The SEM was first introduced in the 1970s by Urie Bronfenbrenner as a conceptual model for understanding human development and later developed as a theory in the 1980s (Bronfenbrenner, U., 1977; Bronfenbrenner, U., 1986). The initial theory by Bronfenbrenner consisted of placing an individual in the center surrounded by nesting circles representing various systems (Bronfenbrenner, U., 1992). The *microsystem* is the closest level to the individual contains the strong influences and interactions with family and peers. The second circle is the *mesosystem* includes the relationships and interactions with the immediate surrounds, like school, workplace, church and neighborhood. The *exosystem* can exerts both negative and positive effects on an individual indirectly with interactions with community and social networks. The *macrosystem* include societal, religious and cultural values and laws. Lastly, the *chronosystem* contains elements of time and historical content, such as family dynamics and timing of death of parents and in the revised model, policy is included in the most outer level (Bronfenbrenner, U., 1986).

The SEM has been used broadly in many health issues as it focused on many major contributors that might affect health. This model states that health could be affected by the interaction and relationships between the individual, the community and the environment.
(Kilanowski, J. F., 2017). The CDC have used the SEM for a number of health promotion programs which involved the interpersonal, organization, community and policy level, for example, violence prevention, health college campuses, geriatric health and colorectal cancer prevention (Kilanowski, J. F., 2017) and tobacco prevention and treatment (Kalkhoran, S., Benowitz, N. L., & Rigotti, N. A., 2018).

The socio-ecological model provides a useful framework for the study of early tobacco use as it comprises a system of levels of influences on tobacco initiation, addiction and maintenance. This model is useful for framing preventative measures at each level as well (Green et al., 1996; Corbett, 1999; Levesque et al., 2000). This system takes into account the micro-level and macro-level factors operating at the individual, groups, organizations, communities and populations level synergistically (Corbett, K. K., 2001).

**Socio-ecological Model and Tobacco Control**

The SEM has been used extensively for the study of tobacco control in the literature. According to one review article by Corbett (2011), within the socio-ecological approach, an important component to tobacco control is the Individual level factors, which include behavioral education and clinical intervention. Examples include well designed school programs and clinicians’ contribution meeting the needs for youths. At the next Group or social level, social norm, peers and influences within the personal social networks including parents and family members are the factors that are targeted for attitudinal change and informal restrictions in the household (Corbett, K. K., 2001). The Organization level includes the effects of rules within clubs, worksite and school. At the Community level, effective prevention strategies include restricting access to tobacco products and collaboration with community leaders. Lastly, at the Population level, effective approaches include communication campaigns though mass media,
use of warning labels, policies that increase taxes and prices for tobacco products (Corbett, 2001).

The socio-ecological model could be used more specifically on smoking initiation. In an article published in the *Journal of the American College of Cardiology* by Kalkhoran et al. (2018), initiation and maintenance of tobacco use is affected by multiple factors described in the SEM. This framework categorizes the various factors into four levels of influence organized in an ascending order of individual, interpersonal, community/organizational, and societal/policy levels. In this article, the authors looked at factors at the *Individual* level and found that smoking is more common among non-Hispanic white adolescents than blacks or Hispanics and those with lower socio-economic status (US Department of Health and Human Services, 2012). At the *Interpersonal* level, youth smoking initiation is strongly influenced by peers. Adolescents who smoke are often friends with other smokers and those who do not smoke but have smoker friends are more likely to start smoking themselves (Kobus, K., 2003). Perceived social norm of smoking among peers have been associated with smoking among adolescents as one study found non-smoking eighth graders are more likely to be smoking 1 year later if they estimate a higher percentage of their peers at school were smokers (Ellickson, P., Bird, C., Orlando, M., Klein, D., & McCaffrey, D., 2003). The influence of family on adolescent smoking has shown mixed results in different studies. While some studies have found that parental smoking appeared to be associated with adolescent smoking (Gilman et al., 2009), some studies showed no effect (USDHHS, 2012).

At the *community* level, there are evidence in the literature that both the cost and marketing of tobacco products influence initiation of use. Higher prices of the tobacco products have been strongly associated with a reduction in cigarette use (Chaloupka, F. J., 1999). and this
effect was seen in both adult and youth cigarette consumption rates (Ross, H. and Chaloupka, F. J., 2003). One of the strongest policy tool to deter smoking initiation is by raising tobacco excise tax rates at the federal, state or local government level (Kalkhoran, S., Benowitz, N. L., & Rigotti, N. A., 2018).

Also in the community level, marketing strategies including advertisements and promotional effects are strongly associated with both smoking initiation and maintenance among adolescents (USDHHS, 2012). In one prospective cohort study among 1752 never-smoker adolescents, results showed that youths having a favorite cigarette ad at baseline in 1993 and the possession or willingness to use promotional items was associated with future cigarette smoking at 3 year follow-up (Pierce, J. P., Choi, W. S., Gilpin, E. A., Farkas, A. J., & Berry, C. C., 1998). A meta-analysis of 51 studies found that adolescents exposed to pro-tobacco marketing and media increase the odds of youth holding positive attitudes towards tobacco use and they are two times more likely to initiate smoking (Wellman, R. J., Sugarman, D. B., DiFranza, J. R., & Winickoff, J. P., 2006).

At the policy level, an 11-year longitudinal study with pooled results from the National Longitudinal Youth Survey from 1997 to 2007 showed that having smoke free laws in workplaces are associated with a lower odds of smoking initiation by youths. Also taxes were associated with lower percentage of new smokers but not current adolescent smokers. This study noted that the presence of smoke-free laws at the workplace has a similar effect to a $1.57 tax increase on smoking initiation. (Song, A. V., Dutra, L. M., Neilands, T. B., & Glantz, S. A., 2015).

Use of mandatory warning labels on tobacco packages is one of the evidence based tobacco control policies that aim to reduce the demand of tobacco products, along with measures
like increasing the price of tobacco products by raising taxes and smoke free policies (WHO, 2017). The World Health Organization assembled the Framework Convention on Tobacco Control (FCTC) which act as a public health treaty since 2005 (WHO, 2017). The implementation of the FCTC seems to help countries in increased adoption of advertising restrictions and smoke-free legislation (Hiilamo, H., & Glantz, S., 2017) and increasing the effective implementation of effective tobacco control policies is a major global public health priority (WHO, 2017). One review article looked at the impact of pictures on the effectiveness of tobacco warnings labels among 28 countries (Fong, G. T., Hammond, D., & Hitchman, S. C., 2009). This article concluded that a broad range of studies supports the inclusion of graphic pictures on tobacco warning labels, as they are more easily noticed than text-only warning labels. The graphic pictures in the warning labels can significantly enhance the effectiveness. (Fong, G. T., Hammond, D., & Hitchman, S. C., 2009).
CHAPTER 3
METHODOLOGY

The purpose of the present study is to examine the effect of Internet and conventional advertisement exposure on use of e-cigarettes among a national sample of adolescents. In addition, this study compared the effect of Internet advertisement exposure on e-cigarette use among current cigarette smokers and non-smokers. Based on the socio-ecological model, this study determined which individual, interpersonal, community and policy factors at each level of the model were associated with e-cigarette use. Furthermore, this study ascertained the top three self-reported reasons for using e-cigarettes among adolescents. The following chapter includes a description of the methodology, including respondents, sample design, sampling procedures, data management and data analysis for the current study.

Institutional Review Board Approval

The National Youth Tobacco Survey (NYTS) has been updated and included in the pre-approved list of approved datasets that do not require review by the University of Alabama Institute Review Board (IRB). Therefore, the current study does not require submission to the IRB (see Appendix A).

Study Design

This study employed a cross-sectional study design, which is commonly used in medical and health education research (Cottrell & McKenzie, 2011). In observational studies like cross-sectional analysis, the investigator measures both the outcome and exposure at one specific moment in time (Maninder Singh, S., 2016). This type of study is usually inexpensive and less
time consuming than experimental studies. Researchers are able to compare different populations at defined time point and gather information about the entire population under study (Baratt, 2009). However, causal relationship cannot be made in cross-sectional studies. Also, these observational studies are prone to recall bias, as participants are often asked to remember past even.

**Purpose and Scope of the NYTS**

The National Youth Tobacco Survey (NYTS) was developed in conjunction with the State Youth Tobacco Survey (YTS) to provide the data necessary to support the design, implementation, and evaluation of state and national tobacco prevention and control programs. The NYTS supplements other existing surveys, such as the Youth Risk Behavior Surveillance System (YRBSS), by providing more comprehensive data on tobacco-related indicators for both middle and high school students from grade 6 to 12 (CDC, Office on Smoking and Health, 2017). The NYTS provides multiple specific measures and data for six of the twenty tobacco-related Healthy People 2020 objectives (USDHHS, 2010). Specific questions in the questionnaire are tailored to objectives that aim to reduce tobacco use and initiation of use among adolescents. In particular, our study is closely linked with the Healthy People 2020 objective TU-18, which aim to reduce the proportion of adolescents in grade 6 to 12 who are exposed to tobacco marketing.

**The NYTS Sample Description**

The 2017 NYTS followed a stratified, three-stage cluster sample design in order to produce a nationally representative sample of middle school and high school students in the United States. Annually since 2011, the NYTS collect data that are representative of all middle and high school students in the 50 states and the District of Columbia. The Centers of Disease
Control (CDC) and the Food and Drug Administration (FDA) have collaborated to administer
the survey since 2011 (CDC, Office on Smoking and Health, 2017).

Sampling procedures were random and conducted without replacement at all stages. The
three stages included: 1) Primary Sampling Units (PSUs) (defined as a county, or a group of
small counties, or part of a very large county) within each stratum; 2) Secondary Sampling Units
(SSUs) (defined as schools or linked schools) within each selected PSU; and 3) students within
each selected school. Students were protected by anonymity and participating students completed
the survey via pencil and paper using a self-administered, scannable questionnaire booklet (CDC,
Office on Smoking and Health, 2017). Participation was voluntary at the school and individual
level. CDC’s Institutional Review Board (IRB) requires that parents be given the opportunity to
opt their student out of participating in the survey.

The NYTS Sampling Methods

Inclusion criteria. The universe of this study consisted of all public and private school
students enrolled in middle schools and high schools (grade 6 through 12) in the 50 U.S. states
and the District of Columbia.

Exclusion criteria. Special education schools, alternatives schools, Department of
Defense-operated schools, Bureau of Indian Affairs schools, vocational schools that serve only
pull-out populations were excluded. Students enrolled in regular schools unable to complete the
questionnaire without special assistance, students who do not consent to participate in the survey
were also excluded.

Sample design. The NYTS was designed to produce national estimates at a 95%
confidence level with a margin of error of 5% by school level (middle school and high school),
by grade (6, 7, 8, 9, 10, 11, and 12), by sex (male and female), and by race/ethnicity (non-Hispanic white, non-Hispanic black, and Hispanic) (CDC, Office on Smoking and Health, 2017).

The 3-stages sampling method could be summarized as follows:

1) Selection of PSUs: Eighty-five PSUs were selected from 16 strata with probability proportional to the total number of eligible students enrolled in all eligible schools located within a PSU.

2) Selection of schools: A total of 170 large schools or SSUs were selected from the 85 sample PSUs. The samples PSUs are subsampled to support the selection of small and medium sized schools. The PSU subsamples were selected with simple random sampling, and the schools were drawn with probability proportional to the total number of eligible students enrolled in a school.

3) Selection of students: All the students enrolled in any one selected class were chosen for participation. Classes were selected from course schedules provided by each school so that all eligible students had only a single chance of selection.

The NYTS questionnaire

The 2017 NYTS survey instrument consisted of 88 items. The first five questions collected demographic information about the students. The rest of the survey measured a set of tobacco related topics included: prevalence of tobacco product use; knowledge of and attitudes toward tobacco use; media and advertising exposure, accessibility to tobacco products; nicotine dependence; cessation attempts; exposure to second-hand smoke; harm perception; exposure to warning labels.
Experts within CDC’s Office on Smoking and Health (OSH) and Epidemiology Branch took part in designing the NYTS questionnaire. Collaborations with local, state and federal stakeholders, including representatives from FDA, enabled the CDC to review the instrument prior to each annual cycle to remove redundancies and examine the most relevant indicators (CDC, Office on Smoking and Health, 2017).

**Data collection**

The 2017 NYTS was administered in schools across the nation from February 13, 2017 till June 14, 2017. The school selected to participate in the 2017 NYTS were located in 32 different states. Data collectors were selected from a pool of previously trained data collectors and they visited on average three schools per week. A total of 185 out of 241 schools participated, yielding a school participation rate of 76.8%. A total of 17,872 complete questionnaires were collected out of a sample of 20,144 students, yielding a response rate of 88.7%. The overall participation rate, calculated as the product of the school-level and student-level participation rates to be 68.1% (CDC, Office on Smoking and Health, 2017).

**Data management**

The collected questionnaire booklets were scanned and converted from single school-specific ASCII files into a single national SAS file. Since the NYTS was administered via pencil and paper method, it was possible for participants to provide inconsistent or multiple answers to a question. To tackle this problem, the CDC created a series of data-cleaning specifications in order to eliminate internal inconsistencies (CDC, Office on Smoking and Health, 2017).

The 2017 NYTS dataset is available for public use in two formats: Statistical Analysis System (SAS) and Microsoft Access. The 2017 NYTS dataset was first downloaded in the SAS format and converted to IBM Statistical Package for the Social Sciences (SPSS) version 24 for
all the statistical analyses performed in the current study. Variables of interest were selected based on the individual, interpersonal, community and policy level factors in the socio-ecological model. Variables of interest were recoded for statistical analysis. Recoded variables included Ethnicity, Race, Perceived addictiveness, Tobacco user in household, Internet advertisement exposure, Conventional advertisement exposure and Warning labels. The original items in the 2017 NYTS dataset are listed in Appendix B.

Regarding the weighting of the NYTS data, according to the methodology report of the 2017 NYTS, multiple procedures were used to weight the data including application of sampling weights, nonresponse adjustments and post-stratification to national estimates by grade and weight trimming. The final student-level response data were weighted to reflect the initial probabilities of selection and nonresponse patterns. (CDC, Office on Smoking and Health, 2017).

**Variables of Interest**

**Moderating factors.** The NYTS contained four demographic items including age (9 to 19 years old or older), gender (male, female), self-reported ethnicity (Hispanic or Non-Hispanic) and self-reported race (American Indian or Alaska Native, Asian, Black, Native Hawaiian or other Pacific Islander, White). For ethnicity, response options were recoded to Hispanic and Non-Hispanic.

**Individual factors.** The NYTS contained two items regarding the attitudes towards e-cigarettes use. The two variables of interest were perceived harmfullness (No harm, little, some or a lot of harm) and perceived addictiveness (Less addictive, equally addictive, more addictive than cigarettes).
**Interpersonal factors.** The NYTS contained one item in the interpersonal level. The variable of interest is the presence of tobacco user in the household (Yes or No).

**Community factors.** The NYTS contained 5 items related to Community factors. Variables of interest included Internet advertisement exposure (Never/I do not use the internet, Rarely, Sometimes, Most of the time, Always) and conventional advertisement exposure (Never/I have not been exposed, Rarely, Sometimes, Most of the times, Always). The Conventional advertisement exposure variable is defined as the combined advertisement exposure via newspaper/magazines, in stores and television. Other community factors included the perceived accessibility to tobacco products in a store (Easy, somewhat easy, not easy at all).

**Policy factors.** The NYTS included one item about e-cigarette warning label exposure (Never/I did not see an e-cigarette package, Rarely, Sometimes, Most of the time, Always).

**Dependent variables.** The main outcome variable of interest is the behavior of e-cigarette use. The behavioral construct of e-cigarette use refers to the ever use of electronic cigarettes for one day or more. For our study, e-cigarette use is derived from item 30 of the NYTS, which asked “In total, on how many days have you used e-cigarettes in your entire life?” Responses of 1 day to over 100 days were redefined as yes for e-cigarette use. Responses of 0 days were redefined as no for e-cigarette use.

The Odds Ratio (OR) calculated for each logistic regression model are adjusted for the cigarette users. Every logistic regression included current cigarette smoking status as a variable and all OR variables are adjusted.
Table 3.1

Summary of Variables of Interest

<table>
<thead>
<tr>
<th>Level</th>
<th>Variable name</th>
<th>Item</th>
<th>Response options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderating</td>
<td>Age</td>
<td>1</td>
<td>9 to 19</td>
</tr>
<tr>
<td></td>
<td>Gender</td>
<td>2</td>
<td>Male, female</td>
</tr>
<tr>
<td></td>
<td>Grade</td>
<td>3</td>
<td>6th, 7th, 8th, 9th, 10th, 11th, 12th, ungraded</td>
</tr>
<tr>
<td></td>
<td>Ethnicity</td>
<td>4</td>
<td>Hispanic, non-Hispanic (Recoded)</td>
</tr>
<tr>
<td></td>
<td>Race</td>
<td>5</td>
<td>American Indian or Alaska Native, Asian, Black, Native Hawaiian or Pacific Islander, White</td>
</tr>
<tr>
<td>Individual</td>
<td>Perceived harmfulness</td>
<td>68</td>
<td>No harm, little, some or a lot of harm</td>
</tr>
<tr>
<td></td>
<td>Perceived addictiveness</td>
<td>69</td>
<td>Less addictive, equally addictive or more addictive than cigarettes,</td>
</tr>
<tr>
<td>Interpersonal</td>
<td>Tobacco user in household</td>
<td>86</td>
<td>Yes, No (Recoded)</td>
</tr>
<tr>
<td>Community</td>
<td>Internet advertisement exposure</td>
<td>78</td>
<td>Never/I do not use the internet, Rarely, Sometimes, Most of the time, Always (Recoded)</td>
</tr>
<tr>
<td></td>
<td>Conventional advertisement exposure (via newspaper, stores, TV)</td>
<td>79, 80, 81</td>
<td>Never/I do not use, Rarely, Sometimes, Most of the time, Always (Recoded)</td>
</tr>
<tr>
<td></td>
<td>Accessibility to tobacco products in a store</td>
<td>60</td>
<td>Easy, Somewhat easy, Not easy at all</td>
</tr>
<tr>
<td>Policy</td>
<td>Warning labels</td>
<td>62</td>
<td>Never/I did not see an e-cigarette package, Rarely, Sometimes, Most of the time, Always (Recoded)</td>
</tr>
<tr>
<td>Outcome</td>
<td>E-cigarette use</td>
<td>30</td>
<td>No, Yes</td>
</tr>
</tbody>
</table>

Note: Recoded = response options are recoded from the original response options
Missing Data

Missing data are not uncommon in all types of research, even in well-designed and controlled studies (Hyun Kang, 2013). The problems of missing data include biased estimates, reduction in statistical power and subsequently an invalid conclusion (Hyun Kang, 2013). Missing data can occur in many circumstances; such as outright refusal, respondents overlook or forget to answer some questions, respondents not knowing how to answer or the question was inapplicable. In longitudinal studies, data may be missing because respondents have died or moved away before the next wave (Allison, 2009).

For the current study, Listwise deletion was the method used when handling missing data. This is when any respondent who failed to select a response for any of the items in the NYTS questionnaire, it was considered to be missing data. The entire record from participants with any missing responses would be eliminated from the analysis of this study.

Data Analysis

Data analyses were analyzed using the International Business Machines (IBM) Statistical Packages for Social Sciences version 24 (SPSS Statistics 24). Descriptive statistical analyses, binary logistic regression were conducted on variables of interest listed in table 3.2.
Table 3.2

Statistical Analysis Used for Research Questions

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Statistical Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is the relationship between Internet advertisement exposure and e-cigarette use?</td>
<td>Descriptive Statistics, Binary Logistic Regression</td>
</tr>
<tr>
<td>2. What is the relationship between conventional advertisement exposure and e-cigarette use?</td>
<td>Descriptive Statistics, Binary Logistic Regression</td>
</tr>
<tr>
<td>a) via newspaper/magazines</td>
<td></td>
</tr>
<tr>
<td>b) via stores</td>
<td></td>
</tr>
<tr>
<td>c) via television</td>
<td></td>
</tr>
<tr>
<td>d) via combination of 4 mediums</td>
<td></td>
</tr>
<tr>
<td>3. What moderating factors (e.g., age, sex, race/ethnicity, grade) and individual factors (e.g., perceived harmfulness, perceived addictiveness) are associated with e-cigarette use?</td>
<td>Descriptive Statistics, Binary Logistic Regression</td>
</tr>
<tr>
<td>4. Is the interpersonal factor (e.g. tobacco user in household) associated with e-cigarette use?</td>
<td>Descriptive Statistics, Binary Logistic Regression</td>
</tr>
<tr>
<td>5. What community factors (e.g. exposure to Internet and conventional advertisements, accessibility to tobacco products in stores) are associated with e-cigarette use?</td>
<td>Descriptive Statistics, Binary Logistic Regression</td>
</tr>
<tr>
<td>6. Is the policy factor (e.g. exposure to warning labels) associated with e-cigarette use?</td>
<td>Descriptive Statistics, Binary Logistic Regression</td>
</tr>
<tr>
<td>7. What is the relationship between all the significant factors identified and e-cigarette use?</td>
<td>Binary Logistic Regression</td>
</tr>
<tr>
<td>8. What are the top three self-reported reasons for using e-cigarettes among adolescents?</td>
<td>Descriptive Statistics</td>
</tr>
</tbody>
</table>
Table 3.3

Research Questions Related to Independent and Dependent Variables

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Independent Variables</th>
<th>Dependent Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <strong>What is the relationship between Internet advertisement exposure and e-cigarette use?</strong></td>
<td>Internet advertisement exposure</td>
<td>E-cigarette use</td>
</tr>
<tr>
<td>2. <strong>What is the relationship between conventional advertisement exposure and e-cigarette use?</strong></td>
<td>Conventional advertisement exposure</td>
<td>E-cigarette use</td>
</tr>
<tr>
<td>a) via newspaper/magazines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) via stores</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) via television</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) via combination of 4 mediums</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. <strong>What moderating factors (e.g., age, gender, race, grade) and individual factors (e.g. perceived harmfulness, perceived addictiveness) are associated with e-cigarette use?</strong></td>
<td>Age, Gender, Ethnicity, Race, Grade, Perceived harmfulness, Perceived addictiveness</td>
<td>E-cigarette use</td>
</tr>
<tr>
<td>4. <strong>Is the presence of a tobacco user in the household associated with e-cigarette use? (interpersonal level factor)</strong></td>
<td>Tobacco user in household</td>
<td>E-cigarette use</td>
</tr>
<tr>
<td>5. <strong>Is the accessibility to tobacco products in stores associated with e-cigarette use? (community level factor)</strong></td>
<td>Internet advertisement exposure, Conventional advertisement exposure, Accessibility to tobacco products in store</td>
<td>E-cigarette use</td>
</tr>
<tr>
<td>6. <strong>Is the exposure to warning labels associated with e-cigarette use? (policy level factor)</strong></td>
<td>Exposure to warning labels</td>
<td>E-cigarette use</td>
</tr>
<tr>
<td>7. <strong>What is the relationship between all the significant factors identified and e-cigarette use?</strong></td>
<td>All significant factors from research question 1 to 6</td>
<td>E-cigarette use</td>
</tr>
<tr>
<td>8. <strong>What are the top three self-reported reasons for using e-cigarettes among adolescents?</strong></td>
<td>E-cigarette users</td>
<td></td>
</tr>
</tbody>
</table>
Research Questions

Details for each research question and the corresponding data analysis are listed below:

RQ 1. What is the relationship between Internet advertisement exposure and e-cigarette use? (including comparison between non-cigarette users and current cigarette users). Analysis began by defining the current cigarette smoking status by dividing respondents into current cigarette smoker and non-cigarette smoker. Using item 11 in the NYTS, which asked, “During the past 30 days, on how many day did you smoke cigarettes?” individual who responded with “0 days” are labeled as Non-cigarette smoker. Individual who selected any other responses as having smoked for 1 to 30 days are labeled as Current cigarette smoker. Comparisons between non-cigarette users and current cigarette users will continue for RQ 1 to 7.

Analysis began with descriptive statistics, followed by binary logistic regression between the predictor Internet advertisement exposure variable and the outcome variable of e-cigarette use. The responses in the NYTS item 78 are recoded to produce a scale ranging from 1 (No exposure), 2 (rarely), 3 (sometimes), 4 (most of the time) to 5 (always).

RQ2. What is the relationship between conventional advertisement exposure and e-cigarette use? Analysis began with descriptive statistics, followed by binary logistic regression between the predictor conventional advertisement exposure variable and the outcome variable of e-cigarette use. There are 4 parts to this research question: including the effects of advertisements in newspaper, stores, television and the overall combined effect of four mediums. The responses in the NYTS item 79, 80, 81 are recoded to produce a scale ranging from 1 (No exposure), 2 (rarely), 3 (sometimes), 4 (most of the time) to 5 (always).
RQ3. What moderating factors (e.g., age, gender, race/ethnicity, grade) and individual factors (e.g., perceived harmfulness, perceived addictiveness) are associated with e-cigarette use? Analysis began with descriptive statistics of the various moderating factors and individual factors including perceived harmfulness and perceived addictiveness of e-cigarettes. Binary logistic regressions were used to analyze the differences among group means for the various predictor variables and the outcome variable of e-cigarette use.

RQ4. Is the presence of a tobacco user in the household associated with e-cigarette use? (Interpersonal level factor) Analysis began with recoding responses to Item 86 in the NYTS to a dichotomous variable. Item 86 inquired about the presence of tobacco users in the same household, which asked “Does anyone who lives with you now…?” Responses that answered, “No one lives with me now uses any form of tobacco” is recoded as “No”, all other responses are recoded as “Yes”. Descriptive statistics and binary logistic regression was performed in the statistical analysis.

RQ5. Is the accessibility to tobacco products in stores associated with e-cigarette use? (Community level factor) Descriptive statistics and binary logistic regression analyses were performed to analyze the relationship between the predictors and outcome variable. Accessibility to tobacco products in store was measured as a categorical predictor variable in item 60 in the NYTS.

RQ 6. Is the exposure to warning labels associated with e-cigarette use? (Policy level factor) Analysis began with recoding response options for Item 60, which asked “During the past
30 days, how often did you see a warning label on an e-cigarette package?” Recoded responses included 1(Never), 2 (Rarely), 3(Sometimes), 4(Most of the time) and 5 (Always). Descriptive statistics and binary logistic regression analysis was performed.

**RQ 7. What is the relationship between all the significant factors identified and e-cigarette use?** Analysis involved all the significant factors identified in research question 1 to 6 as listed above. All the significant factors are put into a binary logistic regression model to determine the relationship with e-cigarette use.

**RQ 8. What are the top three self-reported reasons for using e-cigarettes among adolescents?** Descriptive statistical analysis was performed to identify the top three response options to item 33 in the survey that asked, “What are the reasons you have used e-cigarettes?”
CHAPTER 4

RESULTS

The purpose of the present study was to investigate the effect of Internet and conventional advertisement exposure (via newspaper/magazines, stores and television) on electronic cigarette use among a national sample of American adolescents. The present study involved secondary data analysis of the 2017 National Youth Tobacco Survey (NYTS). Additionally, this study identified individual, interpersonal, community and policy factors associated with e-cigarette use among adolescents based on the socio-ecological model. All statistical analyses were performed using SPSS Version 24 with a *priori* significance level of <0.01.

Sample Characteristics

The student response for the 2017 NYTS sample was 17,872. Descriptive statistical analysis was conducted to provide sample characteristics. As shown in Table 4.1, of the sample, 44.1% (n= 7532) participants identified as White, 16.7% (n= 2983) as African American, 25.8% (n= 4614) as Hispanic and 10.9% (n=1955) as others. Fifty percent (n= 8881) were male, 57.4% (n= 10,186) were in high school (Grades 9 to 12) and the average age was 14.62 years old (M=14.62, SD=2.08).

Table 4.2 displays the Individual level variables of interest. Out of the 17,872 participants included in the analysis, 34.7% (n=6199) perceived e-cigarette use to have some harm, 27.4% (n=4889) perceived a lot of harm, 26.1% (n=4485) perceived little harm, and 9.5% (n=1639) perceived no harm. When asked to compare e-cigarettes with traditional combustible cigarettes,
44.3% \((n=4838)\) perceived e-cigarettes to be equally addictive, 44.3% \((n=4831)\) perceived e-cigarettes to be less addictive and 11.4% \((n=1244)\) perceived e-cigarettes to be more addictive.
Table 4.1

Demographics of the NYTS sample of adolescents (N=17,872)

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Frequency (n)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>7532</td>
<td>42.1</td>
</tr>
<tr>
<td>African American</td>
<td>2983</td>
<td>16.7</td>
</tr>
<tr>
<td>Hispanic</td>
<td>4614</td>
<td>25.8</td>
</tr>
<tr>
<td>Other</td>
<td>1955</td>
<td>10.9</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>36</td>
<td>.2</td>
</tr>
<tr>
<td>10</td>
<td>12</td>
<td>.1</td>
</tr>
<tr>
<td>11</td>
<td>1018</td>
<td>5.7</td>
</tr>
<tr>
<td>12</td>
<td>2413</td>
<td>13.6</td>
</tr>
<tr>
<td>13</td>
<td>2495</td>
<td>14.0</td>
</tr>
<tr>
<td>14</td>
<td>2479</td>
<td>13.9</td>
</tr>
<tr>
<td>15</td>
<td>2704</td>
<td>15.2</td>
</tr>
<tr>
<td>16</td>
<td>2588</td>
<td>14.6</td>
</tr>
<tr>
<td>17</td>
<td>2525</td>
<td>14.2</td>
</tr>
<tr>
<td>18</td>
<td>1361</td>
<td>7.7</td>
</tr>
<tr>
<td>19</td>
<td>146</td>
<td>.8</td>
</tr>
<tr>
<td><strong>Grade</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle School</td>
<td>7562</td>
<td>42.6</td>
</tr>
<tr>
<td>High School</td>
<td>10186</td>
<td>57.4</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>8881</td>
<td>50.2</td>
</tr>
<tr>
<td>Female</td>
<td>8815</td>
<td>49.8</td>
</tr>
</tbody>
</table>

*Note. Some predictors do not add up to total sample due to missing values.*
Table 4.2

*Distributions of the Individual Level Variables of Interest Among a National Sample of Adolescents (N=17,872)*

<table>
<thead>
<tr>
<th>Individual Factor</th>
<th>Frequency (n)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived harmfulness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No harm</td>
<td>1639</td>
<td>9.2</td>
</tr>
<tr>
<td>Little harm</td>
<td>4485</td>
<td>25.1</td>
</tr>
<tr>
<td>Some harm</td>
<td>6199</td>
<td>34.7</td>
</tr>
<tr>
<td>A lot of harm</td>
<td>4889</td>
<td>27.4</td>
</tr>
<tr>
<td>Perceived addictiveness (compared with cigarettes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less addictive</td>
<td>4831</td>
<td>44.3</td>
</tr>
<tr>
<td>Equally addictive</td>
<td>4838</td>
<td>44.3</td>
</tr>
<tr>
<td>More addictive</td>
<td>1244</td>
<td>11.4</td>
</tr>
</tbody>
</table>

*Note.* Some predictors do not add up to total sample due to missing values.

The distribution of the Interpersonal level variable of interest is displayed in Table 4.3.

Of the 17,872 participants included in this analysis, 60.1% (n=10737) did not have a tobacco user in the same household and 39.9% (n=10737) reported having a tobacco user in the same household.

Table 4.3

*Distributions of the Interpersonal Level Variables of Interest Among a National Sample of Adolescents (N=13,754)*

<table>
<thead>
<tr>
<th>Interpersonal Factor</th>
<th>Frequency (n)</th>
<th>Valid percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco user in household</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>10737</td>
<td>60.1</td>
</tr>
<tr>
<td>Yes</td>
<td>7135</td>
<td>39.9</td>
</tr>
</tbody>
</table>

*Note.* Some predictors do not add up to total sample due to missing values.
Table 4.4 shows the community level variables of interest. Regarding Internet advertisement exposure, 38.8% (n=6601) of respondents were never exposed to Internet e-cigarette advertisements. Of the 17,872 valid responses in the analysis, 32.2% (n=5482) were rarely exposed, 20.7% (n=3522) were sometimes exposed, 4.9% (n=839) were exposed most of the time and 3.3% (n=557) were always exposed to Internet e-cigarette advertisements.

The three mediums of conventional advertisement exposure included the following: printed advertisements in newspaper or magazines; advertisements in stores, supermarkets or gas stations; and advertisements on television. As shown in Table 4.4, of the 17,872 responses, 61.5% (n=10434) reported never being exposed to e-cigarette advertisements in printed material. Twenty-one percent (n=3553) were rarely exposed, 12.2% (n=2076) were sometimes exposed, 2.9% (n=495) were exposed most of the time, and 2.4% (n=409) were always exposed to e-cigarette advertisements found in newspaper or magazines.

Regarding e-cigarette advertisement exposure in stores, 29.7% (n=5041) of respondents were never exposed to such e-cigarette advertisements. Out of the 17,872 valid responses in the analysis, 26.8% (n=4554) were rarely exposed, 23.4% (n=3966) were sometimes exposed, 11.9% (n=2019) were exposed most of the time, and 8.2% (n=1387) were always exposed to e-cigarette advertisements found in stores, supermarkets or gas stations.

For e-cigarette advertisement exposure via television, 39.4% (n=6739) of respondents were never exposed to e-cigarette advertisements on television. From the 17,872 complete survey responses, 31.8% (n=5437) were rarely exposed, 20.1% (n=3434) were sometimes exposed, 4.8% (n=816) were exposed most of the time and 3.9% (n=661) were always exposed to e-cigarette advertisements on television.
Table 4.4

*Distributions of the Community Level Variables of Interest Among a National Sample of Adolescents (N=17,872)*

<table>
<thead>
<tr>
<th>Community Factor</th>
<th>Frequency (n)</th>
<th>Valid percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Internet advertisement exposure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never/I don’t use internet</td>
<td>6601</td>
<td>38.8</td>
</tr>
<tr>
<td>Rarely</td>
<td>5482</td>
<td>32.2</td>
</tr>
<tr>
<td>Sometimes</td>
<td>3522</td>
<td>20.7</td>
</tr>
<tr>
<td>Most of the time</td>
<td>839</td>
<td>4.9</td>
</tr>
<tr>
<td>Always</td>
<td>557</td>
<td>3.3</td>
</tr>
<tr>
<td><strong>Conventional advertisement exposure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Via Newspaper/Magazines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never/ I don’t read newspaper</td>
<td>10434</td>
<td>61.5</td>
</tr>
<tr>
<td>Rarely</td>
<td>3553</td>
<td>20.9</td>
</tr>
<tr>
<td>Sometimes</td>
<td>2076</td>
<td>12.2</td>
</tr>
<tr>
<td>Most of the time</td>
<td>495</td>
<td>2.9</td>
</tr>
<tr>
<td>Always</td>
<td>409</td>
<td>2.4</td>
</tr>
<tr>
<td>Via Stores/supermarket/gas station</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never/ I never go to stores</td>
<td>5041</td>
<td>29.7</td>
</tr>
<tr>
<td>Rarely</td>
<td>4551</td>
<td>26.8</td>
</tr>
<tr>
<td>Sometimes</td>
<td>3966</td>
<td>23.4</td>
</tr>
<tr>
<td>Most of the time</td>
<td>2019</td>
<td>11.9</td>
</tr>
<tr>
<td>Always</td>
<td>1387</td>
<td>8.2</td>
</tr>
<tr>
<td>Via Television</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never/ I do not watch TV</td>
<td>6739</td>
<td>39.4</td>
</tr>
<tr>
<td>Rarely</td>
<td>5437</td>
<td>31.8</td>
</tr>
<tr>
<td>Sometimes</td>
<td>3434</td>
<td>20.1</td>
</tr>
<tr>
<td>Most of the time</td>
<td>816</td>
<td>4.8</td>
</tr>
<tr>
<td>Always</td>
<td>661</td>
<td>3.9</td>
</tr>
<tr>
<td>Access to tobacco products in a store</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Easy</td>
<td>3671</td>
<td>21.5</td>
</tr>
<tr>
<td>Somewhat easy</td>
<td>7721</td>
<td>45.2</td>
</tr>
<tr>
<td>Not easy at all</td>
<td>5679</td>
<td>33.3</td>
</tr>
</tbody>
</table>

*Note.* Some predictors do not add up to total sample due to missing values.
Table 4.4 also displays how easy participants think others their age could buy tobacco products in a store. Forty-five percent (n=7721) thought it was somewhat easy, 21.5% (n=3671) thought it was easy, and 33.3% (n=5679) thought it was not easy at all to purchase tobacco products in a store.

Table 4.5 shows the policy level variable of interest, where respondents were asked how often did they see a warning label on an e-cigarette package. Out of the 17,872 responses, 87.5% (n=15105) said they never or did not see any warning labels on e-cigarette packages, 4.8% (n=821) reported rarely, 3.0% (n=514) indicated sometimes, 1.8% (n=313) reported most of the time, and 3.0% (n=515) indicated always.

Table 4.5

*Distributions of the Policy Level Variables of Interest Among a National Sample of Adolescents (N=17,872)*

<table>
<thead>
<tr>
<th>Policy Factor</th>
<th>Frequency (n)</th>
<th>Valid percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warning label exposure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never/I didn’t see any</td>
<td>15105</td>
<td>87.5</td>
</tr>
<tr>
<td>Rarely</td>
<td>821</td>
<td>4.8</td>
</tr>
<tr>
<td>Sometimes</td>
<td>514</td>
<td>3.0</td>
</tr>
<tr>
<td>Most of the time</td>
<td>313</td>
<td>1.8</td>
</tr>
<tr>
<td>Always</td>
<td>515</td>
<td>3.0</td>
</tr>
</tbody>
</table>

*Note. Some predictors do not add up to total sample due to missing values.*

Research Questions

Respondents were categorized as either current cigarette smokers or non-smokers based on their response to item 11 in the NYTS which asked, “During the past 30 days, on how many days did you smoke cigarettes?” Individuals who responded with “0 days” were labeled as Non-cigarette smoker. Individuals who selected any other responses as having smoked for 1 to 30 days were labeled as Current cigarette smoker. Relationships between the outcome and predictor
variables were examined and comparisons between non-smokers and current cigarette smoker were made for each research question.

E-cigarette use was the outcome variable of interest, which was derived from item 30 in the NYTS, which asked, “In total, on how many days have you used e-cigarettes in your entire life?” Individuals who answered 0 days were recoded as e-cigarette non-users and those who answered 1 day to over 100 days were recoded as e-cigarette users. Table 4.6 below displays the percentage of e-cigarette users in our sample to be 20.1%.

Table 4.6

_Distribution of E-cigarette use among a National Sample of Adolescents (N=17872)_

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>E-cig use No</td>
<td>14030</td>
<td>78.5</td>
</tr>
<tr>
<td></td>
<td>E-cig use YES</td>
<td>3519</td>
<td>19.7</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>17549</td>
<td>98.2</td>
</tr>
<tr>
<td>Missing</td>
<td>System</td>
<td>323</td>
<td>1.8</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>17872</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Note. E-cig use = E-cigarette use*

Table 4.6a

_Cross tabulation between E-cigarette use and Current Cigarette Smoking Status (N=17,222)_

<table>
<thead>
<tr>
<th>EcigYN</th>
<th>Cigstatus</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nonsmoker</td>
<td>Cig smoker</td>
</tr>
<tr>
<td>Count</td>
<td>13626</td>
<td>215</td>
</tr>
<tr>
<td>% within EcigYN</td>
<td>98.4%</td>
<td>1.6%</td>
</tr>
<tr>
<td>% within Cigstatus</td>
<td>83.7%</td>
<td>22.8%</td>
</tr>
<tr>
<td>% of Total</td>
<td>79.1%</td>
<td>1.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ecig use YES</th>
<th>Count</th>
<th>Count</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>% within EcigYN</td>
<td>78.5%</td>
<td>21.5%</td>
<td>100.0%</td>
</tr>
<tr>
<td>% within Cigstatus</td>
<td>16.3%</td>
<td>77.2%</td>
<td>19.6%</td>
</tr>
<tr>
<td>% of Total</td>
<td>15.4%</td>
<td>4.2%</td>
<td>19.6%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total</th>
<th>Count</th>
<th>Count</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>% within EcigYN</td>
<td>94.5%</td>
<td>5.5%</td>
<td>100.0%</td>
</tr>
<tr>
<td>% within Cigstatus</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>% of Total</td>
<td>94.5%</td>
<td>5.5%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
Table 4.6a displays the cross tabulation between e-cigarette use and current cigarette smoking status. Majority of the students surveyed were non-cigarette smokers and e-cigarette non-users. There is overlap between e-cigarette and cigarette use as 77.2% of current cigarette smokers also use e-cigarettes, hence, cigarette smoking status was an important variable in every logistic regression model in the current study.

RQ 1. What is the relationship between Internet advertisement exposure and e-cigarette use?

Binary logistic regression was used to analyze the effect of Internet advertisement exposure on e-cigarette use. Current cigarette smoking status was also included in the model. Table 4.7 displays the results of the maximum likelihood tests along with the standard errors and odds ratios of the main effect.

As shown in Table 4.7, the overall relationship between Internet advertisement exposure and e-cigarette use was statistically significant (p<0.001). The Nagelkerke R value was 0.16, which meant 16% of the variance was explained by this model. Participants who were cigarette smokers were 17.72 times more likely to use e-cigarette (OR=17.72; 95% CI [15.01, 20.91]; p<0.001).

Comparisons were made between the five categories of Internet advertisement exposure (Never, rarely, sometimes, most of the time, always) using the first category as the reference, which was defined as individuals who reported “Never” being exposed to Internet e-cigarette advertisements. Compared with those who were never exposed, those who were “rarely” exposed were 1.67 times more likely to use e-cigarettes (OR=1.67; 95% CI [1.50, 1.85]; p<0.001). Individuals who were “sometimes” and “most of the time” exposed to Internet advertisements were 2.18 (OR=2.18; 95% CI [1.95, 2.44]; p<0.001) and 2.56 (OR=2.56; 95% CI [2.14, 3.06]; p<0.001) times more likely to use e-cigarettes respectively when compared to those never
exposed. Participants who were “always” exposed to Internet e-cigarette advertisements were 2.15 times more likely to use e-cigarettes than those who were never exposed (OR=2.15; 95% CI [1.72, 2.70]; p<0.001).

Figure 1 shows that the predicted probabilities for e-cigarette use for cigarette smokers were generally higher than non-smokers at the five different levels of Internet advertisement exposure (Never, rarely, sometimes, most of the time, always). As Internet advertisement exposure increased from Never to Always, the predicted probabilities for e-cigarette use initially increased and then plateaued off. The highest OR was 2.56 for those individuals who reported exposure to Internet advertisements most of the time. A slight drop in predicted probabilities was observed when Internet advertisement exposure went from most of the time to always; the OR decreased from 2.56 to 2.15. The difference in e-cigarette use between Always and Most of the time was not statistically significant (p=0.21). Similarly, the difference in e-cigarette use between Always and Sometimes was also not significant (p=0.92).

Table 4.7

Logistic Regression for Internet Advertisement Exposure and E-cigarette use (N=17,872)

<table>
<thead>
<tr>
<th>Step 1</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>OR</th>
<th>95% C.I. for EXP(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>Cig status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>2.874</td>
<td>.085</td>
<td>1152.877</td>
<td>1</td>
<td>.000</td>
<td>17.715</td>
<td>15.007</td>
</tr>
<tr>
<td>Rarely</td>
<td>.511</td>
<td>.053</td>
<td>93.752</td>
<td>1</td>
<td>.000</td>
<td>1.667</td>
<td>1.503</td>
</tr>
<tr>
<td>Sometimes</td>
<td>.778</td>
<td>.057</td>
<td>186.486</td>
<td>1</td>
<td>.000</td>
<td>2.178</td>
<td>1.948</td>
</tr>
<tr>
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<td>.938</td>
<td>.092</td>
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<td>1</td>
<td>.000</td>
<td>2.555</td>
<td>2.135</td>
</tr>
<tr>
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<td>.767</td>
<td>.115</td>
<td>44.336</td>
<td>1</td>
<td>.000</td>
<td>2.153</td>
<td>1.718</td>
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<td>-</td>
<td>.100</td>
<td>2447.161</td>
<td>1</td>
<td>.000</td>
<td>.007</td>
<td></td>
</tr>
</tbody>
</table>

4.943
Note. OR = odds ratio; CI = confidence interval; Cig status = Current cigarette smoking status; Internet ad = Internet Advertisement Exposure; Reference category is “Never” exposed to Internet e-cigarette advertisements.

Figure 4.1. Predicted probabilities of e-cigarette use with varying levels of Internet advertisement exposure between cigarette smoker and non-smoker. Internet advertisement exposure: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Most of the time, 5 = Always.
RQ2. What is the relationship between conventional advertisement exposure and e-cigarette use?

Binary logistic regression was used to analyze the effect of three conventional advertisement methods (via newspaper/magazines, stores, television) on e-cigarette use. Current cigarette smoking status was also included in the model. Table 4.8 shows the results of the maximum likelihood tests along with the standard errors and odds ratios of the main effect.

a) Conventional advertisement exposure (via newspaper). As displayed in Table 4.8, the overall relationship between newspaper advertisement exposure and e-cigarette use was statistically significant (p<0.001). The Nagelkerke R value was 0.15, which meant 15% of the variance was explained by this model. Participants who were cigarette smokers were 17.09 times more likely to use e-cigarette (OR=17.09; 95% CI [14.49, 20.16]; p<0.001).

Comparison was made between those who were never exposed to newspaper e-cigarette advertisements and those who were “rarely” exposed. The Odds Ratio (OR) indicates that participants who rarely see these advertisements were 1.39 times more likely to use e-cigarettes (OR=1.39; 95% CI [1.26, 1.54]; p<0.001). Individuals who were “sometimes” and “most of the time” exposed to newspaper advertisements were 1.56 (OR=1.56; 95% CI [1.39, 1.77]; p<0.001) and 1.87 (OR=1.87; 95% CI [1.50, 2.34]; p<0.001) times more likely to use e-cigarettes respectively when compared to those never exposed. Participants who were “always” exposed to newspaper e-cigarette advertisements were 1.52 times more likely to use e-cigarettes than those who were never exposed (OR=1.52; 95% CI [1.17, 1.97]; p<0.001).

Figure 2 shows that the predicted probabilities for e-cigarette use for cigarette smoker were higher than non-smoker at the 5 different levels of newspaper advertisement exposure. As newspaper advertisement exposure increased from Never to Always, the predicted probabilities for e-cigarette use initially increased and peaked at Most of the time, plateaued, and then dropped...
slightly at *Always*. The highest OR was 1.87 for individuals who reported exposure to newspaper advertisements *most of the time*. The OR was slightly lower at 1.52 when newspaper advertisement exposure increased from *most of the time* to *always*. For newspaper advertisement exposure, the difference in e-cigarette use between *Always* and *Most of the time* was not statistically significant (p=0.22). Similarly, the difference in e-cigarette use between *Always* and *Sometimes* (p=0.84) and *Always* and *Rarely* (p=0.53) were not significant.
Table 4.8

Logistic Regression for Newspaper Advertisement Exposure on E-cigarette use (N=17,872)

<table>
<thead>
<tr>
<th>Step</th>
<th>Cig status</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>OR</th>
<th>95% C.I. for EXP(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Newspaper ad</td>
<td>.332</td>
<td>.052</td>
<td>41.003</td>
<td>1</td>
<td>.000</td>
<td>1.394</td>
<td>1.259 – 1.543</td>
</tr>
<tr>
<td></td>
<td>Rarely</td>
<td>.447</td>
<td>.062</td>
<td>51.940</td>
<td>1</td>
<td>.000</td>
<td>1.564</td>
<td>1.385 – 1.766</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>.628</td>
<td>.113</td>
<td>30.628</td>
<td>1</td>
<td>.000</td>
<td>1.874</td>
<td>1.500 – 2.341</td>
</tr>
<tr>
<td></td>
<td>Most of the time</td>
<td>.418</td>
<td>.133</td>
<td>9.932</td>
<td>1</td>
<td>.002</td>
<td>1.519</td>
<td>1.171 – 1.971</td>
</tr>
<tr>
<td></td>
<td>Always</td>
<td>-</td>
<td>.094</td>
<td>2443.989</td>
<td>1</td>
<td>.000</td>
<td>.010</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>2.839</td>
<td>.084</td>
<td>1135.862</td>
<td>1</td>
<td>.000</td>
<td>17.094</td>
<td>14.493 – 20.163</td>
</tr>
</tbody>
</table>

Note. OR = odds ratio; CI = confidence interval; Cig status = Current cigarette smoking status; Newspaper ad = Newspaper Advertisement Exposure; Reference category is “Never” exposed to Newspaper e-cigarette advertisements.
Figure 4.2. Predicted probabilities of e-cigarette use with varying levels of Newspaper advertisement exposure between cigarette smoker and non-smoker. Internet advertisement exposure; 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Most of the time, 5 = Always.
b) Conventional advertisement exposure (via stores). The overall relationship between in-store advertisement exposure and e-cigarette use was statistically significant (p<0.001) as shown in Table 4.9. The Nagelkerke R value was 0.15, which meant 15% of the variance was explained by this model. Participants who were cigarette smokers were 17.83 times more likely to use e-cigarette (OR=17.83; 95% CI [15.11,21.04]; p<0.001).

Comparison was made between those who were never exposed to in-store e-cigarette advertisements and those who were “rarely” exposed. The OR indicates that participants who rarely see these advertisements were 1.51 times more likely to use e-cigarettes (OR=1.51; 95% CI [1.35,1.70]; p<0.001). Individuals who were “sometimes” and “most of the time” exposed to in-store advertisements were 1.84 (OR=1.84; 95% CI [1.64, 2.08]; p<0.001) and 2.06 (OR=2.06; 95% CI [1.79, 2.37]; p<0.001) times more likely to use e-cigarettes respectively when compared to those never exposed. Participants who were “always” exposed to newspaper e-cigarette advertisements were 1.95 times more likely to use e-cigarettes than those who were never exposed (OR=1.95; 95% CI [1.66, 2.29]; p<0.001).

Figure 3 shows the predicted probabilities for e-cigarette use for cigarette smoker and non-smokers when exposed to varying levels of in-store e-cigarette advertisements. The scatterplot showed that current cigarette smokers were more likely to use e-cigarettes than non-smokers; and the predicted probabilities were highest for participants who were exposed most of the time.
### Table 4.9

*Logistic Regression for In-store Advertisement Exposure on E-cigarette use (N=17,872)*

<table>
<thead>
<tr>
<th>Step</th>
<th>Cig status</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>OR</th>
<th>95% C.I. for EXP(B)</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Cig status</td>
<td>2.881</td>
<td>.084</td>
<td>1164.536</td>
<td>1</td>
<td>.000</td>
<td>17.831</td>
<td>15.112</td>
<td>21.040</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Store ad</td>
<td></td>
<td></td>
<td>153.634</td>
<td>4</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rarely</td>
<td>.414</td>
<td>.060</td>
<td>47.916</td>
<td>1</td>
<td>.000</td>
<td>1.514</td>
<td>1.346</td>
<td>1.702</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>.612</td>
<td>.060</td>
<td>103.238</td>
<td>1</td>
<td>.000</td>
<td>1.844</td>
<td>1.638</td>
<td>2.075</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Most of the time</td>
<td>.722</td>
<td>.071</td>
<td>102.979</td>
<td>1</td>
<td>.000</td>
<td>2.058</td>
<td>1.790</td>
<td>2.366</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Always</td>
<td>.667</td>
<td>.082</td>
<td>66.553</td>
<td>1</td>
<td>.000</td>
<td>1.949</td>
<td>1.660</td>
<td>2.288</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>-4.936</td>
<td>.102</td>
<td>2345.904</td>
<td>1</td>
<td>.000</td>
<td>.007</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* OR = odds ratio; CI = confidence interval; Cig status = Current cigarette smoking status; Store ad = Store Advertisement Exposure; Reference category is “Never” exposed to Newspaper e-cigarette advertisements.
Figure 4.3. Predicted probabilities of e-cigarette use with varying levels of In-store advertisement exposure between cigarette smoker and non-smoker. Internet advertisement exposure; 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Most of the time, 5 = Always.
c) Conventional advertisement exposure (via television). As shown in Table 4.10, the overall relationship between television advertisement exposure and e-cigarette use was statistically significant (p<0.001). The Nagelkerke R value was 0.14, which meant 14% of the variance was explained by this model. Participants who were cigarette smokers were 17.54 times more likely to use e-cigarette (OR=17.54; 95% CI [14.87, 20.67]; p<0.001).

The group who were never exposed to in-store e-cigarette advertisements was defined as the reference category for comparisons. Participants who were “rarely” exposed were 1.36 times more likely to use e-cigarettes (OR=1.36; 95% CI [1.23,1.50]; p<0.001). Individuals who were exposed to television advertisements “most of the time” were 1.55 times more likely to use e-cigarette compared to those never exposed (OR=1.55; 95% CI [1.28, 1.88]; p<0.001). Participants who were “always” exposed to newspaper e-cigarette advertisements were 1.50 times more likely to use e-cigarettes than those who were never exposed (OR=1.50; 95% CI [1.22, 1.86]; p<0.001).

Figure 4 shows the predicted probabilities for e-cigarette use for cigarette smoker and non-smokers when exposed to different levels of television e-cigarette advertisements. The scatterplot showed that current cigarette smokers were more likely to use e-cigarettes than non-smokers in general, with the predicted probabilities plateau off at most of the time.
Table 4.10

*Logistic Regression for Television Advertisement Exposure on E-cigarette use (N=17,872)*

<table>
<thead>
<tr>
<th>Step</th>
<th>Cig status</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>OR</th>
<th>Exp(B)</th>
<th>95% C.I. for EXP(B)</th>
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</thead>
<tbody>
<tr>
<td>1a</td>
<td>Cig status</td>
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<td>.084</td>
<td>1162.884</td>
<td>1</td>
<td>.000</td>
<td>17.535</td>
<td>14.873</td>
<td>20.673</td>
</tr>
<tr>
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<td>TV ad</td>
<td></td>
<td></td>
<td>67.323</td>
<td>4</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rarely</td>
<td>.307</td>
<td>.051</td>
<td>36.739</td>
<td>1</td>
<td>.000</td>
<td>1.360</td>
<td>1.231</td>
<td>1.502</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>.390</td>
<td>.057</td>
<td>46.809</td>
<td>1</td>
<td>.000</td>
<td>1.477</td>
<td>1.321</td>
<td>1.651</td>
</tr>
<tr>
<td></td>
<td>Most of the time</td>
<td>.438</td>
<td>.098</td>
<td>20.114</td>
<td>1</td>
<td>.000</td>
<td>1.550</td>
<td>1.280</td>
<td>1.877</td>
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<tr>
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<td>.407</td>
<td>.108</td>
<td>14.089</td>
<td>1</td>
<td>.000</td>
<td>1.502</td>
<td>1.215</td>
<td>1.858</td>
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<td>.097</td>
<td>2377.424</td>
<td>1</td>
<td>.000</td>
<td>.009</td>
<td></td>
<td></td>
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</tbody>
</table>

Note. OR = odds ratio; CI = confidence interval; Cig status = Current cigarette smoking status; TV ad = TV Advertisement Exposure; Reference category is “Never” exposed to Newspaper e-cigarette advertisements.
Figure 4.4. Predicted probabilities of e-cigarette use with varying levels of Television advertisement exposure between cigarette smoker and non-smoker. Internet advertisement exposure; 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Most of the time, 5 = Always.
d) Combined advertisement exposure (via Internet, newspaper, store and TV)

Table 4.11 displays the overall relationship between the combined advertisement exposure (via 4 different mediums) and e-cigarette use analyzed in one model. The Nagelkerke R value was 0.16, which meant 16% of the variance was explained by this model. Participants who were cigarette smokers were 17.93 times more likely to use e-cigarette (OR=17.93; 95% CI [15.14, 21.23]; p<0.001).

When analyzed separately in previous analysis, all four mediums were statistically significant predictors for e-cigarette use. However, when analyzed in one model as shown in Table 4.11, newspaper (p=0.328) and television (p=0.079) became non-significant. Advertisement exposure via Internet (p<0.001) and stores (p<0.001) remained statistically significant predictors of e-cigarette use.
<table>
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<th>Cig status</th>
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<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>OR</th>
<th>Exp(B)</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
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<td>Internet ad</td>
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<td>.086</td>
<td>1121.126</td>
<td>1</td>
<td>.000***</td>
<td>17.928</td>
<td>15.141</td>
<td>21.228</td>
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</tr>
<tr>
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<td>Rarely</td>
<td>.402</td>
<td>.063</td>
<td>40.671</td>
<td>1</td>
<td>.000***</td>
<td>1.495</td>
<td>1.321</td>
<td>1.691</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>.670</td>
<td>.073</td>
<td>85.099</td>
<td>1</td>
<td>.000***</td>
<td>1.955</td>
<td>1.695</td>
<td>2.254</td>
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<tr>
<td></td>
<td>Most of time</td>
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<td>.111</td>
<td>53.357</td>
<td>1</td>
<td>.000***</td>
<td>2.247</td>
<td>1.809</td>
<td>2.793</td>
<td></td>
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<tr>
<td></td>
<td>Always</td>
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<td>.165</td>
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<td>.000***</td>
<td>2.127</td>
<td>1.538</td>
<td>2.941</td>
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<td>Newspaper ad</td>
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<td></td>
<td>Rarely</td>
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<td>.057</td>
<td>3.492</td>
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<td>.062</td>
<td>1.113</td>
<td>.995</td>
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</tr>
<tr>
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<td>.072</td>
<td>.631</td>
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<td>.427</td>
<td>1.059</td>
<td>.920</td>
<td>1.218</td>
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<td>Most of time</td>
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<td>.128</td>
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<td>.226</td>
<td>1.168</td>
<td>.908</td>
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</tr>
<tr>
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<td>.189</td>
<td>.025</td>
<td>1</td>
<td>.875</td>
<td>.971</td>
<td>.671</td>
<td>1.405</td>
<td></td>
</tr>
<tr>
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<td>Store ad</td>
<td>29.799</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Rarely</td>
<td>.203</td>
<td>.067</td>
<td>9.097</td>
<td>1</td>
<td>.033**</td>
<td>1.226</td>
<td>1.074</td>
<td>1.399</td>
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</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>.322</td>
<td>.071</td>
<td>20.666</td>
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<td>.000***</td>
<td>1.380</td>
<td>1.201</td>
<td>1.585</td>
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<tr>
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<td>Most of time</td>
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<td>.081</td>
<td>23.555</td>
<td>1</td>
<td>.000***</td>
<td>1.482</td>
<td>1.265</td>
<td>1.738</td>
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</tr>
<tr>
<td></td>
<td>Always</td>
<td>.345</td>
<td>.097</td>
<td>12.567</td>
<td>1</td>
<td>.000***</td>
<td>1.412</td>
<td>1.167</td>
<td>1.708</td>
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</tr>
<tr>
<td></td>
<td>TV ad</td>
<td>8.352</td>
<td>.079</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rarely</td>
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<td>.060</td>
<td>.811</td>
<td>1</td>
<td>.368</td>
<td>.948</td>
<td>.843</td>
<td>1.065</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
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<td>.071</td>
<td>5.686</td>
<td>1</td>
<td>.017*</td>
<td>.845</td>
<td>.735</td>
<td>.970</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Most of time</td>
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<td>.113</td>
<td>4.061</td>
<td>1</td>
<td>.044*</td>
<td>.796</td>
<td>.637</td>
<td>.994</td>
<td></td>
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<td>Always</td>
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<td>.143</td>
<td>2.356</td>
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<td>.125</td>
<td>.803</td>
<td>.606</td>
<td>1.063</td>
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<td>Constant</td>
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<td>.000</td>
<td>.006</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. OR = odds ratio; CI = confidence interval; Cig status = Current cigarette smoking status; Internet ad = Internet Advertisement Exposure; Newspaper ad = Newspaper Advertisement Exposure; Store ad = Store Advertisement Exposure; TV ad = TV Advertisement Exposure; Reference category is “Never” exposed to e-cigarette advertisements via the four mediums.

* p < .05.

** p < .01.

*** p < .001.
RQ3. What moderating factors (e.g. age, gender, race/ethnicity, grade) and individual factors (e.g., perceived harmfulness, perceived addictiveness) are associated with e-cigarette use?

Binary logistic regression was used to analyze the relationship between the various predictors and the outcome variable of e-cigarette use.

**Age.** As shown in Table 4.12, age is a statistically significant predictor of e-cigarette use (OR=1.297; 95% CI [1.27, 1.32]; p<0.001). Being a current cigarette smoker makes an individual 14.5 times more likely to use e-cigarette (OR=14.51; 95% CI [12.33, 17.07]; p<0.001). The Nagelkerke R value was 0.19, which meant 19% of the variance was explained by this model. Figure 5 shows the scatterplot with predicted probabilities of e-cigarette use plotted against age for cigarette smokers and non-smokers.

Table 4.12

*Logistic Regression for Age on E-cigarette use (N=17,872)*

<table>
<thead>
<tr>
<th>Step</th>
<th>Cig status</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig</th>
<th>OR</th>
<th>Exp(B)</th>
<th>95% C.I. for EXP(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cig status</td>
<td>2.675</td>
<td>.083</td>
<td>1042.063</td>
<td>1</td>
<td>.000</td>
<td>14.507</td>
<td>12.332</td>
<td>17.065</td>
</tr>
<tr>
<td>1</td>
<td>Age</td>
<td>.260</td>
<td>.011</td>
<td>600.575</td>
<td>1</td>
<td>.000</td>
<td>1.297</td>
<td>1.270</td>
<td>1.324</td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>-6.105</td>
<td>.118</td>
<td>2660.006</td>
<td>1</td>
<td>.000</td>
<td>.002</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* OR = odds ratio; CI = confidence interval; Cig status = Current cigarette smoking status
Figure 4.5. Predicted probabilities of e-cigarette use plotted against age (from 9 to 19 years old) between cigarette smoker and non-smoker.
**Sex.** Sex is a significant predictor of e-cigarette use as shown in Table 4.13. With males as the reference category, females were 0.86 times less likely to use e-cigarette than males (OR=0.86; 95% CI [0.79, 0.93]; p<0.001). The Nagelkerke R value was 0.14, which meant 14% of the variance was explained by this model. Also, current cigarette smokers were 17.30 times more likely to use e-cigarettes than non-smokers (OR=17.30; 95% CI [14.76, 2028]; p<0.001).

Table 4.13

*Logistic Regression for Sex on E-cigarette use (N=17,872)*

<table>
<thead>
<tr>
<th>Step</th>
<th>Cig status</th>
<th>Sex</th>
<th>Constant</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>OR</th>
<th>Exp(B)</th>
<th>95% C.I. for EXP(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1^a</td>
<td>2.851</td>
<td>-.155</td>
<td>-4.411</td>
<td>.081</td>
<td>.041</td>
<td>.091</td>
<td>1</td>
<td>.000</td>
<td>17.302</td>
<td>.856</td>
<td>[.790, .928]</td>
</tr>
<tr>
<td></td>
<td>1240.589</td>
<td>14.276</td>
<td>2358.818</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* OR = odds ratio; CI = confidence interval; Cig status = Current cigarette smoking status. Males were used as the reference category for comparison.
Figure 4.6. Predicted probabilities of e-cigarette use plotted against sex between cigarette smoker and non-smoker. 1 = Male (Reference category), 2 = Female.
Race. Table 4.14 displays the relationship between the different racial/ethnic groups with e-cigarette use. Race is a significant predictor of e-cigarette use (p<0.001). Current cigarette smokers are 17.24 times more likely to use e-cigarette than non-smokers (OR=17.24; 95% CI [14.65, 20.30]; p<0.001). The Nagelkerke R value was 0.15, which meant 15% of the variance was explained by this model. Whites were used as the reference category for comparison. African-Americans were 0.472 times less likely to use e-cigarette than Whites (OR=0.472; 95% CI [0.413, 0.541]; p<0.001). The difference between Whites and Hispanics was not significant (p=0.513). Participants who identified as other race were 0.77 times less likely to use e-cigarettes than Whites (OR=0.77; 95% CI [0.67, 0.88]; p<0.001).

Table 4.14

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>OR</th>
<th>95% C.I. for EXP(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cig status</td>
<td>2.847</td>
<td>.083</td>
<td>1168.624</td>
<td>1</td>
<td>.000</td>
<td>17.244</td>
<td>14.646</td>
</tr>
<tr>
<td>1a</td>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AA</td>
<td>-.750</td>
<td>.069</td>
<td>118.452</td>
<td>1</td>
<td>.000</td>
<td>.472</td>
<td>.413</td>
</tr>
<tr>
<td></td>
<td>Hispanic</td>
<td>.032</td>
<td>.049</td>
<td>.428</td>
<td>1</td>
<td>.513</td>
<td>1.033</td>
<td>.938</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>-.267</td>
<td>.071</td>
<td>14.136</td>
<td>1</td>
<td>.000</td>
<td>.766</td>
<td>.667</td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>-4.346</td>
<td>.094</td>
<td>2123.214</td>
<td>1</td>
<td>.000</td>
<td>.013</td>
<td></td>
</tr>
</tbody>
</table>

Note. OR = odds ratio; CI = confidence interval; Cig status = Current cigarette smoking status; AA = African-American. Reference category used is Whites.
Figure 4.7. Predicted probabilities of e-cigarette use plotted against race between cigarette smoker and non-smoker. 1 = White (Reference category), 2 = African-American, 3=Hispanic, 4=Others.
**Grade.** Table 4.15 shows that high school students (grade 9 to 12) were 3.09 times more likely than middle school students to use e-cigarettes (OR=3.08; 95% CI [2.82, 3.39]; p<0.001). The Nagelkerke R value was 0.19, which meant 19% of the variance was explained by this model. The status of being a current cigarette smoker makes an individual 15.30 times more likely to use e-cigarette when compared with non-smokers (OR=15.30; 95% CI [13.01, 18.00]; p<0.001).

Table 4.15

*Logistic Regression for Grade (Middle / High school) on E-cigarette use (N=17,872)*

<table>
<thead>
<tr>
<th>Step</th>
<th>Cig status</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>OR</th>
<th>Exp(B)</th>
<th>95% CI for Exp(B) Lower</th>
<th>95% CI for Exp(B) Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>1*a</td>
<td>High school</td>
<td>1.128</td>
<td>.047</td>
<td>564.918</td>
<td>1</td>
<td>.000</td>
<td>3.089</td>
<td>2.815</td>
<td>3.391</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>-5.099</td>
<td>.098</td>
<td>2715.961</td>
<td>1</td>
<td>.000</td>
<td>.006</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* OR = odds ratio; CI = confidence interval; Cig status = Current cigarette smoking status. Reference category used is middle school.
Figure 4.8. Predicted probabilities of e-cigarette use plotted against grade between cigarette smoker and non-smoker. 1 = Middle school students (Reference category), 2 = High school students.
**Perceived harmfulness.** Table 4.16 displays the relationship between perceived harmfulness and e-cigarette use. Perceived harmfulness was a significant predictor of e-cigarette use \(p<0.001\). Current cigarette smokers were 14.53 times more likely to use e-cigarettes than non-smokers \(\text{OR}=14.53; 95\% \text{ CI }[12.21, 17.28]; p<0.001\). The Nagelkerke R value was 0.26, which meant 26\% of the variance was explained by this model. The reference category used for comparison was the group who perceived “a lot of harm” with e-cigarette use. Individuals who perceived “no harm” were 10.98 times more likely to use e-cigarettes \(\text{OR}=10.98; 95\% \text{ CI }[9.24, 13.05]; p<0.001\). Participants who perceived “little harm” were 9.33 times more likely to use e-cigarettes \(\text{OR}=9.33; 95\% \text{ CI }[8.04, 10.82]; p<0.001\), and those who perceived “some harm” were 3.17 times more likely to use e-cigarettes than those who perceived “a lot of harm” \(\text{OR}=3.17; 95\% \text{ CI }[2.72, 3.69]; p<0.001\).

Table 4.16

*Logistic Regression for Perceived harmfulness on E-cigarette use (N=17,872)*

<table>
<thead>
<tr>
<th>Step 1a</th>
<th>Cig status</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>OR</th>
<th>95% C.I. for EXP(B)</th>
<th>Exp(B)</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Perceived harmfulness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No harm</td>
<td>2.396</td>
<td>.088</td>
<td>738.673</td>
<td>1</td>
<td>.000</td>
<td>10.98</td>
<td>9.237 – 13.051</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Little harm</td>
<td>2.233</td>
<td>.076</td>
<td>863.481</td>
<td>1</td>
<td>.000</td>
<td>9.326</td>
<td>8.036 – 10.824</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Some harm</td>
<td>1.152</td>
<td>.078</td>
<td>219.065</td>
<td>1</td>
<td>.000</td>
<td>3.165</td>
<td>2.717 – 3.687</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>-5.760</td>
<td>.118</td>
<td>2363.771</td>
<td>1</td>
<td>.000</td>
<td>.003</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* OR = odds ratio; CI = confidence interval; Cig status = Current cigarette smoking status. Reference category used is “A lot of harm.”
Figure 4.9. Predicted probabilities of e-cigarette use with perceived harmfulness between cigarette smoker and non-smoker. Perceived harmfulness 1 = No harm, 2 = Little harm, 3 = Some harm, 4 = A lot of harm (reference category).
**Perceived addictiveness.** The relationship between perceived addictiveness and e-cigarette use was significant (p<0.001). The Nagelkerke R value was 0.19, which meant 19% of the variance was explained by this model. Participants who perceived e-cigarette to be “more addictive” than combustible cigarettes were used as the reference category. As shown in Table 4.17, participants who perceived e-cigarettes to be “less addictive” were 2.47 times more likely to use e-cigarettes (OR=2.47; 95% CI [2.11, 2.91]; p<0.001). However, the comparison of e-cigarette use among those who perceived e-cigarettes to be “equally addictive” and “more addictive” showed no statistical significance (p=0.125). Current cigarette smokers were 12.97 times more likely to use e-cigarette than non-smokers (OR=12.97; 95% CI [10.75, 15.65]; p<0.001).

Table 4.17

*Logistic Regression for Perceived addictiveness on E-cigarette use (N=17,872)*

<table>
<thead>
<tr>
<th>Step</th>
<th>Cig status</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
<th>95% C.I.for EXP(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Perceived</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>addictiveness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Less addictive</td>
<td>.906</td>
<td>.082</td>
<td>122.335</td>
<td>1</td>
<td>.000</td>
<td>2.474</td>
<td>2.107  to 2.905</td>
</tr>
<tr>
<td></td>
<td>Equally addictive</td>
<td>-.131</td>
<td>.085</td>
<td>2.358</td>
<td>1</td>
<td>.125</td>
<td>.877</td>
<td>.742   to 1.037</td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>-4.112</td>
<td>.129</td>
<td>1023.219</td>
<td>1</td>
<td>.000</td>
<td>.016</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* OR = odds ratio; CI = confidence interval; Cig status = Current cigarette smoking status. Reference category used are those who perceived e-cigarettes as “more addictive” than combustible cigarettes.
Figure 4.10. Predicted probabilities of e-cigarette use with perceived addictiveness between cigarette smoker and non-smoker. Perceived addictiveness when compared with combustible cigarettes; 1 = Less addictive, 2 = Equally addictive, 3 = More addictive (reference category).
RQ4. Is the presence of a tobacco user in household associated with e-cigarette use? (interpersonal level factor)

Analysis began with recoding responses to Item 86 in the NYTS to a dichotomous variable. Item 86 inquired about the presence of tobacco users in the same household, which asked, “Does anyone who lives with you now…?” Responses that answered, “No one lives with me now uses any form of tobacco” were recoded as “No,” and all other responses were recoded as “Yes”. Binary logistic regression was used to analyze the relationship between the predictor and e-cigarette use.

The presence of a tobacco user in the household made an individual 2.10 times more likely to use e-cigarette (OR=2.10; 95% CI [1.93, 2.28]; p<0.001). In this model, cigarette smokers were 14.54 times more likely to use e-cigarette than non-smokers (OR=14.54; 95% CI [12.39, 17.06]; p<0.001). The Nagelkerke R value was 0.17, which meant 17% of the variance was explained by this model.

Table 4.18  

Logistic Regression for Presence of Tobacco user in household on E-cigarette use  
(N=17,872)

<table>
<thead>
<tr>
<th>Step</th>
<th>Cig status</th>
<th>Tobacco user in household</th>
<th>Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.677 .082</td>
<td>.741 .041</td>
<td>-4.632 .091</td>
</tr>
<tr>
<td></td>
<td>1075.982</td>
<td>319.683</td>
<td>2612.730</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
<th>95% C.I. for EXP(B)</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>.000</td>
<td>14.535</td>
<td>12.387</td>
<td>17.056</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>.000</td>
<td>2.098</td>
<td>1.934</td>
<td>2.275</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>.000</td>
<td>.010</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. OR = odds ratio; CI = confidence interval; Cig status = Current cigarette smoking status. Reference category used is the group who do not have a tobacco user in the same household.
Figure 4.11. Predicted probabilities of e-cigarette use plotted against the presence of tobacco user in the household. Comparisons are shown between cigarette smoker and non-smoker. 1 = No tobacco user in the household (reference category), 2 = Tobacco user in the household.
RQ5. What community factors (e.g. exposure to Internet and conventional advertisements, accessibility to tobacco products in stores) are associated with e-cigarette use?

The effects of Internet and conventional advertisement exposure were discussed in detail in RQ 1 and 2. Binary logistic regression was used to analyze the relationship between the predictor and the e-cigarette use outcome. Access to tobacco products was a significant predictor to e-cigarette use (p<0.001). The Nagelkerke R value was 0.17, which meant 17% of the variance was explained by this model. Cigarette smokers were 16.06 times more likely to use e-cigarette than non-smokers (OR=16.06; 95% CI [13.63,18.93]; p<0.001). Participants who felt it was easy to buy tobacco products were 2.88 times more likely to use e-cigarettes (OR=2.88; 95% CI [2.57, 3.23]; p<0.001). Students who felt it was somewhat easy to access tobacco products were 1.88 times more likely to use e-cigarette than those who thought it was “not easy at all” (OR=1.88; 95% CI [1.70, 2.09]; p<0.001). The reference category used was the group who indicated it was “not easy at all” to access tobacco products.

Table 4.19

Logistic Regression for access to tobacco products on E-cigarette use (N=17,872)

<table>
<thead>
<tr>
<th>Step</th>
<th>Cig status</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>OR</th>
<th>Exp(B)</th>
<th>95% C.I.for EXP(B)</th>
<th>95% C.I. for OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Cig status</td>
<td>2.776</td>
<td>.084</td>
<td>1096.883</td>
<td>1</td>
<td>.000</td>
<td>16.06</td>
<td>13.627</td>
<td>18.929</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Access to tobacco products</td>
<td>324.615</td>
<td>2</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Easy</td>
<td>1.058</td>
<td>.059</td>
<td>322.948</td>
<td>1</td>
<td>.000</td>
<td>2.88</td>
<td>2.566</td>
<td>3.232</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Somewhat easy</td>
<td>.633</td>
<td>.053</td>
<td>143.007</td>
<td>1</td>
<td>.000</td>
<td>1.88</td>
<td>1.698</td>
<td>2.090</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>-4.957</td>
<td>.101</td>
<td>2430.779</td>
<td>1</td>
<td>.000</td>
<td>.007</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. OR = odds ratio; CI = confidence interval; Cig status = Current cigarette smoking status. Reference category used is the group who thought access to tobacco products was “not easy at all”.*
Figure 4.12. Predicted probabilities of e-cigarette use plotted against the access to tobacco products. Comparisons are shown between cigarette smoker and non-smoker. 1 = Easy, 2 = Somewhat easy, 3 = Not easy at all.
**RQ 6. Is the policy factor (e.g. exposure to warning labels) associated with e-cigarette use?**

Binary logistic regression was used for analysis and results indicated that warning label exposure was a statistically significant predictor to e-cigarette use (p<0.001). As shown in Table 4.20, the Nagelkerke R value was 0.20, which indicated 20% of the variance was explained by this model. Compared with the reference category that was “never” exposed to warning labels on e-cigarette packages, students who were “always” exposed were 5.65 times more likely to use e-cigarettes (OR=5.65; 95% CI [4.57, 6.97]; p<0.001).

Figure 12 displays the scatterplot that showed the predicted probabilities for e-cigarette use plotted against different levels of warning label exposure. Students who were “never” exposed had lower likelihood to use e-cigarette than those who those who were always exposed to the warning labels. The scatterplot level off and showed the predicted probabilities for those who “rarely”, “sometimes”, “most of the time” or “always” exposed to warning labels were similar. If the last category “always” was used as the reference category instead, the comparison between “always” and “rarely” was not significant (p=0.10). Similarly, the comparison with “sometimes” (p=0.186) and “most of the time” (p=0.183) were also not significant.
Table 4.20

Logistic Regression for warning labels exposure on E-cigarette use (N=17,872)

<table>
<thead>
<tr>
<th>Step</th>
<th>Cig status</th>
<th>OR</th>
<th>95% C.I. for EXP(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Warning label</td>
<td>Exp(B)</td>
<td>Lower</td>
</tr>
<tr>
<td>1a</td>
<td>Cig status</td>
<td>2.425</td>
<td>11.302</td>
</tr>
<tr>
<td></td>
<td>Rarely</td>
<td>1.518</td>
<td>4.565</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>1.541</td>
<td>4.670</td>
</tr>
<tr>
<td></td>
<td>Most of the time</td>
<td>1.512</td>
<td>4.535</td>
</tr>
<tr>
<td></td>
<td>Always</td>
<td>1.731</td>
<td>5.646</td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>-4.284</td>
<td>.014</td>
</tr>
</tbody>
</table>

Note. OR = odds ratio; CI = confidence interval; Cig status = Current cigarette smoking status. Reference category used is the group who were “never” exposed to e-cigarette warning labels.
Figure 4.13. Predicted probabilities of e-cigarette use plotted against the warning label exposure. Comparisons are shown between cigarette smoker and non-smoker. 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Most of the time, 5 = Always.
**RQ 7. What is the relationship between all the significant factors identified and e-cigarette use?**

All the significant factors were entered into a binary logistic regression model for analysis using the Enter method. The Nagelkerke R value for this model was 0.37, which indicated 37% of the variance was explained by this model. The Hosmer and Lemeshow Goodness of fit test showed non-significance (p=0.385) that indicated this model was suitable and a good fit for the data. Table 4.21 displays all the significant predictors identified in RQ 1 to 6. In this model, four predictors became non-significant including newspaper advertisement exposure (p=0.746), store advertisement exposure (p=0.083), TV advertisement exposure (p=0.332), and sex (p=0.291). The other predictors, including current cigarette smoking status, age, race, grade, perceived harmfulness, perceived addictiveness, presence of tobacco user in household, Internet advertisement exposure, access to tobacco products and warning label exposure, were all significant predictors of e-cigarette use in this model.
Table 4.21

Logistic Regression for all significant predictors identified on e-cigarette use (N=17,872)

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
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RQ 8. What are the top three self-reported reasons for using e-cigarettes among adolescents?

Descriptive statistical analysis was performed to identify the top three response options to item 33 in the NYTS survey that asked, “What are the reasons you have used e-cigarettes?” The most frequently reported reasons for using e-cigarettes included the following: “Friend or family member used them” (n=1596, 8.93%), “They are available in flavors such as mint, candy, fruit, or chocolate” (n=1031, 5.74%); and “I used them for some other reason” (n=965, 5.40%).
CHAPTER 5

DISCUSSION

The use of e-cigarettes has increased drastically since 2011 and became a major public health concern. E-cigarettes have surpassed other tobacco products and became the most popular nicotine product used by middle and high school students (Arrazola et al., 2015). Adolescents are exposing themselves to a variety of harmful substances found in the aerosol, such as nicotine, diacetyl, heavy metals, chemicals, carcinogens and flavorings (CDC, 2018). It has been suggested that exposure to e-cigarette advertisements played a role in the rapid rise in use of such devices (CDC, 2017a). However, the relationship between e-cigarette advertisement exposure and e-cigarette use has not been studied before using the socio-ecological model as the theoretical framework.

Many studies have examined the general effect of advertisement exposure on intention to use e-cigarette but none focused on Internet advertising and actual e-cigarette use. The purpose of this study was to examine the effect of Internet and conventional (via newspaper/magazines, stores and television) advertisement exposure on the use of e-cigarettes among a national sample of American adolescents. Additionally, this study identified individual, interpersonal, community and policy factors associated with e-cigarette use among adolescents based on the socio-ecological model.

Summary of the Sample Population

Data from the 2017 NYTS national survey was analyzed for the current study. The survey was administered to a nationally representative sample of middle school and high school
students in the United States (CDC, Office on Smoking and Health, 2017). A total of 17,872 adolescents completed the survey. While most participants were White (44.1%), a fairly large sample of racial and ethnic minority youths also participated: 25.8% Hispanic, 16.7% African American, and 10.9% other. The majority of these youths (57.4%) were in high school and on average about 15 years old (14.62 years). Both male and female students were equally represented. Approximately 20% of the youths in the study reported e-cigarette use, and about 80% reported no e-cigarette use in their entire life.

Students’ exposure to four types of advertisement was explored: Internet, newspaper, television, and in stores. Approximately 38.8% reported to never being exposed to Internet e-cigarette advertising. In contrast, a larger proportion of adolescents reported to never being exposed to e-cigarette advertisements in newspaper (61.5%) and television (39.4%). Additionally, the results suggest that e-cigarette advertising are most common in stores, as only 29.7% of adolescents reported never being exposed to e-cigarette advertisements in supermarkets, stores and gas stations.

Research Questions

RQ 1. What is the relationship between Internet advertisement exposure and e-cigarette use?

This research question examined the relationship between Internet advertisements exposure on e-cigarette use among a national sample of adolescents. The overall relationship between Internet advertisement exposure and e-cigarette use was statistically significant. Participants who were “always” exposed to Internet e-cigarette advertisements were 2.15 times more likely to use e-cigarettes than those who were never exposed. Additionally, participants
who were cigarette smokers were 17.72 times more likely to use e-cigarette when compared to non-smokers in this model.

RQ2. What is the relationship between conventional advertisement exposure and e-cigarette use?

This research question examined the relationship between the three mediums of conventional advertisement exposure (via newspaper, stores and television) on e-cigarette use among a sample of American adolescents. Firstly, the overall relationship between newspaper advertisement exposure and e-cigarette use was statistically significant. Individuals who were “always” exposed to such advertisements were found to be 1.52 times more likely to use e-cigarettes than those who were never exposed. Furthermore, current cigarette smokers were 17.09 times more likely to use e-cigarette when compared to non-smokers in this model.

Secondly, the relationship between in-store advertisement exposure and e-cigarette use was statistically significant as shown in Table 4.9. Students who were “always” exposed to advertisements in stores were found to be 1.95 times more likely to use e-cigarettes than those who were never exposed. Thirdly, the overall relationship between television advertisement exposure and e-cigarette use was statistically significant as shown in Table 4.10. It was found that students who were “always” exposed to television e-cigarette advertisements were 1.50 times more likely to use e-cigarettes than those who were never exposed. When we compare the odds ratio for “never” versus “always” exposed for all 4 mediums, Internet advertisement had the highest OR of 2.15, followed by stores advertisement (OR=1.95), newspaper (OR=1.52) and television (OR=1.50).

Finally, the four mediums were analyzed in one single model in the last part of this research question. Although the four mediums were all significant when analyzed separately,
newspaper (p=0.328) and television (p=0.079) were no longer significant in this model. However, advertisement exposure via Internet (p<0.001) and stores (p<0.001) remained statistically significant predictors of e-cigarette use.

RQ3. What moderating factors (e.g. age, gender, race/ethnicity, grade) and individual factors (e.g., perceived harmfulness, perceived addictiveness) are associated e-cigarette use?

All of the factors investigated in this research question were significant predictors of e-cigarette use. Age was a significant predictor of e-cigarette use as shown in Table 4.12. As age increased, the predicted probabilities of e-cigarette use also increased. The scatterplot in Figure 5, showed the shape of the curve for non-smokers follow that of an exponential curve while for the cigarette smokers, the shape was more hyperbolic. Sex was also a significant predictor of e-cigarette use, with females being 0.86 times less likely to use e-cigarette than males as shown in Table 4.13.

The relationship between race and e-cigarette use was significant as displayed in Table 4.14. African-Americans were 0.47 times less likely to use e-cigarettes than Whites. While the comparison between Hispanics and Whites were not significant, students in other races were 0.77 times less likely to use e-cigarettes than Whites.

Grade was divided into middle and high school for comparison and the overall association with e-cigarette use was significant. It was found that high school students were 3.09 times more likely to use e-cigarettes than middle school students.

Perceived harmfulness was a significant predictor of e-cigarette use. Students who perceived “no harm” are 10.98 times more likely to use e-cigarette than those who perceived “a lot of harm” as shown in Table 4.16. As students perceived e-cigarette to be increasingly more harmful, the likelihood of e-cigarette use decreased. The relationship between perceived
addictiveness and e-cigarette use was significant as displayed in Table 4.17. Participants who perceived e-cigarettes to be “less addictive” than combustible cigarettes were 2.47 times more likely to use such devices.

*RQ4. Is the presence of a tobacco user in the household associated with e-cigarette use? (interpersonal level factor)*

This research question examined the relationship of having a tobacco user in the household and e-cigarette use among a national sample of adolescents. Compared to those students who don’t live with a tobacco user in the household, those students who lived in a household with a tobacco user are 2.10 times more likely to use e-cigarettes (Table 4.18).

*RQ5. Is the accessibility to tobacco products in stores associated with e-cigarette use? (community level factor)*

In this research question, community level factor such as advertisement exposure and accessibility to tobacco products were found to have a significant relationship with e-cigarette use. As discussed in previous RQ 1 and 2, the relationships between the four mediums of e-cigarette advertisements (Internet, newspaper, stores and television) and e-cigarette use were significant. As for accessibility to tobacco products in stores, participants who felt it was easy to buy tobacco products were 2.88 times more likely to use e-cigarettes than those who felt it was “not easy at all”.

*RQ 6. Is the exposure to warning labels associated with e-cigarette use? (policy level factor)*

This research question examined the relationship between warning labels exposure with e-cigarette use. Students are exposed to the warning labels printed on the e-cigarette packages possessed by themselves or their friends and family members. Table 4.20 showed that students
who were “always” exposed were 5.65 times more likely to use e-cigarette than those who were “never” exposed to such warning labels. As seen in the scatterplot in Figure 12, the only significant comparison was between the “never” and “always” exposed group. Students who see the warning labels rarely, sometimes or most of the time are just as likely to use e-cigarette as those who was always exposed. This finding suggested that the presence of warning labels did not really affect e-cigarette use in those people who already have an e-cigarette package in their proximity. Only those students who never see such warning labels are less likely to use it because they did not come across an e-cigarette package.

RQ 7. What is the relationship between all the significant factors identified and e-cigarette use?

This research question attempted to examine all the significant factors identified in research question 1 to 6 in one statistical model. This model explained 37% of the variance observed in e-cigarette use, which is the highest in any model previously examined. Four predictors became non-significant in this model, including newspaper advertisement exposure, store advertisement exposure, TV advertisement exposure and sex. This finding suggests that out of the four mediums of advertising, only Internet advertisement remained significant while the other three conventional methods became non-significant in this model. The relationship between e-cigarette use and current cigarette smoking status, age, race, grade, perceived harmfulness, perceived addictiveness, presence of tobacco user in household, Internet advertisement exposure, access to tobacco products and warning label exposure were all significant.
RQ 8. What are the top three self-reported reasons for using e-cigarettes among adolescents?

This research question examined the top three self-reported reasons for e-cigarette use among adolescents and the most popular reasons given include “Friend or family member used them”, “They are available in flavors such as mint, candy, fruit, or chocolate” and “I used them for some other reason”. However, in the NYTS survey, no extra space was given to students to elaborate and explain what the other reasons were. Other reasons that were not included in the answer list could influence e-cigarette use among adolescents.

**Meaningfully Significant Predictors for E-cigarette Use**

Meaningful significant predictors of e-cigarette use included current cigarette smoking status, age, race, grade, perceived harmfulness, perceived addictiveness, presence of tobacco user in household, Internet advertisement exposure, access to tobacco products and warning label exposure. Specifically, current cigarette smoking status was an important factor that influenced the likelihood of e-cigarette use in every factor at each level in this theoretical model. Additionally, the predicted probabilities of e-cigarette use increased as age increased, coinciding with the transition from middle school to high school. Race was a significant predictor in e-cigarette use; African-Americans and Other races were less likely to use e-cigarettes when compared with White students, whereas the difference between Hispanics and Whites were not significant.

At the individual level, as perceived harmfulness increased, the likelihood of e-cigarette use decreased. For perceived addictiveness, the use of e-cigarette is increased when students perceive them to be less addictive than traditional combustible cigarettes. At the Interpersonal level, having a tobacco user in the same household increased the predicted probabilities of e-
cigarette use. At the community level, as Internet advertisement exposure increased, the predicted probabilities of e-cigarette use increased. Additionally, ease of access to tobacco products in stores increased the likelihood of e-cigarette use. At the policy level, exposure to warning labels exposure was associated with e-cigarette use.

**Discussion**

Use of tobacco products among American adolescents was associated with various individual, interpersonal, community and policy factors based on the socio-ecological model (Kalkhoran, 2018). In our present study, all the variables investigated at each level were significant predictors of e-cigarette use when analyzed separately, including current cigarette smoking status, age, sex, race, grade, perceived harmfulness, perceived addictiveness, presence of tobacco user in household, Internet and conventional advertisement exposure, access to tobacco products and warning label exposure.

Many studies have examined the effect of advertisement exposure on e-cigarette use among youths (Stroup, 2018; Pu, 2017). However, studies that contrasted the impact of Internet and conventional advertising on e-cigarette actual usage has been unknown. Findings from the present study suggested increased exposure to Internet e-cigarette advertising is associated with e-cigarette use. Additionally, the conventional advertisement exposure via newspaper, stores and television were also associated with e-cigarette use among adolescents. This is consistent with previous findings that engagement with online tobacco marketing was associated with higher incidence of initiation and use (Soneji, 2018). The combined effect of e-cigarette advertising using all 4 methods was analyzed in one model and the results showed only Internet and store advertisements were significant. In the final model where all fourteen predictors were included, only Internet advertisement exposure out of the four mediums remained significant.
One possible reason why Internet marketing is crucial for tobacco products promotion is because the Internet is becoming one of the most used tools in everyday life. According to the Pew Research Center’s 2018 Teens, social media and technology survey, smartphone ownership has become an ubiquitous element of adolescents’ life: 95% of teens reported they have a smartphone or access to one. Mobile connections also facilitate a range of online activities, as 45% of teens felt they are online on a near-constant basis (Anderson & Jiang, 2018). Findings of our study was consistent with this observation as only 38.8% of students claimed to never being exposed to online e-cigarette advertising while 61.5% of students claimed to not reading newspaper/magazines.

The reason why Internet advertisement exposure became more influential than conventional medium like television could be explained by the adolescents’ changing habit of using popular online streaming platforms (e.g. Netflix, YouTube, Amazon, Hulu) rather than watching live TV. Findings from a recent survey found that 55% of US teens did not see the need for a cable or satellite TV, and this number has increased steadily for the last few years (McAlone, 2017). In 2012, only 32% of teens thought television were unnecessary. Furthermore, a recent survey of US college students by LendEDU found only 8% of respondents said they did not own a Netflix account, which means a remarkable 92% audience penetration (McAlone, 2017).

A phenomenon that was observed for all of the four mediums of advertisement exposure is that the predicted probabilities of e-cigarette use tend to plateau and peak when the audience reported to see the advertisement most of the time. The likelihood for use is not highest when students are always exposed to the advertisements. A possible reason for this observation is offered by a previous study utilizing data from Nielsen’s Digital Brand effect, researchers
revealed that advertising campaigns resonate with consumers based on the concept of frequency, which is the number of times consumers see an advertising campaign. Researchers found that exposure to digital advertising five to nine times is the optimal range to improve the promotion of the brand in the campaign; however, after a peak in exposures, resonance in consumers begins to fall (Okadar, n.d.).

Age was found to be a significant predictor of e-cigarette use such that as students get older, they are more likely to use e-cigarettes. For our sample, similar findings with grade was consistent with this observation, in that high school students were 3.09 times more likely to use e-cigarettes than middle school students. Previous studies have also shown this steady increase in e-cigarette use with increasing age and grade (Giovacchini, Pacek, McClernon & Que, 2017; Cooper, Case, Loukas, Creamer & Perry, 2016). These findings highlight the strong need of research to investigate the age-related trajectories of e-cigarette use among adolescents.

The gender difference observed in our study had been well established in many previous studies. Males are significantly more likely to have tried e-cigarettes than females. The increased prevalence of vaping among male students could be due to sociocultural characteristics or increased responsiveness to current marketing messages and trends (Perikleous, Steiropoulos, Paraskakis, Constantinidis & Nena, 2018). Another study suggested males had a high risk of e-cigarette use linked to their lower harm perception (Amrock, Zakhar, Zhou & Weitzman, 2014). Our study also found that lowered perceived harmfulness and addictiveness were associated with increased likelihood of e-cigarette use. Previous findings were consistent with the generalization that males tend to appraise lower harm comparative with females and avoid risky behaviors only when they perceive severe risks (Harris & Jenkins, 2006). According to the Naitonal Institute of
Drug Abuse (NIDA), two times as many boys use e-cigarette than girls (National Institute on Drug Abuse., 2016).

The observed frequent use of e-cigarettes in older adolescents could be explained by the fact that older students are more informed about e-cigarettes, being more exposed to marketing campaigns in digital and traditional advertisements (Peters, Meshack, Lin, Hill & Abughosh, 2013). E-cigarettes are also easier to obtain from retail stores and through the internet for older teens, given the lack of regulation of age restrictions laws (Morain & Malek, 2017).

The racial differences observed in our study were consistent with previous statistical reports which found African Americans youths have significantly lower prevalence of tobacco smoking than Hispanics and Whites (Arrazola et al., 2015). On average, AA also initiate smoking at a later age (CDC, Surgeon General's Reports, 1998). Research studies highlight that African Americans have disproportionately higher rates of several smoking-related diseases like heart disease, cancer and stroke, despite the fact that they also start smoking later in life and smoke fewer cigarettes per day than Whites (CDC, n.d.). African Americans smokers tend to be less successful at smoking cessation than White and Hispanic smokers. This is possibly due to lower utilization of cessation strategies such as medications and counseling (CDC, n.d.).

In our study, we found that there was no significant difference in e-cigarette use between Hispanics and Whites. In previous research, Hispanic and White adolescents were characterized by similar prevalence of e-cigarette use, and both groups used tobacco at a higher rate than African Americans adolescents (Arrazola et al., 2015). One study found that Hispanic adolescents used e-cigarettes at higher rates in early adolescence, while White adolescents used at higher rates in mid-to-late adolescence (Lanza, Russell & Braymiller, 2016).
One major finding of our study was that perceived harmfulness was an important predictor of e-cigarette use among adolescents, as students who perceived “no harm” were ten times more likely to use e-cigarette than those who perceived “a lot of harm”. Previous research also demonstrated that perception of risk plays an important role in decision-making regarding tobacco use. For example, many current and former smokers cite concerns about the health risk as the reason for quitting (Rutten et al., 2015). Similarly, consumer’s risk perception about e-cigarettes plays a role in how these newer products are used. The belief that e-cigarettes are less harmful than cigarettes is one of the most cited reasons for e-cigarette use (Rass et al., 2014).

Our results are consistent with a recent comprehensive review of consumer’s perceived risk with different tobacco products where most e-cigarette users perceived e-cigarettes as less harmful than cigarettes (Czoli, Fong, Mays & Hammond, 2017).

Our research found that warning label exposure on e-cigarette packages are significantly associated with e-cigarette use. Adolescents come into contact with e-cigarette packages either by purchasing themselves or their friends and family have possession of the products. An increase in exposure to the warning label appears to have no effect in deterring students from using it. In fact, those students who were “always” exposed to warning labels were 5.65 times more likely to use e-cigarette than those who were “never” exposed. This finding raised questions about the effectiveness of having warning labels on the e-cigarette packages. By the time adolescents are in contact with e-cigarette packages and can see the warnings, it maybe already too late to influence their use. With respect to the content of warnings, previous research on their efficacy has shown mixed results. One study found no impact of e-cigarette warnings on young adult’s e-cigarette harm perceptions and intention to use (Mays, Smith, Johnson, Tercyak & Niaura, 2016). Another study claimed that smokers and e-cigarette users exposed to e-
cigarette ads with addiction warning had higher perceived risk beliefs and lower willingness to try e-cigarettes compared to the unexposed group (Berry, Burton & Howlett, 2017).

In summary, one key finding of our research is that when all significant predictors in each level of the socio-ecological model are analyzed in one binary logistic regression model, four predictors became non-significant: the three conventional advertisement mediums of newspaper, stores and television advertisement exposure, and gender. Internet advertisement exposure remained significant in this model; this finding suggests online advertising is an influential method of e-cigarette product promotion. When we compare the exposure of advertisements among middle and high school students in order of frequency, 56.3% are exposed to stores, followed by Internet (42.9%), TV (38.4%) and newspaper (34.6%) (NIDA, 2016). Even though Internet advertisements were not the most common, it was the most significant predictor of e-cigarette use out of the four mediums. The overall impact of Internet advertisement could possibly be greater than previously anticipated.

Limitations

Several limitations exist for this current study. For example, the cross-sectional design, the collection of self-reported responses, recall bias, social desirability bias, question bias and the possible omission of important factors outside the theoretical framework that could influence e-cigarette use.

This study utilized data from the 2017 NYTS, which may not reflect the current extent of e-cigarette use among adolescents in the United States. The NYTS does not describe cause and effect because of its cross-sectional nature, which meant causal associations could not be made between the predictors and outcome. Also, the items in the NYTS were not created with the socio-ecological model in mind and the survey items were not content validated for the SEM.
Furthermore, participants were asked about past events that happened in their lifetime or in the past months, which could have introduced some recall bias in the results. Additionally, because this survey was carried out in the setting of the school inside the classroom, students might give socially acceptable responses regarding tobacco use. Social desirability bias occurs when respondents provide an answer to a question or reports a behavior that is favorable to the interviewee (Thompson & Phua, 2005). Some sensitive topics that can lead to social desirability bias include personal income, health status, religion, weight, alcohol and smoking status (Krumpal, 2013). Question bias can result in problems in the validity of a measure (Furnham, 1986). The phrasing of questions is a limitation because participants may not understand the terminology or phrase presented in the questionnaire.

Lastly, the NYTS consists of a large sample size, which skewed significant p values. Therefore, for the present study, the significance p values were limited to <.01 instead of <.05. Cross-sectional studies have the advantage of being highly cost-effective, as they could be completed in a short period of time and collect a large sample of data.

**Strengths of the Study**

Despite the limitations of the study, several strengths also exist, including a large sample size, use of a nationally representative sample of adolescents, solid sampling methods, weighting of response data and a well-established theoretical framework. The NYTS was able to gather a large amount of data from adolescents across the nation annually since 2011 due to close collaboration between The Centers of Disease Control (CDC) and the Food and Drug Administration (FDA). The 2017 NYTS followed a stratified, three-stage cluster sample design in order to produce reliable data that are representative of all middle and high school students in the 50 states and the District of Columbia. (CDC, Office on Smoking and Health, 2017).
The NYTS also used solid sampling techniques to ensure selection of schools and students were random. The three stages sampling method included random selection of Primary Sampling Units (PSUs), Secondary Sampling Units (SSUs) and subsequently selection of students within each selected school. Additionally, the NYTS oversamples AAs, Hispanics, Asian Americans and American Indians/Native Alaskan to ensure there were enough cases in each category (CDC, Office on Smoking and Health, 2017). Therefore, the NYTS was able to attain the target sample size in the key subgroups of interest.

Another notable strength of the current study is that the NYTS used procedures to weight the data including sampling weights, nonresponse adjustments and post-stratification to national estimates by grade and weight trimming. The final student-level response data used in the current study had been weighted to reflect the initial probabilities of selection and nonresponse patterns and to alleviate large variations in sampling weights. Although the sample was designed to be approximately self-weighting, survey weights were employed to produce unbiased estimates.

Lastly, the socio-ecological model (SEM) was used as the theoretical framework for the current study. This is the appropriate framework for the study of tobacco use because it examined factors in the individual, interpersonal, community and policy level using a systematic approach. The SEM had been used repeatedly in many studies for the study of factors that are associated with tobacco use initiation among youths (Corbett, 2001; Kalkhoran, 2018), nicotine replacement therapy use (King, 2018) and tobacco, drug and alcohol use among youths (Williams, 2012). Therefore, the SEM was the relevant theoretical framework for the present study.
Implications

The current study contributes to the literature by providing valuable insights regarding the influential impact of Internet advertisement exposure on e-cigarette use. Findings of this study provide new information on various factors in the individual, interpersonal, community and policy level that influence the use of e-cigarette among a national sample of adolescents.

The findings from the current study have significant implications for health educators, healthcare professionals and researchers. Results from this study suggest Internet advertisement exposure exerts a far greater effect on e-cigarette use than other conventional advertisement methods. Further research should expand on our findings on the significance of Internet advertisement on e-cigarette use and explore the reasons why Internet advertising is more influential than conventional methods. There is a gap in knowledge about nature of Internet e-cigarette advertising in general, including the audience penetration, types of advertisements and promotions and the impact on consumers’ perceived risks. Furthermore, perceived harmfulness and addictiveness are two aspects that could be addressed in public health education in order to reduce e-cigarette initiation and use. Special attention to regulations on Internet advertisements are warranted as online marketing strategies are achieving widespread audience penetration in the target population of adolescents.

Health education and promotion. The roles of a health educator include providing education on behaviors that promote health and wellness, developing and implementing strategies to improve health, assess needs of the target population and advocating for improved policies (Society of Public Health Education [SOPHE], 2018). Certified health education specialist are individuals required to meet academic qualifications by adhering to specific areas of responsibilities and competencies (National Commission for Health Education Credentialing
[NCHEC], 2018). Of the seven areas of responsibility, area six states that health educators must serve as a resource and disseminator of accurate information related to health issues. Area seven states that health educators should advocate for the promotion of positive health practices and behaviors (NCHEC, 2018).

Based on the individual factors in the socio-ecological model, findings from this study has implications for health education efforts that increase awareness and knowledge about the harms of e-cigarette use among youths in schools, organizations and community. A previous study has shown that comprehensive tobacco control programme can influence tobacco use by changing attitudes and population norms (Gilpin, Lee & Pierce, 2004). At the interpersonal level, health education programs should not only target current cigarette smokers, but also reach out to non-smokers who are residing in the same household as they are easily influenced by smokers to initiate tobacco use. Family engagement involving parents and family members are important in health education and promotion (Middleton & Cortese, 1994).

Our findings at the community level suggest that online marketing are becoming the mainstream method of advertisements so more research is warranted. Additionally, tobacco products should be less accessible at stores for sale to minors, as perceived ease in obtaining tobacco products was associated with increased use. The finding from this study on the policy factor suggests that the effectiveness of warning labels on e-cigarette package is questionable as increased exposure was associated with increase use of e-cigarettes. Research shows no impact of e-cigarette warnings on young adult’s e-cigarette harm perceptions and intention to use (Mays et al., 2016). Health promotion efforts aimed at individual, interpersonal and community level at early stage of adolescence may be more useful than placing warning labels on e-cigarette
packages. Also, health educators should also serve as advocates and work with policy makers and lawmakers to place tighter regulations on Internet e-cigarette advertisements.

Our findings underscore the urgent need for health education interventions to convey accurate information about the harms of e-cigarettes to the public, especially the adolescents who are exposed to vast amount of advertisements on the Internet. Proper health education about the harms of e-cigarette at middle school or earlier could possibly curb the sharp rise in use among adolescents as low perceived harm is strongly associated with e-cigarette initiation and use. Additionally, our findings encourage government agencies and policymakers to have further discussions about tighter regulations on e-cigarette advertisements in general, especially those on the Internet.

**Recommendation for Future Research**

A significant finding in the present study was that Internet advertisement exposure was a significant predictor to e-cigarette use, to a greater extent than the conventional methods of placing advertisements in newspaper, stores and on television. Limited experimental research is available on the impact of Internet advertisements on e-cigarette use among youths. Thus, further studies should ascertain the causal relationship between online advertisement exposure and e-cigarette use. A content analysis for Internet advertisement should be considered as a future study as there is a knowledge gap about how Internet advertisements are being delivered to the adolescents.

The racial difference in e-cigarette use observed in our study, which indicated a lower prevalence among African American youths when compared to Whites and Hispanics, was consistent with previous literature (Arrazola et al., 2015). However, prevalence of e-cigarette use among African American adults is similar to Whites (CDC. African Americans and Tobacco
Use, n.d.). Further research is needed to assess factors that led to initiation of e-cigarette use later in life among African American despite a lower prevalence among the youths.

This research raised questions about the effectiveness of warning labels on e-cigarette packages as increased exposure was associated with increased use, instead of exerting any negative effect to deter adolescents from using these devices. Further research is needed to find efficient ways to convey warning messages to youths as appearance on the e-cigarette package may already be too late.

Lastly, the top three self-reported reasons for e-cigarette use included having friends or family member who are users, the attraction of flavors and some other unmentioned reason. Future research should explore what these other reasons are and respondents should be given an opportunity to elaborate in future NYTS. Omission of these unspoken reasons may lead to inaccurate assessment of e-cigarette use among American youths.
REFERENCES


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APPENDICES

Appendix A

IRB Approval Letter
December 5, 2018

Rebecca Leung
Department of Health Sciences
College of Human Environmental Sciences
The University of Alabama
Box 870311

Ms. Leung:

Your request submitted November 30, 2018, to update the list of approved publicly available datasets that do not require review by the UA Institutional Review Board has been reviewed. The following data set has been approved for inclusion on the previously approved list:

1. National Youth Tobacco Survey (NYTS) available for public use via the Centers for Disease Control and Prevention (CDC).

If you have any questions or if I can be of further assistance, please feel free to contact me at (205) 348-8461.

Sincerely,

[Signature]

MSM, CIP
Director & Research Compliance Officer
Office for Research Compliance
Appendix B

2017 National Youth Tobacco Survey Items
1. How old are you?
A. 9 years old
B. 10 years old
C. 11 years old
D. 12 years old
E. 13 years old
F. 14 years old
G. 15 years old
H. 16 years old
I. 17 years old
J. 18 years old
K. 19 years old or older

2. What is your sex?
A. Male
B. Female

3. What grade are you in?
A. 6th
B. 7th
C. 8th
D. 9th
E. 10th
F. 11th
G. 12th
H. Ungraded or other grade

4. Are you Hispanic, Latino, Latina, or of Spanish origin? (Select one or more)
A. No.
B. Yes, Mexican, Mexican American, Chicano, or Chicana
C. Yes, Puerto Rican
D. Yes, Cuban
E. Yes, Another Hispanic, Latino, Latina, or Spanish origin

5. What race or races do you consider yourself to be? (Select one or more)
A. American Indian or Alaska Native
B. Asian
C. Black or African American
D. Native Hawaiian or Other Pacific Islander
E. White
11. During the past 30 days, on how many days did you smoke cigarettes?
   A. 0 days
   B. 1 or 2 days
   C. 3 to 5 days
   D. 6 to 9 days
   E. 10 to 19 days
   F. 20 to 29 days
   G. All 30 days

30. In total, on how many days have you used e-cigarettes in your entire life?
   A. 0 days
   B. 1 day
   C. 2 to 10 days
   D. 11 to 20 days
   E. 21 to 50 days
   F. 51 to 100 days
   G. Over 100 days

33. What are the reasons you have used e-cigarettes? (Select one or more)
   A. I have never tried an e-cigarette
   B. Friend or family member used them
   C. To try to quit using other tobacco products, such as cigarettes
   D. They cost less than other tobacco products, such as cigarettes
   E. They are easier to get than other tobacco products, such as cigarettes
   F. Famous people on TV or in movies use them
   G. They are less harmful than other forms of tobacco, such as cigarettes
   H. They are available in flavors, such as mint, candy, fruit, or chocolate
   I. They can be used in areas where other tobacco products, such as cigarettes, are not allowed
   J. I used them for some other reason

60. How easy do you think it is for kids your age to buy tobacco products in a store?
   A. Easy
   B. Somewhat easy
   C. Not easy at all

62. During the past 30 days, how often did you see a warning label on an e-cigarette package?
   A. I did not see an e-cigarette package during the past 30 days
   B. Never
   C. Rarely
   D. Sometimes
   E. Most of the time
   F. Always
68. How much do you think people harm themselves when they use e-cigarettes some days but not every day?
A. No harm
B. Little harm
C. Some harm
D. A lot of harm

69. Do you believe that e-cigarettes are (LESS ADDICTIVE, EQUALLY ADDICTIVE, or MORE ADDICTIVE) than cigarettes?
A. Less addictive
B. Equally addictive
C. More addictive
D. I have never heard of e-cigarettes
E. I don’t know enough about these products

78. When you are using the Internet, how often do you see ads or promotions for e-cigarettes?
A. I do not use the Internet
C. Rarely
D. Sometimes
E. Most of the time
F. Always

79. When you read newspapers or magazines, how often do you see ads or promotions for e-cigarettes?
A. I do not read newspaper/magazines
B. Never
C. Rarely
D. Sometimes
E. Most of the time
F. Always

80. When you go to a convenience store, supermarket, or gas station, how often do you see ads or promotions for e-cigarettes?
A. I never go to a convenience store, supermarket, or gas station
B. Never
C. Rarely
D. Sometimes
E. Most of the time
F. Always
81. When you watch TV, how often do you see ads or promotions for e-cigarettes?
A. I do not watch TV
B. Never
C. Rarely
D. Sometimes
E. Most of the time
F. Always

86. Does anyone who lives with you now? (Select one or more)
A. Smoke cigarettes
B. Smoke cigars, cigarillos, or little cigars
C. Use chewing tobacco, snuff, or dip
D. Use e-cigarettes
E. Smoke tobacco in a hookah or waterpipe
F. Smoke pipes filled with tobacco (not waterpipes)
G. Use snus
H. Use dissolvable tobacco products
I. Smoke bidis (small brown cigarettes wrapped in a leaf)
J. No one who lives with me now uses any form of tobacco