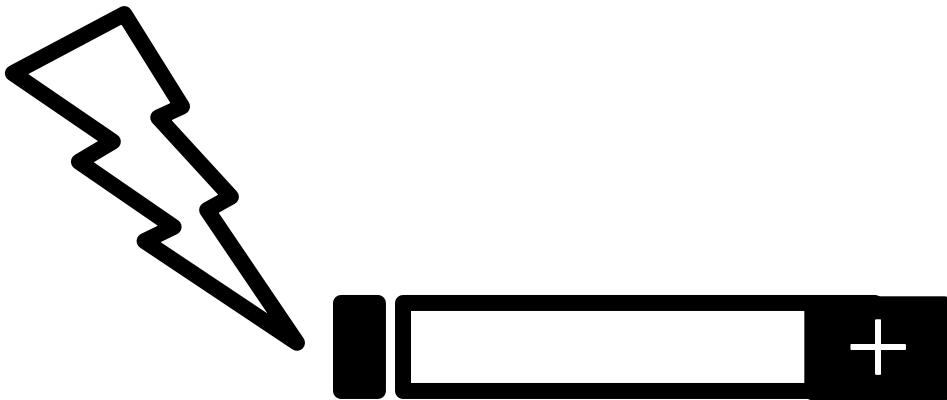


SMOKING HOT!



The Rising Usage of E-Cigarettes among Adolescents & the Repercussions of Such Trends

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For my Dad.

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I. Abstract

Cigarette usage among teenagers is currently at record low rates. Public health officials should be applauding this great accomplishment, however they are having a growing fear of a new invention on the market – e-cigarettes. Usage of e-cigarettes among teenagers is growing rapidly and the consequences of such a trend are still widely unknown. The following study sought to answer the question, “In regards to the currently increasing popularity and usage of e-cigarettes among adolescent first-time smokers; do these products have the potential to serve as a gateway to traditional cigarette use and future tobacco addiction?” I conducted a study in which I surveyed over 200 high school students and 180 young adults using both qualitative and quantitative questions, to gauge the perspectives and usage of e-cigarettes among the two groups. The data collected from the surveys provides useful insights and paves the way for policy recommendations that can help combat the trendiness of this new tobacco-related product.

II. Introduction

Tobacco use to this day remains a leading cause of preventable death in the United States. Policy makers and public health officials have made important progress in combating teenage smoking in the US. The CDC has reported that high school student smoking rates in 2013 were at an all-time low of 15.7%, which was a 57% decrease since its peak in 1997¹. In 2009, President Barack Obama signed the Family Smoking Prevention and Tobacco Control Act, which gave the FDA more control over tobacco, prohibited the sale of cigarettes and smokeless tobacco to individuals under the age of 18, and banned advertising and marketing to children². Through such initiatives by policy officials, sharply increasing tobacco costs, and creating more places that ban public smoking, smoking rates among teens have been steadily declining in recent years, in hopes to someday reach 0%.

Although these decreasing rates are commendable and should be celebrated, other forms of tobacco use are on the rise, causing alarm. According to the National Youth Tobacco Survey distributed by the CDC, the number of high school students who have tried e-cigarettes rose from 4.7% in 2011 to 10% in 2012, and the number of middle school students who have tried e-cigarettes doubled³. While the numbers of adolescents smoking traditional cigarettes is declining, the number of e-cigarette users is sharply increasing. It took nearly 16 years for teen cigarette smoking rates to decrease by half from 1997 to 2013, yet it took only one year from 2011 to

¹ Myers, Matthew L. 2014 Jun 12. "New Survey Shows U.S. Youth Smoking Rates Fell to Record Low in 2013." Campaign for Tobacco-Free Kids. Retrieved Nov 29 2014. Found at: http://www.tobaccofreekids.org/press_releases/post/2014_06_12_cdc.

² Food and Drug Administration, HHS. 2010 Mar 9. "Regulations restricting the sale and distribution of cigarettes and smokeless tobacco to protect children and adolescents. Final rule." Federal Register. 75(53):13225-32. Retrieved on Nov 29 2014. Found at: <http://www.gpo.gov/fdsys/pkg/FR-2010-03-19/pdf/2010-6087.pdf>.

³ Koch, Wendy. 2013 Sep 5. "E-cigarette use doubles among U.S. teens." *USA Today*. Retrieved on Nov 29 2014. Found at: <http://www.usatoday.com/story/news/nation/2013/09/05/e-cigarette-use-doubles-among-us-teens/2768155/>.

2012 for e-cigarette usage rates among teens to double. If teenage smoking rates are to continue to be fought, these other avenues for smoking must be further explored.

Since e-cigarettes are so new on the market and were only introduced a few years ago, the research on the topic is of crucial importance. Researchers have tried to determine why more and more adolescents are trying these products for the first time, and they have found that they primarily learn about them from either internet advertising or from their peers⁴. Other studies attribute the rise in popularity to the various flavors that the nicotine for these products comes in, such as cotton candy⁵. While many researchers are trying to figure out the cause of the increased usage, there is not much research that explores why this is important, or what may result from the increased usage. As stated by Time magazine, “Many teens who start with e-cigarettes may be condemned to struggling with a lifelong addiction to nicotine and conventional cigarettes.”⁶ Studies warn about the possibility of teens forming tobacco addictions as a result of using the e-cigs; however they fail to actually examine whether or not this increase in e-cigarette usage will actually lead to future tobacco addiction, or usage of traditional cigarettes. This gap in the research needs to be further explored in order to properly educate policy makers and officials about the urgency of the matter.

It is therefore important to see whether adolescents who are first-time smokers have tried an e-cigarette, and if they have subsequently tried or have thought about trying, a traditional cigarette for the first time. In exploring these outcomes, it will also be important to research the

⁴ Cho, Jun Ho;Shin, Eunyoung; Moon, Sang-Sik. 2011 Nov. “Electronic Cigarette Smoking Experience Among Adolescents.” *Journal of Adolescent Medicine*. 49(5):542-546. Retrieved on Dec 1 2014. Found at: <http://www.sciencedirect.com/science/article/pii/S1054139X11002734>.

⁵ Glum, Julia. 2014 Nov 14. “Teens Smoking E-Cigarettes: Marketing May Be To Blame For Increase In Number Of Vaping High School Students.” *International Business Times*. Retrieved on Dec 1 2014. Found at: <http://www.ibtimes.com/teens-smoking-e-cigarettes-marketing-may-be-blame-increase-number-vaping-high-school-1724105>.

⁶ Sifferlin, Alexandra. 2014 Jun 12. “Teen Smoking Is Way Down: But What About E-Cigs?” *Time Magazine*. Retrieved Dec 1 2014. Found at: <http://time.com/2864214/teen-smoking-is-way-down-but-what-about-e-cigs/>.

perceptions that these minors have of e-cigarettes and general tobacco smoking. In understanding whether or not minors with no history of tobacco use are trying e-cigarettes and later trying e-cigarettes, the counterargument should also be observed to see if adolescents, who have already smoked traditional cigarettes, have tried an e-cigarette in an effort to transition from cigarettes or quit smoking. This information will determine if e-cigarettes can be a method of smoking cessation, as well as finding any other benefits that these products may possess.

The completion of this research will fill a very important gap in the subject of teenage e-cigarette usage and smoking. With this acquired knowledge, officials will have the ability to make more informed policy recommendations and understand why this issue is important at this time, and needs to be addressed before it continues to grow.

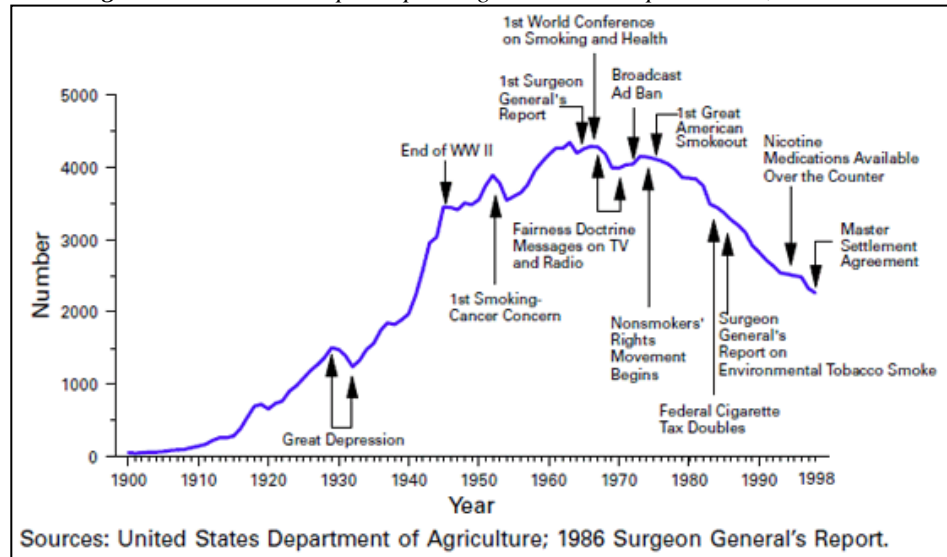
III. Review of the Literature

Cigarette smoking has a long history in the United States. The introduction of tobacco blends to allow and improve the inhalation of tobacco, invention of the safety match, improvements in mass production, increasing mass transportation and distribution of products, and creation of mass media advertisements all contributed to the rapid increase in smoking rates after World War II in the 1940s⁷. It was not until the 1950s that physicians began to question the health consequences of smoking, which led to the findings in 1964 by the U.S. Surgeon General's Advisory Committee, that smoking may cause cancer⁸. Since then, public officials have worked diligently to bring smoking rates down on this number one cause of preventable

⁷ 1999 Nov 5. "Achievements in Public Health, 1900-1999: Tobacco Use -- United States, 1900-1999". *Morbidity and Mortality Weekly Report*. 48(43):986-993. Centers for Disease Control and Prevention. Retrieved from: <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm4843a2.htm>.

⁸ Smith, Derek R. 2008 Sep 9. "The historical decline of tobacco smoking among United States physicians: 1949-1984". *Tobacco Induced Diseases*. 4(1): 9. Retrieved from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2556033/>.

Figure 1: Annual Adult per capita Cigarette Consumption Rates, 1900-1998



death. Figure 1 illustrates a timeline of how public health initiatives and policy implementations impacted the annual adult per capita cigarette consumption rates from 1900-1998⁹.

Although cigarette smoking was in steady decline among adults since the 1960s, smoking rates among adolescents actually began to climb during the 1990s. This spike in teen smoking rates can be attributed to the increase of peer pressure and re-normalization of smoking among teens, as well as the influence of tobacco marketing targeted at teens during this time¹⁰. Due to this increase during the 1990s, officials have worked harder at combating teen smoking rates and researching the proper methods to lower rates. Since 2000, in order to decrease access and prevalence of smoking among teens, most of the states in the U.S. have enacted laws and policies to restrict and limit indoor and outdoor smoking¹¹. In 2006, the U.S. Surgeon General also released a statement that reinforced the findings that smoking, as well as secondhand smoking,

⁹ Burns, David M; Johnston, Lloyd D. 2000. "Overview of Recent Changes in Adolescent Smoking Behavior". *Smoking and Tobacco Control Monograph*. 14(1):1-8. Retrieved from: http://cancercontrol.cancer.gov/BRP/tcrb/monographs/14/m14_1.pdf.

¹⁰ Burns, David M; Johnston, Lloyd D. 2000. "Overview of Recent Changes in Adolescent Smoking Behavior". *Smoking and Tobacco Control Monograph*. 14(1):1-8. Retrieved from: http://cancercontrol.cancer.gov/BRP/tcrb/monographs/14/m14_1.pdf.

¹¹ Blue, Laura. 2012 Oct 30. "Smoke-Free Laws Are Saving Lives". *Time Magazine*. Retrieved from: <http://healthland.time.com/2012/10/30/smoke-free-laws-are-saving-lives/>.

cause cancer¹². Just recently in 2009, President Barack Obama signed the Family Smoking Prevention and Tobacco Control Act, which provides FDA the power to lower the amount of nicotine in products, forbid advertisements geared towards minors, and ban the sale of sweetened and flavored cigarettes¹³. All of these initiatives have dramatically reduced the number of teenage smokers through increasing health concerns, decreasing availability, and reducing pressure from the tobacco industry. Today, smoking rates among 8th graders have declined by 80% since 1996, and among 12th graders they have declined by 50%¹⁴. Teen smoking rates are continuing to decline in the US, and today only 9% of all teens smoke¹⁵; clearly the strategies of policy makers and public health groups are proving to be effective. The trend of decreasing cigarette usage in recent years highlights the decline of the once almighty tobacco industry.

In the decades it took government agencies and officials to understand the true detrimental effects of cigarettes, millions of lives were lost. Each year, about five million people worldwide die as a result of tobacco use¹⁶. This high number of tobacco related deaths inspired the creation of a safer alternative to smoking. In 2003, a 52 year old pharmacist, inventor, and smoker by the name of Hon Lik, developed the first modern day electronic cigarette in Beijing, China¹⁷. Lik wanted to develop a product that would be healthier to smoke since his father was

¹² U.S. Department of Health and Human Services. 2006. "The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General. Secondhand Smoke What It Means to You". U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. Retrieved from: <http://www.surgeongeneral.gov/library/reports/secondhand-smoke-consumer.pdf>.

¹³ Zeleney, Jeff. 2009 Jun 22. "Occasional Smoker, 47, Signs Tobacco Bill". *The New York Times*. Retrieved from: http://www.nytimes.com/2009/06/23/us/politics/23obama.html?_r=0.

¹⁴ Cartwright, Julia. 2013 Dec 18. "Monitoring the Future Report Shows a 9% Decline in Teen Smoking". Legacy for Health. Retrieved from: <http://legacyforhealth.org/newsroom/statements/monitoring-the-future-report-shows-a-9-decline-in-teen-smoking>.

¹⁵ The Truth Campaign. 2014. "Get the Facts". Retrieved from: <http://www.thetruth.com/>.

¹⁶ Centers for Disease Control and Prevention. 2014 Apr 24. "Smoking and Tobacco Use Fast Facts". Centers for Disease Control and Prevention. Retrieved from: http://www.cdc.gov/tobacco/data_statistics/fact_sheets/fast_facts/.

¹⁷ Consumer Advocates for Smoke-free Alternatives Association. 2011-2012. "E-cigarette History". Consumer Advocates for Smoke-free Alternatives Association. Retrieved from: http://casaa.org/E-cigarette_History.html.

addicted to cigarettes and as a result died of lung cancer¹⁸. The concept for the product was “to use a piezoelectric ultrasound-emitting element to vaporize a pressurized jet of liquid containing nicotine diluted in a propylene glycol solution.”¹⁹ The creation of this product was meant to be a safer alternative to smoking, but to still provide the sensation of smoking a cigarette through the use of nicotine. Once the product was introduced to the European market in 2006, the device was redesigned to its current form that “simulates cigarette smoking and deliver[s] heated nicotine to the user.”²⁰ Figure 2 shows an illustration of a modern day electronic cigarette (more commonly known as an e-cigarette), which the FDA defines as a battery-operated device designed to deliver nicotine, flavor, and other chemicals through the creation of an aerosol to be inhaled by the user²¹. Soon after, it was introduced to the US market in 2007, where the product sold for about \$150-\$250, well outside the range of the common consumer²². Soon these products were made more affordable and available to everyone.

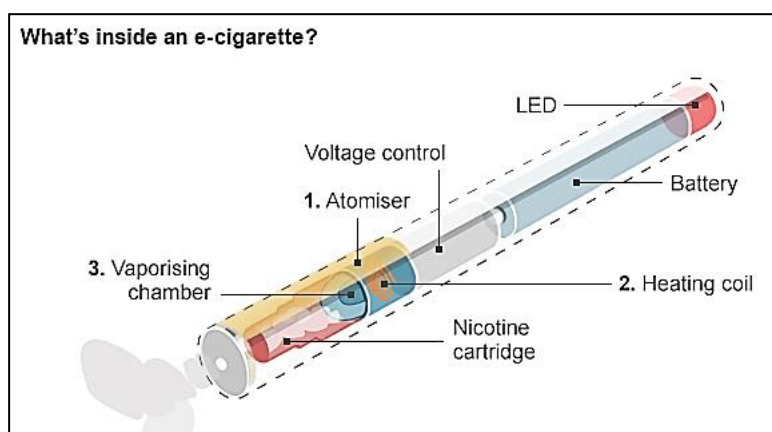


Figure 2: The construction of a modern day e-cigarette. Source: BBC News Scotland

¹⁸ Blue, Laura. 2012 Oct 30. “Smoke-Free Laws Are Saving Lives”. *Time Magazine*. Retrieved from: <http://healthland.time.com/2012/10/30/smoke-free-laws-are-saving-lives/>.

¹⁹ 2012 Aug 15. "CA Patent 2518174 – A Non-Smokable Electronic Spray Cigarette". WikiPatents. Found at: <http://www.wikipatents.com/CA-Patent-2518174/a-non-smokable-electronic-spray-cigarette>.

²⁰ Hummel, Barry. “Emerging Issues of Electronic Nicotine Devices (ENDS) (aka Electronic Cigarettes or E-Cigarettes). Quit Doc Research and Education Foundation. Retrieved from: [http://www.hernandoantidrug.org/Emerging%20Issues%20of%20E-Cigarettes%20-%20handout\[3\].pdf](http://www.hernandoantidrug.org/Emerging%20Issues%20of%20E-Cigarettes%20-%20handout[3].pdf).

²¹ U.S. Food and Drug Administration. 2015. “Electronic Cigarettes”. Retrieved from: <http://www.fda.gov/NewsEvents/PublicHealthFocus/ucm172906.htm>.

²² Zeleny, Jeff. 2009 Jun 22. “Occasional Smoker, 47, Signs Tobacco Bill”. *The New York Times*. Retrieved from: http://www.nytimes.com/2009/06/23/us/politics/23obama.html?_r=0.

Once e-cigarettes became more widespread, they began to rise in popularity in the U.S. Many public health professionals praised the product as a “strategy of harm reduction — an approach to risky behavior that prioritizes minimizing damage rather than eliminating the behavior,” the same strategy used behind needle exchange programs²³. This is because, not only had burning and actual tobacco been eliminated from the product, but a 2010 study found that “the scarce evidence indicates the existence of various toxic and carcinogenic compounds, albeit in possibly much smaller concentrations than in traditional cigarettes.”²⁴ Therefore many public health officers viewed the product as safer because there’s no tobacco or combustion in the product. One official states that, “When you take away the tobacco and combustion then you’re taking away the bulk of the problem.”²⁵ However many public health officials cannot agree on the benefits and risks of smoking e-cigarettes and if they are an effective means for smoking cessation, with increasing concerns developing about the risks as the product’s popularity has soared.

The popularity of e-cigarettes continues to grow rapidly. Since their introduction on the U.S. market, about 21% of adults who smoke traditional cigarettes, admitted to having used an e-cigarette; up from the 10% of adults in 2010²⁶. The trend is also very noticeable among teenagers. While traditional cigarette smoking rates among high school teens dropped by 11% from 2010 to 2011, the number of those teens who have tried an e-cigarette nearly doubled

²³ Fairchild, Amy L; Bayer, Ronald; Colgrove, James. 2014 Jan 23. “The Renormalization of Smoking? E-Cigarettes and the Tobacco ‘Endgame’”. *New England Journal of Medicine*. 370:293-295. Retrieved From: <http://www.nejm.org/doi/full/10.1056/NEJMp1313940>.

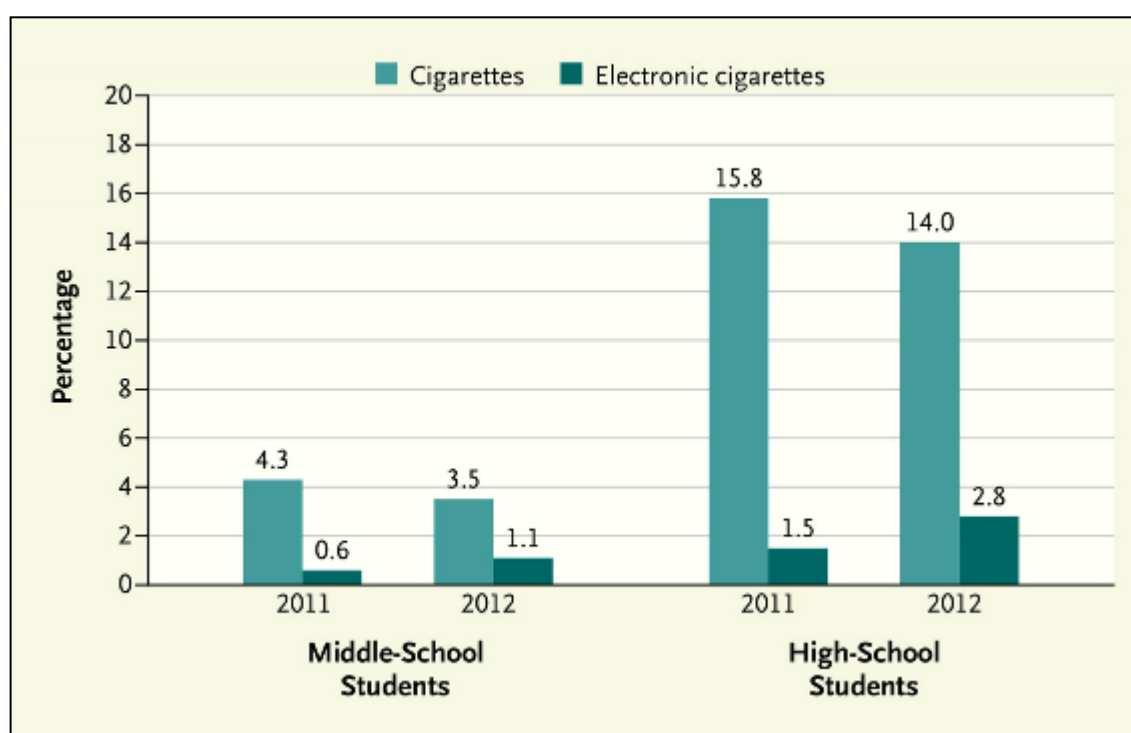
²⁴ Flouris, Andreas D. 2010 Jan 20. “Electronic cigarettes: miracle or menace?”. *British Medical Journal*. 2010(340):c311. Retrieved from: http://www.bmj.com/content/340/bmj.c311?ijkey=cad82f6e3b7d554c219ee369a3ee2d371657774c&keytype=tf_ipsecsha&linkType=FULL&journalCode=bmj&resid=340/jan19_1/c311&hwoasp=authn:1370530080:4073158:1583720516:0:0:oJQnz9Ikhmf/0RqcJsKPOg==.

²⁵ Plackett, Benjamin. 2013 Aug 22. “The Cloudy Science of E-Cigarettes”. *Inside Science*. Retrieved from: <http://www.insidescience.org/content/cloudy-science-e-cigarettes/1367>.

²⁶ Centers for Disease Control and Prevention. 2013 Feb 28. “About one in five U.S. adult cigarette smokers have tried an electronic cigarette”. Centers for Disease Control and Prevention. Retrieved from: http://www.cdc.gov/media/releases/2013/p0228_electronic_cigarettes.html.

during the same time period²⁷. According to the National Youth Tobacco Survey of 2015, the CDC found that e-cigarette usage among teenagers had nearly tripled from 2013-2014 to an astonishing 13% of adolescents – much higher than that of traditional cigarettes²⁸ Figure 3 represents these trends among U.S. teenagers in middle school and high school. However, the majority of teens smoking e-cigarettes are teens that currently smoke traditional cigarettes. Only about 0.7% of teens have actually tried an e-cigarette without prior smoking experience,

Figure 3: Use of Cigarettes and Electronic Cigarettes by U.S. Students in 2011 and 2012.



according to a report by the CDC²⁹. Nonetheless, it is important to examine the e-cigarette smoking trends among teens to see if there is actually causation between e-cigarette smoking and future cigarette addiction or if smoking e-cigarettes is proven to decrease traditional cigarette smoking rates.

²⁷ Cartwright, Julia. 2013 Dec 18. "Monitoring the Future Report Shows a 9% Decline in Teen Smoking". Legacy for Health. Retrieved from: <http://legacyforhealth.org/newsroom/statements/monitoring-the-future-report-shows-a-9-decline-in-teen-smoking>.

²⁸ Tavernise, Sabrina. 2015. "Use of E-Cigarettes Rises Sharply Among Teenagers, Report Says." *NYT*.

²⁹ Sifferlin, Alexandra. 2014 Jun 12. "Teen Smoking Is Way Down. But What About E-cigs?". *Time Magazine*. Retrieved from: <http://time.com/2864214/teen-smoking-is-way-down-but-what-about-e-cigs/>.

While the popularity of e-cigarettes continues to rise among adolescents, there are several factors that may be influencing the market growth. For example, when e-cigarettes first came on the market, there were no regulations on the product and it was free to develop and expand. One such neglected regulation was the sale to minors. Up until early 2014, minors under the age of 18 were legally able to purchase electronic cigarettes from stores, vendors, and online³⁰. This meant that until just recently, minors were able to legally obtain e-cigarettes freely and without adult supervision. This could have contributed to the rapid increase in the number of users that doubles each year. Another contributing factor to the rise in popularity is the fact that until 2014, e-cigarette companies were able to manufacture various flavors of e-cigarettes. Many researchers argue that there is no doubt that the numerous flavors introduced, such as milkshake or bubblegum are attractive to minors³¹. Tobacco industries know that 90% of those who currently use tobacco products began smoking before the age of 18³². It is therefore only likely that tobacco companies try to do everything they can to market their products to minors. Since it is known that the taste for sweets increases as age decreases, cigarette companies want to create sweet candy-like versions of their products so minors will be inclined to try them. This strategy parallels the tobacco industry's past strategies when they marketed flavored cigarettes. A ban was placed on the production of flavored cigarettes by the FDA in 2009 when studies showed that 17-year-old smokers were three times more likely to use flavored cigarettes than that of smokers over the age of 25³³. Clearly the tobacco companies knew of an effective strategy

³⁰ The Huffington Post. 2013 Sep 3. "9 Terribly Disturbing Things About Electronic Cigarettes". *The Huffington Post*. Retrieved from: http://www.huffingtonpost.com/2013/09/03/electronic-cigarettes_n_3818941.html.

³¹ BBC News Correspondent. 2014 Jul 10. "Scottish teenagers admit trying e-cigarettes." *BBC News Scotland*. Retrieved from: <http://www.bbc.com/news/uk-scotland-28258190>.

³² Cancer Action Network. 2013. "Cancer Brief: Flavored Tobacco Big Tobacco's Latest Effort to Hook Kids." Cancer Action Network. American Cancer Society. New York Action Center. Retrieved from: <http://acscan.org/action/ny/updates/2583/>.

³³ Hartman, Brian. 2009 Sep 22. "New Law Bans Flavored Cigarettes". ABC News. Retrieved from: <http://abcnews.go.com/Health/QuitToLive/law-bans-sale-flavored-cigarettes/story?id=8640262>.

creating flavored cigarettes. They wanted to recreate this success through a revamp in the e-cigarette market.

This lack of regulation also allowed minors to use e-cigarettes in places where traditional cigarettes were banned. Because there was no legal ban on the public smoking of e-cigarettes as there is with traditional cigarettes, youths were sneaking e-cigarettes into public schools and were vaping under their desks and on school premises³⁴. This serious issue of minors bringing nicotine products to school needed to be addressed immediately. As a result in early 2014, the City of Los Angeles passed a law banning the smoking of e-cigarettes in public places such as bars, nightclubs, restaurants, parks, shopping centers, schools, and other areas where traditional cigarettes are not allowed³⁵. This initiative was to deter the prevalence of e-cigarettes in public as well as make it less fun to smoke them. By regulating the public smoking of e-cigarettes, users are forced outside of restaurants or bars if they want to smoke; making users leave their friends, the excitement, and the fun in order to step out to smoke³⁶. Because this regulation is fairly new, many minors still had the access to e-cigarettes in public, and this was only one step in combating the issue of increasing popularity.

A contributing factor that also possibly explains the accelerated growth of the product among minors is the advertising aspect of the e-cigarette companies. Many researchers report that the increase in advertisements for e-cigarettes is responsible for increasing the exposure of the product to adolescents. The journal *Pediatrics* reports that, between 2011 and 2013 exposure

³⁴ Moore, Irene; Chang, Hetty; Larsen, Kate. 2014 Apr 19. "Los Angeles E-Cigarette Ban Takes Effect". NBC News Los Angeles. Retrieved from: <http://www.nbclosangeles.com/news/local/Less-Than-24-Hours-Before-the-E-Cig-Ban-Takes-Effect-255825081.html>.

³⁵ Zahniser, David; Gerber, Marisa. 2014 Mar 4. "L.A. bans e-cigarettes in parks, restaurants, and workplaces". *The Los Angeles Times*. Retrieved from: <http://articles.latimes.com/2014/mar/04/local/la-me-0305-e-cigarettes-20140305>.

³⁶ Zahniser, David; Gerber, Marisa. 2014 Mar 4. "L.A. bans e-cigarettes in parks, restaurants, and workplaces". *The Los Angeles Times*. Retrieved from: <http://articles.latimes.com/2014/mar/04/local/la-me-0305-e-cigarettes-20140305>.

to e-cigarette TV ads increased by 256% among adolescents ages 12 to 17³⁷. Ads are not specifically geared towards children; however these television ads are being broadcast on television stations that have wide ranges of viewer audiences. While e-cigarette companies may have been increasing the amount of advertisements geared towards adults, they failed to recognize that children under the age of 18 are also exposed to these ads when they are made public. Not only are television advertisements creating early exposure to tobacco smoking, but internet advertisements are as well. One study found that the main contact routes for exposure to e-cigarettes among Korean students were from the Internet (46.4%), friends (27.9%), and television (11.0%)³⁸. These advertisements are proving to expose many children under the age of 18 to the tobacco products; increasing their curiosity.

In response to these findings and reports, the FDA has made in 2014 several proposed regulations. In April 2014, the FDA proposed the regulation of e-cigarettes, the same as tobacco products, which would restrict sales to those over 18, ban smoking of them in public places, require companies to publish their list of ingredients, and ban the advertising of the product nationwide³⁹. This regulation is currently still being processed by the federal government due to the resistance it has faced from the lobbying of cigar and cigarette companies. However, due to the previously described reasons, the FDA needs to work on regulating the product in order to prevent the growth of minors using the product.

Granted that researchers are still unsure of the social consequences that come with increased e-cigarette usage among adolescents, they do know several impacts that the product

³⁷ Healy, Michelle. 2014 Jun 2. "An 'explosion' of youth exposure to e-cigarette TV ads". USA Today. Retrieved from: <http://www.usatoday.com/story/news/nation/2014/06/02/e-cigarettes-tv-ads-youth/9760425/>.

³⁸ Cho, Jun Ho;Shin, Eunyoung; Moon, Sang-Sik. 2011 Nov. "Electronic Cigarette Smoking Experience Among Adolescents." *Journal of Adolescent Medicine*. 49(5):542-546. Retrieved from: <http://www.sciencedirect.com/science/article/pii/S1054139X11002734>.

³⁹ Young, Sandra. 2014 Apr 24. "FDA proposes crackdown on e-cigarettes." CNN. Retrieved from: <http://www.cnn.com/2014/04/24/health/fda-e-cigarette-regulations/>.

has on users' health. While e-cigarettes deliver much lower amounts of nicotine than traditional cigarettes, the nicotine is still dangerous. Not only is nicotine highly addictive, but in 2014 the Surgeon General reported that "nicotine can hurt developing adolescent brains."⁴⁰ Even though e-cigarettes have significantly lower levels of nicotine than their predecessor, they still deliver nicotine to the user. This trace amount of nicotine can potentially cause issues to adolescents' brain function and development if used persistently; this is a matter that should not be taken lightly. Since nicotine is also highly addictive, and these teenagers are inhaling it, it is crucial to see if e-cigarette usage can lead to future tobacco addiction.

A second negative health consequence of smoking e-cigarettes is the inhalation of secondhand vapor. The World Health Organizations issued a report stating that "The vapors 'pose a serious health threat to adolescents and fetuses,' 'increase exposure of nonsmokers and bystanders to nicotine and a number of toxicants,' and some studies have found that bystanders absorb more nicotine from vapor than from tobacco smoke"⁴¹. Not only can using an e-cigarette be detrimental to the health of the user, but it can also negatively impact the peers of the one smoking. This increase in the number of teenagers using the product is also consequently increasing the number of minors exposed to secondhand vapor, which is more dangerous than actually smoking the e-cigarette itself. It is important for teens to have limited access to these products so that they are not causing a domino effect by releasing secondhand vapor.

The rapidly increasing growth of e-cigarettes among minors is unsettling. Although strides have been made to dramatically decrease teen smoking rates in recent years, the e-cigarette market is proving to be a new challenge that public health officials are struggling to

⁴⁰ Mickle, Tripp. 2014 Nov 13. "E-Cigarette Use by Teens Rising." *The Wall Street Journal*. Retrieved from: <http://online.wsj.com/articles/e-cigarette-use-by-youths-rising-government-study-shows-1415901602>.

⁴¹ Shute, Nancy. 2014 Aug 26. "Health Organizations Call For A Ban On E-Cigarettes Indoors." NPR. Retrieved from: <http://www.npr.org/blogs/health/2014/08/26/343382661/health-organizations-call-for-a-ban-on-e-cigarettes-indoors>.

control. While many people have researched the potential causes of the popular trend such as marketing techniques, unrestricted sales, peer relations, and creation of various flavors, not much research has been done on the consequences of trying e-cigarettes. Studies have yet to observe what happens after teenagers smoke e-cigarettes for the first time and whether or not they are more comfortable with trying traditional cigarettes afterward. They also do not examine if the use of e-cigarettes among teenagers who already smoke is an effective treatment for quitting smoking. This report hopes to explore those questions further, in order to help create a better understanding of the effects of e-cigarettes on minors.

IV. Methodology

Phase I – Adolescent Survey

The research for this study was conducted in two phases. Phase I of this research examined the relationship and perceptions of e-cigarettes (as well as general smoking trends) among high school students (ages 14-18) through the use of a paper-based survey. The survey (Appendix A) consisted of a series of both quantitative and qualitative questions in hopes of determining why e-cigarette usage is increasing so rapidly among this particular age group. The quantitative component of the survey included questions to measure where participants learned about e-cigarettes, if they smoke or have tried smoking, how often they smoke, and how likely they are to smoke. The qualitative component hoped to examine the perceptions that the participants held of e-cigarettes, whether they had a preference for either e-cigarettes or traditional cigarettes, and if there was any possibility of transitioning from using one product to the other. Questions in regards to a participant's demographic information – such as parents' annual income, home zip code, and race/ethnicity – were asked to determine if there were any possible associations between socioeconomic background and e-cigarette usage. The survey was thoroughly examined

and received approval from Occidental College's Institutional Review Board for compliance with the Code of Federal Regulations: Title 45, Part 46⁴².

Surveys were distributed and collected from 242 high school students ages 14-18. Participants for this survey were provided by Don Bosco Technical High School, Ramona Convent Secondary School, St. Francis High School, San Gabriel Mission High School, Norwalk High School, Southeast Academy High School, La Mirada High School, Montebello High School, Artesia High School, and William Workman High School. Participating high schools were selected based on a general willingness to participate when reached out to, as well as having personal connections with the schools' administration. The Los Angeles County Department of Public Health's drug, alcohol, and anti-smoking afterschool program – Friday Night Live – assisted in finding participants within the Norwalk-La Mirada district area schools. It was also important to have participants that attended both public and private schools in order to have a more diverse demographic.

Surveys were distributed to samples of the student bodies of the previously mentioned schools through the assistance of local faculty and staff. Participants were sent home with an informational letter and parental consent form to: 1) describe the nature of the study and enable some transparency of the research to the parents; 2) gain parental consent which allowed the participants (being that they were minors under the age of 18) to complete the survey; and 3) be within accordance of federal regulations regarding human subjects and minors. Once the participants returned a signed parental consent form to a faculty member or administrator, they were given a survey to complete. The collected surveys and signed consent forms were gathered by faculty and administrators and later forwarded to myself, the researcher.

⁴² U.S. Department of Health and Human Services. 2009 Jan 15. Code of Federal Regulations. Title 45: Public Welfare. Part 46: Protection of Human Subjects. Retrieved on Mar 15 2015. Found at: <http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.html>.

Due to the fact that subjects needed to take home and return signed parental consent forms in order to complete the survey, an incentive was offered to ensure that subjects would actively seek parental consent and return the form instead of disregarding the study. The incentive of a \$5.00 Starbucks gift card was offered at random to one of the participants that had returned the signed consent form at each of the schools previously mentioned. Students that wished to participate in the drawing for a gift card were instructed to check a box at the bottom of the parental consent form. This indicated that they wished to use to contact information stated in the consent form to enter the drawing. It is important to incentivize participants through the use of issuing gift cards because studies have shown that prepaid incentives yield significantly higher response rates than surveys that do not⁴³. Therefore, it was important that an incentive be offered for students completing the survey.

Phase II – Young Adult Survey

Once surveys from Phase I were collected and analyzed, it required further examination of e-cigarette usage and trends needed to occur. These initial findings in Phase I of the research laid the foundation for the research conducted in Phase II. Phase II took the research further by examining the e-cigarette and smoking trends, usage, and perceptions among young adult/college students (ages 18-22+); to compare and contrast findings with those among teenage populations. The research was conducted through the use of an online Qualtrics-created survey (Appendix B), containing both quantitative and qualitative questions – in a fashion similar to the adolescent survey used. As with the adolescent survey, the quantitative module of the survey included questions to determine participants’ knowledge of e-cigarettes, smoking and usage rates, and broadly measure how likely they are to smoke. The qualitative module also mirrored the

⁴³ Singer, Eleanor. 2012 Oct 3. “The Use and Effects of Incentives in Surveys” University of Michigan. Retrieved on Dec 1 2014. Found at <https://iriss.stanford.edu/sites/all/files/EDGE/SingerOctober.pdf>.

adolescent survey in that it sought to understand participants' perceptions of e-cigarettes and smoking, and if there was any possibility of transitioning from e-cigarettes to traditional cigarettes or vice versa. One aspect of the young adult survey used in Phase II that differed from the adolescent survey used in Phase I, was that the survey of Phase II included questions in regards to frequency and relevance – asking when was the last time a participant consumed an e-cigarette or cigarette. Questions in regards to demographic information were also included in the Phase II survey. The Phase II survey was also in compliance with federal regulations on human subjects.

Phase II surveys were administered and collected from 189 participants ages 18-22+. Participants for this survey were found through the assistance of colleagues and social media networking, and came from a variety of institutions and backgrounds. Participants gained access to the survey through the distribution of an online link that would take them directly to the survey webpage. Before beginning the survey, the participants' needed to agree to the survey's terms and check a box indicating their consent and approval to continue on to the survey page. This was in agreement with the federal regulations on human subjects and informed consent. Participants then completed the survey online and submitted it. Data was then recorded, managed, and processed by the Qualtrics online system.

I. Results

Phase I – Quantitative Component Results

The sample population of those adolescents surveyed in Phase I are composed of the following demographics. Subjects' ages ranged from 14-18 and were in grades 9-12. The majority of subjects were the age of 17 (34% - 83 of 242), and were in the 12th grade (43% - 105 of 242). Figure 4 and Figure 5 represent the breakdown of subjects' ages and grade levels respectively.

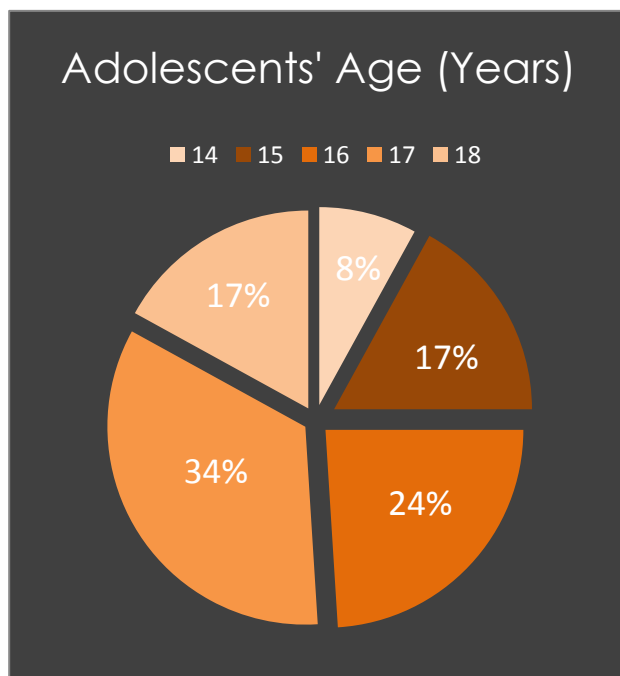


Figure 4: Participants' Reported Age

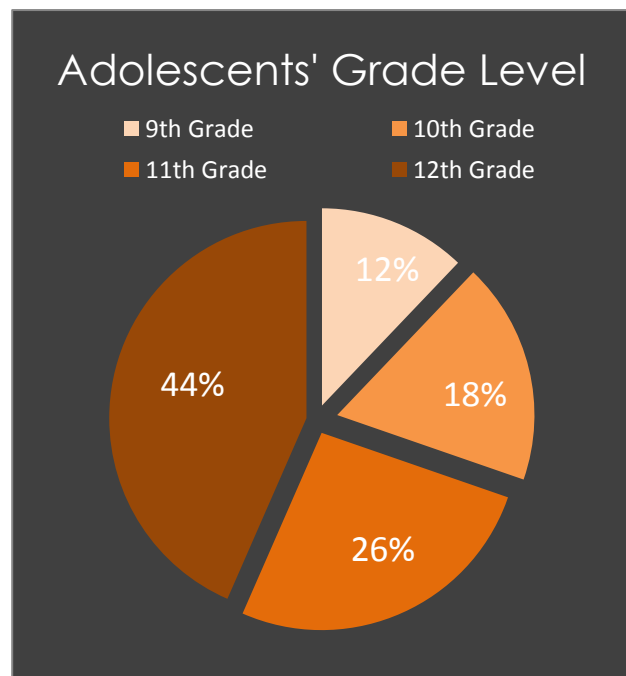
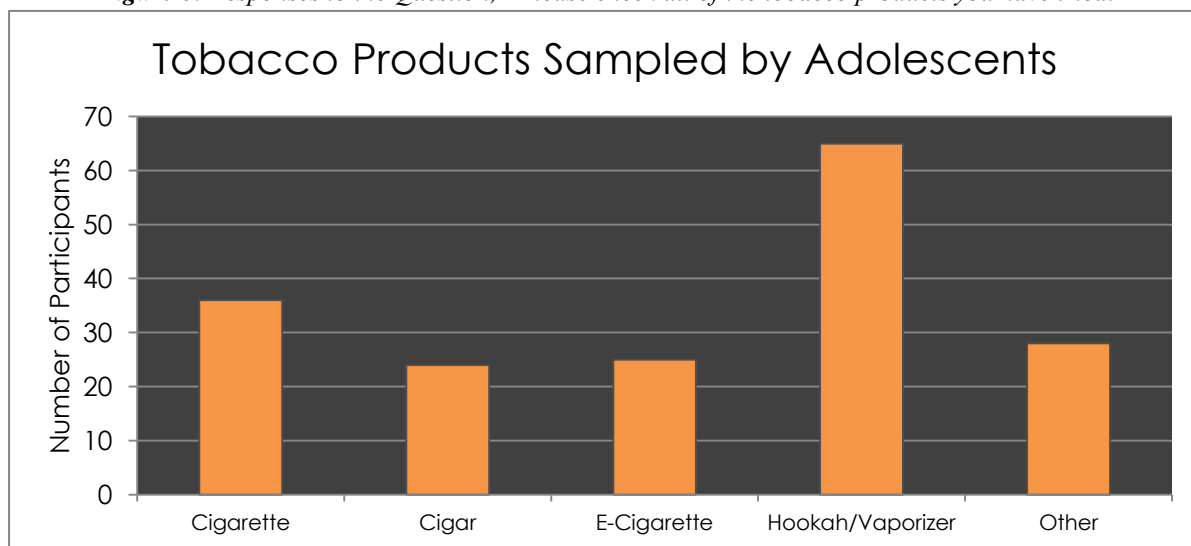


Figure 5: Participants' Reported Current Grade

The majority of subjects reported to be of Hispanic/Latino ethnicity (67% - 161 of 242). The subjects also consisted of 10% (23 of 242) Asian/Pacific Islander, 13% (30 of 242) Mixed or Other, 9% (22 of 242) White, and 1% (3 of 242) Black. Of those subjects that reported their parents' annual household income, 29% (33 of 115) of individuals reported this to be over \$100,000. Followed by 25% (29 of 115) of participants reporting an income between \$40,001 and \$70,000; and 23% (26 of 115) reporting an income between \$70,001 and \$100,000.

The data collected from the surveys of Phase I of the research prove to be quite interesting. While I had hoped to examine the relationship between adolescents and e-cigarettes – focusing on the research question at hand of whether or not e-cigarette usage serves as a potential gateway to regular cigarette consumption – the results reported other valuable information. It should not be surprising that 89% of participants reported that they do not smoke traditional cigarettes and that 90% of participants do not use e-cigarettes. These findings coincide with previously conducted national studies that report only 9% of all high school students in the U.S. regularly smoke traditional cigarettes⁴⁴. 30% (73 of 242) of the respondents did report that they had tried tobacco products before, which included traditional cigarettes, e-cigarettes, cigars, and hookahs/vaporizers. Further investigation of those subjects that have tried tobacco products reveals that those respondents are mainly experimenting with hookah and vaporizers (65 respondents), as seen in Figure 6 below; compared to the number of individuals who have tried e-cigarettes (25 respondents). While more participants admitted to trying cigarettes than the number that reported sampling e-cigarettes as seen in Figure 6, the data illustrates that the knowledge of e-cigarettes among teenagers is great.

Figure 6: Responses to the Question, “Please check all of the tobacco products you have tried.”



⁴⁴ The Truth Campaign. 2014. “Get the Facts”. Retrieved from: <http://www.thetruth.com/>.

According to the data, 83% (200 of 242 survey respondents) of teenagers surveyed reported that they did have knowledge of e-cigarettes, versus a mere 17% (42 of 242 survey respondents) of those that did not. When participants were asked where they gained their knowledge of e-cigarettes, majority of respondents reported that they learned of the product from either friends or peers (86 responses) and from television media (85 responses). This information is represented below in Figure 7. It is also important to note that many subjects reported learning about e-cigarettes from the Internet (64 responses) and from advertisements or billboards (65 responses).

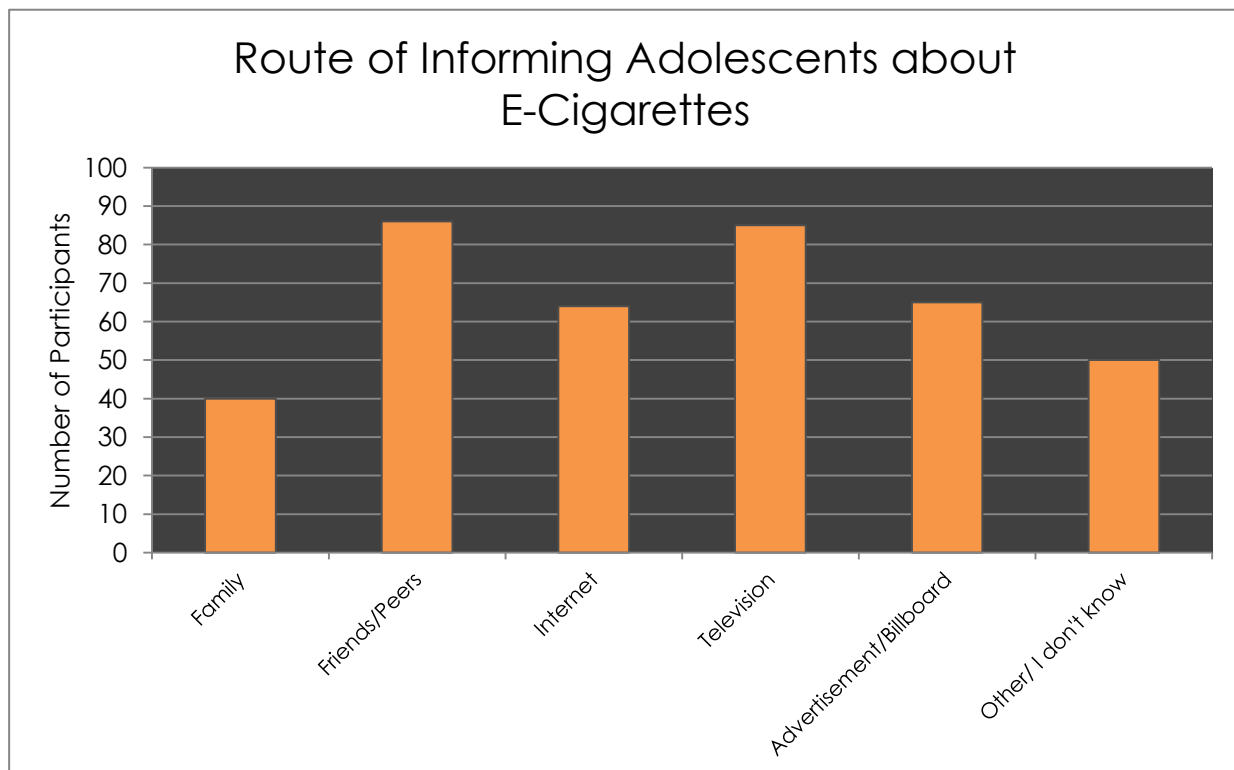
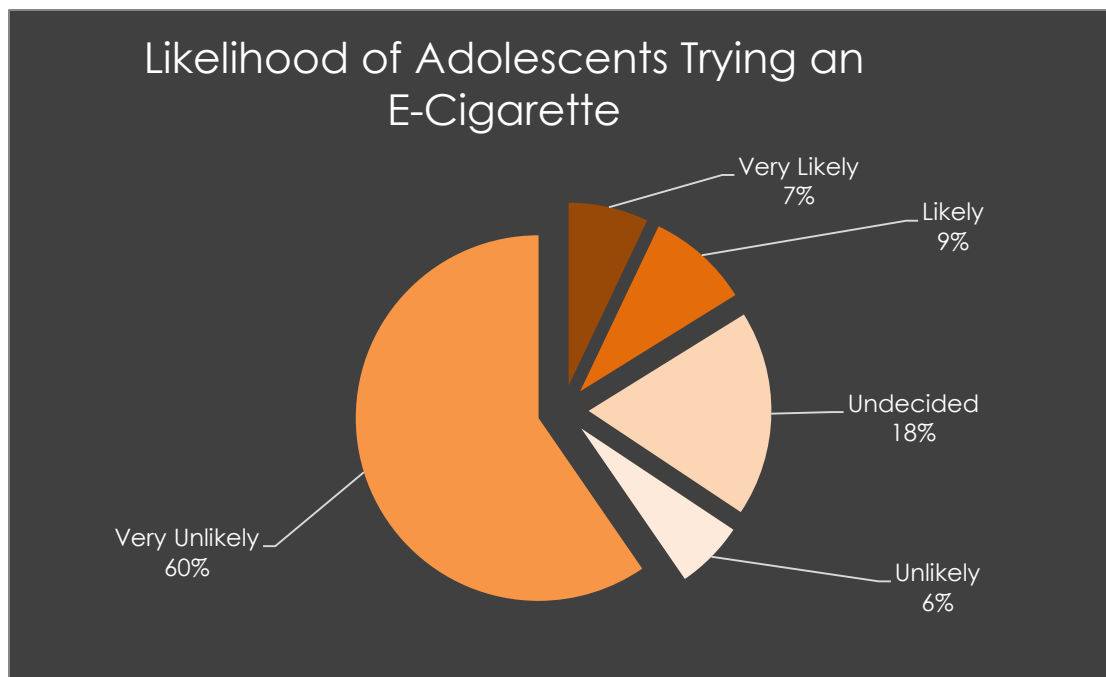


Figure 7: Responses to the Question, “Where did you learn about e-cigarettes? Please check all that apply.”

When subjects were asked to state how likely they are to smoke an e-cigarette, majority (59% of respondents) listed that they were very unlikely to smoke e-cigarettes. In examining this question further, the second largest answer provided was undecided or unsure (18% of respondents). Compared to the percentages of other answers given, this uncertainty among teenagers in regards to e-cigarettes is striking. This is represented by Figure 8, along with the other recorded responses. The undecided opinion of these products has the ability to be influenced in either direction.

Figure 8: Responses to the Question, “How likely are you to smoke an e-cigarette?”



Further data collected reports that when subject were asked to report which product they had tried first – either an e-cigarette or a traditional cigarette – a slightly higher number of participants had tried traditional cigarettes first, as illustrated in Figure 9. Yet, when given the option of which product they would *prefer* to smoke, a higher number of respondents said that they would prefer to smoke e-cigarettes versus traditional cigarettes; as shown in Figure 10.

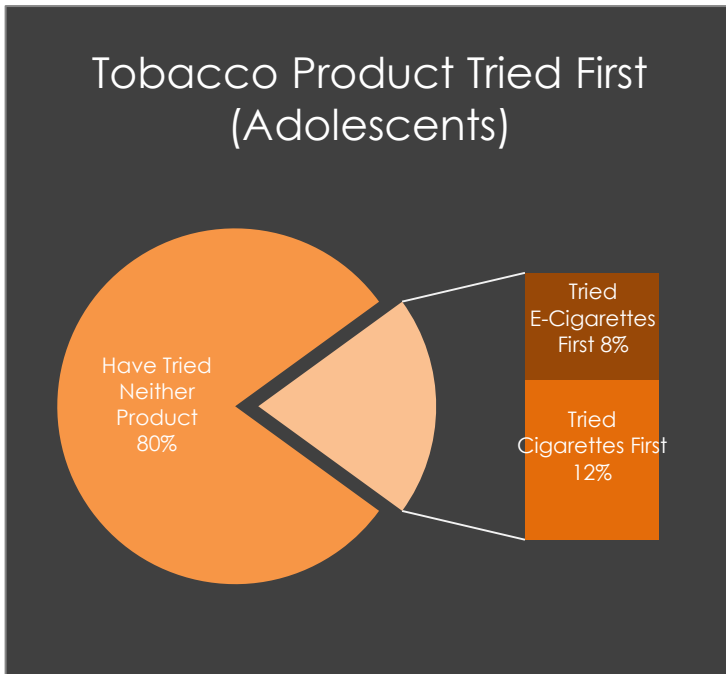


Figure 9: Responses to the Question, “Which product did you try FIRST?”

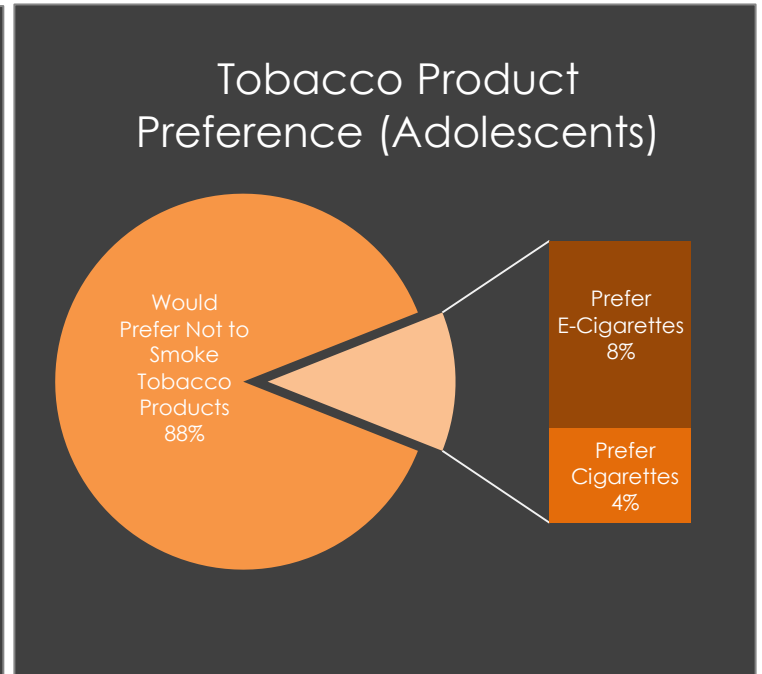


Figure 10: Responses to the Question, “Which product would you prefer to smoke?”

In regards to the attainment of e-cigarettes, 42% of those respondents that smoke e-cigarettes purchase the products from stores. 32% obtain them from a friend or peer, while 23% obtain them from other undisclosed sources. In comparison to obtaining traditional cigarettes among adolescents, 33% of those respondents that smoke cigarettes obtain them from a friend or a peer. 30% obtain cigarettes by purchasing them at the store, and 22% obtain them from other undisclosed sources. 15% also attain cigarettes from a family member. Majority of adolescents obtain e-cigarettes from stores, versus the majority of them obtaining traditional cigarettes from their friends or peers.

Phase I – Qualitative Component Results

Participants were asked to respond to the question, “Please describe your opinion of e-cigarettes in comparison to traditional cigarettes.” The responses provided for this question had some general trends and many similar views were expressed. Many of the respondents stated that

they feel as though e-cigarettes are healthier than traditional cigarettes; albeit that they still have their own safety concerns in regards to health. Participants stated in their surveys that they feel e-cigarettes were safer because they did not contain the harsh carcinogens and toxins that traditional cigarettes have, and that they must be safer to consume since they are fueled by water vapor and do not contain tobacco. Subjects also stated that they felt as though e-cigarettes tasted better than traditional cigarettes, and that some of the flavors that these products came in were refreshing when compared to traditional cigarettes. Respondents also wrote that they liked the fact that e-cigarettes did not create a lingering odor on their person. That makes it easier not only to tolerate in regards to secondhand smoke, but since it did not leave lingering odors on their clothes and thus made them easier to conceal from adults.

Few participants felt as though e-cigarettes were just another marketing technique of the tobacco industry and were merely a fad not to be concerned with. There were also a number of surveys that stated they felt as though they did not have enough knowledge on e-cigarettes and therefore could not draw conclusions or make comparisons to traditional cigarettes. Others felt as though they are a good technique to help a person quit smoking and should be used in that way.

When participants were asked to respond to the question: *“If you typically smoke traditional cigarettes and have recently tried e-cigarettes as an alternative, why did you? Explain,”* the responses were almost unanimous. Most of the surveys stated that they do not smoke traditional cigarettes and therefore could not answer the question (complying with the earlier reported data that only ~10% of respondents smoke e- and traditional cigarettes). Few answers did report that e-cigarettes “do not leave a smell” on a person’s hands the way a traditional cigarette does. Others said that they had made the switch because they wanted to be

healthier, it wasn't as costly as smoking regular cigarettes, and one response stated that they switched to e-cigarettes in an effort to quit smoking.

The participants were also asked to respond to the question, *“If you typically smoke e-cigarettes and have recently tried traditional cigarettes as an alternative, why did you? Explain.”* Again, the majority of responses said that they do not smoke either tobacco product and therefore could not answer the question. One subject stated that they did not want to carry around e-cigarette supplies and have to keep recharging. A couple of other responses said that their friends were using traditional cigarettes and were therefore curious to try. Another survey said that an e-cigarette did not leave them feeling fulfilled, and so went on to try traditional cigarettes.

Phase II – Quantitative Component Results

In Phase II of the research, the sample population of those young adults surveyed consists of the following demographics. The subjects' ages ranged from 18 to 22+ (consisting of a single category of those aged 22 and older). The majority of the participants were 21 (28% - 45 of 163). Figure 11 represents the full breakdown of the participants' ages in Phase II. 49% of the respondents also listed that they racially identified as white, as shown in Figure 12. This was followed by 20% Hispanic/Latino subjects, and 15% Mixed/Other identifying subjects.

When subjects were asked to state their parents' annual household income, the largest percentage of subjects (32% - 53 of 165) reported that their parents' income was above \$100,000. This was followed by 19% (31 of 165) reporting an income of \$40,001 to \$70,000; and then 12% (19 of 165) stating an income of \$70,001 to \$100,000; and 11% (18 of 165) that said their parents' income was between \$20,001 to \$40,000 annually.

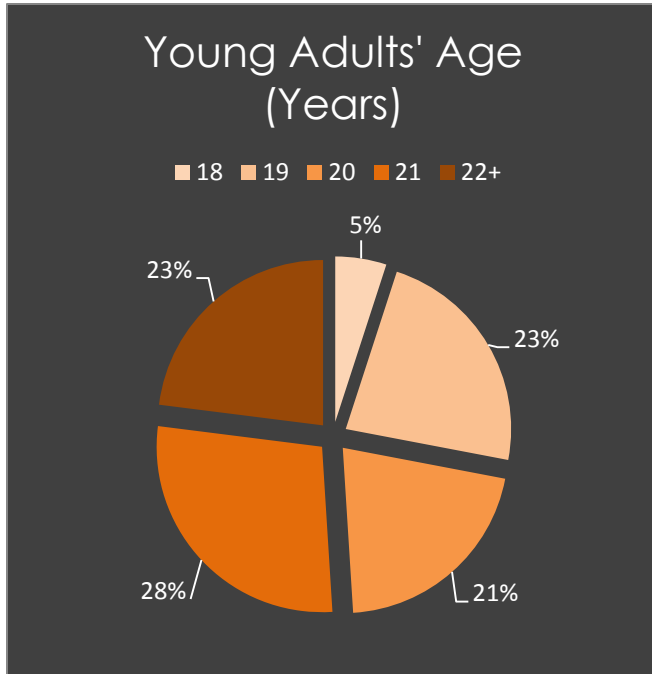


Figure 11: Participants' Reported Age in Phase II

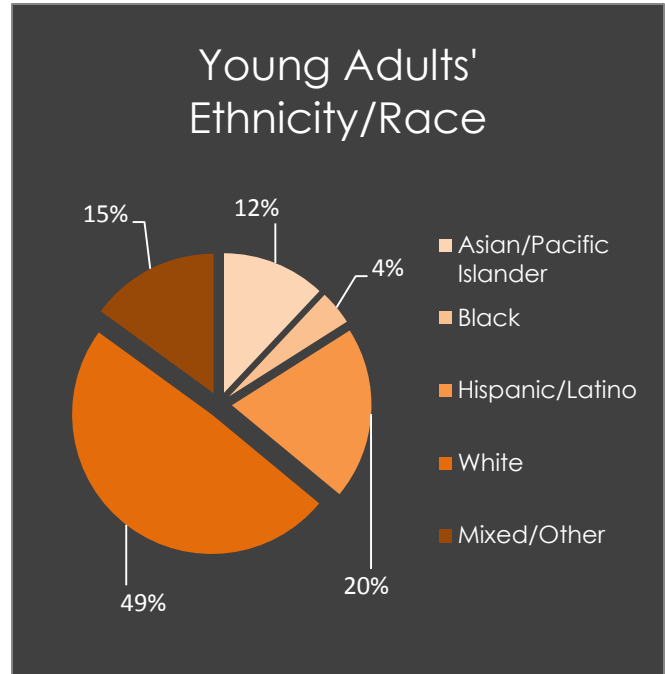


Figure 12: Participants' Reported Ethnicity/Race

The data collected from Phase II of the research had slightly different figures compared to the data found in Phase I. When asked if they had ever smoked a tobacco product before (this includes cigarettes, cigars, e-cigarettes, hookahs and vaporizers), 65% (107 of 165) of individuals reported to having smoked one of these products. This is over double the amount of adolescents that had reported smoking one of these products (30%). Subjects who reported

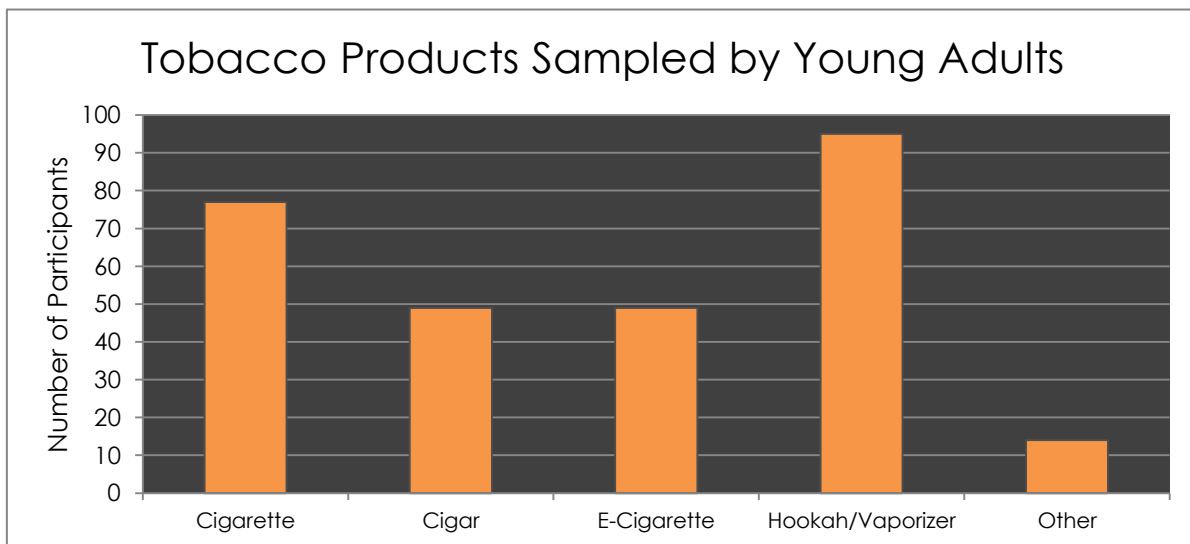


Figure 13: Responses to the Question, "Please check all of the tobacco products you have tried."

having sampled tobacco products mostly stated to having tried hookah/vaporizers, however large numbers of respondents had also tried other products as represented by Figure 13.

According to the findings, an overwhelming 99% (163 of 165) of subjects stated that they knew what an e-cigarette was – much greater than the 83% of adolescents that had reported they had knowledge of the product. When asked to report where they had learned about e-cigarettes, most of the survey participants said that learned about them from their friends or peers. This data is depicted by Figure 14. Other strong influences on the raising of awareness of e-cigarettes among this sample were the Internet and television media; but clearly peers have the strongest influence on this population.

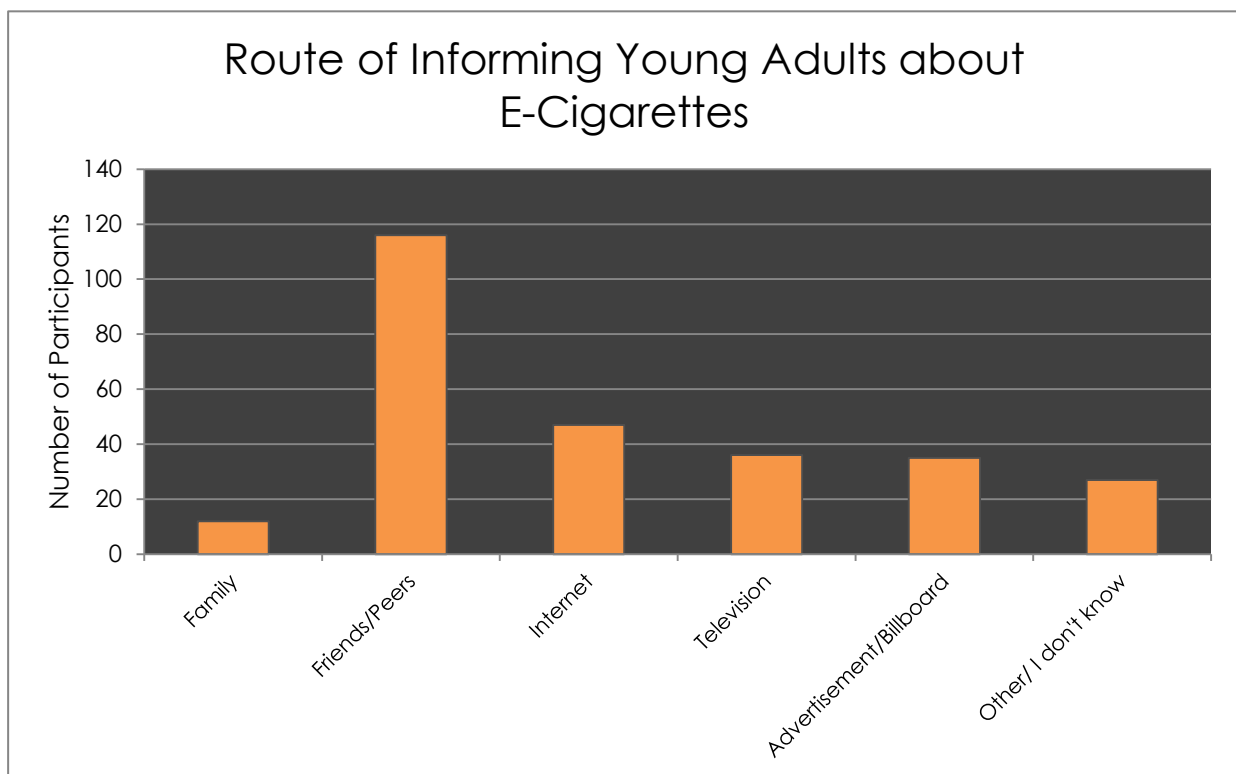


Figure 14: Responses to the Question, “Where did you learn about e-cigarettes? Please check all that apply.”

Although more young adults know about e-cigarettes, it appears that they are less likely to use them. The data shows that 60% (98 of 164) of young adults are very unlikely to smoke an

e-cigarette, and 22% (36 of 164) are unlikely to smoke them as shown in Figure 15. Notice how more young adults are unlikely to smoke an e-cigarette, yet almost double have tried e-cigarettes when compared to that of adolescents back in (Figure 13 versus Figure 6; 48 young adults tried e-cigarettes versus 25 adolescents).

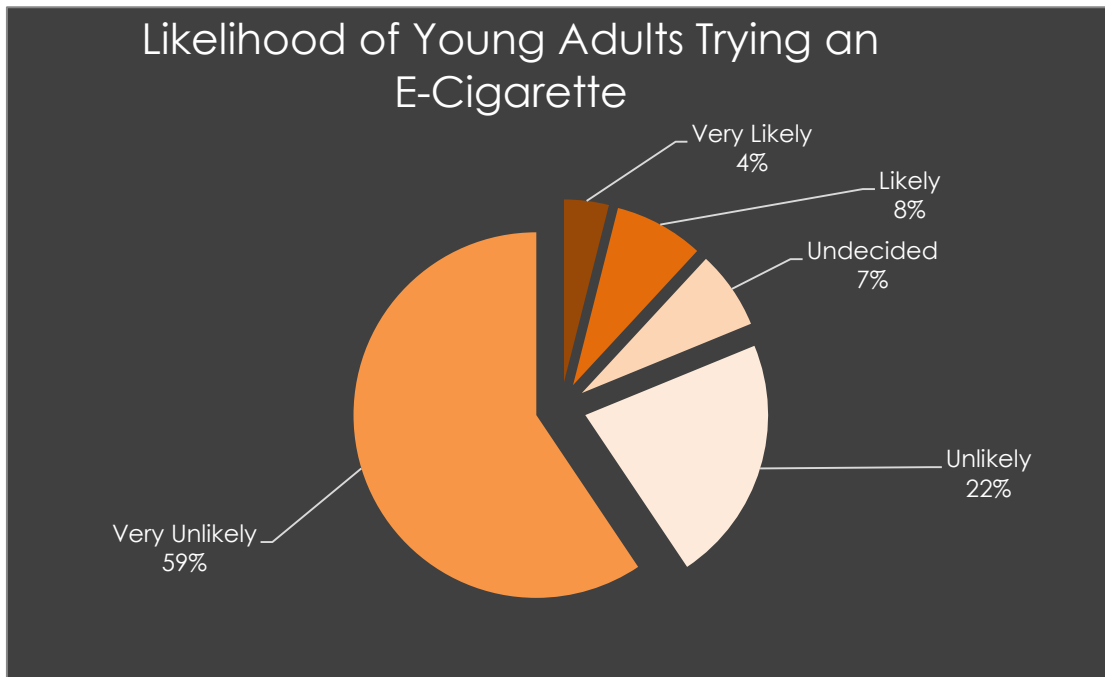


Figure 15: Responses to the Question, “How likely are you to smoke an e-cigarette?”

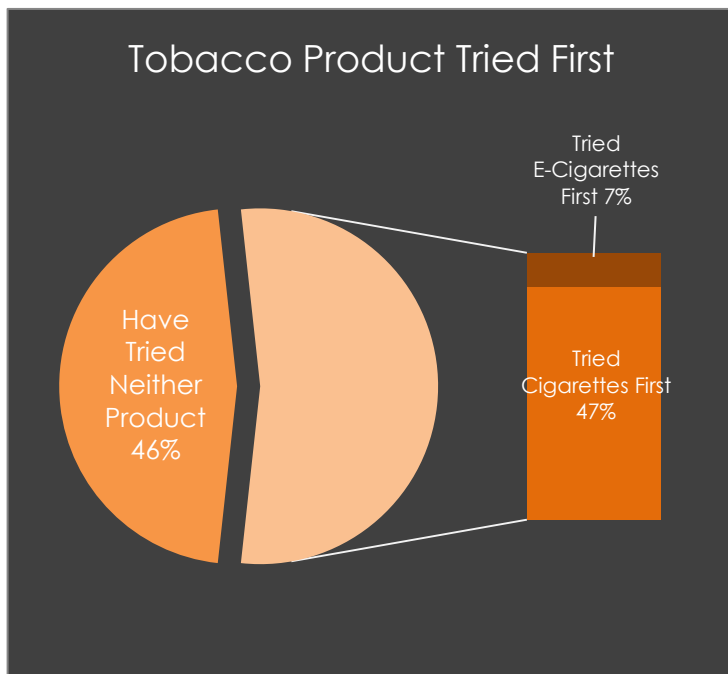


Figure 16: Responses to the Question, “Which product did you try FIRST?”

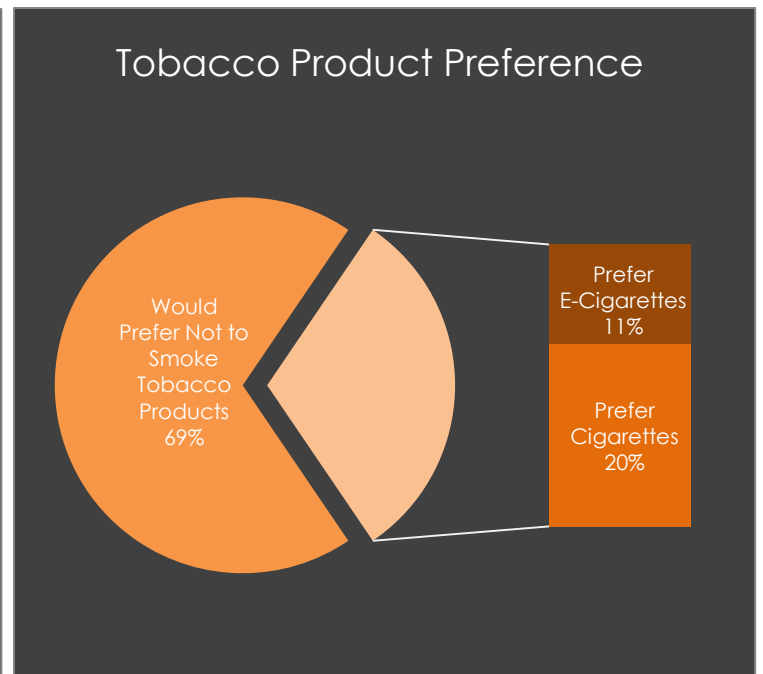


Figure 17: Responses to the Question, “Which product do you prefer to smoke?”

The participants were later asked to state if they had smoked either a traditional cigarette or an e-cigarette first. Of the 84 who had tried the products before, 11 said that they had tried an e-cigarette first while 73 said that they tried a traditional cigarette first. This data is illustrated and further represented in Figure 16. However when the respondents were asked which product they *preferred* to smoke, the numbers were a little closer to each other. 33 of 50 subjects said that they preferred to smoke regular cigarettes, while 17 of 50 subjects noted that they preferred to smoke e-cigarettes – as shown in Figure 17.

In order to determine the usage of cigarettes and e-cigarettes among young adults, the subjects were also asked to report how often they smoke both products. The data shows in Figure 18 that most of the young adults surveyed who smoke rarely smoke traditional cigarettes on average. The same trend is observed for e-cigarettes in Figure 18; the only noticeable difference is that there are fewer responses. The regards to both e-cigarettes and traditional cigarettes, most subjects said that they never smoke the products (80% and 65% respectively). The “*Never*” category was omitted from Figure 18 because it was an outlier and would skew the data.

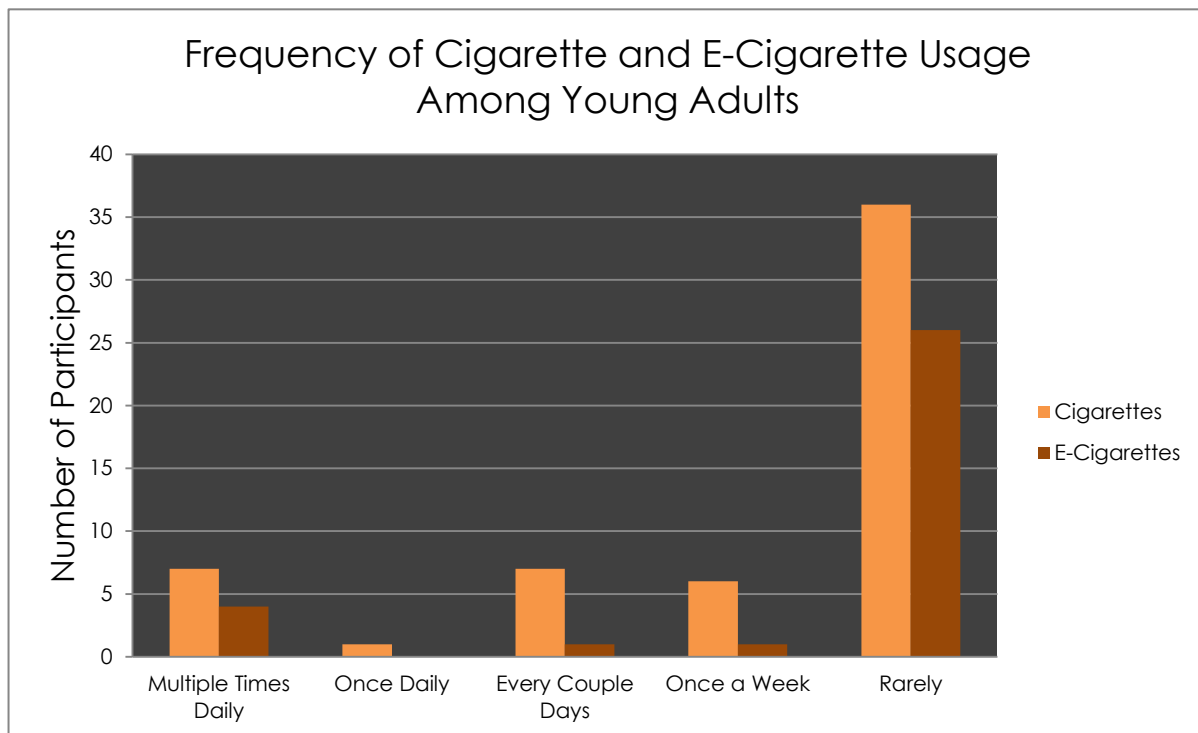


Figure 18: Responses to the Questions, “How often do you smoke traditional cigarettes?” and “How often do you smoke e-cigarettes?”

The survey also asked subjects when was the last time they had an e-cigarette and a traditional cigarette. Of those who had used the product, 60% said that they had smoked an e-cigarette within the past month. This was followed by the next largest group of 16% that listed they had smoked an e-cigarette 2 to 3 weeks prior. The percentage of participants who had smoked a traditional cigarette within the past month was 33%. However a high 22% of respondents reported that they had smoked a traditional cigarette the day of completing the survey – very different from the e-cigarette results. These trends and the comparison between the two questions is depicted in Figure 19. It should be brought to attention that there were many more participants who reported using traditional cigarettes (46 individuals) than there were who stated using e-cigarettes (25 individuals) in these two questions. Besides for the category of “*Within the past month*,” the bar graph of Figure 19 somewhat illustrates an inverse in trends between the two products.

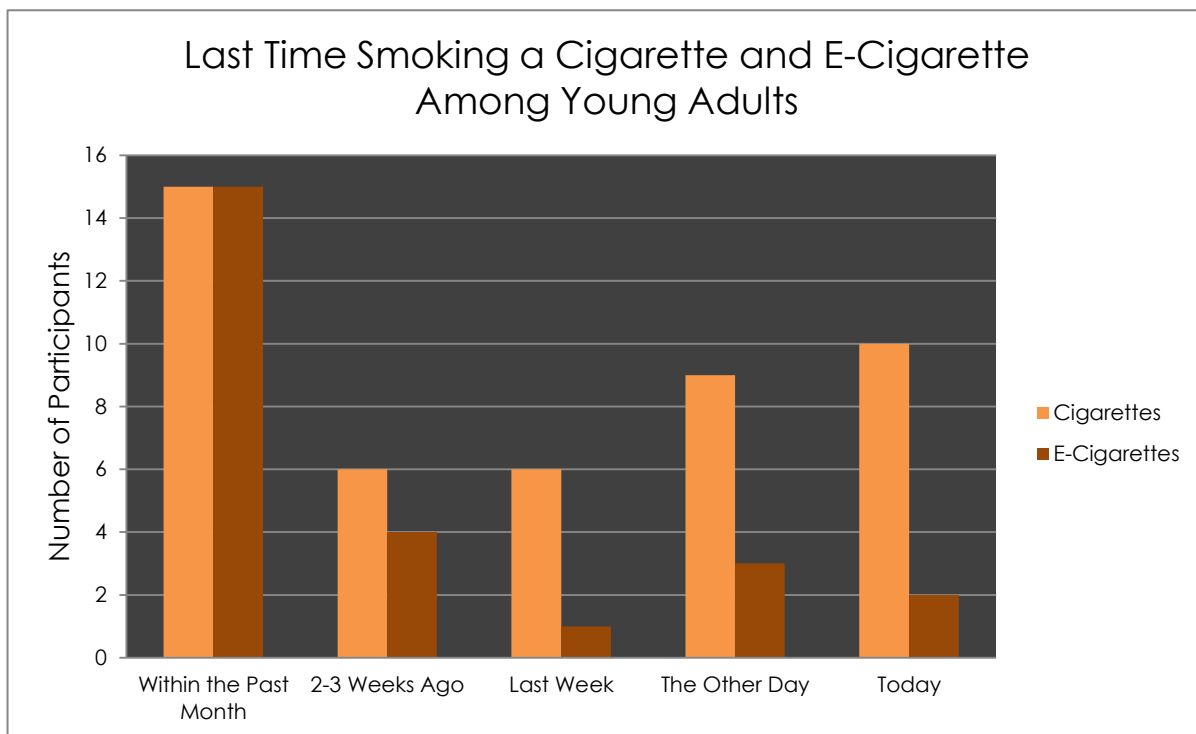


Figure 19: Responses to the Questions, “When was the last time you had a traditional cigarette?” and “When was the last time you had an e-cigarette?”

Phase II – Qualitative Component Results

Survey participants in Phase II of the research were asked to describe their opinion of e-cigarettes in comparison to traditional, just as in Phase I. As was the case with the survey responses in Phase I, many subjects of Phase II stated that they felt as though e-cigarettes were a healthier alternative to traditional cigarettes because they do not contain as many harsh chemicals and toxins as their predecessors. There is some degree of skepticism among the responses given; many subjects said they felt as though there are possibly still underlying health consequences from using e-cigarettes, even though they appear to be healthier than regular cigarettes. There is also a popular opinion among those surveyed claiming that they believe e-cigarettes to be cleaner and taste better than regular cigarettes. Several subjects also said that there was less of a social stigma built around e-cigarettes since they are so new. This allows them to be more widely accepted by others who do not smoke because there is no obvious sign of combustion or foul smelling vapors – as opposed to regular cigarettes. A lot of participants stated that they do not actually have enough knowledge on e-cigarettes and therefore only draw their conclusions from what they have heard by word of mouth or advertisements.

When the subjects were asked to provide insights on why they would transition from smoking traditional cigarettes to e-cigarettes, there were a few more useful responses than that which was found in Phase I. While most subjects said that this question did not apply to them, many of those that did reply stated that their friends had an e-cigarette in a social setting and offered them to try it. Other subjects wrote that they wanted to taste the flavors of e-cigarettes out of curiosity. A couple of participants did say that they switched to an e-cigarette in an effort to quit smoking – but this number was few.

The subjects of Phase II were also asked to answer the question of, “*If you typically smoke e-cigarettes and have recently tried traditional cigarettes as an alternative, why did you? Explain.*” Most of the subjects, again, could not provide insights on this matter; yet of those that did reply there was an overwhelming sense of appeal to the “realness” of traditional cigarettes. Some of the subjects said that they saw traditional cigarettes as having more of a real taste and were more natural than e-cigarettes and thus wanted to try them. This appeal seems to be fueled by curiosity.

VI. Discussions

An analysis of the data compiled in Phase I of the research provides useful information and understanding of the situation at hand. Though the results from the surveys were not what I had intended to find and although my thesis could not be substantiated by what was provided in the surveys, the data collected displays new and important concepts. For example, the survey (Appendix A) asked that subjects state their home zip code. By using this information, I was able to create a Geographic Information Science (GIS) map that illustrates the relationship between where participants who use e-cigarettes and tobacco products come from. Figure 20 shows a map of Los Angeles County by zip code, where the most survey participants who smoke e-cigarettes live. The red areas mark zip codes of high e-cigarette usage among the subjects, while blue areas mark areas of no data or low e-cigarette usage. This information is important because zip codes such as 91001, 91207, 91016, 91741, and 91040 are listed as having large numbers of e-cigarette usage among those surveyed. These zip codes consist of the cities of Altadena, Glendale, Monrovia, Glendora, and Sunland, CA. Each of these cities has a median household income averages anywhere from \$57,000 - \$82,000, which are normal to above average for the county of

Los Angeles⁴⁵. Areas of green or yellow on the map where e-cigarette usage was recorded as lower among survey participants were the zip codes of 90033 and 90007 for instance. These zip codes are for the Los Angeles neighborhoods of Boyle Heights and University Park which have median household incomes of about \$33,000 and \$18,000 respectively, which are low for the county⁴⁶. This information is of importance because smoking and traditional cigarette usage is “directly correlated with income level” and “smoking has become ever more concentrated among populations with lower incomes.”⁴⁷ However, this data collected on e-cigarette usage goes

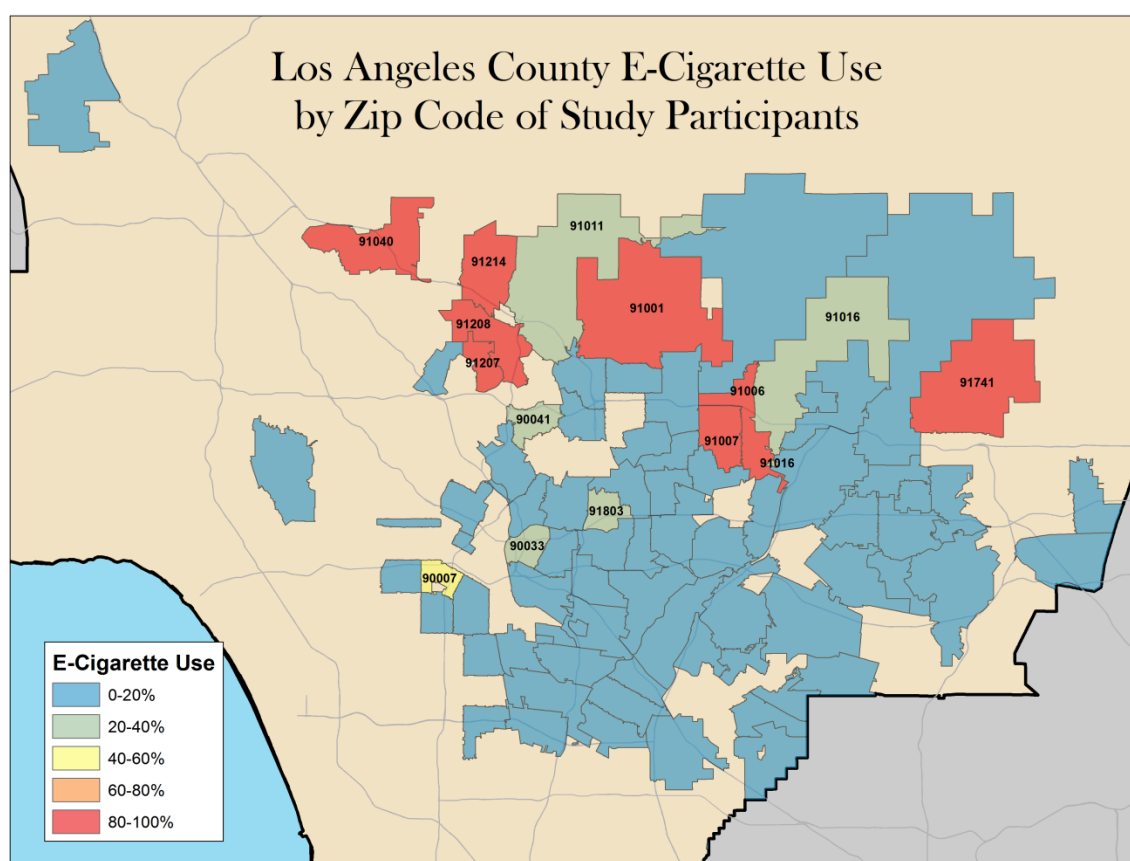


Figure 20: Map of the Reported Home Zip Codes in Los Angeles County of Surveyed Adolescents that Have the Highest Numbers of Subjects Who Have Smoked an E-Cigarette

⁴⁵ “Mapping LA”. 2015. *The Los Angeles Times: Local Neighborhoods*. Retrieved on Apr 12 2015. Found at: <http://maps.latimes.com/neighborhoods/>.

⁴⁶ “Mapping LA”. 2015. *The Los Angeles Times: Local Neighborhoods*. Retrieved on Apr 12 2015. Found at: <http://maps.latimes.com/neighborhoods/>.

⁴⁷ Schmidt, Lorna. 2015. “Tobacco and Socioeconomic Status”. Campaign for Tobacco Free Kids. Retrieved Apr 13 2015. Found at: <http://www.tobaccofreekids.org/research/factsheets/pdf/0260.pdf>.

against this trend and actually shows that a wider demographic of adolescents are using (or at least experimenting) with e-cigarettes.

The data also states that of the 30% of the teenagers surveyed (or 73 teenagers) that had tried tobacco products before, about a third of them (25 teenagers) had tried an e-cigarette. It is also striking how so many adolescents know about e-cigarettes (83% of those surveyed) even though they are so relatively new on the market. Clearly television advertisements are playing a huge role in informing teenagers about such products, since 85 of those surveyed said they learned about e-cigarettes from watching television media. A regulation of the way e-cigarettes are shown on television or an informational ad campaign on e-cigarettes could potentially help inform this group of the harms of such products.

When the data from both Phase I and Phase II of the research are examined and compared to one another, certain insights become clear and there are possible relationships that become apparent. In both the young adult and adolescent populations, peers are the greatest informational source when it comes to e-cigarettes (as seen in Figures 7 and 14). There is another commonality between the two age groups in that in the open-ended qualitative responses, most participants said they do not know much about e-cigarettes and their possible side-effects; even though they argue that they appear to be healthier. Perhaps if educational awareness is increased on these products, then peers can help better inform their fellow peers about the health consequences and effects of smoking such products.

While examining the preferences of and whether adolescents and young adults had tried either an e-cigarette first or a traditional cigarette first, the answers between the two groups vary. As shown in Figures 9 and 16, the majority of both adolescents and young adults had tried traditional cigarettes first. Although this was true, the differences between cigarette and e-

cigarette categories were greater in the young adult Phase II survey. When the subjects of both groups were asked which product they prefer, Figures 10 and 17 show that more adolescents prefer to smoke e-cigarettes, while more young adults prefer to smoke traditional cigarettes. This could be due to the fact that e-cigarettes are a relatively new product, and that there can be a generational preference between the two groups. Teenagers in high school today are being directly exposed to the new e-cigarette market; meanwhile the young adults surveyed were exposed to traditional cigarettes when they were in high school since e-cigarettes were not around like they are today. Therefore, the young adults could already be accustomed to smoking traditional cigarettes and may not see the appeal in e-cigarettes that the younger generation sees. This could also explain why in Figures 8 and 15 more young adults are unlikely to smoke e-cigarettes than adolescents who are largely undecided.

Though a majority of adolescents reported to have never smoked a tobacco product and have not tried either a cigarette or e-cigarette, the smoking rates of the young adults could be a foreshadowing of possible smoking trends. Even though there were fewer participants surveyed in Phase II of the research than in Phase I, a higher rate of young adults reported to having smoked a tobacco product. 65% of the young adults surveyed admitted to having smoked a tobacco product before, which is double that of the 30% of adolescents that reported smoking a tobacco product before. This dramatic increase in smoking rates could be attributed to any number of factors such as it being easier to obtain tobacco products as a young adult rather than an adolescent minor. Nonetheless, this sharp increase in smoking rates over the span of only a few years age difference draws concern to the 18% of adolescents who are unsure how they feel about smoking e-cigarettes.

With the high appeal factor of e-cigarettes reported by both young adults and teenagers – namely by having better flavors, less offensive smells, and perceivably healthier and safer alternative to smoking – adolescents have a somewhat sense of willingness to experiment with these products. This willingness to experiment could possibly be fueled into habitual smoking once the adolescents reach young adulthood; after all, 71 young adult subjects in Figure 19 reported to having either an e-cigarette or cigarette anytime within the past month. In order to prevent smoking rates from increasing once an adolescent reaches young adulthood, it is therefore important to dismiss the myths of e-cigarette attractiveness and properly educate teens on the harms and dangers of such products.

VII. Recommendations

While the sample sizes of adolescents and young adults surveyed were relatively small and cannot hold true statistical significance, the information collected and analysis of such findings can serve as a starting point for recommendations on such issues. One of the first recommendations to make is that there is a need for legislation to keep up with new findings and research. New studies and findings on e-cigarettes are emerging every day and contribute new information on the topic. While e-cigarettes are much too young a product to find any possible long-term detrimental health consequences at this moment, other findings provide crucial data on their health effects. For instance, a recent study found that the levels of aldehyde (a chemical compound used to provide the flavoring of e-cigarettes) within an e-cigarette are high enough and have a large enough concentration to be a toxicological concern⁴⁸. As indicated previously in the findings of this research project, many of the adolescents and young adults were attracted to e-cigarettes because of their flavors and the way they tasted. Now, the FDA already regulates the

⁴⁸ Haelle, Tara. 2015. "E-Cigarette Flavoring Chemicals May Pose Risks When Inhaled". Retrieved on Apr 16 2015. Found at: <http://www.forbes.com/sites/tarahaelle/2015/04/16/e-cigarette-flavoring-chemicals-may-pose-risks-when-inhaled/>.

use of aldehydes in flavorings, yet that is only for food consumption and not inhalation – which is in fact more dangerous⁴⁹. The FDA needs to review such findings and pending that review, implement stronger restrictions on the products in order to better serve and protect the public’s health. There is also a great need for more research on the health effects of e-cigarettes. The American Lung Association has already called on the Obama Administration to conduct further research on the health impacts of e-cigarettes, and to implement stricter FDA regulations on the products⁵⁰. The policy around e-cigarettes needs to keep up with the developing research to ensure that peoples’ risk and exposure to toxins is minimized at all times. There also needs to be more working together and collaboration between research organizations and governmental regulatory bodies.

The research conducted in this study shows that there is a high awareness of e-cigarettes among teenagers and young adults, but not much knowledge of the health effects and consequences. The research also found that a lot of teenagers heard about e-cigarettes from television. Therefore, an ad campaign is needed in order to improve the public’s knowledge on e-cigarettes and their potential hazards. Anti-smoking campaigns are largely an effective means to prevent and stop smoking. In 2013 the CDC launched a mass media ad campaign titled “Tips from Former Smokers”, that was funded by the federal government⁵¹. One of the ads used in the campaign is shown in Figure 21. This campaign proved to be hugely successful by managing to

⁴⁹ Haelle, Tara. 2015. “E-Cigarette Flavoring Chemicals May Pose Risks When Inhaled”. Retrieved on Apr 16 2015. Found at: <http://www.forbes.com/sites/tarahaelle/2015/04/16/e-cigarette-flavoring-chemicals-may-pose-risks-when-inhaled/>.

⁵⁰ American Lung Association. 2015. “American Lung Association Statement on E-Cigarettes”. Retrieved on Apr 14 2015. Found at: <http://www.lung.org/stop-smoking/tobacco-control-advocacy/federal/e-cigarettes.html>.

⁵¹ O’Neill, Stephanie. 2013. “CDC’s provocative anti-smoking ad campaign shows success, study says”. KPCC. Retrieved on Apr 14 2015. Found at: <http://www.scpr.org/news/2013/09/09/39160/cdc-s-provocative-anti-smoking-ad-campaign-shows-s/>.

persuade more than 100,000 Americans to quit smoking, and prompted another 1.6 million to try and quit⁵².



Figure 21: Ad from the CDC's "Tips from Former Smokers" campaign in 2013

The anti-smoking ad campaign was also quite cost beneficial. According to the CDC, “a widely accepted limit for the cost-effectiveness of a public health program is \$50,000 per year of life saved.”⁵³ It was found that the costs from this ad campaign – even when factoring in medications, counseling and other treatments to help people quit smoking – still proved to be 15 times less than the \$50,000 limit⁵⁴. These ad campaigns are incredibly effective in the ways they educate the public of the harms on smoking. Not only were they successful in decreasing the

⁵² O’Neill, Stephanie. 2013. “CDC’s provocative anti-smoking ad campaign shows success, study says”. KPCC. Retrieved on Apr 14 2015. Found at: <http://www.scpr.org/news/2013/09/09/39160/cdc-s-provocative-anti-smoking-ad-campaign-shows-s/>.

⁵³ Preidt, Robert. 2014. “Anti-Smoking Campaign Successful and Cost-Effective, CDC Says.” *Healthy Day*. Retrieved on Apr 14 2014. Found at: <http://consumer.healthday.com/mental-health-information-25/addiction-news-6/tips-former-smokers-campaign-ajpm-cdc-release-batch-1505-694427.html>.

⁵⁴ Preidt, Robert. 2014. “Anti-Smoking Campaign Successful and Cost-Effective, CDC Says.” *Healthy Day*. Retrieved on Apr 14 2014. Found at: <http://consumer.healthday.com/mental-health-information-25/addiction-news-6/tips-former-smokers-campaign-ajpm-cdc-release-batch-1505-694427.html>.

number of people smoking, but they were also proven to be cost-beneficial. If the CDC were to run an ad campaign like this – or even include ads on e-cigarettes on an existing campaign – then the public can be better informed of the product. This will help prevent adolescents and young adults from getting false understandings or being misinformed about e-cigarettes by their peers. These ads can also decrease, or at least slow the rapidly rising rate of e-cigarette usage among teenagers.

A final recommendation would be to implement more alcohol, drug, and tobacco programs within schools and communities. Studies have shown that when research-based substance use prevention programs (research conducted to target the specific needs and address concerns of individual communities) are implemented, use of alcohol, tobacco, and illegal drugs is reduced. While many social and cultural factors affect drug use trends, when young people perceive drug use as harmful, they reduce their level of use⁵⁵. The California partnership program titled *Friday Night Live* is one such program that works with coalitions to help raise awareness of problems of tobacco, drug, and alcohol use within their communities, that has been praised by the Alcoholic Beverage Control, Partnership for Drug-Free Kids and Senator Jean Fuller (R-CA) for its work in actively engaging and protecting youths⁵⁶. Perhaps if these programs became well-versed in the new findings on the health effects of e-cigarettes and were implemented in more schools, then awareness about the potential dangers of e-cigarettes could be brought to youths' attention. These programs can also actively engage adolescents to find ways on how to prevent e-cigarette usage among their peers and communities which may prove

⁵⁵ National Institute on Drug Abuse. 2014. "Preventing Drug Abuse: The Best Strategy". Retrieved on Apr 14 2015. Found at: <http://www.drugabuse.gov/publications/drugs-brains-behavior-science-addiction/preventing-drug-abuse-best-strategy>

⁵⁶ California Friday Night Live Partnership. 2014. "About Us". Retrieved on Apr 16 2015. Found at: <http://www.fridaynightlive.org/about-us/cfnlp-overview/>.

to be more successful since the findings from this research indicate that most teenagers learn about e-cigarettes from their peers.

All of these recommendations can help curb the appeal of e-cigarettes to adolescents to hopefully slow the rising rates of e-cigarette consumption amongst this demographic, and also to potentially lower the willingness to experiment with it and other tobacco products once the teenagers enter young adulthood and they have greater access to these products.

VIII. Conclusions

The rate at which adolescents are smoking e-cigarettes is troubling since there have been major strides in decreasing the rate of teenage smoking in recent years. This new invention is challenging public health officials and researchers determine their health consequences, and establish regulations in order to best protect the public – and most importantly – minors. Although the research conducted in this project was intended to define whether or not e-cigarettes can serve as a potential gateway to traditional cigarette usage among minors, the information that was found addressed other important concepts of the topic. While cigarette usage is traditionally linked to low-income individuals, it was found that e-cigarettes in fact are used by a wider demographic. There is also a strong awareness of e-cigarettes among adolescents as well as young adults; however there is an overwhelming lack of education on the health effects and potential hazards, which is beginning to change as new studies emerge on the product. A greater amount of teenagers are undecided on whether they would smoke an e-cigarette than the young adults who mostly disapprove of them – yet the rates of smoking among young adults are greater. There is the possibility that unless adolescents gain proper knowledge of e-cigarettes and their effects, they will be willing to experiment with the product and possibly

engage in further experimentation with tobacco products once they enter young adulthood where smoking appears to have less of a stigma and used more frequently.

In order to address these findings three recommendations are offered. The first would be to collect further data and research on the health effects and potential harm of e-cigarettes in order to keep the policy and regulations of the product current. The next recommendation would be to launch an ad campaign based on the successful and cost-beneficial 2013 “Tips from Former Smokers” campaign⁵⁷ to actively educate the public on e-cigarettes to dispel myths and lay out the necessary facts for those curious about the product to make informed decisions. And the third recommendation would be to incorporate e-cigarette education into afterschool programs that target the specific needs of particular communities in order to fully engage to youth to prevent smoking in their communities. By educating the adolescents directly, they will be able to share that information with their peers – the primary means of informing adolescents about e-cigarettes. Together, these recommendations could prevent, or at least slow the growth, of e-cigarette usage among adolescents and curb any potential experimentation with other tobacco products in the adolescents near future.

⁵⁷ Preidt, Robert. 2014. “Anti-Smoking Campaign Successful and Cost-Effective, CDC Says.” *Healthy Day*. Retrieved on Apr 14 2014. Found at: <http://consumer.healthday.com/mental-health-information-25/addiction-news-6/tips-former-smokers-campaign-ajpm-cdc-release-batch-1505-694427.html>.

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X. Appendix

Appendix A – Phase I Adolescent Survey

Please check the box to the answer that best applies.

1. What is your age?
 - 14 years
 - 15 years
 - 16 years
 - 17 years
 - 18 years
2. What is your current grade-level?
 - 9th Grade
 - 10th Grade
 - 11th Grade
 - 12th Grade
3. What is your home zip code?

4. Have you ever smoked a tobacco product before? (*This includes cigarettes, cigars, hookahs, e-cigarettes, vaporizers*)
 - Yes
 - No
5. Do you know what an e-cigarette is?
 - Yes
 - No
6. Where did you learn about e-cigarettes?
 - Family
 - Friends / Peers
 - Internet
 - Television
 - Advertisement / Billboard
 - Other / I don't know
7. Please check all of the tobacco products you have tried (*if none, leave blank*):
 - Cigarette
 - Cigars
 - E-Cigarette
 - Hookah / Vaporizer
 - Other
8. Which of the following two tobacco products did you try **FIRST**?
 - Cigarette
 - E-Cigarette
 - I have never tried either product
9. How likely are you to smoke an e-cigarette?
 - Very likely
 - Somewhat likely
 - Unsure / Neutral
 - Somewhat unlikely
 - Very unlikely
10. Which do you prefer to smoke?
 - Cigarette
 - E-cigarette
 - I do not smoke tobacco products
11. How often do you smoke *traditional cigarettes*?
 - Multiple times daily
 - Once daily
 - Every couple days
 - Once a week
 - Rarely
 - Never
12. How often do you smoke *e-cigarettes*?
 - Multiple times daily
 - Once daily
 - Every couple days
 - Once a week
 - Rarely
 - Never
13. If you do smoke *traditional cigarettes*, how do you obtain them?
 - A friend or peer
 - A family member
 - Purchase from a store
 - Other
 - I do not smoke cigarettes

14. If you do smoke *e-cigarettes*, how do you obtain the refills / vaporizer?
- A friend or peer
 - A family member
 - Purchase from a store
 - Other
 - I do not smoke e-cigarettes
15. What is your race/ethnicity?
- Asian / Pacific Islander
 - Black
 - Hispanic / Latino
 - White
 - Mixed / Other
16. What is your parents' annual household income?
- below \$10,000
 - \$10,000 - \$20,000
 - \$20,001 - \$40,000
 - \$40,001 - \$70,000
 - \$70,001 - \$100,000
 - above \$100,000
 - I do not know / Decline to state

18. Please describe your opinion of e-cigarettes in comparison to traditional cigarettes? (*Do you feel that they are healthier/safer, cleaner, taste better, they're flavored, cheaper, easier to obtain, etc.*)

19. If you typically smoke *traditional cigarettes* and have recently tried e-cigarettes as an alternative, why did you? Explain.

20. If you typically smoke *e-cigarettes* and have recently tried traditional cigarettes as an alternative, why did you? Explain.

All reported responses are to be kept confidential between the participant and researcher, and are purely for informational purposes in regards to the study.

Appendix B – Phase II Young Adult Survey

What is your age?

- 18 years
- 19 years
- 20 years
- 21 years
- 22+ years
- N/A

What is your home zip code?

Have you ever smoked a tobacco product before? *(This includes cigarettes, cigars, hookahs, e-cigarettes, vaporizers)*

- Yes
- No

Do you know what an e-cigarette is?

- Yes
- No

Where did you learn about e-cigarettes?

- Family
- Friends / Peers
- Internet
- Television
- Advertisement / Billboard
- Other / I don't know

Please check all of the tobacco products you have tried. *(if none, leave blank)*

- Cigarette
- Cigars
- E-Cigarette
- Hookah / Vaporizer
- Other

Which of the following two tobacco products did you try FIRST?

- Cigarette
- E-Cigarette
- I have never tried either product

How likely are you to smoke an e-cigarette?

- Very Likely
- Likely
- Undecided
- Unlikely
- Very Unlikely

Which do you prefer to smoke?

- Cigarette
- E-Cigarette
- I do not smoke tobacco products

How often do you smoke traditional cigarettes?

- Multiple times daily
- Once daily
- Every couple days
- Once a week
- Rarely
- Never

How often do you smoke e-cigarettes?

- Multiple times daily
- Once daily
- Every couple days
- Once a week
- Rarely
- Never

When was the last time you had an e-cigarette?

- Within the past month
- 2-3 weeks ago
- Last week
- The other day
- Today
- N/A

When was the last time you had a traditional cigarette?

- Within the past month
- 2-3 weeks ago
- Last week
- The other day
- Today
- N/A

What is your race / ethnicity?

- Asian / Pacific Islander
- Black
- Hispanic / Latino
- White
- Mixed / Other

What is your parents' annual household income?

- Below \$10,000
- \$10,000 - \$20,000
- \$20,001 - \$40,000
- \$40,001 - \$70,000
- \$70,001 - \$100,000
- Above \$100,000
- I do not know / Decline to state

Please describe your opinion of e-cigarettes in comparison to traditional cigarettes? *(Do you feel that they are healthier/safer, cleaner, taste better, they're flavored, cheaper, easier to obtain, etc.)*

If you typically smoke traditional cigarettes and have recently tried e-cigarettes as an alternative, why did you? Explain.

If you typically smoke e-cigarettes and have recently tried traditional cigarettes as an alternative, why did you? Explain.



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