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Perceptions and Health Effects of Electronic Cigarettes among College Students

Safia Centner
University of Central Florida

PERCEPTIONS AND HEALTH EFFECTS OF ELECTRONIC CIGARETTES AMONG COLLEGE STUDENTS

by

SAFIA CENTNER

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Thesis Chair: Suha Saleh, Ph.D.

ABSTRACT

Electronic cigarettes, or e-cigarettes, are devices that allow users to inhale an aerosol, which contains chemical additives. E-cigarettes are becoming common for nicotine delivery in addition to traditional cigarettes. The goal of this study was to determine how college students perceive e-cigarettes, how often college students use e-cigarettes, and how they view e-cigarettes compared to tobacco cigarettes. This was accomplished through sending a survey built on Qualtrics to UCF students via Knights Email. This survey included questions about demographics, perceptions, and usage of e-cigarettes. The collected data was downloaded into SPSS and analyzed to compare data among different groups. The demographics of the participants reflected the overall student demographics at UCF including age, ethnicity, and academic status, which allowed for the results to be related to the university population. A little over half of the students who participated in this study have tried e-cigarettes. Those who use e-cigarettes reported that the availability of variety of flavors was the most attractive reason for them. Most participants believe e-cigarettes to be equal in harm or less harmful than tobacco cigarettes. Gender, major, and work status differences were observed in survey responses related to use of e-cigarettes and perception of potential harm. The results of the study provide valuable information that can be used in health education programs about e-cigarettes. The results also support the need for future studies to assess the health impact of e-cigarettes on the physiological functions of lungs and other tissues and compare that to tobacco cigarette damage.

DEDICATION

To my family for their constant encouragement, guidance, and unconditional love.

ACKNOWLEDGMENTS

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INTRODUCTION

In the United States, the use of electronic cigarettes, commonly referred to as e-cigarettes, has been on the rise among adolescents and young adults (U.S. Department of Health and Human Services, 2020). E-cigarettes refer to a group of devices that resemble tobacco cigarettes in that they provide a way for users to breathe in an aerosol which includes various additives- often including nicotine. E-cigarettes are becoming the choice mechanism for nicotine delivery over traditional cigarettes because of their modern aesthetic compared to conventional tobacco cigarettes and because they are perceived as a safer alternative to smoking tobacco (Palazzolo, 2013). Companies that produce e-cigarettes declare that this aerosol contains lower levels of toxins and carcinogens than can be found in tobacco cigarettes (Chen, Todd, & Fairclough, 2019).

Tobacco cigarettes, cigars, and anything that people might smoke have been around for centuries, whereas e-cigarettes are relatively new. In 1963, Herbert A. Gilbert submitted a patent for an early model of the e-cigarette, which was officially patented in 1965. The patent was for a "smokeless nontobacco cigarette" whose purpose was to provide a safe and innocuous way of smoking. The first device, similar to the current e-cigarette, was developed in 2003 by Hon Lik, a Chinese pharmacist, as a potential smoking cessation device in China. Dragonite International, known as Ruyan at the time, obtained a U.S. patent and claimed that this device was a type of e-cigarette that functioned as an aid to quit smoking. As of 2014, 90% of the world's production of e-cigarette materials came from China (U.S. Department of Health and Human Services, 2020).

Structure of e-Cigarettes

First-generation e-cigarettes were similar in structure to conventional cigarettes and contained a compartment for e-liquid, which was the solution that was converted to an aerosol. Second-generation e-cigarettes were longer and more cylinder in shape. Third and fourth-generation e-cigarettes were completely revamped from conventional cigarettes because they had the greatest changes in shape and size and allowed for other customizations.

Users can modify and alter their e-cigarette to fit their desires by changing the components, appearance, and contents of the liquid. Because they can be adjusted so easily, there is major concern that these devices can be used to deliver harmful and injurious toxins (U.S. Department of Health and Human Services, 2020).

Devices that are classified as e-cigarettes must produce aerosol, which the user can inhale. They have a myriad of appearances and designs but are generally constructed the same way. Common characteristics of e-cigarettes include an aerosol producer, a battery (depending on whether the cigarette is disposable or reusable), solution compartment, and a flow sensor (Brown & Cheng, 2014). The aerosol producer is composed of a metal heating component that is wrapped around a wick (Figure 1) (U.S. Department of Health and Human Services, 2020). Within the solution compartment is liquid of which contains various ingredients. The FDA has reported that some have been found to contain nitrosamines (known carcinogens), diethylene glycol (known to have neurologic affects), and other ingredients that have the potential to be harmful to one's health (Palazzolo, 2013). Depending on the type of e-cigarette and e-cigarette company, the liquid can differ in color, flavor, and components. This liquid in open system e-cigarettes can be modified by the user to become more harmful through the addition of various ingredients that may be toxic and

have negative health effects (Brown and Cheng, 2014). E-cigarettes with liquid will produce nicotine in its aerosol but also, whether it contains nicotine not, the aerosol can include metallic particles, including nickel, iron, lead, and tin. These materials are believed to be due to the heating coil components in the aerosol. (Brown and Cheng, 2014). When the user draws upon the e-cigarette, this activates the flow sensor which causes the heating element to be powered. In turn, the e-liquid is heated and converted into an aerosol, and this is what flows into the user's mouth (Brown & Cheng, 2014).

Figure 1: Structure and Components of e-Cigarettes (U.S. Department of Health and Human Services, 2020).

The e-liquid may contain a wide range of contaminants and ingredients that could be knowingly or unknowingly harmful to one's health. Besides nicotine, these ingredients can include propylene glycol, glycerin, nicotine, and flavored chemicals. Liquids that can be bought for the e-cigarette can have nicotine content ranging from 0-24 mg or even more. A systematic review of case reports found the range of nicotine content to be 9-19 mg/ml in several e-cigarette liquid products. The range of nicotine content for most tobacco cigarettes is between 6-28 mg/ml. Both ranges of nicotine content can be lower or greater depending on the company, or for e-cigarettes, the users' modifications (Hua & Talbot, 2016).

Health Effects of e-Cigarettes

Content of e-liquid and the health impact was investigated in several studies that linked the use of e-cigarettes to adverse health effects. For example, the nicotine content of e-cigarettes and nicotine poisoning caused by e-cigarettes were evaluated in a review article that confirmed that nicotine poisoning from e-liquids can occur. The study found an average nicotine concentration of 29.1 mg/ml in e-cigarettes that can lead to nicotine poisonings. The systematic review noted that because e-cigarettes and e-cigarette products are being readily produced with extreme concentrations of nicotine and because of the customizations by the user, the potential for poisoning is on the rise (Hua & Talbot, 2016). In addition to nicotine content, system retention of nicotine was also studied among e-cigarette users. A study found that from 15 puffs, e-cigarettes can deliver 1.3 mg of nicotine. This yield of delivery is similar to or even greater than tobacco cigarettes. Of this 1.3 mg, 93.8% was retained, as compared to average systemic retention of nicotine from tobacco cigarettes which, based on background knowledge and information, is 80-

90%. The study concluded that e-cigarettes deliver similar or greater amounts of nicotine compared to tobacco cigarettes, and cotinine levels in e-cigarette users were like those who smoked regular cigarettes (St. Helen, Dempsey, Jacob, & Benowitz, 2015). Another experiment was designed to further measure effects of the nicotine in the aerosol. A study evaluated the blood and saliva nicotine content in e-cigarette smokers five minutes and 15 minutes after they smoked ten puffs. Even five minutes after the first initial puff, the plasma nicotine levels increased significantly. This experiment showed that e-cigarettes alone were able to increase plasma nicotine and saliva cotinine levels and even meet or surpass those levels seen during conventional smoking (Vansickel & Eissenberg, 2013). Based on the three former studies, it is seen that it is possible for e-cigarettes to contain excessive amounts of nicotine and have similar or greater health effects to conventional cigarettes.

Physiological response after e-cigarette smoking was further studied to determine potential absorption areas and health risks. In addition to the impact of e-cigarettes on buccal region, it has been shown that e-cigarettes can affect other body regions and impact their physiology. One experiment was performed to determine if using an e-cigarette for just five minutes would have an effect. The study found an increase in plasma nicotine levels decrease in nitric oxide, which is used in circulation, an increase in lung and pulmonary resistance (Vardavas et al., 2012). If all this were to be affected after just five minutes, this raises the question of what were to happen when the user vaporizes the product for a longer period of time. It also makes one wonder how long these physiological impacts last and how long they may last when someone uses them often.

The chemistry and aerosols of e-cigarettes and their liquid was further studied and compared to tobacco cigarettes. Several ingredients within the aerosol were identified across e-

cigarette liquids and they include propylene glycol and glycerin, polycyclic aromatic hydrocarbons, tobacco-specific nitrosamines, volatile organic compounds, inorganic compounds, and nicotine. For this reason, e-cigarettes should be seen as something that may be dangerous and as something that could pose a threat to one's health. (Burstyn, 2014).

It was also found that even in small doses, breathing in chemicals found in e-cigarettes can cause irreversible damage to the lungs and can cause chronic lung diseases. The authors of this article state, that "Most e-cigarettes deliver nicotine, which is highly addictive and can harm the developing brains of teens, kids and fetuses in women who vape while pregnant. Some types expose users to even more nicotine than traditional cigarettes." The lasting health effects of e-cigarettes are not fully understood and determined, yet scientists clearly state that vaping is neither safe nor healthy (American Heart Association, Inc., 2018).

e-Cigarettes Usage and Perceptions

Those who do not support the use of e-cigarettes say that there are several reasons to be concerned about e-cigarette usage; cartridges can contain nicotine, vapor and aerosol have an abundance of toxins, can lead to potential future use of tobacco, etc. (Farrell & Hamby, 2018). People think that e-cigarettes are a safer alternative to tobacco cigarettes think this because of the potential to aid in stopping tobacco cigarette smoking and because it does not have the same contaminants as tobacco cigarettes (American Heart Association, Inc., 2018).

In order to measure and determine how people really view e-cigarettes and understand their health risks, an experiment was done to answer the question "Does perceived likelihood of harm related to e-cigarette use differ as a function of consumer segment?". The groups that were used

in the experiment were those who just used electronic cigarettes, those who just used tobacco cigarettes, those who smoked both forms of cigarettes, and those who were not users of any type of cigarette. The groups were provided a survey that asked about their beliefs and usage of e-cigarettes and tobacco cigarettes. Baseline surveys were given that showed that tobacco cigarette smokers still believed e-cigarettes to be more dangerous than those who used e-cigarettes (whether by themselves or with tobacco cigarettes) did. In fact, they believed that e-cigarettes are quite similar to tobacco cigarettes. Those who did not use either form of cigarette are more likely to think of e-cigarettes as addictive, and smokers and these non-users were more likely to view e-cigarettes as containing dangerous chemicals and less likely to view e-cigarettes as safer; they did not think they would help quit smoking tobacco. Those who used e-cigarettes and those who used both e-cigarettes and conventional cigarettes thought that e-cigarettes were safer and could help stop tobacco smoking. The results of this part of the experiment indicated that only those who used e-cigarettes (whether solely or along with conventional cigarettes) viewed them as safer than those who did not use them (Farrell & Hamby, 2018). These results are interesting and important in understanding that perceptions and behaviors can be different depending on the person's demographics, and in this case, smoking behaviors. The second part of the experiment was to answer the question "Does the specificity of information presented via on-ad warning labels influence user groups risk perception?". Warning labels were tested to see what information was needed in order to help people become more aware of the risks of vaping. Users were asked to rate advertisements only focused on e-cigarettes as enjoyable or offensive. The advertisement that had the most neutral response for enjoyment and lowest level of offensiveness was used; the said advertisement was then edited to include either no side effects (control), general harm, self-risk,

and other risk. The experiment noted that perceptions can be affected by the presence of a warning: the more specific and detailed the warning, the higher the level of perceived risk. In that study, they noticed that addiction warning labels on e-cigarettes are present, but they are typically always coupled with a positive health claim which counteracts the warning (Farrell & Hamby, 2018).

Another study was performed to assess beliefs regarding e-cigarettes and the effects. e-cigarettes can have (addiction, future use of tobacco, harm). Participants were divided into never users or ever users, depending on if they have ever used an e-cigarette. The statements most participants agreed with, regardless of smoking behaviors, were harms related to e-cigarette usage, and influence on youth such as influencing youth to use cigarettes themselves. The two statements that had the least agreement were that e-cigarettes could help people quit tobacco and that e-cigarettes are less harmful than smoking. Users were further split and identified as a non-smoker, former smoker, or current smoker. Beliefs about e-cigarettes differed significantly by these tobacco smoking statuses. More current and former smokers when compared to non-smokers supported the statement that e-cigarettes are less harmful than tobacco and that the aerosol is less harmful than cigarette smoke. Overall, when analyzing results of both parts, participants tended to have lower levels of agreement with each other in regards belief statements pertaining to e-cigarette potential benefits and higher levels of agreement with e-cigarette potential harms. Findings indicate that most participants were particularly concerned about potential harmful influences of e-cigarettes on youth (Tan, Lee, & Bigman, 2016).

Perceived impact of headlines about e-cigarettes was evaluated in a study that measured the effects of exposure to conflicting information about e-cigarettes on US adults' perceptions of e-cigarettes. Four positive, four negative, and one neutral headline were chosen, and all presented

conflicting health information. Participants were randomized into four message conditions (positive, negative, neutral, and no headline). Following the presentation of the advertisements, participants were asked if they agreed with statements about harms from e-cigarette use and three statements about benefits of e-cigarette use. Among never users, negative headlines led to stronger beliefs about harms and weaker beliefs about benefits, compared with positive headlines. Viewing conflicting headlines appeared to have a similar effect as negative headlines in lowering never users' beliefs about e-cigarette benefits. In contrast to never users, headlines did not appear to have as much influence on the beliefs of those who were currently using or had tried an e-cigarette. Headlines appeared to have a greater effect on those not actively engaging in usage of e-cigarettes. (Tan, Lee, Nagler, & Bigman, 2017).

Gender differences in e-cigarette use and perception was evaluated. A study found that males were more likely to use e-cigarettes for enjoyment, whereas females were more likely to report usage for stress removal or in times where they might feel extreme peer pressure to use (positive reinforcement versus negative reinforcement). Males also reported more chances of become addicted to e-cigarettes than females. (Piñeiro et al., 2016). Not only has gender been correlated with e-cigarette usage and perceptions, but so has stress level- whether due to external or internal factors. A survey among US adults compared the rates of e-cigarette usage and psychological distress. Those who reported higher levels of stress also reported excessive use of e-cigarettes. Adults ranging from age 18-65 who reported lower levels of sleep duration also reported higher usage of e-cigarette, suggesting a relationship between amount of sleep and e-cigarette usage (Park et al., 2017).

PURPOSE of STUDY and HYPOTHESES

Since the use of e-cigarettes is on the rise, it is important to understand the use and perception of health risk among young adults as this is a stage where health habits form and develop. College students represent a unique and an important subset of young adults that can bring great insight into this group of young adult population. Understanding students' knowledge and perception of the safety of e-cigarettes may aid in identifying potential reasons to their belief and behavior and will allow for recommendation of some education programs aimed at reduction in e-cigarettes use. The objectives of this study are to determine how college students at UCF perceive e-cigarettes, determine college students' usage of e-cigarettes, and determine college students' perceptions of e-cigarettes compared to tobacco cigarettes. Based on past studies and predictions, it is expected that e-cigarette perceptions and usage will differ among different groups of college students.

Null Hypothesis: Gender, major, and other demographic factors will not affect perceptions of health impacts of e-cigarettes and usage of e-cigarettes.

Experimental Hypothesis: Gender, major, and other demographic factors will affect perceptions of health impacts of e-cigarettes usage of e-cigarettes.

> Alternative Hypothesis-1: Males will perceive e-cigarettes as healthier and are more likely to use e-cigarettes than females.

> Alternative Hypothesis-2: Non-health and non-science majors will perceive e-cigarettes as healthier and are more likely to use e-cigarettes than those of health and science majors.

Alternative Hypothesis-3: Students who experience less sleep will perceive e-cigarettes as healthier and are more likely to use e-cigarettes than those who average more sleep.

Alternative Hypothesis-4: Full-time students will perceive e-cigarettes as healthier and are more likely to use e-cigarettes than part-time students.

Alternative Hypothesis-5: Students who have jobs will perceive e-cigarettes as healthier and are more likely to use e-cigarettes than those who do not have jobs.

STUDY DESIGN

Methods and Sampling

This study was conducted at the University of Central Florida (UCF) and included all active undergraduate students during summer 2020 as the sample for the study. To evaluate student's use and perceptions of e-cigarette risks, a survey was prepared and sent by e-mail to all undergraduate students. The survey included three parts: students' demographics, perceptions of e-cigarettes use (Brown et al., 2014), and usage of e-cigarettes (Centers for Disease Control and Prevention, National Adult Tobacco Survey Questionnaire, 2015). Survey questions were built through Qualtrics and sent out to all active UCF students via e-mail. Only students who consented to participate in the survey, and those who were 18 years of age and older had access to the survey. The survey was available for 14 days, and the data was downloaded into the SPSS Statistics program. Descriptive analysis and quantitative analysis including one-way ANOVA were done to compare the differences between different demographics and survey responses among different groups. The study was submitted to and approved by the UCF's Institutional Review Board.

RESULTS

Demographics and Sample Characteristics

Most of the participants in the study were at age 18-22, making up the largest percentage

of the sample (78.55%). Also, most participants in the study were white and/or female, with 54.3%

being white and 66.8% being female (table 1).

Table 1: Demographics		
Variable	**Number (N)**	**Percent (%)**
Total Sample Size	1,529	
Age		
18-22	1201	78.6
23-27	190	12.4
28-32	63	4.12
33-39	40	2.62
>40	35	2.3
Ethnicity		
White	819	54.3
Black or African American	118	7.8
American Indian, Alaska Native, or Native Hawaiian	6	0.4
Asian or Pacific Islander	108	7.2
Hispanic or Latino(a)	347	23
Biracial or Multiracial	79	5.2
Other	31	2.1
Gender		
Female	1007	66.8
Male	481	31.9
Other	20	1.3
Student Classification		
Freshman (0-30 credit hours)	196	13
Sophomore (31-60 credit hours)	267	17.7
Junior (61-90 credit hours)	500	33.2
Senior (91-120 credit hours)	390	25.9
Senior (120+ hours)	145	9.6
Graduate or Professional Student	9	0.6
Non-degree seeking student	1	0.1

In regard to academic status at UCF, most students who partook in the study were juniors

(33.2%) and enrolled full-time (85.7%). 10.1% of the students who participated in the study were

Health Sciences majors and 10.1 % were psychology majors, which made up the largest two majors in the study (table 2).

Table 2: Academic Status		
Variable	**Number (N)**	**Percent (%)**
Enrollment Status at UCF		
Full-Time	1292	85.7
Part-Time	216	14.3
Major		
Health Sciences	153	10.1
Psychology	153	10.1
Biomedical Sciences	83	5.5
Nursing	64	4.2
Mechanical Engineering	72	4.8
Integrated Business	42	2.8
Computer Science	65	4.3
Biology	65	4.3
Finance	48	3.2
Hospitality Management	69	4.6
Other	694	46

Most students did not have a job (50.8%), and of those that worked, most worked part-time (71%). Of the total population, only 35% worked part time. More of the students with jobs worked off-campus than on campus (table 3).

Table 3: Work Status		
Variable	**Number (N)**	**Percent (%)**
Work Status		
Full-Time	214	14.2
Part-Time	528	35
Not Working	766	50.8
Location of Work		
On-Campus	59	8
Off-Campus	682	92

Most students (70.1%) in the study reported sleeping an average of 6-8 hours per night, and most students reported as having very good health (44.1%) (table 4).

Table 4: Average Hours of Sleep and Overall Health		
Variable	**Number (N)**	**Percent (%)**
Hours of Sleep		
More than 8 hours	218	14.5
6-8 hours	1055	70.1
4-6 hours	219	14.5
2-4 hours	12	0.8
Less than 2 hours	2	0.1
Overall Health		
Excellent	200	13.3
Very Good	664	44.1
Good	521	34.6
Fair	108	7.2
Poor	13	0.9

97.1% of all students surveyed had at least heard of an e-cigarette, but only 50% have tried them. Most students (73.3%) reported never using an e-cigarette, followed by daily use (10.9%) and less than monthly use (8%). For reasons of e-cigarette usage, only 38.8% reported using because they believe it to be a healthier option than tobacco. 63.3% report using because they taste better than traditional cigarettes. Most students reported that they believe e-cigarettes to be as harmful as tobacco cigarettes (50.1%). This was followed by those who believed them to be less harmful, which was 29%. 51.8% reported that they used e-cigarettes with nicotine, 38.2% did not use e-cigarettes with nicotine, and 10.1% were not sure. 46.9% have tried to stop smoking, and only 41.1% have seen advertisements or signs promoting e-cigarettes (table 5a and b).

Table 5a: Frequency of e-Cigarette Use		
Variable	**Number (N)**	**Percent (%)**
Have you ever heard of e-cigarettes?		
Yes	1451	97.1
No	44	2.9
Have you ever tried an e-cigarette?		
Yes	746	50
No	745	50
Frequency of Use		
Daily	163	10.9
At least once a week	57	3.8
At least once a month	59	4
Less than monthly	119	8
Not at all	1091	73.3
They may not be as bad for your health.		
Yes	234	38.8
No	369	61.2
They taste better.		
Yes	413	63.3
No	239	36.7
So you can smoke where smoking regular cigarettes is banned.		
Yes	210	33.8
No	412	66.2
They might help you quit.		
Yes	119	20.3
No	467	79.7
Perceptions of Harm		
More harmful than regular cigarettes	223	15.7
Equally harmful	712	50.1
Less harmful than regular cigarettes	413	5.2
Don't Know	74	5.2

Table 5b: Nicotine Content and Advertisement		
Variable	**Number (N)**	**Percent (%)**
Did any of the e-cigarettes that you used in the past 30 days include nicotine?		
Yes	350	51.8
No	258	38.2
Don't know/Not sure	68	10.1
Were any of the e-cigarettes that you used in the past 30 days flavored?		
Yes	378	55.9
No	233	34.5
Don't know/Not sure	65	9.6
During the past 12 months, have you tried to stop smoking e-cigarettes?		
Yes	317	46.9
No	359	53.1
In the last 30 days, have you noticed any advertisements or signs promoting e-cigarettes?		
Yes	584	41.1
No	838	58.9

Frequency of use and Perception of e-Cigarettes among different demographic groups:

Descriptive analysis of responses to frequency of use and perception of e-cigarettes among different demographics is summarized in table 6. One-way ANOVA was used to analyze data among different demographic groups, with focus on frequency of e-cigarette use and perception of harmful effects of e-cigarettes (table 7). According to the p-value calculations comparing the hypotheses groups, four of the ten values showed statistically significant difference in frequency of use and perceptions of e-cigarettes. The p-value for frequency of e-cigarette usage between health majors and non-health majors is significant with a p-value of 0.005. Both frequency of e-cigarette use and perception of harm among males and females was statistically significant with a

p-value of 0.000. The work status among students (those with jobs compared to those without) is also statistically significant with a p-value of 0.000.

Table 6: Frequency of use and Perception of e-Cigarettes among different demographic groups

	Gender				Major				Hours of Sleep				Enrollment Status				Work Status			
	Female		Male		Health and Science		Non-Health and Non-Science		Less than 6 hours		More than 6 hours		Full Time		Part Time		Working		Not Working	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Frequency of E-Cigarette Usage																				
Daily	82	**8.22**	78	**16.56**	57	**11.11**	45	**15.52**	29	**12.55**	134	**10.65**	138	**10.82**	25	**11.68**	101	**13.82**	62	**8.18**
Frequently but Not Daily	131	**13.13**	102	**21.66**	72	**14.04**	57	**19.66**	41	**17.75**	194	**15.42**	219	**17.18**	16	**7.48**	124	**16.96**	111	**14.64**
Not at All	785	**78.66**	291	**61.78**	384	**74.85**	188	**64.83**	161	**69.7**	930	**73.93**	918	**72**	173	**80.84**	506	**69.22**	585	**77.18**
Total	998		471		513		290		231		1258		1275		214		731		758	
Perception of Harm compared to Tobacco Cigarettes																				
Equal or More	713	**73.66**	211	**48.4**	325	**66.19**	166	**60.81**	150	**66.96**	785	**65.53**	795	**65.54**	140	**66.99**	462	**66**	473	**65.51**
Less	203	**20.97**	205	**47.02**	138	**28.11**	101	**37**	62	**27.68**	351	**28.3**	362	**29.84**	51	**24.4**	205	**29.29**	208	**28.81**
Don't Know	52	**5.37**	20	**4.59**	28	**5.7**	6	**2.2**	12	**5.36**	62	**5.18**	56	**4.62**	18	**8.61**	33	**4.71**	41	**5.68**
Total	968		436		491		273		224		1198		1213		209		700		722	

Table 7: One-Way ANOVA Results

	Gender P-Value	Major P-Value	Hours of Sleep P-Value	Enrollment Status P-Value	Work Status P-Value
Frequency of Use	**0.000***	**0.005***	**0.204**	**0.109**	**0.000***
Perceptions of Harm	**0.000***	**0.665**	**0.768**	**0.561**	**0.640**
Have you ever heard of an e-cigarette?	0.716	0.658	0.028*	0.305	0.669
Have you ever tried an e-cigarette?	0.000*	0.145	0.193	0.005*	0.000*
They may not be as bad for your health.	0.000*	0.298	0.363	0.158	0.113
They taste better.	0.064	0.030*	0.072	0.219	0.282
They make it easier to cut down.	0.054	0.297	0.122	0.006*	0.332
So you can smoke where cigarettes are banned.	0.003*	0.088	0.878	0.663	0.548

They might help you quit.	0.117	0.249	0.467	0.011*	0.620
Did they contain nicotine?	0.017*	0.098	0.156	0.245	0.766
Were they flavored?	0.229	0.122	0.068	0.339	0.391
Have you tried to stop smoking?	0.057	0.587	0.456	0.104	0.003*
Have you seen any advertisements relating to e-cigarettes?	0.022*	0.364	0.882	0.462	0.870

*Statistically Significant

Gender Differences in Frequency of Use and Perceptions

When further comparing the data, we found that more males than females used e-cigarettes on a daily basis, and more males viewed e-cigarettes as less harmful than tobacco cigarettes. Gender differences in terms of frequency of use and perception were statistically significant based on one-way ANOVA results. Gender differences were also significant when participants were asked if they have ever tried e-cigarettes, if they perceived them to not be as bad for your health, so they can use where smoking is banned, if they used e-cigarettes that contained nicotine, and if they have seen advertisements.

From a population size of 998 females, 8.22% used e-cigarettes daily and 13.13% used frequently but not daily. From a population of 471 males, 16.56% used daily and 21.66% used less frequently. Thus, a larger percentage of males used them on a daily basis. 78.66% of females did not use e-cigarettes at all, whereas only 61.78% of males did not use at all. In terms of perception of harm, 73.66% of females believed that e-cigarettes are equal in harm or more harmful than tobacco, compared to 48.4% of males. Only 20.97% of females believed them to be less harmful than conventional cigarettes, and 47.02% of males believed them to be less harmful.

Impact of Major on Frequency of Use and Perceptions

There was a statistically significant difference in frequency of e-cigarette use between students in health-related majors (Health Sciences, Psychology, Biomedical Sciences, Nursing, and Biology) compared to the ones in non-health majors, with non-health majors using e-cigarettes more frequently. Non-health majors perceived e-cigarettes as less harmful compared to health majors, but that was not statistically significant.

Among participants, 11.11% of health majors used e-cigarettes daily, compared to 15.52% in non-health majors used daily. 14.04% of health majors used less frequently compared to 19.66% of non-health majors. 74.85% of health and science majors did not use e-cigarettes at all, compared to only 64.83% of non-health and science majors. Regarding perception of harm, 66.19% of health majors believed that e-cigarettes are equal in harm or more harmful than tobacco, 28.11% believed them to be less harmful when compared to tobacco cigarettes, and 5.7% were not sure. Among non-health majors, 60.81% perceived e-cigarettes to be equal in harm or more harmful than conventional, 37% believed them to be less harmful, and 2.2% did not know. These results indicate that non-health and non-science majors may not have the same exposure to knowledge regarding e-cigarettes and their potential harm.

Impact of Hours of Sleep on Frequency of Use and Perceptions

Among participants, 29 of the 231 students who reported sleeping less than 6 hours per night reported using e-cigarettes every day (12.55%). Of those who reported sleeping more than 6 hours per night (1,258 total), 10.65% reported using e-cigarettes daily, and 15.42% reported using less frequently. 69.7% of students who average less than 6 hours of sleep per night do not

use e-cigarettes at all, and 73.93 of those who sleep more do not use at all. Of the 224 students who averaged sleeping less than 6 hours each night, 66.96% (150 people) believed e-cigarettes to be equal in harm or more harmful than conventional tobacco cigarettes. 785 students of the 1,198 students who reported more than 6 hours of sleep (65.53%) perceived e-cigarettes to be more or equal in harm to conventional tobacco cigarettes. 27.68% of those who average less believe them to be less harmful than tobacco cigarettes, and 28.3% of those who average more sleep believe them to be less.

Impact of Enrollment Status on Frequency of Use and Perceptions

Most participants in this study were full-time students (1,275) compared to 214 part-time students. Among these students, 10.82% of full-time students used e-cigarettes daily compared to 11.68% of part-time students. 17.18% full-time students used e-cigarettes frequently but not daily compared to 7.48% part-time students. 72% of full-time students did not use at all compared to 80.84% of part-time students. Of the 1,213 full-time students. 65.54% reported that they believe e-cigarettes to be as equal in harm or more harmful than conventional cigarettes, 29.84% believe them to be less harmful, and 4.62% were unsure. Among part-time student, 66.99% perceived e-cigarettes as harmful or more harmful than conventional cigarettes, 24.4% believed them to be less harmful and 8.61%, did not know.

Impact of Work Status on Frequency of Use and Perceptions

The difference in frequency of e-cigarette use between students who work and students who do not work was statistically significant based on the results of one-way ANOVA, with working students using e-cigarettes more frequently.

Of the 731 students who used e-cigarettes and worked either part-time or full time, 13.82% reported using e-cigarettes every day, 16.96% reported using less frequently, and 69.22% did not use e-cigarettes at all. Also, of those who worked either part-time or full-time, 66% perceive e-cigarettes to be equal or greater in harm when compared to traditional cigarettes, 29.29% believe them to be less harmful, and 4.71% reported that they did not know. Of the 758 students who use e-cigarettes and do not work, 8.18% reported using e-cigarettes daily, 14.64% reported using less frequently, and 77.18% did not use e-cigarettes at all. Of the 722 students who do not work, 65.51% believe tobacco cigarettes to be more harmful than e-cigarettes or as harmful. 28.81% believe e-cigarettes are less harmful, and 5.68% expressed uncertainty.

Impact of Other Demographic Factors on Frequency of Use and Perceptions

Table 8 summarizes results for additional one-way ANOVA analysis. The health status and location of work for the student did not show significant difference among the survey responses. Responses from students at various years at UCF (freshmen, sophomore, junior, senior, or graduate student) were statistically significant in their response to "they make it easier for you to cut down on the number you smoke" and "they might help you quit". Responses from students with different ethnicity showed statistically significant results to the frequency of use and for trying e-cigarettes.

Students with different age groups showed the most statistically significant results for most of the

survey responses.

Table 8: One-Way ANOVA Results (non-hypotheses)					
	Age	**Ethnicity**	**Year at UCF**	**Location of Work**	**Health**
Frequency of Use	0.011*	0.013*	0.366	0.358	0.388
Perceptions of Harm	0.187	0.056	0.921	0.462	0.450
Have you ever heard of an e-cigarette?	0.656	0.139	0.954	0.354	0.980
Have you ever tried an e-cigarette?	0.000*	0.004*	0.409	0.748	0.659
They may not be as bad for your health.	0.001*	0.141	0.165	0.208	0.562
They taste better.	0.111	0.888	0.615	0.535	0.766
They make it easier to cut down.	0.000*	0.460	0.007*	0.105	0.183
So you can smoke where cigarettes are banned.	0.033*	0.606	0.696	0.096	0.336
They might help you quit.	0.000*	0.110	0.002*	0.461	0.225
Did they contain nicotine?	0.923	0.475	0.664	0.837	0.954
Were they flavored?	0.597	0.454	0.219	0.673	0.898
Have you tried to stop smoking?	0.006*	0.615	0.071	0.170	0.470
Have you seen any advertisements relating to e-cigarettes?	0.048*	0.260	0.713	0.204	0.388

*Statistically Significant

DISCUSSION

This study included a relatively large number of participants (1,529 students) from a large public university "University of Central Florida" (UCF). In general, participant's demographics reflected the overall student demographics at UCF including age, ethnicity, and academic status, which makes it possible to generalize the findings. Most students were full-time and were in Health and Psychology majors. Many students reported not working and having over six hours of sleep. That can be attributed to the timing when the study was conducted in Summer 2020, when UCF's classes and operation was virtual due COVID-19 pandemic. During that time, many students may have been temporarily or permanently laid off. With classes being virtual and without the need to go to campus, students can sleep right until the start of class, for example, rather than having to wake up early, get ready, and find parking on campus.

It was not surprising that a high percentage of UCF students have heard of e-cigarettes, considering the prevalence of e-cigarettes in modern society (advertisements, peers, etc.). However, only half the participants tried e-cigarettes. Among e-cigarette users, most participants reported that the reason they use them is because they taste better than tobacco cigarettes. Flavor can indeed be a strong contributing factor to increase popularity of e-cigarette use considering the many flavors available on the market. In spite of favorable responses to a variety of flavors, most participants who use e-cigarettes reported that they perceive e-cigarettes to be as harmful as cigarettes. This response makes one question why they choose to use e-cigarettes. Part of the answer could be due to the immediate satisfaction they receive by selecting tasty flavors, which is not an option in tobacco cigarettes.

Perception of e-cigarette and use varied based on gender, and these differences were found to be statistically significant. More males used e-cigarettes on a daily basis and considered them to be less harmful than tobacco cigarettes compared to females. This could be due to the fact that males reportedly tend to use more for enjoyment and personal pleasure, whereas females are using more for stress removal. This information on gender differences would guide health education programs and efforts in diversifying the outreach plans to address gender differences in perceptions and beliefs related to e-cigarette use.

Students use and perception of e-cigarettes was impacted by their enrollment status, part-time versus full-time. Students who are taking courses full-time are more likely to report higher levels of stress due to increased amounts of homework, exams, and extracurriculars related to school. It is expected that students who experience high levels of stress may use e-cigarettes more to relieve some of the stress. The results, however, showed that more part-time students used e-cigarettes daily compared to full-time students. This could be because students who are part-time may be more likely to have another responsibility in addition to attending school, perhaps an intense job, personal and medical issues, having to care for family members, etc. They also may have more free time, which could cause them to use daily. In spite of increase in e-cigarette use among full-time students, these students perceived e-cigarettes as less harmful than traditional cigarettes compared to part-time students.

Working students (part or full-time job) are expected to express higher levels of stress than those who do not have a job. This can be due to increased responsibility. Difference in e-cigarette use and perception was identified between students who work and students who do not work. The difference was statistically significant. Working students used e-cigarettes more frequently and

perceived them as either equal or less harmful than traditional cigarettes, when compared to students who do not work. Even though students who are working are experiencing increased stress due to juggling multiple responsibilities, an educational program can be designed to address healthier ways to manage these responsibilities and use of e-cigarettes.

Student response to number of hours of sleep showed difference in their use and perception of e-cigarettes. Those who reported less than 6 hours of sleep also reported using e-cigarettes more frequently than those who had more than 6 hours of sleep. Students who experience less sleep might need something to boost their energy, whether it is consuming more caffeine or using an e-cigarette. However, in regard to perception, more of those who reported more than 6 hours of sleep also reported viewing e-cigarettes as less harmful than traditional cigarettes.

The students were divided into two groups based on major: health and science majors versus non-health and non-science majors. The health and science major group included those majoring in Health Sciences, Psychology, Biomedical Sciences, Nursing, and Biology. The other majors listed in the survey were placed in the other group. Those in the non-health and non-science majors reported using e-cigarettes more frequently. More students within health and science majors reported not using e-cigarettes at all compared to the non-health and non-science majors. In regard to perception, more of the health and science majors believed them to be equal in harm or more harmful than tobacco cigarettes. Both results could be explained that students in the health and sciences majors are exposed to health information. Having this background and knowledge would deter health and science majors from engaging in potentially harmful activities.

CONCLUSION

The results of this study are crucial in providing insight in establishing programs to prevent e-cigarette usage and which groups they should be geared towards. Even though most participants reported not using e-cigarettes, the main reason for using e-cigarettes among the ones who use them was the myriad available e-cigarette flavors.

Marketing on the variety of delicious flavors allows e-cigarette companies to profit but also raises the need for programs to provide information to students. For example, those who are not in a health or science major may benefit from an educational program discussing the potential health effects of e-cigarettes. Also, the impact of stress levels on partaking in unhealthy activities can be seen; those who seemed as if they would have more stress tended to use more. This may also suggest that programs could focus on teaching students how to alleviate stress in healthy and safe ways.

A future question that could be explored is investigating the health effects of e-cigarettes. It is important to determine what, if any, damage, or health consequences occur when one uses e-cigarettes. By doing an experiment that looks at the physiological impact, users may have more tangible, visual reasons to believe e-cigarettes may be more dangerous than they think. It would also be beneficial to see if the mechanism and structure of e-cigarettes has side effects, as well as linking e-cigarette usage to specific pathologies and disease.

This study is a good basis for understanding why college students use e-cigarettes. By having some insight into the beliefs of college students, health professionals and scientists can cater e-cigarette prevention programs towards them.

LIMITATIONS

One of the limitations in this study stems from the fact that the survey was sent out via e-mail for students to answer on their own. Students can interpret the questions in their own way. They may not have viewed and understood the questions in the same way, thus causing inaccuracy in their answers. Also, because the survey was sent to all students, there was no control over who participated in the survey.

Appendix I: Survey

APPENDIX I

VALIDATED SURVEY

I. Demographics Questions

1 How old are you?

    a. < 18

    b. 18-22

    c. 23-27

    d. 28-32

    e. 33-39

    f. ≥ 40

2. What is your gender?

    a. Female

    b. Male

    c. Other

3. How would you describe yourself?

    a. White

    b. Black or African American

    c. Hispanic or Latino/a

    d. Asian or Pacific Islander

    e. American Indian, Alaskan Native, or Native Hawaiian

f. Biracial or Multiracial

g. Other

4. What is your status at UCF?

    a.   Freshman (0-30 credit hours)

    b.   Sophomore (31-60 credit hours)

    c.   Junior (61-90 credit hours)

    d.   Senior (91-120 credit hours)

    e.   Senior (120+ credit hours)

    f.   Graduate or Professional Student

    g.   Non-degree Seeking Student

5. What is your enrollment status at UCF?

    a. I am enrolled in classes full-time

    b. I am enrolled in classes part-time

6. What is your major at UCF?

    a.   Health Sciences

    b.   Psychology

    c.   Biomedical Sciences

    d.   Nursing

    e.   Mechanical Engineering

f. Integrated Business

g. Computer Science

h. Biology

i. Finance

j. Hospitality Management

k. Other (please specify):

7. Are you currently working?

a. Yes, full-time

b. Yes, part-time

c. I am not currently working

8. Where do you work?

a. On-campus

b. Off-campus

9. On average, how many hours of sleep do you get per night?

a. More than 8 hours

b. 6-8 hours

c. 4-6 hours

d. 2-4 hours

e. Less than 2 hours

10. In general, would you say your health is:

    a.   Excellent

    b.   Very Good

    c.   Good

    d.   Fair

    e.   Poor

II.   Perception of e-cigarette use

11. Have you ever heard of electronic cigarettes or e-cigarettes? These are electronic devices that contain nicotine in a vapor and are designed to look like cigarettes but contain no tobacco.

    a. Yes

    b. No

    c. Don't know

12. Have you ever tried an electronic cigarette?

    a. Yes

    b. No

    c. Don't Know

13. How often, if at all, do you currently use an electronic cigarette? PLEASE SELECT ONE OPTION.

    a. Daily

    b. Less than daily, but at least once a week

    c. Less than weekly, but at least once a month

    d. Less than monthly

    e. Not at all

    f. Don't know

Which of the following were reasons for your using electronic cigarettes? PLEASE SELECT ONE OPTION FOR EACH STATEMENT.

14. They may not be as bad for your health.

    a. Yes

    b. No

    c. Don't know

15. They taste better.

    a. Yes

    b. No

    c. Don't Know

16. They make it easier for you to cut down on the number of cigarettes you smoke.

a. Yes

b. No

c. Don't know

17. So you can smoke in places where smoking regular cigarettes is banned

a. Yes

b. No

c. Don't Know

18. They might help you quit

a. Yes

b. No

c. Don't Know

19. Are you interested in trying e-cigarettes in the future?

a. Yes

a. No

b. Don't know

20. Do you think electronic cigarettes are more harmful than regular cigarettes, less harmful, or are they equally harmful to health? PLEASE SELECT ONE OPTION.

a. More harmful than regular cigarettes

b. Equally harmful

c. Less harmful than regular cigarettes

d. Don't know

III.   Usage of e-cigarettes

1.

21.   Did any of the electronic cigarettes that you used in the past 30 days include nicotine?

a. Yes

b. No

c. Don't Know/Not Sure

22.   Were any of the electronic cigarettes that you used in the past 30 days flavored to taste like menthol, mint, clove, spice, candy, fruit, chocolate, or other sweets?'

a. Yes, please indicate which:

b. No

c. Don't Know/Not Sure

23.   During the past 12 months, have you tried to stop smoking e-cigarettes?

a. Yes

b. No

24.   In the last 30 days, have you noticed any advertisements or signs promoting e-cigarettes?

   a. Yes

   b. No

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