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Title

Participatory Research on the Prevalence of Multi-Substance Vaping in College Students

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Abstract:

**Objectives:** To assess electronic nicotine delivery system (ENDS) use and vaping behaviors and attitudes in college students.

**Methods:** A student-faculty partnership administered a cross-sectional survey to undergraduate students (N=339) in 2019.

**Results:** 49.8% of students reported using ENDS or vaping in the past 30 days. 48.9% of students who vaped reported vaping more than one substance in the past 30 days. The most commonly vaped substances were cannabis (34.9%), nicotine (26.7%), and flavor (19.2%). Reasons for initiating ENDS use were social (64.8%), for the high (40.8%), and for the flavor (32.4%). Both users and non-users believed ENDS were harmful and favored regulation.

**Conclusions:** Young people who use ENDS commonly vape more than one substance; a critical finding in light of the current vaping lung injury epidemic. The importance of social reasons for initiating ENDS and broad support for regulation suggest jurisdictions consider regulation to reduce ENDS use in young adults.

Keywords:

Electronic Nicotine Delivery Systems; vaping; college; young adults; nicotine; cannabis

## **Participatory Research on the Prevalence of Multi-Substance Vaping in College Students**

### **Introduction**

Fueled by the use of electronic nicotine delivery systems (ENDS), youth tobacco consumption in the United States is on the rise.<sup>1,2</sup> This comes after years of decline in use among both young people and adults.<sup>1,3</sup> The use and manipulation of these electronic devices to deliver nicotine, cannabis, and other substances is widespread, and particularly common among college students.<sup>4</sup> While the long term health effects of these new tobacco products are not fully known,<sup>5</sup> more than 2,800 people have been hospitalized with e-cigarette, or vaping, product use-associated lung injury (EVALI) and 68 deaths have been attributed to the outbreak in 2019–2020 in the United States.<sup>6</sup>

One of the challenges in understanding and monitoring the use of these devices is the rapidly changing product landscape and concomitant changes in language used to describe behaviors.<sup>7</sup> In the mid-2000s, when the modern electronic cigarette was first introduced to the United States, the product was designed to look like a traditional cigarette. Second-generation devices were shaped like pens and often called “vape pens” or “tanks.” Third- and fourth-generation devices vary in shape and size, but frequently are rectangular and mimic a USB stick. These products frequently are referred to by their brand names, such as “JUUL,” or as a “vape” or “mod.” Many researchers now refer to all these devices collectively as “Electronic Nicotine Delivery Systems” (ENDS), even though these devices can be used with flavoring, cannabis, or other products with or without delivering nicotine. “Vaping” is the behavior or practice of inhaling vapor using one of these electronic devices, regardless of the type of device being used

or the substance being vaporized. Throughout this paper, we will use the term “ENDS” to describe devices generally and “vaping” to describe the behavior.

The National Youth Tobacco Survey (NYTS), a nationally representative annual survey of high school and middle school students, first included assessment of ENDS in 2011. Between 2011 and 2018, the survey reported a significant non-linear increase in ENDS use by high school students from 1.5% to 20.8%.<sup>8</sup> While much of this increase likely captures real changes in youth behavior, NYTS also changed the question used to assess ENDS three times in this period as it became clear that young people who self-reported vaping using a “vape pen” might not report using an “e-cigarette.”<sup>8,9</sup> Representative surveys of California high school students in the same time period reveal a lower prevalence of ENDS use than the national prevalence, with the 2017 – 2018 survey reporting 10.9% of high school students currently used ENDS.<sup>10</sup> As in other states, while the overall use of tobacco products in California declined in recent years, use of ENDS by high school students has increased each year.<sup>10</sup>

Less is understood about ENDS use in young adults. National surveys of adult ENDS use, however, point to the highest prevalence among 18 - 24 year old’s compared to older adults.<sup>11</sup> The 2013 – 2014 National Adult Tobacco Survey found that 35.8% of young adults age 18 – 24 had ever used ENDS and 13.6% currently used ENDS.<sup>7</sup> Given the significant increase in ENDS use among youth in subsequent years, the prevalence of use among young adults is likely to be higher than these estimates. In California, young adults under age 30 are significantly more likely to use ENDS (9.4%) than older adults (1.8%).<sup>12</sup>

There are significant gaps in our understanding of the relationship between ENDS use and cannabis. The EVALI outbreak has been clearly linked to vaping cannabis, specifically users modifying ENDS to deliver fluids containing tetrahydrocannabinol (THC) obtained from

informal sources.<sup>6</sup> The 2015 – 2017 California Healthy Kids survey (CHKS), a representative survey of California high school students, found that 16% of 11<sup>th</sup> graders had used cannabis in the last month and 31% had ever used cannabis.<sup>13</sup> These rates are slightly higher than national estimates for cannabis use for the same age range<sup>14</sup> and notably higher than the rate of using all tobacco products.<sup>10</sup> The highest rate of co-use of cannabis and tobacco among youth in California was found among users of ENDS.<sup>10</sup> The rate of cannabis use increases among young adults: the National Survey on Drug Use and Health has consistently found that the highest rates of past month cannabis use occur in the 18 – 25 year old age group, with rates increasing in survey years between 2002 and 2017 and trending slightly higher in California compared to the national average.<sup>14</sup>

Monitoring the Future, a repeated panel survey following nationally representative 12<sup>th</sup> graders into adulthood, found vaping nicotine and cannabis more common in college students (16% and 10.8%, respectively) than in their non college-attending peers (13% and 7.9%, respectively).<sup>15</sup> The data from this annual survey also suggest that the rates of vaping cannabis are increasing rapidly: past year vaping of cannabis among 12<sup>th</sup> graders more than doubled between 2017 – 2019, reaching 20.8%. In just one year, past month vaping of cannabis doubled from 7.5% in 2018 to 14% in 2019.<sup>16</sup>

Studies of youth and adults report that vaping is thought to be less harmful than smoking cannabis or tobacco.<sup>17-20</sup> Many studies have reported ENDS users believe these devices are healthier, safer, less addictive, and less harmful for others in the social environment than combustible cigarettes.<sup>21</sup> However, these perceptions are changing, with more recent studies demonstrating more concern among users and non-users alike compared to earlier studies.<sup>21</sup>

The present study seeks to address a gap in the literature about vaping behaviors and ENDS use, motivations for initiating ENDS use, and beliefs about ENDS use among college students in California. While the context nation-wide is changing rapidly, the context in California is also in flux. In 2018, recreational cannabis became legal; the following year, the county where this study took place banned the sale of ENDS.<sup>22</sup> Thus, the present study reflects a singular moment in time, after legalization of recreational cannabis and just before the EVALI outbreak gained national attention and regulation of ENDS products and vaping came into place.

## **Methods**

This study was developed as a partnership between a faculty member (first author) and undergraduate students in an introductory epidemiology course typically enrolled in by Junior Public Health majors and minors. The faculty member, who has 15 years of experience in community based participatory research (CBPR), developed the course to include a student-driven applied research project collaboratively designed and implemented during the spring 2019 semester. The study design, implementation, data collection, and preliminary analysis was scaffolded over the full semester, beginning with classroom conversations about vaping, during which students shared their own experiences and perceptions of their peers' behaviors and attitudes. In addition to conducting background literature reviews, students had an opportunity to interview a researcher and an alumna who worked in the Tobacco Free Communities Program of the county public health department. Students were encouraged to use their own experiences to identify important questions about ENDS use, substances vaped, and vaping behaviors. These questions were then incorporated into the survey, along with items students identified from national surveys that they believed would capture reliable information

about student behaviors and allow for comparison with representative studies. The survey was initially developed by the undergraduate students, and edited and refined by the faculty member. This study reports the findings on ENDS use by college students at a large public university in California. The human subjects research protocol was drafted by the students, edited by one classmate, and then further refined by the faculty member. The protocol was approved by the University's Institutional Review Board.

A non-probability sampling design was employed after discussion in the class about the strengths and limitations of representative vs. non-representative samples. Students led and tracked administration of the survey tool in a shared Google document. Students disseminated the survey electronically to all Deans of colleges at University, posted the survey on a campus-wide social media platform, and on the Facebook pages of student organizations including cultural groups, sororities and fraternities, and one sports team. One student reviewed the course catalog to identify nine large courses of 100 – 300 students in each discipline and emailed the instructors of each course to request that they distribute the survey to their students. Many students in the course also emailed peers in their own courses via the course learning management software requesting that they complete the survey. The survey was opened on March 25, 2019 and closed on April 15, 2019. The survey was anonymous and participants could choose to opt out after reading a notice of consent.

### *Measures*

To determine eligibility, the survey asked whether participants were undergraduate students. Students were asked to report a series of demographic questions including their general field of study, age, gender identity, sexual orientation, and racial or ethnic identity. Participants

were asked a series of questions about use of ENDS use, which began with the prompt: “The following questions ask about your use of and attitudes about electronic nicotine delivery systems (ENDS), which are also sometimes known as vapes, vape pens, e-hookah, mods, Juul, e-cigarettes and other names. Please answer with respect to any of these types of devices.” This introductory paragraph is similar to the language used in the 2015 – 2019 National Youth Tobacco Surveys. Participants were then asked, “Have you ever used an electronic nicotine delivery system?” If they reported ever using ENDS, they were asked “How old were you when you first tried an electronic nicotine delivery system?” All participants were also asked to report whether they had used ENDS in the past 30 days. If they had used ENDS in the past 30 days, they were asked the average frequency of using ENDS. They were also asked “Why did you start using an electronic nicotine delivery device?” and could select any of the following reasons: To quit using cigarettes, Healthier option to enjoy nicotine, Less smelly option to enjoy nicotine, For social reasons, To enjoy the flavoring, For the high, Other reason (with an option to specify). These possible answers were identified by the student researchers as important factors for them and their peers in initiating ENDS.

Because prior research indicated that some young people who vape cannabis or flavoring do not self-report using “e-cigarettes” or devices that include the word “nicotine,” we asked additional questions about vaping behaviors of all participants, regardless of how they had answered the initial questions on ENDS use. All participants were asked to “Select all the substances you have used with any electronic vapor product in the past 30 days” with the following options: Nicotine, Flavors, Cannabis, Other herbs, Other (with an option to specify), or Have not used any electronic vapor product. In addition, because of particular concerns about flavored products, all participants were asked “Do you use an electronic vapor product with a



flavoring?” Participants were classified as having vaped in the past 30 days if they reported either using ENDS in the past 30 days or responded that they had vaped a particular substance in the past 30 days, regardless of the substance selected.

All participants were asked four questions about their beliefs and attitudes about ENDS: “Do you believe that electronic nicotine delivery systems are more or less harmful than regular cigarettes?” “Do you think that electronic nicotine delivery systems should be regulated like other tobacco products?” “Do you think that using electronic nicotine delivery systems can be harmful for your health?” and “Do you think it is safe to use electronic nicotine delivery systems during pregnancy?” The National Adult Tobacco Survey and National Youth Tobacco Survey assess the harm of ENDS with similar questions. We included the questions on perceptions of harm during pregnancy and regulation of ENDS because these two topics were receiving media attention at the time and students were interested in their peers’ thoughts.

Where questions in the survey assessed ENDS use and beliefs that have previously been measured in national surveys, the question language reflected these previously validated and reliable surveys.<sup>23-25</sup> Additional questions in the survey emerged from student conversations and were included based on principles of CBPR to ensure that questions accurately captured beliefs and behaviors based on community expertise.<sup>26-27</sup>

### *Statistical Methods*

First, we describe the demographic characteristics in the population. Next we estimate the overall prevalence of ever using ENDS and ENDS use in the past 30 days. We describe the distribution of what participants reported vaping with any electronic device in the past 30 days by each substance and then in combination. We estimated the prevalence of past 30 vaping or

ENDS use by demographic characteristics, testing for differences in the prevalence of past 30 day vaping or ENDS use with univariable Poisson regression models with robust standard errors, which best approximates a prevalence ratio.<sup>28</sup> We report the frequency that participants endorsed different reasons for ENDS use and describe the distribution of these reasons by the substances that participants reported vaping in the past 30 days. We also report the frequency of responses to the four beliefs and attitudes questions and describe the distribution of these responses by past 30 day vaping. Using multinomial logistic regression, we compare the prevalence of different beliefs and attitudes by past 30 day vaping.

## **Results**

There were 375 survey responses, including 11 graduate student participants and 10 non-student participants, yielding 354 eligible undergraduate participants. An additional 15 surveys were excluded because of missing data (more than 90% of questions incomplete), leaving an analytic sample size of 339 participants. The characteristics of this sample are presented in Table 1. The sample was largely female (70.1%) and between the ages of 18 – 21 (73.7%). The sample was 87.2% heterosexual. Participants were racially and ethnically diverse with about half identifying as Asian or Pacific Islander (48.8%), and specifically as Vietnamese (13.9%), Filipino (11.2%) and Chinese (8.0%). Hispanic participants made up 22.7% of the sample with 14.6% identifying as Mexican. An additional 15% identified as White. The racial and ethnic make-up of our sample is similar to the total population of students at this University, which is 42.0% Asian, 28.0% Hispanic, 16.9% White, 3.2% Black, and 9.4% other.<sup>29</sup> Most participants were in health and human services majors (45.8%). The remaining participants were from social sciences (13.7%), business (13.1%), science (11.0%), engineering (6.3%), humanities and arts (6.0), and education

(4.2%). The gender distribution of our sample is similar to the representation we would expect proportionally from each college within the University: the College of Health and Human Sciences is 72% female and the College of Social Science is 59% female, whereas Business and Science are respectively 46% and 44% female.

Our assessment of ENDS use and vaping behavior produced different estimates of the prevalence of vaping depending on the survey question (Table 1). About half of participants reported ever using ENDS (47.1%) and a quarter had used ENDS in the past 30 days (23.9%). Most had started using ENDS over the age of 18 (64.8%), with a third starting between the ages of 14 – 18 (31.8%). Of those who reported ENDS use in the past 30 days, half reported using ENDS less than once per day (49.3%), while 18.3% reported using ENDS a few times a day, and 32.4% reported using ENDS several times per day.

When asked to “select all the substances you have used with any electronic vapor product in the past 30 days” 141 participants (39.8%) selected at least one substance. This group includes 68 participants who said “no” to the question “Have you used an electronic nicotine delivery system in the past 30 days?” Of the 68 participants who did not report past 30 days ENDS use but did select a specific substance that they had vaped in the past 30 days, two-thirds (46) reported only vaping cannabis, 4 reported only vaping nicotine, 4 reported only vaping flavor, 2 reported only vaping some other substance, and 12 reported a vaping at least two substances. Of the 141 participants who reported vaping at least one substance in the past 30 days, 69 (48.9%) reported vaping more than one substance. The most common substances that participants reported vaping in the past 30 days were cannabis (34.9%), nicotine (26.7%), and flavor (19.2%) (Figure 1). Of the 72 participants who reported vaping only one substance in the past 30 days, 69.4% reported vaping cannabis, 16.7% reported vaping nicotine, and 11.1% reported vaping

flavor. Of those who reported vaping nicotine, 57.7% also reported vaping flavor and 62.8% also reported vaping cannabis. Just under half of those who reported vaping cannabis also reported vaping nicotine (48.0%). Of those who reported vaping flavor, 80.3% also reported vaping nicotine and 55% also reported vaping cannabis.

We assessed demographic differences in ENDS use and vaping behavior by creating a summary variable that captured all participants who had either reported ENDS use in the past 30 days or reported that they had vaped a particular substance in the past 30 days (Table 1). Half of the participants (49.8%) were classified as having either used ENDS or vaped in the past 30 days. There were no statistically significant differences ENDS use or vaping in past 30 day by gender, age, sexual orientation, or race. Participants studying business had a slightly higher prevalence of ENDS use or vaping in the past 30 days than students in other fields of study (PR 1.34, 95% CI 1.02, 1.77).

Of those who reported using ENDS in the past 30 days, most participants selected multiple reasons for initiating ENDS. The 68 participants who later reported vaping a particular substance in the past 30 days but did not report using ENDS in the past 30 days were not asked this question and are thus excluded from the analysis. The most common reasons for initiating ENDS were for social reasons (64.8%), for the high (40.8%), for the flavor (32.4%), and for a healthier way to use nicotine (22.5%) (Figure 2). Only 4.2% reported initiating ENDS to quit smoking cigarettes. When we examined these reasons by the substance that the participant endorsed vaping in the past 30 days, we found that the most commonly selected reason for vaping nicotine, flavor or cannabis was for social reasons (reported by 51.3% of those who vaped nicotine, 41.1% of those vaped flavor, and 29.4% of those vaped cannabis) (Table 2). “For the high” was the next most common reason selected for initiating ENDS use with 37.2% of

those who reported using nicotine, 25.0% of those who reported using flavors, and 18.6% of those who reported using cannabis selecting this reason.

Participants generally believed that ENDS were harmful (60.6%) and similar in their harm to cigarettes (48.9%) (Table 3). They did not think that ENDS were safe to use during pregnancy (97.2%) and believed that ENDS should be regulated like other tobacco products (87.0%). There were some differences in attitudes by whether or not a participant reported using ENDS or vaping in the past 30 days (Table 3). Those who had used ENDS or vaped in the past 30 days were more likely to say that ENDS are less harmful than regular cigarettes (PR 2.92, 95% CI 1.68, 5.01), and more likely to oppose regulation (PR 3.96, 95% CI 1.71, 9.12). Participants who had used ENDS or vaped in the past 30 days were also more likely to report that ENDS was a little bit harmful compared to very harmful (PR 2.58, 95% CI 1.57, 4.27).

## **Discussion**

The rapidly increasing use of ENDS and changes in vaping behavior warrants frequent monitoring of the prevalence and patterning of use of these products. Our study found that 47.1% of the sample reported ever using ENDS and half reported either using ENDS or vaping in the past 30 days (49.8%). In our study, the most common substance participants reported vaping was cannabis, with 34.9% reporting past 30-day use. The 2016 National Youth Tobacco Survey found that 12.4% of high school students had ever used cannabis in an e-cigarette<sup>30</sup> and a non-representative study of college students in Arizona found that 22.5% had ever vaped cannabis.<sup>20</sup> These stark differences may be partially explained by contextual factors, including legal recreational cannabis and lack of regulation of ENDS and vaping products at the time of this study in California. These differences may also be explained by variances in survey

language. In our survey, 19.1% of our study population who reported no past 30 day use of ENDS nevertheless reported substances they had vaped with “any electronic vapor product” in the past 30 days. Indeed, comparisons between studies and across time periods are difficult at this point because of the rapidly evolving language used by people to describe their practices and used by surveyors to solicit information about these practices.

These data report that social reasons were the primary reason given for initiating ENDS for nicotine (51.3%), flavors (41.1%), and cannabis (29.4%). Another study of college students found that the primary reasons for vaping cannabis was for convenience and discreetness for use in public places.<sup>20</sup> Saddleson et al<sup>31</sup> conducted a study among New York college students and found that 72.1% of current users reported using ENDS for enjoyment. Wong et al<sup>32</sup> found that the most common reasons for use of ENDS were to be with other ENDS users (74%), social gatherings (49%), being in a car (49%) and being in an indoor space (47%). The same study reported that the primary motivations for using ENDS were to replace traditional combustible tobacco products (63%), it is/might be less harmful (60%), and there are more flavor choices (51%).<sup>32</sup> A novel contribution of this study was the finding that 40.8% of college students who use ENDS, report their reason is to get high, including 37.2% of those who vape nicotine. Per CBPR principles, this question was included in our survey based on the experiences of class members and conversations with peers about why they use ENDS. This formative research indicated that students who were using ENDS for nicotine experienced a quick, intense, and brief high, which has a very different quality to the high achieved through vaping cannabis. This is consistent with a small, qualitative study describing user experiences with JUUL which quoted one participant who said that vaping nicotine produced a satisfying ““head rush, and then I feel relaxed... If I’m studying or something I think that helps a little bit.””<sup>33(p86)</sup>

Findings on using ENDS to quit smoking combustible cigarettes are still widely variable. Our study found that only 4.2% of students reported using ENDS for quitting cigarettes. Saddleson et al.<sup>31</sup> found that ENDS use for quitting cigarettes is common among adult smokers, however, young people are less likely to use ENDS for this reason. This may be particularly true in California, which has a lower rate of cigarette use than the rest of the country.<sup>10</sup> Park et al<sup>34</sup> did not find any significant association between ENDS use and intention to quit smoking among current youth smokers. The efficacy of ENDS as a smoking cessation device is still under debate. Also, ENDS are currently not regulated by the Food and Drug Administration as a smoking cessation device.

This study found that college students do not believe ENDS are harmless and are generally supportive of regulating these products. While there were differences in the perception of harm and level of support for regulation by whether students use ENDS or engage in vaping, the differences are less than have been reported in other studies. The 2013-2014 National Adult Tobacco Survey found that 28.6% of young adults age 18 – 24 believed that ENDS use was “very harmful,” and only 10.0% of current ENDS users reported that ENDS use was “very harmful.”<sup>11</sup> In contrast, 60.6% of our sample, including 49.6% of past 30 day users, reported that ENDS use was “very harmful.” This is consistent with the temporal trend of users and non-users alike reporting increased risk.<sup>21</sup>

Our participants reported far more concern about the safety of ENDS during pregnancy than has been reported in other studies. We found that 97.2% of participants, including 96.9% of past 30 days users, believed ENDS were not safe to use during pregnancy. In contrast, a systematic review of seven studies found the perception that ENDS are safe during pregnancy to be widely held among different population subgroups.<sup>35</sup> A representative study of Oklahoma and

Texas women who had recently given birth found that half of the women who had used ENDS during pregnancy did so because they believed these products to be less harmful than regular cigarettes.<sup>36</sup>

Despite higher prevalence of ENDS use and vaping behaviors in this college student sample than is seen in many nationally representative studies of this age group, students did not believe ENDS to be safe and were supportive of regulation. This study was conducted prior to the emergence of the EVALI outbreak and a local ban on the sale of ENDS and vaping products. Perceptions of risk to health for vaping cannabis, in particular, may have changed as a result of media coverage of the outbreak and the specific warning by the Centers for Disease Control and Prevention to avoid vaping tetrahydrocannabinol.

This is the first study of its kind to explore multi-substance ENDS use among California college students. We found that 48.9% of those who reported vaping in the past 30 days vaped more than one substance, which is consistent with vaping behaviors of cases in the EVALI outbreak.<sup>6</sup> This study also employed strategies of CBPR in developing the research questions, creating the survey, and collecting data in collaboration with the population under study. Given the known challenges in ascertainment of use of ENDS and vaping behavior, it is a strength of this study that we included two different assessments of past 30 day use of ENDS and vaping behavior. The study's generalizability is limited due to the non-probability based sampling method we employed. However, to the extent that these results are biased due to the sampling approach, we would expect it to underestimate the prevalence of ENDS use and vaping because of the disproportionate number of students in the survey who are in health-related fields of study.

## **Public Health Implications**



Using ENDS for nicotine, cannabis, or multiple substances in combination is not harmless. Research into the prevalence and patterning of ENDS use and vaping behavior are especially critical in light of the current lung injury epidemic and the Surgeon General’s warning to the public to refrain from ENDS use. This research is most important to inform the development and implementation of interventions among young adults, particularly college students, who are the population most at risk of using ENDS. In the context of legal recreational cannabis use and low tobacco use among youth and young adults in California, vaping of cannabis alone and in combination with nicotine need to be further understood. This study also points to broad support for regulation of these products, even among ENDS users. As most young people initiate ENDS use for social reasons, regulating access to and spaces where ENDS are allowed may help reduce the prevalence of ENDS, just as these regulations reduced the prevalence of cigarette smoking over the past decades.

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Table 1: Characteristics of study participants and prevalence of ENDS use and vaping behavior

Characteristic	Total N (%)	Ever ENDS <sup>1</sup> N (%)	Past 30 day ENDS <sup>1</sup> N (%)	Past 30 day vaping <sup>2</sup> N (%)	Past 30 day Vaping or ENDS <sup>3</sup> use N (%)
Total	339 (100)	152 (47.1)	76 (23.9)	141 (41.6)	169 (49.8)
Gender					
Man	101 (29.9)	54 (54.5)	31 (32.0)	52 (51.5)	58 (57.4)
Woman	237 (70.1)	98 (43.9)	45 (20.4)	89 (37.6)	111 (46.8)
Age					
18 – 21 years	249 (73.7)	116 (49.4)	64 (27.7)	110 (44.2)	132 (53.0)
22 – 25 years	70 (20.7)	30 (44.1)	11 (16.2)	23 (32.9)	28 (40.0)
26 – 35 years	19 (5.6)	5 (26.3)	1 (5.3)	8 (42.1)	8 (42.1)
Sexual Orientation					
Heterosexual	294 (87.2)	132 (47.3)	69 (25.1)	126 (42.9)	152 (51.7)
Mostly	21 (6.2)	11 (55.0)	2 (10.5)	9 (42.9)	10 (47.6)
Heterosexual					
Bisexual	15 (4.4)	5 (33.3)	4 (26.6)	4 (26.7)	4 (26.7)
Gay or Lesbian	4 (1.2)	1 (25.0)	0 (0.0)	1 (25.0)	1 (25.0)
Other	3 (0.9)	1 (33.3)	0 (0.0)	1 (33.3)	1 (33.3)
Race					
Black	7 (2.1)	3 (50.0)	1 (16.7)	2 (28.6)	3 (42.9)
White	51 (15.0)	26 (53.1)	10 (20.4)	26 (51.0)	29 (56.9)
Chinese	27 (8.0)	10 (38.5)	4 (16.0)	6 (22.2)	8 (29.6)

Filipino	38 (11.2)	15 (42.9)	7 (20.0)	18 (47.4)	22 (57.9)
Vietnamese	47 (13.9)	23 (50.0)	9 (20.0)	16 (34.0)	19 (40.4)
Other Asian or	51 (15.0)	21 (43.7)	12 (25.5)	19 (37.3)	23 (45.1)
Pacific Islander					
Mexican	50 (14.6)	22 (45.8)	12 (26.1)	20 (40.0)	27 (54.0)
Other Hispanic	27 (8.0)	11 (44.0)	7 (28.0)	13 (48.1)	16 (59.3)
Other	41 (12.1)	21 (52.5)	14 (35.0)	21 (51.2)	22 (53.7)
Field of Study					
Health	154 (45.8)	69 (46.6)	33 (22.4)	63 (40.1)	73 (47.4)
Humanities	20 (5.9)	11 (57.9)	7 (36.8)	12 (60.0)	13 (65.0)
Business	44 (13.1)	27 (62.8)	10 (23.3)	23 (52.3)	28 (63.6)
Science	37 (11.0)	11 (30.6)	9 (25.7)	12 (32.4)	13 (35.1)
Social Science	46 (13.7)	21 (48.8)	12 (29.3)	20 (43.5)	26 (56.5)
Education	14 (4.2)	2 (16.7)	0 (0)	2 (14.3)	4 (28.6)
Engineering	21 (6.2)	11 (55.0)	5 (26.3)	9 (42.9)	11 (52.4)

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<sup>1</sup> ENDS use was assessed with the introductory language: “The following questions ask about your use of and attitudes about electronic nicotine delivery systems (ENDS), which are also sometimes known as vapes, vape pens, e-hookah, mods, Juul, e-cigarettes and other names. Please answer with respect to any of these types of devices.” Ever ENDS was assessed with the question “Have you ever used an electronic nicotine delivery system?” and past 30 day ENDS was assessed with the question “Have you used an electronic nicotine delivery system in the past 30 days?”

<sup>2</sup> Vaping behavior was assessed with the question “Select all the substances you have used with any electronic vapor product in the past 30 days.” Any participant who selected at least one substance was categorized as having vaped in the past 30 days.

<sup>3</sup> Past 30 day Vaping or ENDS use combines the ENDS and vaping variables and describes any participants who reported ENDS use in the past 30 days and/or reported vaping a particular substance in the past 30 days.



Table 2: Reason for using ENDS by substance reported vaped in past 30 days

Reason for using ENDS	Total N (%)	Nicotine	Flavor	Cannabis
		N (%)	N (%)	N (%)
To quit using cigarettes	3 (4.2)	3 (3.8)	3 (5.4)	2 (2)
Healthier option to enjoy nicotine	16 (22.5)	16 (20.5)	12 (21.4)	11 (10.8)
Less smelly option to enjoy nicotine	9 (12.7)	9 (11.5)	7 (12.5)	8 (7.8)
For social reasons	46 (64.8)	40 (51.3)	23 (41.1)	30 (29.4)
To enjoy the flavoring	23 (32.4)	22 (28.2)	16 (28.6)	15 (14.7)
For the high	29 (40.8)	29 (37.2)	14 (25.0)	19 (18.6)
Other reason	10 (14.1)	8 (10.3)	8 (14.3)	5 (4.9)

Table 3: Attitudes towards ENDS and prevalence ratio comparing those who used ENDS or vaped in past 30 days to those with no past 30 day use

Question	Total N (%)	Past 30 day Vaping or ENDS use N (%)	Prevalence Ratio (95% CI)
Do you believe ENDS are more or less harmful than regular cigarettes?			
More harmful	46 (16.9)	17 (12.8)	0.86 (0.43, 1.71)
About the same	133 (48.9)	54 (40.6)	-
Less harmful	93 (34.2)	62 (46.6)	2.92 (1.68, 5.01)*
Do you think ENDS should be regulated like other tobacco products?			
Yes	220 (87.0)	97 (79.5)	-
No	33 (13.0)	25 (20.5)	3.96 (1.71, 9.12)*
Do you think that using ENDS can be harmful for your health?			
Yes, very harmful	172 (60.6)	68 (49.6)	-
Yes, a little bit harmful	105 (37.0)	66 (48.2)	2.58 (1.57, 4.27)*
No, not particularly harmful	7 (2.5)	3 (2.2)	1.15 (0.25, 5.29)
Do you think it is safe to use ENDS during pregnancy?			
Yes, regular use if safe	1 (0.3)	1 (0.8)	-
Yes, occasional use is safe	7 (2.5)	3 (2.3)	0.86 (0.19, 4.03)
No	277 (97.2)	127 (96.9)	-

\* p value < 0.05.

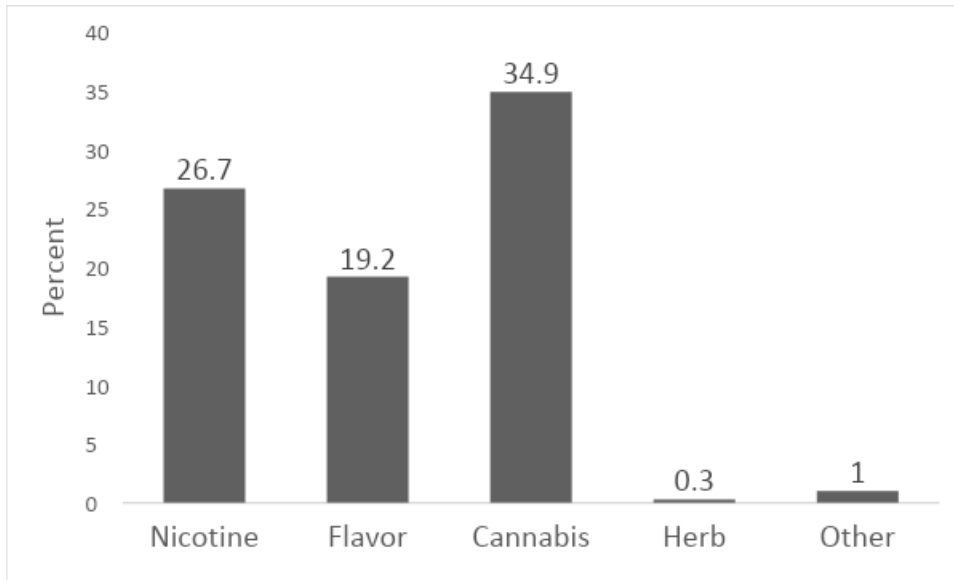


Figure 1: Proportion of participants who reported each substance in the past 30 days

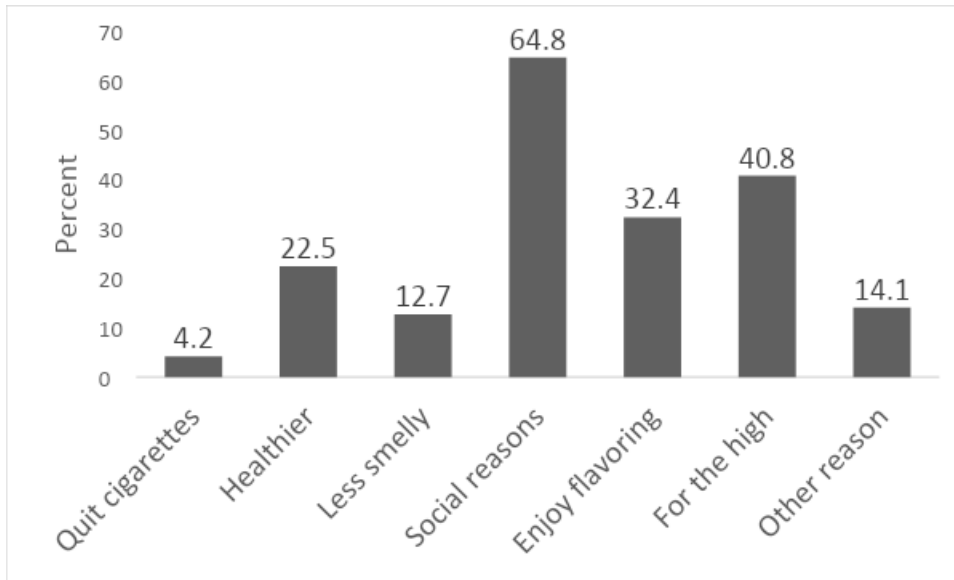


Figure 2: Reasons for initiating ENDS use

## **Figure Captions**

Figure 1: Proportion of participants who reported each substance in the past 30 days

Figure 2: Reasons for initiating ENDS use