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Leah Latimer

leah.latimer@trincoll.edu

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**E-Cigarette Expectancies, Consequences, And Preferred Quit Strategies:
Implications for Interventions with College Students**

Leah Latimer

Professor Laura Holt

PSYC 499: Senior Thesis

Trinity College

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Abstract

Use of Electronic Nicotine Delivery Systems (ENDS), otherwise known as e-cigarettes, is a relatively new and increasingly prevalent behavior among young adults. The purpose of this study was to provide a comprehensive picture of young adult ENDS users by documenting ENDS prevalence, outcome expectancies, negative consequences, dependence, and readiness to quit, with the ultimate goal of informing cessation interventions. A total of 1606 students on six college campuses in the U.S. participated in an online survey that was administered between Fall 2021-Spring 2022. Nearly half (47%) reported using ENDS devices at some point in their lifetime; within that group, 51% reported using ENDS in the past 30 days. As hypothesized, positive outcome expectancies were higher for ENDS users and negative outcome expectancies were higher for non-users. Also as hypothesized, users with a quit attempt reported more positive outcome expectancies and greater e-cigarette dependence compared to users without a quit attempt. Further, frequency of ENDS use was associated with more tobacco and nicotine consequences. Finally, users reporting a prior quit attempt perceived replacing vaping with another activity as the most effective cessation strategy, and the majority have used the strategy of quitting cold turkey. Surprisingly, there was less experience with, and enthusiasm for apps and text-based interventions. These findings will be helpful in shaping successful ENDS cessation development.

**E-Cigarette Expectancies, Consequences, And Preferred Quit Strategies:
Implications for Interventions with College Students**

The use of electronic nicotine delivery systems (ENDS), also referred to as e-cigarettes or electronic cigarettes, has increased significantly among young adults in the United States. Less than a decade ago, only 5% of college students reported ever using e-cigarettes (Sutfin et al., 2013). Recent prevalence estimates indicate a dramatic increase in e-cigarette popularity: 40% of college students used ENDS in their lifetime, and 12% reported being a regular ENDS user (Lanza & Teeter, 2018).

Dual use is relatively uncommon in young adults: only 3% of undergraduates endorsed regular ENDS and combustible cigarette use (Lanza & Teeter, 2018). This is notable because in the beginning, e-cigarettes were seen as a potential aid for cigarette cessation. Early studies noted e-cigarettes, with or without nicotine, were modestly effective at helping smokers to quit, with success rates similar to nicotine patches (Bullen et al., 2013). However, vaping to replace cigarettes was the least popular reason for vaping among adolescents: only 7% of a nationally representative sample of U.S. 12th graders reported this motivation for ENDS use (Evans-Polce et al., 2018, p. 459). In fact, ENDS use is associated with increased risk of combustible initiation in college students (Loukas et al., 2022). It is of concern that e-cigarettes have the potential to become “bridge products” for use of other tobacco products with the attractive appeal of e-cigarettes, making it a starter product for young people (Cobb & Abrams, 2011, p. 195). Indeed, e-cigarettes are achieving the complete opposite as originally hoped: introducing a new, young population to nicotine.

E-cigarettes are harmful beyond creating and fueling addiction. There is increasing evidence that the use of e-cigarettes harms all organ systems in the body (Seiler-Ramadas et al.,

2021). The director of the of CDC's National Center for Chronic Disease Prevention and Health Promotion Karen Hacker noted "... even during the COVID-19 pandemic, e-cigarette use among youth remains a serious public health concern" (Commissioner, 2021, in "Other Key Findings" section). Further, "the indoor secondhand particulate matter exposure levels from e-cigarettes for nonsmokers can be high as in an environment where combustible cigarettes are smoked" (Binns et al., 2018, p. 317). This exposure may have significant toxicological impact for children in households with e-cigarette smokers, but long-term studies are not yet available. Despite numerous negative health effects, youth and young adults ENDS users report perceived social acceptability surrounding ENDS use and a lack of trusted information about health effects (Sanchez et al., 2021). Indeed, non-users and users' attitudes towards ENDS are mixed: 47% of college students did not think ENDS products were healthier than cigarettes, 29% were not sure, and 24% thought ENDS were healthier (Lanza & Teeter, 2018).

In terms of quitting, the 18-24 age group has the lowest odds of quitting use of tobacco/nicotine products in comparison to other age groups (Vu et al., 2019). However, 54% of young adult users report general intentions to quit (Cuccia et al., 2021). This discrepancy most likely reflects an absence of trusted resources to promote and sustain e-cigarette cessation among young people. Recently, research has focused on creating successful cessation programs for e-cigarettes. It is important to understand the difference in expectations between users and non-users, and users seriously interested in quitting, specifically the characteristics that differentiate these groups. Accordingly, the major aims of the current study were to investigate relations among e-cigarette use, expectancies, and readiness to quit in the young adult population.

Background

Electronic Nicotine Delivery Systems (ENDS)

Initial models of ENDS closely resembled tobacco cigarettes and were often termed “cig-a-likes” (Trtchounian & Talbot, 2011). Over time, the design of e-cigarettes has evolved to meet consumers' expectations and demands. Today, there are numerous brands of ENDS devices which all vary in shape, size, and color. Fourth generation e-cigarettes, which include nicotine-salt containing e-cigarettes (such as JUUL products) and disposable e-cigarettes, have become popular for numerous reasons. These devices have a compact design, wide selection of flavors, and user-friendly functions (Omaiye et al., 2019). Even more appealing, the fourth-generation devices use nicotine in a protonated form which reduces throat irritation (Omaiye et al., 2019). Data from 2022 shows that among youth that currently used e-cigarettes, 85% used flavored e-cigarettes and the most commonly used e-cigarette device type was a disposable (Cooper, 2022). There is wide variety in the popularity of brands among users, with more than a fifth of youth e-cigarette users reporting their usual brand was a brand other than the thirteen listed in the survey (Cooper, 2022). Unfortunately, these varied, quickly shifting preferences in the user population can make recent research quickly seem obsolete.

Marketing and Sales of ENDS Products

During September 2014–May 2020, e-cigarette sales increased by 122% (Ali, 2020). Moreover, e-cigarettes with higher nicotine concentrations comprised an extensive and increasing portion of U.S. e-cigarette sales. During 2013-2018, the average nicotine concentration in e-cigarettes sold increased including all flavor categories, and for rechargeable ENDS products (Romberg et al., 2019). Sales of higher nicotine concentration e-cigarettes (> 4% mg/mL) increased from 12% to 75% during 2013-2018, and zero-nicotine products accounted for less than 1% of dollar market share across all years analyzed (Romberg et al., 2019).

Katz et al. (2019) conducted focus groups with undergraduate students about e-cigarettes. Six images of e-cigarette packages were displayed one at a time. Participants immediately commented about the flavors, describing them as “appealing”, “cute”, “playful”, and intriguing” (Katz et al., 2019, p. 84). They reported being distracted by the flavor and that their attention was captured by the visual of the strawberry and fun font right below it. There was consensus that the flavors made the product appealing and that the products were targeting adolescents and young adults, with some students commenting that the packaging looked like it could be for chewing gum. There is a warning that the e-cigarette product contains nicotine, an addictive chemical, but participants seemed to wonder why nicotine was a concern. Some compared the addiction of nicotine to caffeine and sugar addiction. Packages also mentioned unknown long-term health effects, which seemed to concern participants. However, participants thought the modified risk statement, specifically that the product presents a lower risk of tobacco-related disease than traditional cigarettes, undermined the warning labels and ultimately was ambiguous and contradictory. Participants noted how some users could use the modified risk statement as a way to justify e-cigarettes as a non-risky product (Katz et al., 2019).

Recently, some states in the U.S. have imposed restrictions on flavored e-cigarette sales. Ali et al. (2022) analyzed the impact of statewide restrictions by comparing sales data from four states (Massachusetts, Rhode Island, New York, and Washington) with flavor restrictions (before and after implementation) with 35 states without these restrictions, while controlling for emergent events (such as the COVID-19 pandemic). It was found that statewide restrictions on the sale of flavored e-cigarettes were associated with a reduction in the total e-cigarette sales. However, reductions were found only for *non-tobacco* flavored e-cigarette sales in all the experimental states except for Massachusetts, where *all sales* of flavored e-cigarettes decreased.

Further, there was an *increase in sales of tobacco flavored e-cigarettes* in all 4 states, but the increase was of lower magnitude than the reduction in sales of non-tobacco flavored e-cigarettes, which resulted in an *overall decrease* in sales. These results indicate state policy limiting flavored e-cigarettes may not be enough to disincentivize use for most users. However, this type of action is a step in the right direction since there was a reduction in total sales. Further, limiting the access of non-tobacco flavored e-cigarettes may encourage users to switch to tobacco flavored e-cigarettes, as reflected in the increase in sales of all four states with restrictions.

Prevalence Estimates of ENDS Amongst College Students

College students are vulnerable to risky behavior due to experiencing major life transitions (Lanza & Teeter, 2018). Indeed, ENDS use among this population has increased rapidly, as evidenced by recent increases in prevalence estimates. Data collected in 2009 showed that 5% of college students reported ever use of ENDS, with 1.5% reporting past month use, and 72% of students reporting ever use of combustible tobacco. Recent data demonstrated a dramatic increase of ENDS use, with 55% of a large sample of undergraduate college students reporting lifetime use of ENDS products, and nearly 27% reporting past 30-day ENDS use (Holt et al., 2022). Likewise, other recent research has found similar prevalence estimates, with first year college students in 2018 reporting 37% of ever use of e-cigarettes, and about 27% reporting past 30-day use (Roberts et al., 2022). Also, students reporting ever use of combustible cigarettes decreased to 38% (Holt et al., 2022). These statistics reflect a rise in the use of e-cigarettes with a decrease in the popularity of combustible cigarettes in this age group.

Not all students are equally likely to initiate and regularly use ENDS. Holt et al. (2022) reported significant socio-demographic factors associated with likelihood of ENDS use in the college population. Male participants, white participants, and students attending

Northeastern/Mid-Atlantic U.S. institutions were more likely to endorse recent (past 30-day) ENDS use (Holt et al., 2022). Also, those involved in Greek life, those with a history of lifetime or recent tobacco use, and lifetime history of cannabis vaping were more likely to endorse recent ENDS use (Holt et al., 2022). In a smaller sample with college students from the southeastern U.S., identifying as male was also found to a strong predictor of ENDS use, but greater weekday alcohol use, high levels of combustible cigarette smoking, taking prescribed stimulant medication, and low levels of forgiveness to others also predicted being an ENDS user (Hittner et al., 2020). Marijuana use was found to be a moderately important predictor (Hittner et al., 2020). When examining Juul, a brand name for a particular type of e-cigarette, Roberts et al. (2022) found college students who identify as White and with a higher socioeconomic status (SES) are more likely to use Juul. Surprisingly, gender was not associated with Juul use (Roberts et al., 2022). Altogether, factors associated with use of e-cigarettes are mixed and the specific device used may have contributed to these varying factors.

ENDS Use and Health Effects

ENDS use has been found to affect all organs in the body, not just the respiratory system (Seiler-Ramadas et al., 2021). Virgili et al. (2022) and Seiler-Ramadas et al. (2021) provided a review of the literature on health effects of e-cigarettes and similarly categorized them.

Pulmonary System. A range of stress and inflammatory reactions are experienced from e-cigarette exposure, including in the mouth, the nasal passage, the trachea, the bronchial system, and the lungs (Seiler-Ramadas et al., 2021). Propylene glycol is the main component of e-cigarette liquid which has “incited airway irritation, airway obstruction, and an increased severity of dyspnea among individuals who did not previously have the condition” (Seiler-Ramadas et al., 2021, p. 1023). “According to various studies involving high school students, vapers have a

twofold higher risk of chronic cough, phlegm, or dyspnea, together with a greater incidence of asthma” (Virgili et al., 2022, p. 3). These results indicate that many young adults may be dealing with issues because of vaping, and not realizing it.

Also, chronic obstructive pulmonary disease has been caused by ENDS use with effects similar to those with combustible cigarettes (Seiler-Ramadas et al., 2021). Most cases have recovered with medical treatment and vaping cessation, but lung injury linked to vaping may not always be reversible. For example, a “study reported a case series of eight patients who sustained vaping associated acute lung injury”, and one died even after corticosteroid therapy (Seiler-Ramadas et al., 2021, p. 1023).

Oral and Gastrointestinal System. Studies suggest that ENDS aerosols can harm oral health by inducing gingival inflammation. (Seiler-Ramadas et al., 2021). Trace metals copper and chromium have been found to contribute to most common gastrointestinal systems associated with vaping: epigastric pain, nausea and vomiting, diarrhea and hemorrhage (Seiler-Ramadas et al., 2021). Indeed, a young vaper in the emergency department with a fever, abdominal pain, vomiting, and diarrhea had an increase in liver enzymes (Virgili et al., 2022). These have implications for everyday life where seemingly unrelated health problems may stem from vaping within the young adult population.

In two unrelated cases of heavy cigarette smokers switching to ENDS use, relapsed ulcerative colitis was documented (Seiler-Ramadas et al., 2021). These cases are alarming for those who are using ENDS to quit combustible use. Pregnancy health effects are linked to e-cigarette use; “a 1-day-old infant suffered gastrointestinal bleeding with abdominal distension and respiratory distress” (Seiler-Ramadas et al., 2021, p. 1023).

Cardiovascular System. E-cigarette use has been reported to increase heart rate and blood pressure (Seiler-Ramadas et al., 2021; Virgili et al., 2022). There is insufficient evidence associating e-cigarettes with long term changes in heart rate, blood pressure, cardiac geometry, and function (Seiler-Ramadas et al., 2021). But, “arboynls and acrolein found in appreciable levels in e-cigarettes have been found to exert significant cardiovascular toxicity, while nicotine increased the risk of cardiac arrhythmia” (Seiler-Ramadas et al., 2021, p. 1023).

Cognitive and Neurological Functions. E-cigarette use has been found to create headaches, jitteriness, anxiety and irritability (Seiler-Ramadas et al., 2021). Negative long-term impacts on memory and attention have been found with chronic exposure to nicotine, especially in adolescents (Seiler-Ramadas et al., 2021). In one case, a previously healthy 39-year-old male reported a 7-day history of headaches and 2 seizures which was resolved from taking prescribed medication and abstaining from e-cigarette use. Nicotine can also affect the regular course of development of the central nervous system among adolescents, “contributing to attention and cognitive deficits and exacerbating mood disorders” (Virgili et al., 2022, p. 3).

Carcinogenicity/Toxicity. Chemicals present in some ENDS products have extremely harmful consequences. Each ENDS product is unique which makes it difficult to research. “Some chemicals present in e-cigarette aerosols ... are capable of causing DNA damage and mutagenesis, with potential carcinogenic effects” (Seiler-Ramadas et al., 2021, p. 1024). Also, pulegone, a potential human carcinogen that was banned by the U.S. Food and Drugs Administration (FDA) as a food additive, has been reported to be found in many mint-flavored and menthol-flavored e-cigarettes and smokeless tobacco products (Seiler-Ramadas et al., 2021).

Outcome Expectancies

Outcome expectancies are beliefs for both users and non-users that certain outcomes (negative or positive) can be experienced by engaging in a behavior. In the context of e-cigarette use, outcome expectancies examine the beliefs of expected positive and negative effects of drug use. It is clear that ENDS are perceived to have distinctive features, which likely contributes to the product's popularity. Doran and Brikmanis (2016) found "... ANTP (alternative nicotine and tobacco product) expectancies' impact on ANTP use was independent of cigarette expectancies" within a sample of young adult non-daily cigarette smokers (p. 157). This is notable because this suggests alternative nicotine and tobacco products, such as e-cigarettes, are perceived differently than cigarettes, even though these products are delivering the same drug. In a similar vein, Pokhrel et al. (2018) found when comparing ENDS and combustible cigarettes, adults perceived that e-cigarettes are not bad smelling, are considered less harmful, and may be used indoors discreetly. This shows that perceived appearance, as well as a perceived positive "smoking" experience is associated with ENDS use.

Ongoing research is examining specific beliefs underlying ENDS use among adolescents and young adults. Users of e-cigarettes more commonly report perceived positive outcomes in comparison to non-users (Pokhrel et al., 2018). Indeed, expected enjoyment of ENDS has been found to be a crucial part to ENDS use. Barker et al. (2019) found that among adolescents and young adults, expected enjoyment of ENDS was positively associated with use, suggesting that factors such as taste, stress relief, and vape tricks are crucial to the appeal of the product.

There have been commonalities in the research relating to expected positive enjoyment of ENDS. First positive reinforcement was a recurring theme found within focus groups of adult non-users, exclusive ENDS users, and dual users, specifically relating to vape tricks, "sensorimotor experience" (hand movements and inhalation), unique flavors, and stimulation

effects with the ability to vary levels of nicotine (Harrell et al., 2019). Second, multifaceted social benefits were uncovered within focus groups of adult non-users, exclusive users of ENDS, and dual users (Harrell et al., 2019). These benefits include social facilitation, influence on others (use being considered cool and trendy) and convenience (accessibility) (Harrell et al., 2019). Similarly, Doran and Brikmanis (2016) found the likelihood of e-cigarette use was predicted by social facilitation expectancies within a sample of young adult non-daily cigarette smokers. Third, positive internal expectancies, which refers to enjoyment, relaxation, etc. is another factor that has been found to be significant within the young adult user population (Correa et al., 2019). In fact, both "... positive social expectancies and positive internal expectancies were positively associated with quantity and frequency of e-cigarette use" (Correa et al., 2019, p. 735).

Negative affect reduction expectancies, or beliefs about the use of ENDS to reduce unpleasant emotional states, also has been shown to predict ENDS use (Brockenberry et al., 2022; Harrell et al., 2019; Pokhrel et al., 2021). Brockenberry et al. (2022) found within college students that all four types of emotion dysregulation (positive and negative urgency, lack of planning, and lack of perseverance) related to ENDS expectancies. Only negative urgency, the tendency to act impulsively in response to negative emotions, positively predicted negative affect reduction outcome expectancies (Brockenberry et al., 2022). Those with positive urgency, the tendency to act impulsively in response to positive emotions, were more likely to use e-cigarettes (Brockenberry et al., 2022). These findings suggest that e-cigarettes may be viewed as a way to alleviate negative emotions for certain users. Harrell et al. (2019) employed a broader definition of negative affect reduction expectancies with expected *stress reduction* expected by adult non-users, exclusive ENDS users, and dual users (alternative to smoking); expected *boredom reduction* by adult non-users, exclusive ENDS users, cigarette smokers (for about 5-10 minutes),

and dual users (some view vaping more effective than smoking); expected *appetite reduction* by adult non-users, exclusive ENDS users, and dual users (disagreement on the effectiveness). Strikingly, these findings indicate there are patterns of specific negative affect reduction expectations based on user group. Out of all the groups, exclusive vapers seemed to most strongly expect general negative affect reduction. Nonusers are concerned about ENDS use as a form of general coping. Cigarette smokers were skeptical of e-cigarettes being effective for negative affect reduction, for example saying perhaps ENDS use reduces boredom for five to ten minutes. Dual users seemed to notice that e-cigarettes were a decent replacement to cigarettes, but noted ENDS were better at reducing boredom than cigarettes. Further research on weight-control expectancies has found young adult women with lower body esteem have a higher likelihood of ENDS use one year later with weight-outcome expectancies as a mediator (Pokhrel et al., 2021). Meaning, women who have lower body esteem have a higher likelihood of using e-cigarettes, which can partially be explained by weight-control expectancies. Some women expect ENDS to help control their weight likely driving those with lower body esteem to use.

In terms of negative expectancies, Barker et al. (2019) found in adolescents and young adults that negative health concern expectancies were associated with a lower likelihood of use, and among young adults, negative health concerns were associated with a lower likelihood of *ever use*. Similarly, Harrell et al. (2019) found expected negative consequences as a concern among adults including general uncertain health risks, addiction, and uncertain second-hand effects. Adult non-users and cigarette smokers seemed more sure about the potential for health risks, while exclusive e-cigarette users and dual users believed health risks to be minimal in comparison to smoking (Harrell et al., 2019). These findings suggest adults are aware that e-cigarettes pose health risks but are not exactly sure what they are. Lastly, it turns out that ENDS

use is not expected to be entirely socially beneficial, and some report expected negative social consequences. Among young adults, expectancies about negative social influences predicted a lower likelihood of e-cigarette use (Barker et al., 2019). Similarly, Pokhrel et al. (2018) identified the index of negative social consequences as important outcomes of e-cigarette use, with negative social consequences being strongly associated with lower e-cigarette use susceptibility and lower likelihood of e-cigarette use. Perhaps if ENDS are perceived as less socially acceptable, such as cigarettes, then this would be an effective deterrent in discouraging non-users experimentation and motivating users to reduce use or eventually quit.

Users' expectancies have been shown to change. First, over a twelve-month period, young adult e-cigarette users endorsed more negative expectancies and fewer affect related expectancies (Correa et al., 2019). Second, in comparison to those without a reported previous quit attempt, adult ENDS users who had attempted to quit evidenced stronger associations between positive outcome use expectancies and perceived risks, benefits, and barriers to quitting (Peraza et al., 2020). Meaning, users who have not previously quit may be driven to quit over time after gaining negative expectations for ENDS products and noticing they are not as effective for dealing with unpleasant emotional states as previously thought. However, this research suggests after a failed quit attempt, users revert back to their positive expectations, and these expectations may reinforce further ENDS use and make quitting difficult. These findings have implications for e-cigarette cessation treatment. Specifically, interventions may be tailored to an individual's expectations and take into account whether they have attempted to quit previously.

Motivations

There are different factors that motivate individuals to engage in ENDS use and these motivations have been found to differ by age group. Evans-Polce et al. (2018) examined

motivations of 12th grade student ENDS users who completed the 2015 and 2016 surveys of the Monitoring the Future (MTF) study. Three distinct classes of vapers were found: adolescents who were *vaping to experiment* (29.4%), *vaping to replace cigarettes* (7.3%), and *vaping for taste and entertainment* (63.4%). Similar to the research on expectancies, these findings suggest that different intervention strategies may be needed for different subgroups of vapers. Reasons for experimentation with vaping also vary. When analyzing youth focus groups, experimentation themes identified were curiosity, flavors, family/peer influence, easy access, and perceptions of e-cigarettes as “cool” and as a healthier/better alternative to cigarettes (Kong et al., 2015). Other literature highlights how social motivations may be particularly important in understanding ENDS use among college students. One study showed that friends were the primary source of obtaining ENDS and 82.5% usually used ENDS with friends (Lanza & Teeter, 2018).

Vu et al. (2019) examined age differences in e-cigarette usage motivations and behaviors, perceived health benefits, and quit intentions. A sample with ages varying from 18-64 was drawn from a national online survey conducted in 2016. The 18-24 age group was more likely to initiate for reasons surrounding *flavor appeal* and *friend use* and was more likely to try multiple flavors and ENDS products with varying nicotine content. Compared to older age groups, those in the 18-24 age category were less likely to use ENDS as an alternative to cigarettes or as quitting device and perceived fewer health benefits of ENDS use. The association of age differences and perceived health benefits of ENDS use was weakened by combustible cigarette smoking status and other tobacco product use. Those 18-24, especially those who had never smoked cigarettes, had the lowest intention of quitting products containing tobacco/nicotine compared to the other age groups, lower by 44-73% (Vu et al., 2019), suggesting these users are addicted by acknowledging that e-cigarettes are not beneficial for health yet not intending to quit. Perhaps

these types of users who exclusively vape, refrain from smoking cigarettes to deny nicotine addiction. Also, since those in the 18-24 age group initiate e-cigarettes due to friend use then perhaps users do not intend to quit because it is a social behavior. The reasoning might be: if all my friends are using e-cigarettes how bad can it be for my health and what will my friends think if I try to quit?

Initiation and Changes in ENDS Use During the COVID-19 Pandemic. A small percentage (6%) of U.S. young adults reported ENDS initiation during the COVID-19 pandemic (Bennett et al., 2022). Bennett et al. (2022) examined COVID-19 factors and prior substance use as predictors of cigarette and e-cigarette cessation and initiation among U.S. young adults. Those who did not report current ENDS use before the pandemic (September – December 2019) and initiated e-cigarette use at during the pandemic (September – December 2020) were younger, less likely to have a bachelor's degree or higher, more likely to live with children, more likely to be lifetime cigarette and e-cigarette users, reported lower perceived smoking risk, lower perceived e-cigarette use risk, and lower COVID-19 news exposure (Bennett et al., 2022). Predictors of initiation were younger age, less news exposure, lifetime cigarette and e-cigarette use, and cigarette use before the pandemic (September – December 2019) (Bennett et al., 2022). Therefore, the pandemic could have been a stressor which caused former users to re-initiate use, or prompt those with low risk perceptions to use. Similarly, among United States high schoolers, the prevalence of current use increased, and users became more dependent with an increasing proportion of students reporting frequent use (Mirbolouk et al., 2022). Overall, these findings indicate that the pandemic has had an effect on e-cigarette use, which might account for changing trends. The current study examines collected data after COVID-19 was declared a pandemic. Thus, it is important to expand the existing literature documenting ENDS use

behaviors after COVID-19 was declared a pandemic, which will aid scholars in defining the impact of this major historical event.

ENDS Use as an Aid for Combustible Cigarette Cessation?

Early research saw ENDS as a potential aid for combustible cigarette cessation. Research is still in the process of determining the health effects of ENDS use, but it is clear e-cigarette use is not consequence free. But, switching from combustible cigarettes to ENDS can be beneficial. Studies investigating the cessation of conventional cigarette smoking with the aid of ENDS use found improvements in time-based memory and nicotine withdrawal (Seiler-Ramadas et al., 2021). Also, “toxic and carcinogenic metabolites were reportedly lower in e-cigarette smokers than in conventional cigarette smokers” (Seiler-Ramadas et al., 2021, p. 1020).

Unfortunately, studies are finding that ENDS use can increase the likelihood of combustible cigarette initiation for non-smokers. When examining a population of U.S. middle and high school students, e-cigarette use was associated with combustible cigarette use across all ages but the strength of this association was strongest in early adolescence (Lanza et al., 2017). Another longitudinal study with Swiss men found that, compared to non ENDS users, ENDS users at baseline were more likely to initiate combustible smoking fifteen months later (Gmel et al., 2016). Further, ENDS users in this study showed higher nicotine dependence scores, smoked more combustible cigarettes, and were less likely to quit combustible cigarettes (Gmel et al., 2016).

Conversely, research has found that ENDS use can aid with combustible cigarette cessation. Among adults aged 25-44, “combustible cigarette smokers who reported current use of e-cigarettes at the time of survey also reported significantly more past 12 month attempts to quit smoking and had higher rates of successful (combustible) cessation in the past 12 months than

did those who did not currently use e-cigarettes” (Johnson et al., 2019, p. 1336). Another study showed similar results among young adult combustible smokers, where e-cigarette use for combustible smoking cessation was associated with increased odds of combustible smoking cessation six and twelve months later (Mantey et al., 2017). However, young adult combustible smokers who used ENDS for other reasons did not have increased odds of combustible smoking cessation six or twelve months later (Mantey et al., 2017). These data suggest ENDS intentions may be crucial in determining the risk of migration from ENDS use to combustible use.

Theoretical Models Explaining ENDS Use

Social Learning Theory. Social learning theory “argues that deviant peer associations can affect one’s definitions and imitations of deviant behavior, which, in turn, can affect the anticipation of rewards and punishments and eventually one’s own involvement in crime or deviance” (Rocheleau et al., 2020, p. 473). To simplify, the perceptions of your peers and their substance use may influence your own. Akers (1977) identified four principles of social learning theory: “differential association, emphasizing the importance of the behaviors and attitudes of individuals we associate with to the learning process; definitions, highlighting the significance of the meanings we attach to behavior to the learning process; imitation, emphasizing the importance of modeling the behaviors of those around us to the learning process; and differential reinforcement, adding the importance of actual or anticipated rewards and punishments to the learning process” (Rocheleau et al., 2020, p. 475). These mechanisms may not always exactly explain e-cigarette use among everyone, but may be a main factor by making e-cigarettes seem more desirable. Rocheleau et al. (2020) found peer e-cigarette use is associated with current e-cigarette use among high school senior ENDS users, but surprisingly e-cigarette use risk

perceptions were a small mediator of the relationship (about 10%). Perhaps this small mediation might be due to lack of reliable information about ENDS or packaging/marketing of ENDS.

Acquired Preparedness Model (APM). The acquired preparedness model (APM) combines personality and psychosocial learning to explain the etiology and maintenance of maladaptive substance use (Hayaki et al., 2011). “According to the APM, individuals who are high on a risky personality trait are predisposed (prepared) to learn (acquire) certain beliefs and expectations regarding substance use, which in turn influence their behavior” (Hayaki et al., 2011, p. 3). Disinhibition, the tendency to focus on rewards, is a significant vulnerability whereas individuals learn about substance use with an emphasis on the desirable effects (Hayaki et al., 2011). Indeed, within studies of substance abuse, it has been found that positive expectancies are associated with higher levels of drug use (Brandon & Baker, 1991). It has been found among e-cigarette users that positive outcome expectancies are associated with higher use and dependence among current users, and increased use susceptibility among never users (Pokhrel et al., 2014; 2018).

Brockenberry et al. (2022) found a relationship between emotional transdiagnostic vulnerabilities (ETV), negative affect reduction outcome expectancies, and e-cigarette use. Negative urgency positively predicted negative affect reduction outcome expectancies, and positive urgency positively predicted use (Brockenberry et al., 2022). This finding may indicate how e-cigarette use can be reinforced through reduction of negative feelings and increase of positive feelings.

Adolescents who use ENDS are more likely to be evidence behavior problems and a willingness to engage in other risky behaviors. ENDS users at age fourteen had a higher risk of adolescent adjustment problems (school engagement, wellbeing, self-esteem), delinquent

behavior (theft, vandalism, disorderly conduct, graffitiing), and other substance use in comparison to non-users (Staff et al., 2020). Thus, these characteristics of adolescent ENDS users align with the APM's theory of a risky personality trait. Expectancies coupled with a lack of behavioral restraint could make ENDS use very appealing to an unknowing, troubled, impulsive adolescent.

Graduate and undergraduate students who report ENDS use were significantly more likely to have histories of ADHD, PTSD, gambling disorder, and anxiety as well as score significantly greater on impulsivity and reported significantly higher rates of several types of substance use (Grant et al., 2019). Perhaps negative affect reduction is key to understanding these findings, such that ENDS use may be a way to cope with mental health problems, and users are more likely to act on their impulses to feel better. Holt et al. (2022) also examined impulsivity as a predictor of ENDS in undergraduate students and found that "higher in impulsivity perceived more benefits of ENDS use, and in turn, reported more frequent use of ENDS and greater ENDS dependence" (Holt et al., 2022, p. 8). Indeed, it seems that expectations and personality are key components to ENDS use and these studies provide support for the APM.

Readiness to Quit ENDS and ENDS Cessation

A majority (74%) of adolescent and young adult ENDS users indicated they were interested in quitting e-cigarettes, with health risks being the primary reason for wanting to quit (Garey et al., 2021). In another study with a sample of young adults, readiness to quit e-cigarettes in the next 6 months was reported by 20% (range from 18% among e-cigarette/other tobacco/marijuana users to 28% among e-cigarette/other tobacco users), and only 8% reported being ready to quit in the next 30 days (Berg et al., 2021). It has been found with combustible cigarettes that nondaily young adult smokers are less likely to identify as smokers, which

predicts lower readiness to quit smoking (Berg et al., 2009). Perhaps that denial is part of the discrepancy between samples.

Some users are trying to quit vaping; however, little is known about how users fare when they make a quit attempt. In a survey of adolescents and young adults who report regular use of ENDS products, 52% report at least one past serious e-cigarette quit attempt, with an average number of 2.9 of past quit attempts (Garey et al., 2021). Users seem to desire resources, with over 25,000 young people signing up for a text message cessation program within the first five weeks of its launch (Amato et al., 2021).

Vaping vs. Smoking Cessation. Some scholars have assumed that vaping and smoking are fairly similar and have drawn upon smoking cessation models to address the need for ENDS interventions until fairly recently. In the past, similarity assumptions manifested through an absence of messaging about e-cigarettes. Researchers working on creating successful vaping cessation programs admit to a lack of resources specific to ENDS previously: "... when we began this work in 2015, e-cigarette prevention materials in teen-friendly terms and counter-advertising campaigns were extremely limited." (England et al., 2021, p. 2). More recently, work has focused on differences between combustible cigarettes and e-cigarettes. Sanchez et al. (2021) found that vaping and smoking are similar but also have some crucial differences that affect vaping cessation interventions among youth (ages 16-18) and young adult users (19-29). In terms of *barriers to quitting vaping*, there are similarities to smoking with three themes: social benefits, stress reduction, sensory and behavioral gratification. But there are notable perceived differences with three themes: enjoyment of flavors, convenience and discreetness, and lack of self-awareness of vaping behaviors. Similarities for *reasons for quitting* vaping and smoking include financial loss, industry influence (i.e., Big Tobacco profiting), and dependence. Unique

differences in reasons for quitting are lack of trusted information about e-cigarettes, especially on health effects, and perceived social acceptability of vaping. Particularly among those 16-18 years old, “there was a strong stigma against smoking and an apparent desire to dissociate vaping from smoking” (Sanchez et al., 2021, p. 5). It seems those with a strong stigma against smoking do not feel that same stigma with vaping. This research helps to identify perceived differences for both barriers to quitting and reasons for quitting which helps to inform the creation of successful vaping cessation interventions (Sanchez et al., 2021).

Reasons for ENDS Discontinuation by Former Users. Kong et al. (2015) conducted focus groups with youth, which revealed themes for ENDS discontinuation. Themes included health concerns, loss of interest, high cost, bad taste, and view of e-cigarettes as less satisfying than cigarettes. The top reasons for discontinuation were related to losing interest (24%), perceiving e-cigarettes as “uncool” (16%), and health concerns (12%). Youth cigarette smokers that tried e-cigarettes discontinued because of the bad taste (chemical taste), the high cost, and the perception that ENDS were not as satisfying as cigarettes (Kong et al., 2015). It seems these factors continue to be motivators today. Youth and young adults enrolled in a text message vaping cessation program reported health (around 50%), financial cost (about 22%), freedom from addiction (16%), and social impact (about 10%) as common reasons for quitting (Amato et al., 2021).

ENDS Cessation Preferences and Interventions. Bold et al. (2022) conducted focus groups with youth to understand what youth want in a school-based vaping cessation program. Participants expressed a desire for programming to include education surrounding health effects, others’ relatable personal anecdotes, and rewards for quitting. Potential concerns include confidentiality, youth may not participate due to perceptions of lack of interest/apathy or

embarrassment, and the necessity of methods to verify abstinence to limit inaccurate reporting. Youth would also like to learn skills such as ways to deal with stress, relax, and deal with poor concentration/attention (Bold et al., 2022). Further, digital methods, such as smartphone apps, are the most frequently endorsed intervention method by adolescent and young adult ENDS users to aid in e-cigarette cessation (Garey et al., 2021).

Sahr et al. (2021) piloted three methodologies of ENDS cessation by measuring cessation success rates, motivational techniques that contributed to cessation success, and participants' changes after decreasing vape use. Adults who used ENDS at least four days a week and were motivated to quit within two weeks were placed into one of three arms: (1) NRT + behavioral support (NRT quit plan was determined based on their Fagerstrom Test for Nicotine Dependence score modified for vaping); (2) vape-taper + behavioral support (from a pharmacist and recommended nicotine vape-taper plan based on current e-juice nicotine concentration and vaping habits); or (3) a self-guided quit group. A majority of participants (75%) who received behavioral support and a vape-taper plan from pharmacists were more likely to be successful (i.e., vape-free and nicotine-free at 6 months), in comparison to NRT and behavioral support (43%) and self-guided groups (44%) (Sahr et al., 2021). Barriers to quitting noted by participants were social pressures and not being consciously aware of how frequently one vapes. Greater awareness of vaping behaviors along with exercising self-control and establishing new habits were reported key techniques to overcome vaping (Sahr et al., 2021). Hence, college students may especially have a hard time when attempting to quit due to the high prevalence of ENDS use on college campuses; this data might provide some indication of what methods could be beneficial for those who wish to quit.

Impact of the COVID-19 Pandemic on ENDS Cessation. The COVID-19 pandemic introduced many impactful environmental stimuli, such as social distancing, which could potentially contribute to changes affecting prevalence rates as well as predictors of ENDS initiation, use, and readiness to quit. Bennett et al. (2022) examined COVID-19 factors and prior substance use as predictors of cigarette and e-cigarette cessation and initiation among U.S. young adults (aged 18-34 years old). It was found that 38.7% of e-cigarette users before the pandemic (September – December 2019) then quit e-cigarettes during the pandemic (September – December 2020) (Bennett et al., 2022). Predictors of quitting e-cigarettes during the pandemic were greater COVID-19 news exposure, fewer days of reported past-month e-cigarette use before the pandemic (September – December 2019), and no cigarette use before the pandemic (September – December 2019). Also, 6.3% of non e-cigarette users before the pandemic (September – December 2019) initiated during the pandemic (September – December 2020) (Bennett et al., 2022). Predictors of e-cigarette initiation during the pandemic were younger age, lower perceived smoking risk, lifetime cigarette and e-cigarette use, and current cigarette use. These findings highlight the interconnectivity between e-cigarette and cigarette behaviors in terms of chronic use and development of addiction. For example, those who were more likely to quit e-cigarettes during the pandemic were less likely to report cigarette use and frequent e-cigarette use before the pandemic. Also, individual factors (ENDS and combustible use and their perceived risks) and contextual factors (i.e., specifically COVID-19 news exposure) can predict changes in cigarette and e-cigarette use.

Rationale of the Current Study

Within the college population, e-cigarettes are the nicotine product of choice as demonstrated by rising prevalence rates of ENDS and decreased popularity of combustible

cigarettes (Holt et al., 2022). It is important to continue to examine the prevalence of ENDS use to add to the quickly evolving literature not only on prevalence, but also on preferred devices (Cooper, 2022). When looking at socio-demographic factors associated with likelihood of ENDS use, there are commonalities in the literature such as being male, combustible use, and marijuana use (Hittner et al., 2020; Holt et al., 2022). Socio-demographic factors might change, however, based on the type of device used. For example, males were more likely to report ENDS use (Holt et al., 2022), but gender did not have an effect specifically on Juul use (Hittner et al., 2020; Roberts et al., 2022).

Expectancies have been shown to be a consistent predictor of ENDS use. Positive reinforcement, multifaceted social benefits, positive internal expectancies, and negative affect reduction expectancies help to explain the appeal of ENDS (Brockenberry et al., 2022; Correa et al., 2019; Doran & Brikmanis, 2016; Harrell et al., 2019; Pokhrel et al., 2021). With negative outcome expectancies, health concern expectancies and negative social consequences have been found to be crucial to the likelihood of ENDS use (Barker et al., 2019; Harrell et al., 2019). Although positive expectancies are more likely to be reported by ENDS users compared to non-users (Pokhrel et al., 2018) additional research is needed to determine which types of positive expectancies best differentiate these groups. When looking specifically at users, it has been found there are differing motivations, mainly for reasons surrounding flavor appeal and friend use within the 18-24 age group (Vu et al., 2019). Although this study does not examine user motivations, focusing on user outcome expectancies may provide insight into motivating expectations for users. Further, perhaps there are differences in endorsed expectancies based on frequency of use, with frequent users holding different expectations than occasional users. A focus on user expectations and their relation to nicotine dependence is imperative to examine.

More than half of adolescents and young adults who report regular use of e-cigarette products report one past serious e-cigarette quit attempt, and it has been found that those with a previous quit attempt report more positive outcome use expectancies, perceived risks, benefits, and barriers to quitting (Garey et al., 2021; Peraza et al., 2020). Further, there is research on why users would like to quit, with health and social impact found to be consistent motivators over time (Amato et al., 2021; Kong et al., 2015). Missing from the literature, however, is an understanding of what methods users have employed to quit and which strategies they would find helpful. Digital methods are the most frequently endorsed intervention method to aid e-cigarette cessation by adolescent and young adult users (Garey et al., 2021). However, it is unknown how helpful young adults perceive digital methods to be and whether other methods, such as group support or nicotine replacement, might also be preferred. It is also unknown if quit attempts might be related to negative consequences a young adult user has been experiencing. Perhaps it takes a critical number or type(s) of consequences to motivate a user to quit. The current study explored this possibility by examining a recently developed measure of ENDS-related consequences. Overall, more in-depth data on ENDS prevalence estimates, quit attempts, young adults' preferences for support with cessation, and correlates of cessation attempts are needed to shape successful e-cigarette cessation development, which is very important due to proven adverse effects of ENDS use.

Research Questions and Hypotheses

In the current study, I sought to better understand predictors of ENDS use, as well as predictors of readiness to quit. Specifically, I formulated three hypotheses:

H1: First, I hypothesized that negative outcome expectancies were higher for non-users and positive outcome expectancies were higher for ENDS users. As aforementioned, users more

commonly report perceived positive outcomes in comparison to non-users (Pokhrel et al., 2018). I expected differences between ENDS users and nonusers to be particularly pronounced for negative affect regulation expectancies and perceived social benefits, with these types of expectancies endorsed more frequently among users.

H2: Second, I hypothesized users who reported a past quit attempt would have higher overall positive expectancies, more negative consequences associated with ENDS use scores, and higher ENDS dependence. Research has shown that ENDS users with a prior quit attempt endorsed higher positive outcome use expectancies, perceived risks, benefits, and barriers to quitting (Brandon & Baker, 1991; Peraza et al., 2020).

H3: Third, I hypothesized users who report vaping less often or who report using both combustible tobacco and ENDS will score higher on readiness to quit. Berg et al. (2021) found readiness to quit and quit attempts were associated with fewer days of use and higher nicotine e-liquids, while combustible tobacco use predicted a past year quit attempt. Perhaps users interested in quitting are initially trying to wean themselves off e-cigarettes by using for fewer days but using a higher nicotine content. Dual users (i.e., those who use both combustible tobacco and ENDS) may be more motivated to quit on account of engaging in a less socially acceptable behavior (combustible use).

I also formulated two research questions, which I addressed through exploratory analyses:

RQ1: Which resources do participants believe will be most/least helpful to stop ENDS use? Which resources have already been used by participants?

RQ2: Is age of ENDS initiation associated with making a quit attempt?

Method

Participants

A total of 1606 students participated in an online survey which focused, broadly, on health and substance use behaviors among college students. The College Health and Substances Experiences (CHASE) survey was administered between Fall 2021-Spring 2022. Participants were recruited from 6 different universities across the United States located in the following regions: 10.6% ($n = 165$) Northeast and Mid-Atlantic, 30.1% ($n = 471$) Southeast, 26.2% ($n = 441$) Midwest, and 33.2% ($n = 519$) Southwest. The average age of participants was 19.33 years ($SD = 1.36$), with 24.2% ($n = 378$) identifying as male, 73.4% ($n = 1148$) identifying as female, 0.4% ($n = 6$) identifying as transgender, and 2.0% ($n = 32$) identifying as gender queer. The breakdown by self-reported race was: 70.3% ($n = 1098$) White, 7.5% ($n = 117$) Black or African American, 11.3% ($n = 117$) Asian or Asian American, 5.4% ($n = 84$) Mixed Race, and 3.9% ($n = 61$) Other. In terms of ethnicity, a majority of participants identified as not Hispanic or Latino 83.1% ($n = 1301$), and 16.9% ($n = 264$) identified as Hispanic or Latino. More information on participants' demographics can be found on Table 1.

Measures

History of Combustible Cigarette, E-Cigarette Use, and Quit Attempts

Participants were asked to report (Yes/No) to the question: "In your lifetime, have you smoked a cigarette, cigar, or cigarillo (even just a few puffs)?" If participants responded "Yes", they were prompted with several follow-up questions: "How old were you the first time you used a tobacco product, even one or two puffs?" (under 10, 11, 12, etc.); "In the past 30 days, how often did you use a cigarette, cigar, or cigarillo?" (*every day, some days, not at all*); "In the past 30 days, how much did you smoke?" (*less than half a pack per day, half to a pack per day, etc.*).

Participants were asked to report (Yes/No) to the question: “Have you ever used an Electronic Nicotine Delivery System (ENDS) product, (i.e., e-cigarettes, vape pen, or e-hookah) as intended (i.e., with nicotine cartridges and/or e-liquid/e-juice), even one or two puffs?” If participants responded “Yes”, they were prompted with several follow-up questions, namely: “How old were you the first time you used an ENDS product, (i.e., e-cigarette, vape pen, pod device, or e-hookah), as intended (i.e., with nicotine cartridges and/or e-liquid/e-juice) even one or two puffs?” (under 10, 11, 12, etc.) and “During the past 30 days, have you used any ENDS product (i.e., an e-cigarette, vape pen, pod device, e-hookah), even one or two puffs, as intended (i.e., with nicotine cartridges and/or e-liquid/e-juice)?” Participants who answered “Yes” also indicated how many days within the last 30 they used one or more specific devices including disposable e- cigarettes, vape pens, JUUL/PHIX (i.e., devices that use a pod), and advanced personal vaporizers. Specifically for disposable e-cigarettes, participants were asked: “On those (#) days, how many disposable e-cigarettes or disposable nicotine cartridges did you usually use per day?” (*fewer than 1 per day, 1 per day, more than 1*). Participants were asked to report (Yes/No) on the question: “Have you ever tried to quit or stop using an ENDS product (for example, e-cigarette, vape pen, JUUL, or e-hookah)?”

E-cigarette Dependence

We assessed e-cigarette dependence by averaging the four items on the E-Cigarette Dependence Scale (Morean et al., 2018). The measure uses a five-point response scale (0=*never*, 4=*almost always*) and its reliability was .90. A sample item from the scale is: “I find myself reaching for my e-cigarette without thinking about it..”

Readiness to Quit Vaping. We assessed readiness to quit vaping by asking those who answered “Yes” to past 30-days ENDS use: “Are you seriously thinking about quitting the use of

e-cigarettes?” (*yes, within the next 30 days, within the next 6 months, in more than 6 months, or I am not thinking about quitting the use of e-cigarettes*) (Hinds et al., 2016). If participants answered affirmatively to past 30-day ENDS use and ever cigarette use, they were prompted to answer (Yes/No) to the follow up questions: “During the past 30 days, did you use any ENDS products (for example, e-cigarettes, vape pens, or e-hookah) to try and quit cigarette smoking?” and “Have you ever successfully quit smoking cigarettes by using ENDS product (for example, e-cigarette, vape pen, or e-hookah)?”

Tobacco and Nicotine Consequences (TANCS). To determine the extent to which participants experienced negative consequences of vaping, we administered the Tobacco and Nicotine Consequences Scale (TANCS) (Grigsby, 2019). This 17-item measure asked participants to read each statement and select a number ($0 = \text{Never}$, $1 = 1\text{-}2 \text{ Times}$, $2 = 3\text{-}5 \text{ Times}$, $3 = 6 \text{ or More Times}$) that indicated how much they have experienced issues related to vaping within the last six months. Consequences were broken down into 5 categories: psychological consequences (4 items) (for example “I have felt guilty or ashamed”) ($\alpha=.87$), physical consequences (4 items) (for example “I have not eaten properly”) ($\alpha=.89$), personal/interpersonal consequences (4 items) (for example “I have been rude or obnoxious towards others while vaping”), physical dependence (3 items) (for example “I spend too much time trying to get more vape products”) ($\alpha=.47$), and psychological dependence (2 items) (for example “I have found it difficult to limit how much I vape”) ($r = .78$). We ultimately excluded the personal/interpersonal consequences subscale because of its lack of immediate relevance to ENDS use. Of note, the $\alpha=.81$ for physical dependence when one item was excluded (“I spend too much time trying to get more vape products”).

Young Adult E-Cigarette Use Outcome Expectancies. To examine the expected outcomes that might happen if one engages in e-cigarette use, all participants, regardless of reported history of ENDS or combustible cigarettes, completed the Young Adult E-Cigarette Use Outcome Expectancies (Pokhrel et al., 2018). The measure uses a ten-point response scale (0=*unlikely*, 9=*likely*). We averaged the 28 positive outcome expectancies to create one positive expectancies variable. We also examined five positive expectancy subscales within the larger subscale namely: social enhancement (10 items) (for example “gain respect of friends”), affect regulation (7 items) (for example “feel good”), positive sensory experience (3 items) (for example “smell good”), positive ‘smoking’ experience (5 items) (for example “enjoy “smoking” indoors”) , and weight control (3 items) (for example “prevent weight gain”). Reliability of the positive expectancies subscale was excellent ($\alpha=.95$). Similarly, for negative expectancies, we created one subscale of all 15 negative outcome expectancies and then for the four specific subscales: negative health consequences (5 items) (for example “damage your health”), negative social consequences (5 items) (for example “look awkward”), addiction concern (2 items) (for example “feel controlled by e-cigarettes”), and negative sensory experience (3 items) (for example “have bad taste in your mouth”). Reliability of the positive expectancies subscale was excellent ($\alpha=.93$).

ENDS Quit Resources Used/Preferred

Participants who answered “Yes” to the question about a prior quit attempt were prompted with the follow up questions: “Which of the following services/resources did you use to help you stop vaping” and “How helpful do you think each of the following strategies was to quit vaping?”. Participants chose from an expansive list of 15 items including but not limited to online (for example a texting program for vaping cessation), medication, professional (for

example one-on-one counseling), social support (for example group support). Participants also could write in an answer. This list was adapted from a measure used to assess smoking cessation resources in Camenga et al. (2021).

Design and Procedure

Participants were recruited for the College Health and Substance Use Experience (CHASE) survey primarily through introductory psychology subject pools. At one of the Northeast sites, students also were recruited through classroom presentations, social media, business cards, fliers, or information sent out via email. To be eligible, survey participants must have been enrolled at their institution, and between the ages of 18-24. The CHASE survey was administered via the platform Qualtrics and took between 60 and 90 minutes. Participants provided their informed consent before beginning the survey. Students who completed the survey were provided compensation either with research participation credit for a course, extra credit, or they were entered into a drawing for an Amazon gift card (at the Northeast site only). Those who wished to receive credit were provided a separate link through an additional survey that had no link to their previous responses to maintain anonymity.

Results

E-cigarette Use

In the sample of 1606 participants, 47.3% reported using ENDS devices at some point in their lifetime. Among the 47.3% of those who reported ENDS use ever, 51.1% reported using ENDS in the past 30 days. Specifically, for type of ENDS device used within the past 30 days, 40.6% of participants report using a disposable nicotine cartridge, 31.7% report using a vape pen/hookah pen/EGO (has a battery and a refillable tank for e-liquids), 56.2% report using a JUUL/PHIX e-cigarette, and 12.9% report using a mod or advanced personal vaporizer. In the

overall sample, when asked about cigarette, cigar, or cigarillo use in the past 30 days, 15.7% reported less than half a pack per day, 0.8% reported half to a pack per day, 0.6% reported one to two packs per day, 0.2% reported two packs per day, and 82.7% reported no use at all. A small percentage of college students, 4%, reported using any ENDS to successfully quit smoking cigarettes.

I ran a crosstabs with chi square in order to examine which demographic factors, if any, were associated with past 30 day ENDS use. Those who identified as white were more likely to have used ENDS within the past 30 days: $\chi(5, N = 740) = 14.42, p = .013$. In addition, students attending a college in the Northeast or Mid-Atlantic were more likely to use ENDS within the past 30 days: $\chi(3, N = 741) = 11.67, p = .009$.

Expectancies by User Group

In order to determine if the endorsement of different types of expectancies varied by user group (i.e., nonusers, lifetime but not past month use, and past month use) I ran a one-way ANOVA.

Positive Expectancies

The three user groups differed significantly on overall positive expectancies, $F(2, 699) = 28.78, p < .001$. Consistent with my first hypothesis, post-hoc comparisons using Tukey's test indicated those who used ENDS in the past month ($M = 3.64, SD = 1.66$) endorsed significantly more positive expectancies than nonusers ($M = 2.53, SD = 1.55$) and those with a history of lifetime use, but no past month use ($M = 2.79, SD = 1.58$). There were no significant differences between nonusers and history of lifetime use when examining overall positive expectancies. When examining positive expectancy subscales by user group, all subscales were significant except for social enhancement expectancies. Social enhancement expectancies did not evidence

group differences once the alpha was adjusted for multiple comparisons [$F(2, 699) = 3.10, p = .046$].

Affect Regulation Expectancies. Regarding subscales for which I observed differences, there was a statistically significant difference among user groups for affect regulation expectancies, $F(2, 699) = 57.33, p < .001$. Post-hoc comparisons using Tukey's test indicated those who used ENDS in the past month ($M = 5.18, SD = 2.56$) endorsed significantly more affect regulation expectancies than nonusers ($M = 2.91, SD = 2.17$) and those with a history of lifetime use but not past month use ($M = 3.38, SD = 2.27$). There were no significant differences between nonusers and history of lifetime use when examining affect regulation expectancies.

Positive Sensory Expectancies. There was a statistically significant difference among user groups and positive sensory experience expectancies, $F(2, 699) = 17.47, p < .001$. Post-hoc comparisons using Tukey's test indicated nonusers ($M = 2.33, SD = 1.76$) endorsed significantly fewer positive sensory experience expectancies than those who reported use in the past month ($M = 3.36, SD = 2.16$) and those with a history of lifetime use but not past month use ($M = 2.90, SD = 2.04$). With positive sensory experience expectancies, there were no significant differences between those who report use in the past month and those with a history of lifetime use but no recent use.

Positive Smoking Experience Expectancies. There was a statistically significant difference among user groups and positive 'smoking' experience expectancies, $F(2, 699) = 21.95, p < .001$. Post-hoc comparisons using Tukey's test indicated those who have used ENDS in the past month ($M = 3.63, SD = 1.94$) endorsed significantly more positive 'smoking' experience expectancies than nonusers ($M = 2.45, SD = 1.86$) and those with a history of lifetime use but not past month use ($M = 2.77, SD = 2.04$). There were no significant differences between

nonusers and those with a history of lifetime use but no recent use with positive ‘smoking’ experience expectancies.

Weight Control Expectancies. There was a statistically significant difference among user groups and weight control expectancies, $F(2, 699) = 7.89, p < .001$. Post-hoc comparisons using Tukey’s test indicated those who have used ENDS in the past month ($M = 3.46, SD = 2.64$) had significantly more weight control expectancies than nonusers ($M = 2.61, SD = 2.10$). There were no significant differences between those with a history of lifetime use ($M = 2.93, SD = 2.30$) and nonusers, as well as no significant differences between those with a history of lifetime use and past month use. More information about positive outcome expectancies by user group can be found on Table 2.

Negative Expectancies

The three user groups varied significantly on their reported means of overall negative expectancies, $F(2, 699) = 64.03, p < .001$. Consistent with my first hypothesis, post-hoc comparisons using Tukey’s test indicated those who have used ENDS in the past month ($M = 4.38, SD = 1.75$) had significantly fewer overall negative expectancies than nonusers ($M = 6.55, SD = 2.24$) and few overall negative expectancies than those with a history of lifetime use but not past month use ($M = 5.58, SD = 2.00$). When examining negative expectancy subscales by user group, all subscales were significant, which I describe below.

Expectancies for Negative Health Consequences. There was a statistically significant difference among user groups and negative health consequences, $F(2, 699) = 20.38, p < .001$. Post-hoc comparisons using Tukey’s test indicated those who have used ENDS in the past month ($M = 6.01, SD = 6.75$) had significantly fewer negative health consequence expectancies than nonusers ($M = 7.54, SD = 8.04$), and those with a history of lifetime use ($M = 7.16, SD = 7.86$).

With negative health consequence expectancies, there were no significant differences between those with a history of lifetime use and nonusers.

Expectancies for Negative Social Consequences. There was a statistically significant difference among user groups and negative social consequences, $F(2, 699) = 65.35, p < .001$. Post-hoc comparisons using Tukey's test indicated those who used ENDS in the past month ($M = 2.78, SD = 1.79$) endorsed significantly fewer negative social consequence expectancies than nonusers ($M = 4.98, SD = 5.53$), and compared to those with a history of lifetime use ($M = 3.48, SD = 4.18$).

Addiction Concern Expectancies. There was a statistically significant difference among user groups and addiction concern, $F(2, 699) = 10.32, p < .001$. Post-hoc comparisons using Tukey's test indicated nonusers ($M = 6.35, SD = 3.14$) had significantly more addiction concern expectancies than past month users ($M = 5.12, SD = 2.77$) and those with a history of lifetime use ($M = 5.57, SD = 3.20$). There were no significant differences between those with a history of lifetime use and past month use.

Negative Sensory Expectancies. There was a statistically significant difference among user groups and negative sensory experience, $F(2, 699) = 91.72, p < .001$. Post-hoc comparisons using Tukey's test indicated those who have used ENDS in the past month ($M = 3.24, SD = 2.35$) endorsed significantly fewer negative sensory experience expectancies than nonusers ($M = 6.75, SD = 2.92$) and those with a history of lifetime use ($M = 5.26, SD = 2.97$). More information about positive outcome expectancies by user group can be found on Table 3.

Previous Quit Attempts, Expectancies, and Consequences

Regarding quit attempt history, there were a few ways in which students with quit attempts differed from those who did not report a quit attempt. Regarding expectancies, ENDS

quitters reported more positive expectancies compared to non-quitters, $t(348)=-2.193$, $p=.029$, 95% CI [-.74, -.040], which was part of my second hypothesis. Specifically, those without a previous quit attempt had a mean positive expectancy score of 3.02 ($SD = 1.59$) and those with at least one quit attempt had a mean positive expectancy score of 3.41 ($SD = 1.74$). These groups did not differ in their endorsement of negative expectancies, $t(348)=-0.10$, $p=.992$, 95% CI [-.42, .41]. Those without a previous quit attempt had a mean negative expectancy score of 4.99 ($SD = 2.04$), while those who reported a quit attempt had a mean negative expectancy score of 4.99 ($SD = 1.90$).

When examining e-cigarette dependence, students with a quit attempt were significantly more likely to score higher on e-cigarette dependence compared to non-quitters, $t(374)=-3.963$, $p<.001$, 95% CI [-.73, -.25], which was consistent with my second hypothesis. Specifically, those without a previous quit attempt had a mean dependence score of 1.90 ($SD = 1.09$) and those who reported a quit attempt had a mean dependence score of 2.39 ($SD = 1.25$). In terms of tobacco and nicotine consequences, my second hypothesis was supported. Specifically, students with a quit attempt reported more negative consequences when compared to non-quitters, $t(348)=-4.669$, $p<.001$, 95% CI [-.38, -.15]. Those without a previous quit attempt had a mean TANCS score of 1.22 ($SD = .43$) and those who reported a quit attempt had a mean TANCS score of 1.48 ($SD = .63$).

E-cigarette Quantity/Frequency

To test my second hypothesis, a Pearson product-moment correlation coefficient was computed to assess the relation between negative consequences and ENDS quantity/frequency. There was a positive correlation between the two variables, $r = .347$, $n = 350$, $p < .001$. Consistent with my second hypothesis, higher e-cigarette frequency was associated with more

tobacco and nicotine consequences. When examining the relation between TANCS subscales and ENDS quantity/frequency, each subscale was significantly correlated with ENDS use.

Specifically, there was a positive correlation between TANCS psychological consequences and ENDS quantity/frequency, $r = .277$, $N = 350$, $p < .001$; TANCS physical consequences and ENDS quantity/frequency, $r = .226$, $N = 350$, $p < .001$; TANCS physical dependence and ENDS quantity/frequency, $r = .284$, $N = 350$, $p < .001$; and TANCS psychological dependence and ENDS quantity/frequency, $r = .471$, $N = 350$, $p < .001$. More information about correlations among e-cigarette quantity/frequency and TANCS can be found on Table 4.

Readiness to Quit

Table 5 displays how the same endorsed each readiness to quit item. Of note, the two most commonly endorsed items were “I’m not thinking of quitting” (33%) and “Within the next 30 days” (28%). To test my third hypothesis, a Pearson product-moment correlation coefficient was computed to assess the relation between e-cigarette quantity/frequency and readiness to quit, as well as a t-test to determine the difference between dual users (i.e., combustible and ENDS users) and exclusive e-cigarette users. There was a positive correlation between e-cigarette quantity/frequency and readiness to quit, $r = -.179$, $n = 374$, $p < .001$. Lower e-cigarette frequency was related to higher readiness to quit, which supports my third hypothesis.

When examining the difference between dual users and exclusive ENDS users on readiness to quit, they did not differ, $t(245)=1.64$, $p=.052$, 95% CI [-.057, .611]. Exclusive ENDS users had a mean readiness to quit score of 1.61 ($SD = 1.16$) and dual users had a mean readiness to quit score of 1.33 ($SD = 1.25$). Although the results were not significant, there was a trend for exclusive ENDS users to express more motivation to quit than dual users, which was opposite of what I hypothesized.

Research Questions

In the first section below, I describe findings related to what resources were utilized by those who reported a previous ENDS quit attempt. In the second section I describe the strategies that were perceived as most/least helpful by the same sample. Information about utilized quit resources and desired quit resources can be found in Tables 6 and 7. Finally, I describe exploratory analyses where I examine correlations with the age of ENDS initiation.

Quit Resources from Users with a Previous Quit Attempt

I examined descriptive statistics to determine what services/resources users with a former quit attempt have utilized. The most popular service/resource was quitting “cold turkey”, with 68.2% of the sample reporting using this strategy. Willpower was the second most popular service/resource, with 65.3% of the sample reporting using this strategy. The third most popular was replacing vaping with another exercise with 30.6% of the sample utilizing this strategy.

Reported Desired Quit Resources from Users With A Previous Quit Attempt

I examined descriptive statistics to examine what services/resources users with a former quit attempt perceived as most/least helpful. Replacing vaping with another exercise was the most endorsed service/resource, with a mean of 3.93. The second most endorsed strategy was willpower, with a mean of 3.71. Help or support from friends or family was the third most endorsed strategy, with a mean of 3.62.

A Pearson product-moment correlation coefficient was computed to assess the relation between e-cigarette quantity/frequency, e-cigarette dependence, desired ENDS quit resources, and outcome expectancies. First, there was an inverse correlation between e-cigarette frequency and group support, $r = -.183$, $n = 348$, $p < .001$. Higher e-cigarette frequency was related to lower perceived helpfulness of group support. Second, there was an inverse correlation between

e-cigarette frequency and help or support from friends or family, $r = -.126$, $N = 349$, $p < .001$.

Higher e-cigarette frequency was related to lower perceived helpfulness of help or support from friends or family. Third, there was an inverse correlation between e-cigarette frequency and willpower, $r = -.132$, $N = 374$, $p = 0.13$. Higher e-cigarette frequency was related to lower perceived helpfulness of willpower. Addiction concern outcome expectancies and affect regulation outcome expectancies were not significantly correlated with desired quit resources. E-cigarette dependence also did not correlate with any of these variables. More information about desired quit resources and correlations can be found on Table 8.

Age Of ENDS Initiation, Previous Quit Attempts, ENDS Frequency, And ENDS Dependence

A Pearson product-moment correlation coefficient was computed to assess the relation between e-cigarette quantity/frequency, e-cigarette dependence, a previous quit attempt, and age of ENDS initiation. First, there was an inverse correlation between age of ENDS initiation and a previous quit attempt, $r = -.132$, $n = 734$, $p < .001$, with younger age of initiation being associated with a greater likelihood of a quit attempt. Also, there was an inverse correlation between age of ENDS initiation and e-cigarette frequency, $r = -.146$, $n = 737$, $p < .001$, such that using ENDS at an earlier age was associated with more current ENDS use. Findings for ENDS initiation and e-cigarette dependence were similar: $r = -.191$, $n = 374$, $p < .001$. Overall, these correlations suggest that those who initiate ENDS at a younger age are vaping more frequently, have higher ENDS dependence, and are more likely to attempt to quit. More information on these correlations can be found on Table 9.

Discussion

The present study aimed to explore predictors of ENDS use and cessation in the young adult population. Sutfin et al. (2013), Lanza and Teeter (2018), and Holt et al. (2022) have

examined ENDS prevalence rates which have been rising over time, making this area a pressing area of concern. I examined potential correlates of e-cigarette use including outcome expectancies, negative consequences, dependence, and readiness to quit from college students at college campuses across the United States using an online survey. To my knowledge, this is the first study to examine negative consequences and ENDS, as well as to inquire about utilized and desired quit strategies.

Demographic Predictors of Vaping

I expected to replicate the previous literature regarding examining socio-demographic factors associated with the likelihood of ENDS use, specifically being male (Hittner et al., 2020; Holt et al., 2022). However, those who identified as white and attendance at a college in the Northeast or Mid-Atlantic were the only factors associated with past 30 day ENDS use. The lack of a gender difference in the current study may have been due to the underrepresentation of males. That is, had our sample contained a larger proportion of males perhaps we would have found significant gender differences such as Holt et al. (2022). Or it is possible that as ENDS products are on the market longer, gender differences are becoming less apparent.

Outcome Expectancies and ENDS Use

The hypothesis that positive outcome expectancies would be higher for ENDS users and negative outcome expectancies would be higher for non-users largely was supported. Interestingly, perceived social benefits was the only outcome expectancy subscale that did not differ between ENDS users and nonusers, which was unexpected. This hypothesis was based on research demonstrating that users commonly report more perceived positive outcomes, and social facilitation expectancies predicted the likelihood of ENDS use (Pokhrel et al., 2018; Doran and Brikmanis, 2016). One interpretation is that expected positive effects of drug use are important

for ENDS use in college students. However, in this population prevalence estimates of ENDS use have been increasing over time. Perhaps e-cigarettes are no longer perceived as socially advantageous because use has become normalized. Use may no longer be considered “cool” or “trendy”, but instead socially trivial. Another interpretation is that greater awareness of negative health consequences is creating a shift in the public perception starting with the perception that ENDS use is socially inconsequential, neither socially beneficial nor harmful.

Profile of ENDS Users with a Past Quit Attempt

The second hypothesis, specifically, that users with a quit attempt would report more positive outcome expectancies and would score higher on e-cigarette dependence in comparison to users without a quit attempt, was supported. Further, I found support for the idea that higher ENDS frequency would be associated with more tobacco and nicotine consequences. The aforementioned hypothesis was based on research demonstrating that ENDS users with a prior quit attempt endorsed higher positive outcome use expectancies, perceived risks, benefits, and barriers to quitting in comparison to those who never attempted to quit (Peraza et al., 2020). This suggests that frequent users notice more consequences associated with ENDS use which may, in turn, prompt a quit attempt. However, perceived positive outcomes of ENDS use may become more salient for highly dependent ENDS users during/after a quit attempt (Peraza et al., 2020).

Readiness to Quit

Users seem polarized on intentions for quitting in that a substantial proportion were not thinking of quitting at all, while another proportion were considering quitting within the next 30 days. There was mixed support for my final hypothesis. Users who reported vaping less often scored higher on readiness to quit. However, there was not a significant difference between dual users and exclusive ENDS users on readiness to quit. In fact, opposite than hypothesized,

exclusive ENDS users may be slightly more motivated to quit than dual users. The aforementioned hypothesis was based on research by Berg et al. (2021), where readiness to quit was associated with fewer days of use, and combustible tobacco use predicted a past year quit attempt. One interpretation is that users who are considering quitting in the future purposefully reduce ENDS use in order to prepare for that next step. Another interpretation is that infrequent users are less dependent on ENDS, therefore making it easier to consider quitting in the future. Dual users may not consider quitting ENDS in the near future because they are using ENDS to quit combustible use or are less bothered by the general concept of substance use. Perhaps this population is engaging in multiple, possibly illicit, substance use which lowers concern about nicotine use. Past research supports this interpretation where college students who report ENDS use had significantly higher rates of substance use (such as amphetamines, cocaine, hallucinogens, marijuana, opiates, alcohol) (Grant et al., 2019). Or perhaps this population is purposefully seeking to engage in ‘rebellious’ behavior through use of less popular nicotine devices.

Utilized and Desired Quit Strategies

Few published studies have examined experiences with ENDS cessation strategies among users with a past quit attempt. The top five strategies used to quit were “cold turkey”, willpower, replacing vaping with another exercise, help or support from friends or family, and other. Results were similar for the perceived helpful top five: replacing vaping with another exercise, willpower, help or support from family or friends, quitting “cold turkey”, and group support. Exploratory analyses indicated that higher ENDS frequency was related to lower perceived helpfulness of group support, support from friends or family, and willpower. Interestingly, e-cigarette dependence did not correlate with any of the variables. These findings suggest frequent

users are aware of requiring intensive quitting strategies in order to be successful, where social support alone may not be enough. Use of e-cigarettes may be mindless and habitual for certain users, which presents unique challenges when quitting.

A texting program and vaping app for cessation were relatively unpopular among users with a previous quit attempt in terms of actual reported use and perceived helpfulness. This was surprising because although past research with this exact measure is not published, existing literature supports the notion that young users report widespread support for digital methods. For example, Amato et al. (2021) mentions how over 25,000 young people signed up for a text message cessation program within the first five weeks of its launch. Further, Garey et al. (2021) found in a sample of 14–21-year-old regular ENDS users that participants were most willing to utilize digital cessation methods, for example an app-based intervention. Although this sample included a younger age range with a mean age of 16, I would not expect a major discrepancy between results. These conflicting findings suggest that users in college environments who have attempted to quit seem to be less aware of the existence of digital resources, which is why they might have been perceived as less helpful in comparison to others.

Age of E-cigarette Initiation and Quit Attempts

A research question I examined was whether age of initiation of e-cigarettes was associated with making a quit attempt. Our results indicated that those who initiated younger had a greater likelihood of a quit attempt. Further exploratory analyses revealed that using ENDS at an earlier age was associated with more current ENDS use (higher frequency) and higher scores on current e-cigarette dependence. Sharapova et al. (2020) found similar findings: those who initiated ENDS at 13 years or younger were more likely to report higher frequency of daily use and dependence, even after accounting for age, sex, race/ethnicity, survey year, and current use

of other tobacco products. Taken together, these findings suggest age of initiation may have implications for current use and levels of dependence. One reason an earlier age is so crucial when it comes to long term outcomes is because “...the developing brain in childhood and adolescence shows a high degree of neuroplasticity, or the ability to learn and respond to stimuli quickly. Exposure to nicotine at this formative stage can therefore lead to faster progression to an addicted state compared with initiation as an adult” (Sharapova et al., 2020, p. 4). The younger population should be one of the main targets when developing ENDS prevention programs because there are long lasting consequences of earlier ENDS initiation. Delaying age of initiation, rather than preventing ENDS use altogether, may be a more realistic goal. Also, this information is important for those developing ENDS cessation programs because it may be trickier for someone to quit who started using e-cigarettes at a younger age versus someone who began relatively recently. Perhaps different approaches should be used with this population, specifically guidance may be needed in being weaned off nicotine, whether that is through nicotine replacement products or another means (e.g., gradual reductions in nicotine strength).

Limitations

There are several limitations to the current study. Although we recruited participants from several different colleges and universities across the U.S., our sample was relatively homogenous with respect to race and gender. In another study with a sample of current ENDS users between the ages of 18-26 years old from four geographically diverse, large U.S. public universities, about 48% of the sample was female and 62% was non-Hispanic White (Merianos et al., 2022). Also, a little over half of the sample were first-year students. These factors may have limited the generalizability of results to other college campuses with more diverse sociodemographic characteristics. Moreover, the length of the online survey (60-90 minutes) and

the fact that the data were self-reported may have increased the chances of participant fatigue or of participants misperceiving a question because of haste or inability to get clarification. To reduce this likelihood, participants had to complete check questions throughout the survey to ensure sufficient attention. However, this strategy cannot guarantee accurate reporting. Another limitation was that the measures of outcome expectancies, tobacco and nicotine consequences (TANCS), and readiness to quit were only administered to half of the overall sample as part of a planned missing data design (Graham et al., 2006) used to reduce response burden among participants.

Lastly, one limitation of our study was that we did not measure details about previous quit attempts. Therefore, we were limited in our ability to understand the nuances of e-cigarette quit attempts. It would be interesting to know the number of previous quit attempts and the success rate when attempting to quit. In addition, it would be useful to understand the barriers to quitting experienced by participants. Future studies should aim to provide a fuller picture of this construct, and examine factors that make a quit attempt more or less successful.

Implications and Future Directions

This study aimed to fill several gaps in e-cigarette literature. While ENDS is now being studied more widely in the context of being a concern, there has not yet been sufficient research examining outcome expectancies, readiness to quit, negative consequences, and the experiences of those who report a past quit attempt. In fact, this was the first study to examine negative consequences of ENDS use and to inquire about the experiences of those with a past quit attempt. Since this study was among the first to address these specific factors, it is important to replicate and extend this research. With e-cigarettes being the most popular tobacco and nicotine device among young adults, it is essential to understand the factors that place individuals at

greater risk of using ENDS and becoming frequent users. While this study suggested several risk factors for ENDS use including certain sociodemographic factors, higher positive outcome expectancies, and lower negative outcome expectancies these findings need to be replicated so specialists can accurately develop interventions to target profiles which are “at risk” on college campuses. Future research also should examine why social enhancement expectancies were the only nonsignificant expectancy subscale when comparing user groups. If ENDS products have become normalized among the college population, it is important to reduce the likelihood of ENDS initiation and promote widespread knowledge about the dangers of use.

Also, this study suggested several factors associated with making a quit attempt, such as age of initiation, positive expectancies, dependence, and negative consequences. In terms of readiness to quit, users seem to be polarized: either not thinking of quitting or thinking of quitting within the next 30 days. If these findings are replicated, cessation interventions can be tailored in terms of program development and recruitment. Specialists can create a profile for those who might be considering quitting, and providing the right tools might make the difference in raising successful cessation rates. Perhaps someone who is not thinking of quitting at all or within the next six months would be encouraged to limit the frequency of use, meanwhile someone who is thinking of quitting in the next thirty days would be provided resources such as nicotine replacement therapy or directed to a tested digital cessation app. It is also important to understand what strategies are being used and deemed as helpful by those who report a past quit attempt so the literature accurately reflects user experiences. Based on this study’s novel findings demonstrating low utilization of digital methods, universities should focus on ways to disseminate information about the availability of these digital options. Perhaps qualitative research will further shed light on why a majority of users with a prior quit attempt are doing so

“cold turkey”. These experiences will change over time, so it is important to constantly update the literature and accurately understand the experiences of users attempting to quit. Furthermore, we must continue to educate individuals with reliable research on the potential risks and consequences of vaping, as well as long-term effects. Finally, policy makers must take into account findings that may influence policies regarding the sale and use of ENDS.

Conclusion

The findings of the current study add to the rapidly developing research on nicotine vaping; specifically, the factors associated with predictors of use, dependency, and quitting. Additionally, this study contributes to the limited knowledge of the experiences of users who have attempted to quit. The findings of this study have several important implications for future prevention and intervention. The study demonstrates that about half of college students who report lifetime use of ENDS, have used e-cigarettes in the past 30 days. ENDS users have higher positive outcome expectancies in comparison to non-users. Those who report using e-cigarettes less frequently score higher on readiness to quit, and high frequency users report more negative consequences. Users who report a past quit attempt report more positive expectancies and score higher on e-cigarette dependence. Also, younger age of initiation was associated with a past quit attempt, higher current dependence, and greater frequency of current ENDS use. Future interventions can utilize screenings to quickly identify those at risk of use and users who are considering quitting to aid in providing proper resources. Cessation programs can implement the quitting strategies rated as helpful, and take into account what strategies that users are using when trying to quit. Future research should concentrate on replicating and further examining the predictors that make college students more vulnerable to initiate and maintain vaping, as well as determining what makes a quit attempt successful.

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Tables

Table 1

Demographic Characteristics for Overall Sample

Study variable	<i>n</i>	%
Age (<i>M, SD</i>)	1563	19.33(1.36)
Biological sex at birth		
Male	382	24
Female	1183	76
Gender identity		
Male	378	24
Female	1148	73
Trans (female to male)	5	.3
Trans (male to female)	1	.1
Gender queer (or having no gender identity)	32	2
Race/ethnicity		
White	1098	70
African American/Black	117	8
Asian/Asian American	177	11
American Indian/Alaska Native	25	2
Hispanic/Latino	264	17
Bi/Multiracial	84	5
Other	61	4
Class year		
Freshman	827	53
Sophomore	322	21
Junior	242	16
Senior	147	9
Senior +	26	2
Graduate student	1	.1
Greek-life involvement in college	246	16
NCAA student-athlete	205	7
College/university		
Rowan University	51	3
Trinity College	114	7
East Tennessee State University	471	30
Saint Louis University	411	26
University of Houston	231	15
Sam Houston State University	288	18
ENDS ever use		
No	825	53
Yes	741	47
Past 30-day ENDS use		
No	362	49
Yes	379	51

Table 2*Descriptive Statistics and One-Way Analyses of Variance in Positive Expectancies by ENDS User Group*

Measure	Nonusers <i>n</i> = 352		History of lifetime <i>n</i> = 178		Past month use <i>n</i> = 172		<i>F</i> (2, 699)	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Overall positive outcome expectancies	2.53	1.55	2.79	1.58	3.64	1.66	28.78	<.001
Social enhancement	2.32	1.65	2.32	1.67	2.69	1.84	3.104	.046
Affect regulation	2.91	2.17	3.38	2.27	5.18	2.56	57.33	<.001
Positive sensory experience	2.33	1.76	2.90	2.04	3.36	2.16	17.47	<.001
Positive 'smoking' experience	2.45	1.86	2.77	2.04	3.63	1.94	21.95	<.001
Weight control	2.61	2.10	2.93	2.30	3.46	2.64	7.89	<.001

Table 3*Descriptive Statistics and One-Way Analyses of Variance in Negative Expectancies by ENDS User**Group*

Measure	Nonusers <i>n</i> = 352		History of lifetime use <i>n</i> = 178		Past month use <i>n</i> = 172		<i>F</i> (2, 699)	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Overall negative outcome expectancies	6.55	2.24	5.58	2.00	4.38	1.75	64.03	<.001
Negative health consequences	7.54	8.04	7.16	7.86	6.01	6.75	20.38	<.001
Negative social consequences	4.98	5.53	3.48	4.18	2.78	1.79	65.35	<.001
Addiction concern	6.35	3.14	5.57	3.20	5.12	2.77	10.32	<.001
Negative sensory experience	6.75	2.92	5.26	2.97	3.24	2.35	91.72	<.001

Table 4*Intercorrelations for E-Cigarette Frequency and Tobacco and Nicotine Consequences Subscales*

Variable	1	2	3	4	5
1 E-cigarette frequency total	---				
2 Psychological consequences (TANCS)	.277***	---			
3 Physical consequences (TANCS)	.266***	.727***	---		
4 Physical dependence (TANCS)	.284***	.529***	.454***	---	
5 Psychological dependence (TANCS)	.44***	.641***	.513***	.658***	---
6 Overall TANCS	.471***	.920***	.883***	.674***	.778***

Note. TANCS=Tobacco and Nicotine Consequences Scale. $n=1566$ E-cigarette frequency total, $n=350$ for all TANCS subscales and overall TANCS scale.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 5*Scores for Readiness to Quit Scale*

Readiness to Quit	<i>n</i>	%
Yes, within the next 30 days	105	28
Yes, within the next 6 months	94	25
Yes, in more than 6 months	52	14
I am not thinking about quitting the use of e-cigarettes	123	33

Note. The question was asked only to ENDS users who report past 30-day use.

Table 6*Utilized and Desired ENDS Cessation Resources from Users with a Previous Quit Attempt*

Services/resources	Utilized Percent (<i>n</i>)	Perceived Helpfulness Mean (SD)
Quitting “cold turkey”	68.2 (245)	3.28 (1.35)
Willpower	56.3 (202)	3.71 (1.29)
Replacing vaping with another exercise	30.6 (110)	3.93 (1.24)
Help or support from friends or family	23.7 (85)	3.62 (1.39)
Other	10 (36)	1.66 (1.15)
Nicotine replacement products	7.2 (26)	2.87 (1.34)
A texting program for vaping cessation	3.9 (14)	1.99 (1.13)
A vaping cessation app	3.6 (13)	2.15 (1.16)
Group support	2.2 (8)	3.04 (1.49)
One-on-one counseling	1.7 (6)	2.86 (1.50)
Books, pamphlets, videos, or other materials	1.7 (6)	1.82 (1.08)
Medications like Zyban/Wellbutrin/Bupropion or Chantix/Varenicline	0.8 (3)	2.32 (1.26)
Internet or web-based program	0.8 (3)	1.90 (1.06)
A telephone quitline or helpline	0 (0)	1.89 (1.09)
Acupuncture	0 (0)	1.97 (1.09)
Hypnosis	0 (0)	1.84 (1.07)

Note. n=359

Table 7

Themes from Open-Ended Responses from Reported and Desired ENDS Cessation Resources from Users with a Previous Quit Attempt

Other responses	<u>Utilized</u> services/resources <i>n</i> = 34	<u>Perceived helpful</u> services/resources <i>n</i> = 8	Example Quote
Not addicted	20	0	“Never ever was addicted or owned one. Decided not to hit them anymore one day”
Did not like ENDS in the first place	3	0	“Didn't like it so I stopped doing it socially”
For another person	2	0	“Pregnancy (for my child)”
Distinct reason	2	1	“Vacation”
Quitting with another	1	0	“Bf quitting with me”
Nicotine free vaping device	1	2	“Nicotine free vaping device”
Knowledge about addiction	1	1	“Finding out that the urge doesn't go away, and that you have to work to fight the urge”
Zyn pouches (nicotine pouches)	1	1	“Zyn pouches”
Social media	0	1	“Tik tok”

Table 8

Intercorrelations for Select Perceived Helpfulness Quit Resources, E-Cigarette Frequency, E-Cigarette Dependence, and Select Expectancy Subscales (i.e., Addiction Concern, Affect Regulation)

Variable	1	2	3	4	5	6	7	8
1 Nicotine Replacement Products	---							
2 Group Support	.44***	---						
3 Help or support from friends or family	.39***	.67***	---					
4 Quitting “cold turkey”	.02	.02	.09	---				
5 Willpower	.09	.19***	.28**	.58***	---			
6 E-Cigarette Dependence	.1	-.13	-.045	-.12	-.14	---		
7 E-Cigarette Frequency	-.05	-.18***	-.13**	-.07	-.13**	.64***	---	
8 Addiction Concern Outcome Expectancies	.07	.08	.08	.01	.01	.2**	.20**	---
9 Affect Regulation Outcome Expectancies	.10	0.01	-.09	.00	-.03	.48***	.41***	.25***

** $p < .01$, *** $p < .001$.

Table 9*Intercorrelations for Age of ENDS Initiation, Attempting to Quit an ENDS Product, E-Cigarette Frequency, and E-Cigarette Dependence*

Variable	1	2	3
1 Age of ENDS Initiation	---		
2 Reported attempt to Quit ENDS	-.13***	---	
3 E-Cigarette Frequency	-.15***	.18***	---
4 E-Cigarette Dependence	-.19***	.20***	.63***

Note. $n=737$ Age of initiation, $n=738$ Reported quit attempt, $n=1566$ E-Cigarette frequency, $n=377$ E-Cigarette dependence

* $p < .05$, ** $p < .01$, *** $p < .001$

Figures

Figure 1

Positive Expectancies by ENDS User Group

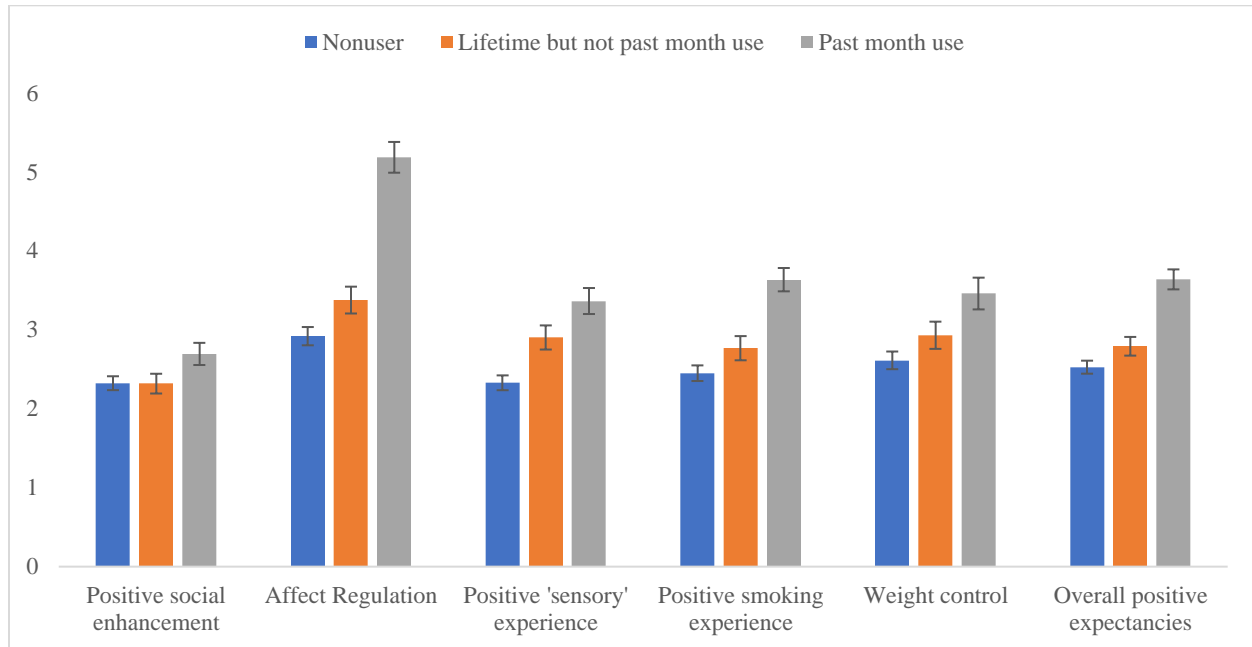


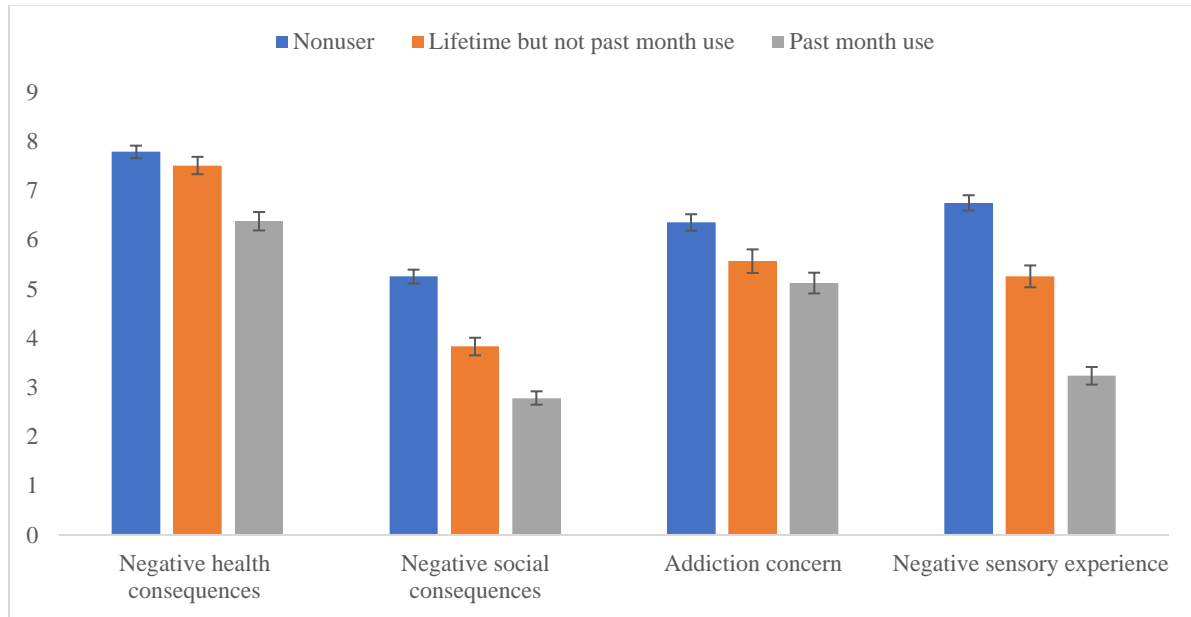
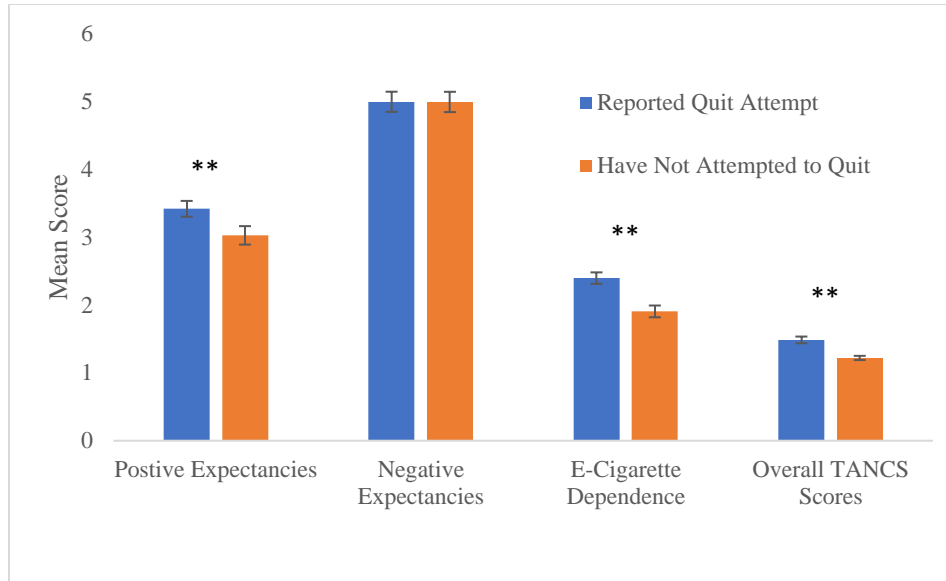
Figure 2*Negative Expectancies by ENDS User Group*

Figure 3

Comparing Means of Positive Expectancies, Negative Expectancies, ENDS Dependence, and Overall TANCS Scores by Quit Status History



Note. ** $p < .001$

Figure 4

Exclusive ENDS Users and Dual Users Mean Readiness to Quit Scores

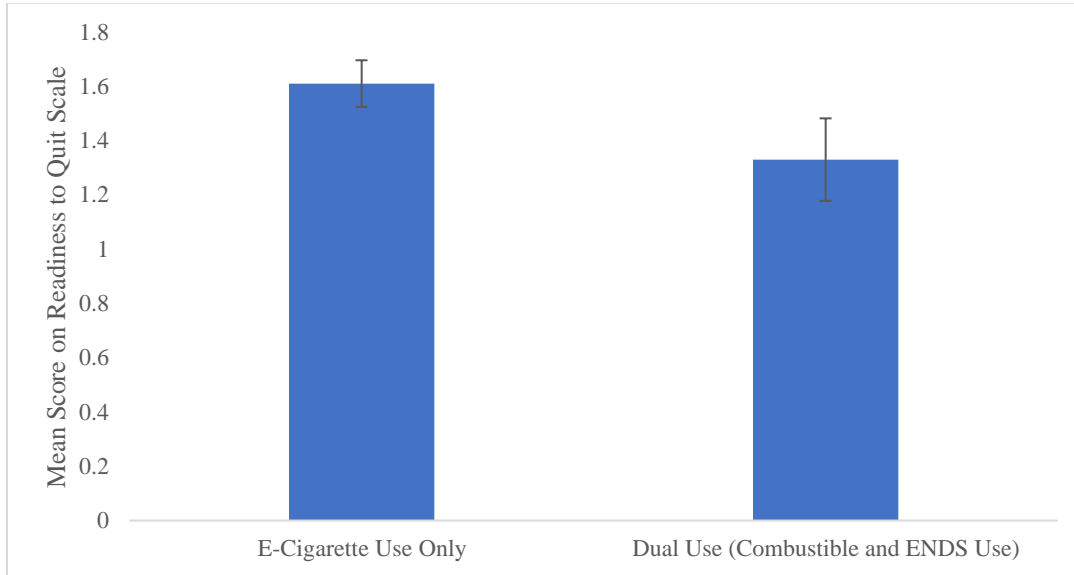


Figure 5

Percent Utilizing Specific Quit Resources Among Users With a Prior Quit Attempt

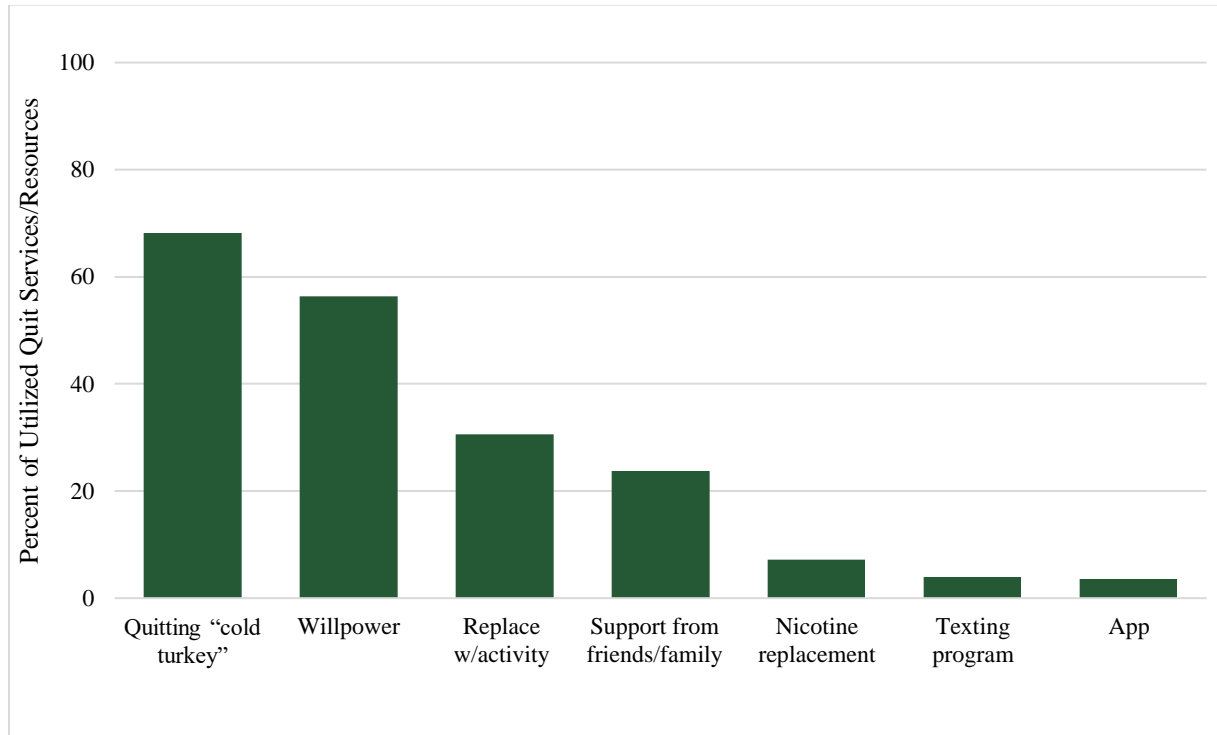


Figure 6

Mean Percent Helpfulness of Quit Resources Among Users With a Prior Quit Attempt

