

Trajectories of Nicotine Use Leading to Dual and Cyclical Tobacco Product Use in Young Adults

Afton Kechter PhD^{1,✉}, Kelsey A. Simpson MA¹, Rachel Carmen Ceasar PhD¹, Sara J. Schiff BA^{2,✉}, Naosuke Yamaguchi BS^{1,✉}, Ricky N. Bluthenthal PhD¹, Sabrina L. Smiley PhD^{1,3,✉}, Jessica L. Barrington-Trimis PhD¹

¹Department of Population and Public Health Sciences, Keck School of Medicine, University of Southern California, Los Angeles, CA, USA

²Department of Psychology, University of California Los Angeles, Los Angeles, CA, USA

³Division of Health Promotion and Behavioral Science, School of Public Health, College of Health and Human Services, San Diego State University, San Diego, CA, USA

Corresponding Author: Jessica L. Barrington-Trimis, PhD, Department of Population and Public Health Sciences, Keck School of Medicine, University of Southern California, 2001 N. Soto Street, 312G, Los Angeles, CA 90089, USA. Telephone: 323-442-8248; Fax: 323-865-0103; Email: jtrimis@usc.edu

Abstract

Introduction: Young adult never-smokers who vape are at elevated risk of initiating cigarettes, while young adults who smoke often begin vaping to substitute or reduce cigarette use. Reasons underlying different use patterns of tobacco products are not well-understood.

Aims and Methods: We conducted 1-on-1 qualitative interviews with young adults ($N = 62$) who vape in Los Angeles, California from June 2018 to June 2019. Participants were 18–25 years old (79% male; racially/ethnically diverse) and self-reported vaping $\geq 1x/week$. We used a semi-structured interview guide and applied thematic analysis method to analyze data.

Results: Young adults initiated vaping due to peer socialization and e-liquid flavor novelty. They often reported vaping (after first smoking) due to a belief that e-cigarettes are healthier, social pressure to quit smoking, and convenience of use. Participants reported smoking (after first vaping) when traveling outside of the United States where vaping products were less accessible, and cigarettes were normative. Many of the personal narratives described patterns of dual and cyclical use, which was often attributed to nicotine dependence and cost, or described as dependent upon the current environment (eg, at a party).

Conclusions: The current study characterizes nicotine use trajectories and reasons why young adults vape, and smoke cigarettes. Dual and cyclical use of both e-cigarettes and cigarettes was common; this pattern of use should be considered in policy and prevention work to address nicotine dependence among young people.

Implications: We display findings from the current study in a model depicting common trajectories of nicotine use, along with reasons for initiation, transitions between products, and dual/cyclical e-cigarette and combustible cigarette use.

Introduction

The continued high prevalence of e-cigarette use (vaping) in young adults in the United States,^{1–3} has led to debate regarding the role of vaping products in the overall health of this population. Some research suggests that vaping is a healthier and safer alternative to cigarettes and should be utilized as a cessation tool for adult cigarette smokers.⁴ However, use of e-cigarettes among youth who report no history of cigarette smoking is common,^{5,6} and evidence indicates that never-smoking adolescents and young adults who have used e-cigarettes (vs. those who have not) are at greater risk of subsequently initiating cigarette use (smoking)^{7,8} and progressing to more regular patterns of smoking.^{6,9–12} While extensive research documents evidence of switching between tobacco products, there is little research examining *why* this occurs. Such perspectives would offer insight to preventionists and policy makers on how to reduce adverse public health impacts of vaping to prevent transition from vaping to smoking among youth, without discouraging transitions from smoking to vaping among long-term smokers. The current study stems from this gap in knowledge and sought to identify risk and

resiliency mechanisms underlying tobacco product use patterns among young adults.

Some empirical attention has been directed toward understanding mechanisms underlying experimentation with smoking among young adults who vape.¹³ One study proposed a “catalyst model” whereby perceived safety, taste and discrete product characteristics, and greater social acceptability contributes to e-cigarettes being more appealing tobacco products to adolescents. After youth are familiar with e-cigarettes, they may re-evaluate and transition to tobacco smoking due to nicotine dependence and accessibility. Additionally, some of the more nuanced complexities of varying product types, nicotine content, and dual use likely influence product switching in real-world settings.¹³ Others discuss the potential for transitioning away from cigarettes to vaping, as many seek a safer form of nicotine administration.⁴ Research is needed to examine the applicability of this model and the proposed pathways underlying various patterns of nicotine use to inform public health recommendations.

The current study aimed to speak with young adults who vape to explore factors that influence them to (1) initiate

Received: July 30, 2021. Revised: November 10, 2021. Accepted: November 24, 2021

© The Author(s) 2021. Published by Oxford University Press on behalf of the Society for Research on Nicotine and Tobacco. All rights reserved.

For permissions, please e-mail: journals.permissions@oup.com.

vaping and smoking, (2) try additional tobacco products, and (3) report dual use of e-cigarettes and combustible cigarettes. This study characterizes why and how tobacco use occurs among young adults from shared narratives and perspectives.

Methods

We used the consolidated criteria for reporting qualitative research checklist to comprehensively report important aspects of the current qualitative study.¹⁴

Participants and Procedures

Young adults who use e-cigarettes (ages 18–25, $N = 62$) were recruited via fliers and online advertisements from the Los Angeles, California metropolitan area. Initial respondents were screened for eligibility through online surveys and over the phone. To be included in the study, young adults had to be 18–25 years-old and self-report vaping on a weekly basis or more for at least 5 months prior to study enrollment. Those who met inclusion criteria were selected for an in-person interview from June 2018 to June 2019 at the University of Southern California (USC). One-on-one interviews were conducted in a designated private room by a team member (AK, KAS, SJS). Interviews lasted about 1 h. Immediately after, participants completed a quantitative survey online administered via the REDCap system. Participants were remunerated \$50 for completion of the qualitative interview and quantitative survey.

Ethics Statement

Written informed consent was obtained from each participant prior to enrollment. All study procedures were approved by the USC Institutional Review Board.

Qualitative Interviews

We used a semi-structured interview guide with open-ended questions designed to elicit respondents' experiences and perspectives.¹⁵ The interview guide was pilot tested ($n = 5$) and revised before being finalized for use in the remaining interviews. Interviewers noted whether participants first used cigarettes or e-cigarettes and began with corresponding questions (eg, for e-cigarette-first users, beginning with questions on e-cigarettes). The interviewer then asked participants about their use of the other product. See [Supplemental Material 1](#) for full interview guide.

Quantitative Measures

Participants provided self-report data on gender (male, female), race (Asian, Black or African American, Native Hawaiian or Pacific Islander, White, Multiethnic or Multiracial, Other), ethnicity (Hispanic/Latino, Non-Hispanic/Latino), current enrollment in higher education (yes, no, do not know/missing), and current subjective financial status (do not meet basic expenses, just meet basic expenses, meet needs with little left, live comfortably). Participants also provided data on whether (yes/no) they were an e-cigarette-only user or dual e-cigarette and combustible cigarette user, whether they ever felt addicted to vaping, and whether they had ever tried to stop or cut down on use of electronic nicotine devices. Finally, participants provided data on past 30-day combustible cigarette use and past 30-day e-cigarette use (0 days, 1–5 days, 6–19 days, 20–29 days, or all 30 days).

Qualitative Analysis

All interviews were audio-recorded. Trained staff transcribed recordings verbatim and edited transcriptions to remove identifiers. Transcripts were uploaded to NVivo (Version 12.6) for analysis. The goal of the qualitative project was to speak with young adults who use e-cigarettes and learn about their process and experiences around tobacco use. We applied Braun and Clarke's thematic analysis method to analyze the data.¹⁶ To accomplish this, seven team members read through an initial set of transcripts and wrote memos separately. Members discussed memos in subsequent analysis meetings and developed 19 codes to describe emergent concepts from the data. After the iterative process of revising and finalizing these codes, two team members were randomly assigned to code each transcript. A master file was created to merge the double coding and used in the current analysis.

Data related to cross-nicotine product use emerged during the interviews, and were most frequently mentioned in data coded for "origin story" (describing the first time a participant used a cigarette or e-cigarette) and "changing patterns of nicotine" (describing changes in smoking use; increasing or decreasing dose/patterns of use to get desired effect; or "tolerance" for higher levels of nicotine). See [Supplemental Material 2](#) for codebook. For advanced coding, two team members (AK and research assistant) reviewed codes and discussed memos, emergent ideas, and global narratives until saturation was achieved. Finally, AK organized quotations and discussed with the entire team until consensus was reached.

Results

Participants were mostly male ($N = 48$; 79%), racially/ethnically diverse ($N = 32$; 52.4% non-White), and about half were enrolled in higher education ($N = 33$; 53%; [Table 1](#)). Mean age at the time of interview was 20.9 years ($SD = 1.3$). Half of the sample ($N = 31$; 50%) identified as e-cigarette only users, and the other half as dual e-cigarette and combustible cigarette users. More than half of the sample respondents ($N = 25$; 56%) reported feeling addicted to vaping at some point and roughly half reported vaping nicotine every day in the past month ($N = 28$; 47%).

Participants discussed reasons for initiation to maintenance with e-cigarettes and cigarettes. We organized these trajectories under the following categories: (1) initiation of nicotine use; (2) cigarette use first, then e-cigarette use; (3) e-cigarette use first, then cigarette use; (4) e-cigarette use with no cigarette use; and (5) dual-product and cyclical use trajectories.

Initiation of Nicotine Use

The most common reason reported for initiating both vaping and smoking was social influence. Young adults often described someone in their social circle having an e-cigarette or cigarette and offering it to them to try for the first time.

It started as a social thing [then] branched into an addiction... My first vaping experience was when I was in 8th grade, 14 [years old], and someone at school had a little pen thing, [and] they were like "It's nicotine, try this, try that" - and it was crazy, way harsher than a cigarette... [vaping] didn't even cross my mind before he introduced that.—Participant 33 (22-year-old male)

Table 1. Sociodemographic and Substance Use Characteristics of Total Sample of Young Adult Vapers Aged 18–25 (*N* = 62)

Characteristic	<i>N</i> (%) or <i>M</i> (SD)
Gender, <i>N</i> (%)	
Male	48 (78.7)
Female	13 (21.3)
Race, <i>N</i> (%)	
Asian	8 (13.1)
Black or African American	3 (4.9)
Native Hawaiian or Pacific Islander	1 (1.6)
White	29 (47.5)
Multiethnic or multiracial	11 (18.0)
Other	9 (14.8)
Ethnicity, <i>N</i> (%)	
Hispanic/Latino	15 (24.6)
Non-Hispanic/Latino	46 (75.4)
Age, <i>M</i> (SD)	20.9 (1.3)
Currently enrolled in higher education, <i>N</i> (%)	
Yes	33 (53.2)
No	24 (38.7)
Do not know/missing	5 (8.0)
Current subjective financial status, <i>N</i> (%)	
Do not meet basic expenses	1 (1.6)
Just meet basic expenses	13 (21.3)
Meets needs with a little left	24 (39.3)
Live comfortably	21 (34.4)
Missing	2 (3.3)
E-cigarette/combustible cigarette user, <i>N</i> (%)	
Sole e-cigarette user	31 (50.0)
Dual e-cigarette/combustible cigarette user	30 (48.4)
Past 30-day combustible cigarette use, <i>N</i> (%)	
0 days	12 (28.6)
1–5 days	18 (42.9)
6–19 days	8 (19.0)
20–29 days	2 (4.8)
All 30 days	2 (4.8)
Past 30-day number of days vaped nicotine product, <i>N</i> (%)	
0 days	0 (0.0)
1–5 days	6 (10.2)
6–19 days	12 (20.3)
20–29 days	13 (22.0)
All 30 days	28 (47.5)
Ever felt addicted to vaping, <i>N</i> (%)	
Yes	25 (55.6)
No	20 (44.4)
Ever tried to stop or cut down use of electronic nicotine devices, <i>N</i> (%)	
Yes	45 (75)
No	15 (25)

Available data *N*s for denominator ranged from 45 to 62.

I was like 16–17 [when I first smoked a cigarette], I was still in high school. I was with a group of friends. They were smoking cigarettes [and one] day I just smoked a cigarette [with them].—Participant 10 (22-year-old male)

Another young adult talked about how seeing other people vaping made them curious to try it. They said they did not think much about it other than that vaping seemed to be a new societal trend.

I'm a very open-minded person so I was thinking of it as nothing, a new trend that everyone is going through - monkey see monkey do kind of thing - where everyone is like oh look this is something new so I wanna do it.—Participant 15 (21-year-old male)

In addition to the novelty of vaping that intrigued some participants to initiate use, others reported that the flavors were a key reason to try vaping.

I just liked the flavors... It's the flavors and the cool tricks you can do.—Participant 36 (22-year-old male)

Cigarette Use First, Then E-cigarette Use

Participants who reported beginning with smoking and then vaping commonly said vaping felt healthier (or “cleaner”) than smoking.

I tried vaping as an alternative [to cigarettes to] look out for [my] health... I was [using cigarettes when I was] 18/19 [and] I don't know if I was just looking for something different because you get that [smoke] smell... it's just bad. [The vape] was flavored [which] helps. I felt [vaping is] a lot healthier.—Participant 10 (22-year-old male)

Young adults also reported switching from smoking to vaping for social acceptance, likely also due to the perceived “healthiness” of vaping.

I would smoke cigarettes in the [fraternity] house, but in the house of 20 guys, it would rub some people the wrong way. It wasn't even about the smoke it was them realizing what I was doing [and] that's when the JUUL came [around] I was like I should stop [smoking cigarettes]... I wasn't trying to be that much of an asshole, and [vaping was] more convenient.—Participant 62 (24-year-old male)

I smelled like cigarettes and [girls] didn't like that so I was like how am I going to be able to hook up with these older chicks... [And] everyone was saying [vaping] was safer [than smoking cigarettes].—Participant 12 (20-year-old male)

E-cigarettes Use First, Then Cigarette Use

Young adults who reported beginning vaping and then smoking often reported that this happened when they were traveling to places outside of the United States, such as Europe, where smoking cigarettes was perceived as the norm and much more accessible than vaping products.

I traveled to Europe ... [and] I lost my vaping device. I was fine for a little and then I started smoking cigarettes. Everyone smoked [cigarettes] in Europe so I would prefer that... Cigarettes were never addictive to me before I started vaping.—Participant 16 (21-year-old female)

After high school I went to Rome for [a] semester... Everyone smokes [in Europe]... [I] started smoking [cigarettes] a little bit. I liked [cigarettes], most people don't like the taste, I [do]... And then everyone [studying abroad] started smoking. It wasn't like we were all doing it because of each other, we were all like “when in Rome.” Not every

day all the time, but on the weekends if we went out or maybe once or twice a week, you know how Europeans will just take off and go to the café, buy an espresso and smoke a cigarette.—Participant 30 (20-year-old male)

E-cigarette Use With No Cigarette Use

In contrast to participants who reported both smoking and vaping, some participants reported that they never smoked combustible cigarettes due to negative perceptions and experiences surrounding cigarettes. For some, negative perceptions that deterred use of combustible cigarettes was tied to second-hand experiences (ie, disliking that family members smoke).

[Vaping] is better for you than cigarettes. I've never smoked cigarettes. My mom still smells [like] cigarettes - she's smoked my whole life. I can hear her voice change, since I was younger, to now, it's real rough now. And it smells bad... I hate that she smokes.—Participant 26 (21-year-old male)

For others, participants reported having more general perceptions (not tied to personal experience) that cigarettes are toxic and harmful, which prevented them from ever trying combustible cigarettes.

I always perceived cigarettes as so harmful and so toxic. Granted they do have the tobacco and the tar... whatever proven to be harmful for carcinogenic chemicals. I know it's not healthy to be inhaling anything that is not oxygen in through my lungs, I at least get to know that [vaping is] not a cigarette. I would never smoke a cigarette because I just think it would be disgusting. Their appearance and aesthetic, the concept around [cigarettes], is just so frowned upon I feel nowadays, and the fact that they do have this physical tobacco coming out of them [compared to] this JUUL is like a little tiny electronic device, they appear so different.—Participant 28 (19-year-old male)

Dual-Product and Cyclical Use

Many participants reported using both cigarettes and e-cigarettes simultaneously (dual use) or alternating between products across varying timespans (cyclical use) at the time of interview. Some young adults used both e-cigarettes and cigarettes depending on their day-to-day environment. Specifically, participants described vaping as more convenient to use everywhere since they do not have to go outside as they would for cigarettes. This ease of use was talked about in a positive light by some.

Vaping is all around... If you're inside your house you vape, you don't need to go outside... Cigarettes I think, especially if I'm drinking [at a party], then I would want [to smoke].—Participant 9 (19-year-old male)

Some participants talked about certain products and patterns of vaping leading to greater nicotine addiction than combustible cigarettes, multiple transitions between smoking and vaping.

There's this weird pendulum push back with a lot of people that I know where they started [with] cigarettes, they went

to JUUL to help them get off cigarettes, [but] they became way more addicted to nicotine with [JUUL], so now they're going back to cigarettes.—Participant 58 (22-year-old male)

Others talked about how the ease and mindlessness of being able to use e-cigarettes indoors was detrimental to their original intentions of switching to vaping to quit smoking.

When I started [vaping] I just found myself using it all the time. With cigarettes at least I'd have to get myself up, go outside, light the cigarette, put it out, and then walk back in - it's a whole process. I'd just be sitting there doing homework and I'm just [vaping], and I'm like hold up, this is supposed to help me quit?—Participant 1 (20-year-old male)

Costs of cigarettes versus e-cigarettes was reported to drive product choice, but there was not agreement on which product was cheaper.

I went back to cigarettes because vaping was so expensive because [e-liquids] are expensive; it's just cheaper to do cigarettes.—Participant 41 (21-year-old female)

It was a health issue but it was also a financial issue because cigarettes cost a lot of money so I bought a salt nicotine vape and then I started smoking [cigarettes] less...—Participant 9 (19-year-old male)

Across all participants who discussed dual and cyclical use of tobacco products, this nonlinear use occurred over many years of nicotine use. Among the participants we interviewed, many talked about similar reference points of time such as initiation of tobacco use during high school, for some middle school, and then commonly switching products and/or escalating tobacco use during college. Participants often talked about having a predominant tobacco product they were currently using, which had previously changed over time, and likely continued to change after this interview.

I vaped for about a year and a half [at the beginning of college] and then I could feel it wasn't good. My chest was full of phlegm [after] I was vaping all day and I got rid of it. I lasted probably a day and then I got back into cigarettes... I smoked cigarettes from [start of summer] 2016 until the spring of 2017. Then I got a vape again and vaped until end of winter/beginning of spring of 2018... I feel better with vaping, and I don't smell like cigarettes and it's cheaper.—Participant 13 (22-year-old male)

The first year of me really getting into cigarettes was when I was going back and forth between actual cigarettes and vaping. For the last year and a half [to] two years, unless I don't have my vape and someone offers me a cigarette, I'm vaping.—Participant 20 (21-year-old male)

Many participants, regardless of their trajectory, named shame as the emotion surrounding this (tobacco use) aspect of their life.

My dad smoked cigarettes, like a chain smoker, and that disgusted me. [Friends] would offer me cigarettes and I'd say no, but then the vape I was like whatever it's [blueberry] flavor so that's how it all started... Everything went downhill after that first vape kit - I didn't care what I was thinking anymore, like "oh it's not that bad let me [try] all things... [But before] I really thought [people who vaped and smoked] were losers. Then they brought it to me at school. I think that was the gate... I was so dumb. The day after I [vaped], [I was like] fuck [it I'm down [to try cigarettes]]. And then after [smoking menthol] cigarettes [regularly], I went back to vaping but with nicotine...—Participant 41 (21-year-old female)

These five nicotine use categories and reasons leading to each are displayed in Figure 1. We organize these categories by progression of use (or nicotine use trajectories as characterized above: initiation, transition, and maintenance). The most common reason for initiation of both cigarette and

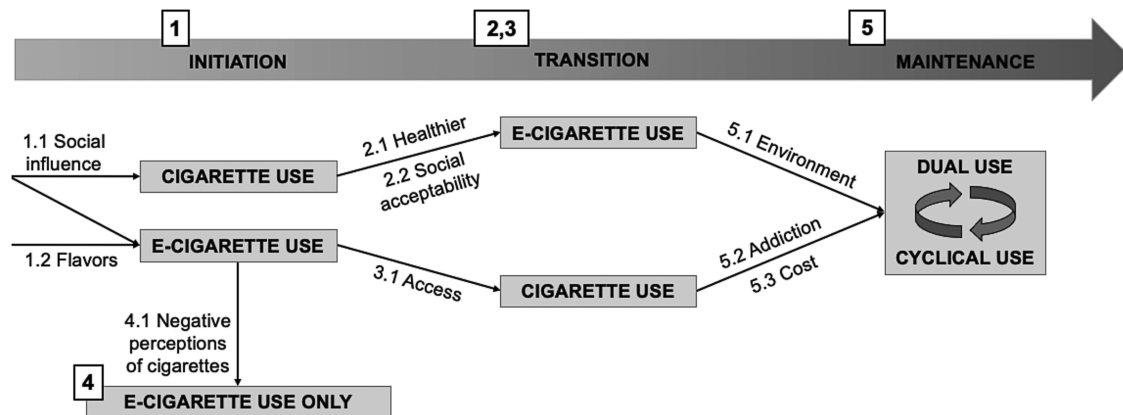


Figure 1. Model of trajectories of nicotine use leading to dual and cyclical tobacco product use. Participants discussed reasons for initiation of and transitions between tobacco products, which are discussed in detail in the results section. We organized these by type of use and trajectory: (1) initiation of e-cigarette and combustible tobacco use (reasons include 1.1 social influence and 1.2 flavors); (2) combustible tobacco products to e-cigarettes (reasons include 2.1 that e-cigarettes are healthier and 2.2 social acceptability of e-cigarettes); (3) e-cigarettes to combustible products (reasons include 3.1 accessibility and normativity of cigarettes in regions outside of the United States); (4) e-cigarette only users (reasons include 4.1 negative perceptions or experiences with e-cigarettes); and (5) dual-product and cyclical use trajectories (reasons include 5.1 environment [eg, using e-cigarettes in one venue and cigarettes in another], 5.2 addiction/dependence [seeking additional sources of nicotine] and 5.3 cost of tobacco products).

e-cigarette use was social influence. E-liquid flavors were commonly mentioned as an additional reason for initiation of e-cigarettes. Participants who began with cigarette use and then used e-cigarettes often reported this was because they believed e-cigarettes were healthier and more socially acceptable. Participants who began with e-cigarettes and then used combustible cigarettes commonly said this occurred due to accessibility and normativity of cigarettes in regions outside of the United States. Few participants were e-cigarette only users and reported this was due to negative perceptions or experiences with cigarettes. The final and most informative category was in the maintenance stage of use where participants reported dual-product and cyclical use trajectories of tobacco use. Common reasons were due to the environment (eg, using e-cigarettes in one venue and cigarettes in another), nicotine addiction/dependence (seeking additional sources of nicotine), and cost of tobacco products.

Discussion

The current study reports common trajectories and reasons why young adults began vaping or smoking and then continued to use one or both products. Our findings suggest that there are common reasons for the initiation of either product—social influences have been a key driver of initiation for decades and continue to be an important factor in youth initiation. Young adults also reported initiating vaping due to flavor novelty. People who smoked cigarettes and then began vaping reported that vaping products were seen as a healthier option than cigarettes, social pressure to quit smoking, and vaping is often more convenient than smoking cigarettes. However, young adults started vaping and then began smoking commonly reported this occurred when traveling outside the United States where vaping products were less accessible, and smoking was more normative than vaping. For many young adults in our sample, nicotine use was a nonlinear process whereby young adults described alternating between products either over long periods of time or depending on the setting they were in, because of product costs, and—interestingly—to reduce the profound feelings of nicotine dependence from vaping compared to cigarettes. Dual and cyclical use was common and is an important use pattern that should be taken into consideration in future research, and in the development of policy or prevention efforts to address tobacco product use among young people.

For both smoking and vaping, being in a social setting was the most common reason young adults reported initial use. This aligns with previous research that shows youth who are around friends and family who smoke and vape are more likely to begin consuming nicotine regularly themselves.^{17,18} E-liquid flavors were also described as a reason for initiating use in the current study, which aligns with the literature that suggests sweet and candy flavors not only appeal to nicotine naive youth but also young adult smokers trying to cut down.^{19–21} Furthermore, early adolescent use in a social setting and use of flavors were both described in narratives discussing long-term nicotine use, which is likely impacted at least in part because the brains of younger adolescents are more sensitive to nicotine²² and younger adolescents are more susceptible to social influences.²³ Nicotine and highly palatable foods such as high sugar increase dopamine in similar ways which with repetition over time contributes to the development of addiction among vulnerable people.^{24,25}

Together, social influence and combination of nicotine and flavors continue to be key drivers for initiation of tobacco products.

Social acceptability and societal norms played a large role in which tobacco products young adults were currently using. Some reported switching from smoking to vaping due to peer pressure and perceptions that vaping is healthier as well as being more convenient to use. Multiple lines of research have called for better education and intervention addressing the health effects from vaping, which are often compared to the health effects from smoking, rather than independently or in reference to not using any nicotine products.^{26,27} Youth often report that vaping is relatively safer than smoking and leave it there, without further consideration of the absolute safety (or lack thereof) of using high nicotine content products. Even in the absence of combustion, misperceptions of nicotine use disorder and abuse liability can be readily addressed in intervention and education efforts. Others began smoking after vaping while traveling abroad. These findings connect with previous literature^{28,29} and hold important implications for prevention efforts. Specifically, the timing and context with which prevention programs are delivered may prevent the three-fold increase in cigarette smoking while studying abroad.²⁹ It is worth noting that while few participants reported only using e-cigarettes, most study participants reported both vaping and smoking regardless of which product they initiated with.

Narratives and self-report data indicated dual and cyclical use was common for young adult nicotine users at the time of our study. Some participants said they used both cigarettes and e-cigarettes depending on the environment (eg, vaping when they are inside or at work and smoking if they are outside or at a party). Some participants reported they began vaping to quit smoking but because of ease of use (ie, indoors while studying) felt they became more addicted to nicotine. This finding illustrates the lack of information and education about self-titration and puffing topography, which varies by user type.^{30–32} Some participants reported they went back to smoking cigarettes after vaping because it became cheaper than exclusively vaping, while others reported vaping instead of smoking because of cost. Many participants who talked about dual and cyclical use also reported negative perceptions of tobacco products prior to use and then cognitive dissonance and shame around continued use. Participants commonly reported not “taking to” cigarettes upon first use, but with continued tobacco use, especially dual use with e-cigarettes and e-liquid flavors, they developed nicotine dependence, which is commonly reported among young people using high nicotine content e-cigarettes or dual using both e-cigarettes and cigarettes.³³

These findings have implications for policymakers, prevention scientists, and interventionists interested in reducing the adverse public health impact of tobacco use among young adults. First, policy makers addressing nicotine dependence and the vaping epidemic should consider evidence in a holistic picture of *why* young adults use nicotine rather than which nicotine product(s) they use. Second, studies should avoid examining transition between products in only one direction, or a linear fashion, as it was uncommon for individuals to simply switch from vaping to smoking or smoking to vaping one time. Cyclical use patterns appeared common and should be evaluated for prevalence in population-based studies. Finally, public health messages on abuse liability and topography

of vaping are warranted and should target adolescent and young adult vaping prevention and cessation efforts.

The generalizability of these findings may be limited by the small sample from Southern California, which included a substantial proportion of males; replication is warranted. Our findings are also limited by the inclusion criteria that required participants to have used e-cigarettes weekly for 5 months prior to study, which excluded participants who may have transitioned from e-cigarette to combustible cigarettes exclusively (ie, were not using e-cigarettes at the time of study). Due to the qualitative nature of this study, no conclusions can be drawn regarding the prevalence or cause of young adults tobacco use. To understand how prevalent the phenomena reported herein are, future research is warranted. We encourage future research to examine tobacco use on a continuum of dual and cyclical use rather than fixed state. While people may report a predominant product of choice at one period, it was common that our study participants reported use of other products simultaneously, and that the product of choice changed and likely continued to change after the interview.

The current study demonstrates credibility from a large team of coders who reached consensus on concepts emerging from the data and confirmability from providing sufficient detail on the researcher's interpretation being grounded in the data. Findings advance, refine, and expand on the body of knowledge about trajectories of young adult tobacco use. The current study involved prolonged engagement with data and regular debriefing, along with confirmability from detailing methods, recruitment, data collection, and analytic process.³⁴ In conclusion, this study provides narratives on young adult trajectories of nicotine use and characterizes reasons for initiation and maintenance of tobacco products. Findings align with and offer empirical evidence for many of the nicotine product transition hypotheses previously described in the literature.¹³ We display findings in a model intended to contribute to the evolving and refining understanding of this phenomena. We encourage researchers to replicate and test this model across various samples and multiple timepoints as well as expand to tobacco use cessation. Researchers and policy makers should consider costs (eg, of vaping products vs. cigarettes), environment (eg, ease of indoor vaping versus outdoor smoking), and health education (eg, in educating the public regarding the relative and absolute safety of vaping, particularly regarding abuse liability, as it becomes known), in addition to standard practices that focus on reducing initiation in social settings.

Supplementary Material

A Contributorship Form detailing each author's specific involvement with this content, as well as any supplementary data, are available online at <https://academic.oup.com/ntr>.

Funding

Research reported in this publication was supported by grant number U54CA180905 from the National Cancer Institute (NCI) at the National Institutes of Health (NIH) and the Food and Drug Administration (FDA) Center for Tobacco Products (CTP), grant number K01DA042950 from the National Institute for Drug Abuse (NIDA) at NIH, grant R01CA226917 from NIH/NCI, and grant 27-IR-0034 from the Tobacco Related Disease Research Program (TRDRP).

Role of Funder

The funder had no role in the design and conduct of the study; collection, management, analysis, or interpretation of the data; or preparation, review, or approval of the manuscript.

Declaration of Interests

None declared.

Acknowledgments

We are grateful for our team of research assistants who transcribed audio files and helped with initial data analysis.

Data Availability Statement

The data underlying this article will be shared on reasonable request to the corresponding author.

References

1. Cullen KA, Gentzke AS, Sawdey MD, *et al.* E-cigarette use among youth in the United States, 2019. *JAMA*. 2019;322(21):2095–2103.
2. Miech R, Leventhal A, Johnston L, O'Malley PM, Patrick ME, Barrington-Trimis J. Trends in use and perceptions of nicotine vaping among US youth from 2017 to 2020. *JAMA Pediatr*. 2021;175(2):185–190.
3. Wang TW, Neff LJ, Park-Lee E, *et al.* E-cigarette use among middle and high school students—United States, 2020. *Morb Mortal Wkly Rep*. 2020;69(37):1310–1312.
4. Hajek P, Phillips-Waller A, Przulj D, *et al.* A randomized trial of e-cigarettes versus nicotine-replacement therapy. *N Engl J Med*. 2019;380(7):629–637.
5. Barrington-Trimis JL, Berhane K, Unger JB, *et al.* Psychosocial factors associated with adolescent electronic cigarette and cigarette use. *Pediatrics*. 2015;136(2):308–317.
6. Leventhal AM, Strong DR, Kirkpatrick MG, *et al.* Association of electronic cigarette use with initiation of combustible tobacco product smoking in early adolescence. *JAMA*. 2015;314(7):700–707.
7. U.S. Department of Health and Human Services. *E-cigarette Use Among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2016. https://e-cigarettes.surgeongeneral.gov/documents/2016_sgr_full_report_non-508.pdf. Accessed November 10, 2021.
8. National Academies of Sciences, Engineering, and Medicine. *Public Health Consequences of E-Cigarettes*. Washington, DC: The National Academies Press; 2018. <https://www.nap.edu/read/24952/chapter/1>. Accessed November 10, 2021.
9. Primack BA, Soneji S, Stoolmiller M, Fine MJ, Sargent JD. Progression to traditional cigarette smoking after electronic cigarette use among US adolescents and young adults. *JAMA Pediatr*. 2015;169(11):1018–1023.
10. Wills TA, Knight R, Sargent JD, Gibbons FX, Pagano I, Williams RJ. Longitudinal study of e-cigarette use and onset of cigarette smoking among high school students in Hawaii. *Tob Control*. 2017;26(1):34–39.
11. Gmel G, Baggio S, Mohler-Kuo M, Daeppen JB, Studer J. E-cigarette use in young Swiss men: is vaping an effective way of reducing or quitting smoking? *Swiss Med Wkly*. 2016;146:w14271.
12. Barrington-Trimis JL, Urman R, Berhane K, *et al.* E-cigarettes and future cigarette use. *Pediatrics*. 2016;138(1):e20160379.
13. Schneider S, Diehl K. Vaping as a catalyst for smoking? An initial model on the initiation of electronic cigarette use and the

- transition to tobacco smoking among adolescents. *Nicotine Tob Res.* 2016;18(5):647–653.
14. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): A 32-item checklist for interviews and focus groups. *Int J Qual Health Care.* 2007;19(6):349–357.
 15. Patton MQ. *Qualitative Research and Evaluation Methods.* 3rd ed. Thousand Oaks, CA: Sage; 2002.
 16. Nowell LS, Norris JM, White DE, et al. Thematic analysis: striving to meet the trustworthiness criteria. *Int J Qual Methods.* 2017;16(1):1–13.
 17. Green MJ, Gray L, Sweeting H. Youth vaping and smoking and parental vaping: a panel survey. *BMC Public Health.* 2020;20(1):1111.
 18. Wang JW, Cao SS, Hu RY. Smoking by family members and friends and electronic-cigarette use in adolescence: A systematic review and meta-analysis. *Tob Induc Dis.* 2018;16:05.
 19. Chen JC, Green K, Fryer C, et al. Perceptions about e-cigarette flavors: a qualitative investigation of young adult cigarette smokers who use e-cigarettes. *Addict Res Theory.* 2019;27(5):420–428.
 20. Morean ME, Butler ER, Bold KW, et al. Preferring more e-cigarette flavors is associated with e-cigarette use frequency among adolescents but not adults. *PLoS One.* 2018;13(1):e0189015.
 21. Pepper JK, Ribisl KM, Brewer NT. Adolescents' interest in trying flavoured e-cigarettes. *Tob Control.* 2016;25(Suppl 2):ii62–ii66.
 22. U.S. Department of Health and Human Services. *The Health Consequences of Smoking—50 Years of Progress. A Report of the Surgeon General.* Atlanta, GA: Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2014. https://www.ncbi.nlm.nih.gov/books/NBK179276/pdf/Bookshelf_NBK179276.pdf. Accessed November 10, 2021.
 23. U.S. Department of Health and Human Services. *Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General.* Atlanta, GA: Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2012. https://permanent.fdlp.gov/gpo21718/http___www.surgeongeneral.gov_library_preventing-youth-tobacco-use_full-report.pdf. Accessed November 10, 2021.
 24. Criscitelli K, Avena NM. The neurobiological and behavioral overlaps of nicotine and food addiction. *Prev Med.* 2016;92:82–89.
 25. Landry RL, Groom AL, Vu TT, et al. The role of flavors in vaping initiation and satisfaction among U.S. adults. *Addict Behav.* 2019;99:106077.
 26. McKelvey K, Baiocchi M, Halpern-Felsher B. Adolescents' and young adults' use and perceptions of pod-based electronic cigarettes. *JAMA Netw Open.* 2018;1(6):e183535.
 27. Kechter A, Schiff SJ, Simpson KA, et al. Young adult perspectives on their respiratory health symptoms since vaping. *Subst Abuse.* 2020:1–13.
 28. Eisenberg ME, Toumbourou JW, Catalano RF, Hemphill SA. Social norms in the development of adolescent substance use: a longitudinal analysis of the International Youth Development Study. *J Youth Adolesc.* 2014;43(9):1486–1497.
 29. Firth C, LaBrie JW, D'Amico EJ, Klein DJ, Griffin BA, Pedersen ER. Changes in cigarette, e-cigarette, and cannabis use among U.S. College Students studying abroad. *Subst Use Misuse.* 2020;55(10):1683–1691.
 30. Goldenson NI, Buchhalter AR, Augustson EM, Rubinstein ML, Van Hoof D, Henningfield JE. Abuse liability assessment of the JUUL system in two nicotine concentrations compared to combustible cigarette, nicotine gum and comparator electronic nicotine delivery system. *Drug Alcohol Depend.* 2020;217:108441.
 31. Lee YO, Nonnemaker JM, Bradfield B, Hensel EC, Robinson RJ. Examining daily electronic cigarette puff topography among established and nonestablished cigarette smokers in their natural environment. *Nicotine Tob Res.* 2018;20(10):1283–1288.
 32. Stiles MF, Campbell LR, Graff DW, Jones BA, Fant RV, Henningfield JE. Pharmacodynamic and pharmacokinetic assessment of electronic cigarettes, combustible cigarettes, and nicotine gum: Implications for abuse liability. *Psychopharmacology.* 2017;234(17):2643–2655.
 33. Vogel EA, Prochaska JJ, Ramo DE, Andres J, Rubinstein ML. Adolescents' E-cigarette use: Increases in frequency, dependence, and nicotine exposure over 12 months. *J Adolesc Health.* 2019;64(6):770–775.
 34. Lincoln YS, Guba EG. *Naturalistic Inquiry.* Beverly Hills, CA: Sage Publications; 1985.