It's addiction at this Point": A qualitative examination of youth E-cigarette use trajectory in the United States

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ABSTRACT

E-cigarettes (electronic cigarettes) have been the most used tobacco product among US youth since 2014, reaching a plateau during the COVID-19 pandemic. Youth e-cigarette use is associated with negative health consequences such as impaired cognitive functioning. For many, the COVID-19 pandemic altered social interactions, harm perceptions, and product availability. This changed the frequency and locations in which youth use e-cigarettes. To better understand youth e-cigarette use, we need more information on factors that can alter e-cigarette use, specifically, how the pandemic changed e-cigarette use among youth. In 2020-2021, we conducted online, individual interviews with 19 youth (aged 13-17) e-cigarette users living in the US to explore how COVID-19 impacted their e-cigarette use. Youth described a progression of e-cigarette use from initial experimentation, regular social use, and ultimately to nicotine addiction demonstrated by individual use in isolation. Many youth initiated e-cigarette use due to influences by friends or family members. Youth discussed progression to social use, with social interactions as an important reason for use and an avenue for expanding one's knowledge of e-cigarettes. After a period of time, youth began to recognize that the social interactions mattered less, suggesting to them that they had become addicted. This realization became more apparent during COVID-19, which changed how youth used e-cigarettes, especially around where use was occurring, health concerns, and use behavior and frequency. In our interviews, youth trajectory began with an initiation with family and friends, progressed to social use, and eventually developed to addiction, at which point social use was no longer the primary motivation for e-cigarette use. Understanding the trajectory of e-cigarette use will allow for effective interventions that reduce harm to youth from e-cigarette use.

KEYWORDS: e-cigarettes, youth, adolescents, trajectory, social influence

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Introduction

Since 2014, e-cigarettes (electronic cigarettes) have been the most used tobacco product among middle and high school students in the United States; past 30-day rates were 23% in 2019 and 22% in 2020 during the COVID-19 pandemic.[1] E-cigarette use among youth is associated with increased odds of tobacco use later in life, which is often referred to as the gateway hypothesis.[2–5] This suggests that exposure to nicotine during adolescence may make adolescents nicotine dependent, which may lead to combustible cigarette use later in adulthood.[6–8] Exposure to nicotine during adolescence is associated with lasting cognitive and behavioral impairments, including effects on memory, attention, and prefrontal cortex activation.[2,9–11]

The COVID-19 pandemic profoundly affected health behaviors, including dramatic shifts in sleep, physical activity, and substance use.[12] In the US, Nearly 40% of youth that used e-cigarettes during COVID-19 reported increasing use since the start of the pandemic[13], though there were discrepancies on whether youth e-cigarette use increased or decreased during COVID-19.[13–15] This potential decrease in youth e-cigarette use during COVID-19 could be due to US's media coverage of E-cigarette or Vaping Product Use-Associated Lung Injury (EVALI) in the previous year.[16] With the outbreak of EVALI in the US, youth became more aware of the severe health outcomes of e-cigarette use, including organ failure and related lung disease.[17]

There are associations between COVID-19 and e-cigarette use among youth. COVID-19 diagnosis was 2.6 times more likely among youth who had used e-cigarettes in the past 30 days compared to those who had not.[18] Though youth are at a lower risk of contracting COVID-19 compared to older adults, e-cigarette use may increase that risk.[18,19]

The trajectory of e-cigarette use has typically been studied based on changes in the frequency of use or user groups. Those who used e-cigarettes at least 14 days a month in eighth grade (approximately 13-14 years old) were more likely to report daily

e-cigarette use by the end of ninth grade (approximately 14-15 years old) and use of other substances, including cannabis.[20] For some, the trajectory of e-cigarette use showed a process where increased e-cigarette use replaced smoking cigarettes and for others, dual use of e-cigarettes and cigarettes became the norm.[21,22]

Research on youth e-cigarette use trajectory in the context of COVID-19 has been emerging.[13–15,23] However, to our knowledge, no qualitative research examined e-cigarette use trajectories in the context of COVID-19 and no research on the role of social influences on these trajectories exists. Yet examining the social influences of e-cigarette use is important because social constructs shape an individual's e-cigarette use and trajectory of changes in use. We aim to address this gap by examining the trajectories of e-cigarette use in the context of COVID-19 using qualitative methods.

Materials and Methods

Participants

Eligibility criteria included being aged 13-17, past 30-day e-cigarette use, and residing in the United States. Recruitment for participants occurred in two waves. Wave 1 (August-November 2020) used a nationwide panel research company and resulted in 38 eligible youth, with two completing interviews. Wave 2 (December 2020-February 2021) utilized a youth advisory board and snowball sampling, resulting in 47 eligible youth, with 17 completing interviews. Parental consent and youth assent were obtained for all participants.

Data Collection

The primary goal of this study was to evaluate how youth modify e-cigarettes, with the secondary goal of examining motivations, experiences, and expectancies of e-cigarette use. REDACTED FOR REVIEW report on the findings pertaining to modifications. This paper describes the trajectories of e-cigarette use in the context of COVID-19. All participants completed a brief survey assessing basic demographics and past tobacco use (cigarettes, cigar products, and e-cigarettes). Individual interviews conducted by a trained moderator from JSI Research & Training Institute, Inc., (JSI) occurred in late 2020 and early 2021. The moderator was a white female in her thirties with master's degrees in public health and social work. Interviews followed a semi-structured interview guide that included questions about e-cigarette type(s) used, use behaviors over time (first use, current use, effect of COVID-19), what they like about their products, and various modifications. Interviews were conducted over a web-based video conferencing platform, and, when possible, cameras were used. During the interviews, members of the research team were present, though they remained muted and with their cameras off. The median length of the interview was 45 minutes, ranging from 27 minutes to 63 minutes. Upon completion of the interview, participants were emailed a fact sheet with information about e-cigarette cessation and a $50 gift card. All interviews were recorded, de-identified and transcribed by JSI. Georgia State University Institutional Review Board approved this study.

Analysis

The data were analyzed inductively in NVivo version 12.0 using a thematic analysis approach.[24] The team utilized a modified codebook, which they had previously used with adult e-cigarette users. Two coders independently coded one transcript and met to discuss discrepancies. The remaining 18 transcripts were then divided between the two coders. The research team read the coded transcripts and wrote memos that discussed the themes. The first author then read all the memos and corresponding transcripts and synthesized the results.

Results

Participants (n = 19) were aged 16 and 17, majority male (58%), 37% female, and Black/African American (79%), with 10.5% identifying as White and 10.5% identifying as more than one race. The median age at first e-cigarette use was 14 (Table 1). Participants discussed their e-cigarette use, social use of e-cigarettes, changes in how e-cigarettes are used over time, and changes in e-cigarette use due to COVID-19. The importance of

Table 1. Demographic results of youth who use e-cigarettes. (n = 19).

Sex	n (%)
Male	11 (58)
Female	7 (37)
Other	1 (5)
Race, n (%)	
Black/African American	15 (79)
White	2 (10.5)
More than one race[a]	2 (10.5)
Ethnicity, n (%)	
Spanish/Hispanic/Latinx	2 (11)
Not Spanish/Hispanic/Latinx	17 (89)
Age in years, n (%)	
16	8 (42)
17	11 (58)
Age at first ENDS use, median (IQR)	14 (2)
Lifetime cigarette smoking	
Never	3 (16)
1-99 cigarettes	12 (63)
100 cigarettes or more	4 (21)
Ever cigar product use (yes)[b]	4 (21)

Note.
[a]One participant indicated both Black/African American and White as their race. Another participant indicated their race as Asian and White.
[b]Cigar products: traditional cigars, cigarillos, or filtered cigars, even one or two puffs.

social interactions and influences from friends and family on initiation and transitions in e-cigarette use emerged as a central theme: **role of social influences in early stages of e-cigarette trajectories**. Another central theme was the **role of addiction in transition to established e-cigarette use**.

Initiation of E-cigarette use

Role of social influences in early stages of e-cigarette trajectories was one of the main themes we identified. In this section on initiation, we discuss the following sub-themes for this theme: e-cigarette initiation through families and e-cigarette initiation through friends.

E-cigarette initiation through families. For many participants, the initiation of e-cigarette use occurred through either family or friends, who facilitated access to e-cigarettes by making e-cigarettes available in the home, sharing e-cigarettes, or acting as a source for purchasing e-cigarettes. Participants mentioned having their cousins introduce them to e-cigarettes, saying, "We were kind of family oriented… We had come together, and we were in a kind of a party. So, a cousin of mine actually introduced it to me" (male, 17, Black/ Non-Hispanic). Another described stealthily learning to use e-cigarettes from her older cousins: "So when they are out, I'd go sneak in their room, puff and then move out, until I became a fan" (female, 17, Black/ Non-Hispanic). One participant mentioned starting to use e-cigarettes because his parents smoked but he did not like how cigarettes tasted, so decided to use e-cigarettes instead. Another participant described using e-cigarettes because their father used them. Thus, in many interviews, family were mentioned as facilitating e-cigarette initiation among youth.

E-cigarette initiation through friends. Friends also played a prominent role in the initiation of e-cigarettes. Many participants mentioned starting to use e-cigarettes to imitate their friends. One stated, "I just saw one of my friends doing it then I copied it" (female, 17, Black/ Non-Hispanic) or and another said that they were just "fumbling around with it" (male, 16, Asian, White/ Non-Hispanic). Others initiated because their friends explicitly suggested using e-cigarettes, especially when it was seen as "healthier" than cigarettes. One participant stated, "I was smoking a small cigarette. So, my friend told me that it was unhealthy… He said that there are some modern ways I can prevent the harmful effects of cigarettes. And he showed me a vape… And that's how I started" (male, 16, Black/Non-Hispanic).

Social use of e-cigarettes

Still under the main theme of role of social influences in early stages of e-cigarette trajectories, the following sub-themes were identified in the social use of e-cigarettes with friends and community disapproval of e-cigarettes.

Social use of e-cigarettes with friends. Participants frequently discussed social interactions and social use of e-cigarettes as an important reason for continued use, as well as an avenue for expanding their knowledge of e-liquids, devices, and ways to use e-cigarettes. Friends made use more enjoyable, "Well, there's no fun in doing it alone, so I do with friends" (female, 17, Black/ Non-Hispanic). Multiple participants mentioned vaping with friends more than vaping alone, such as "But when I'm vaping with friends, it's fun because you vape a lot, but when you are alone, you don't vape a lot." (male, 16, Black/Non-Hispanic. Different friend groups had different dynamics, and participants had to assess whether it was socially acceptable to use e-cigarettes based on the friend group they were with at the time. In addition to potentially increased use, participants mentioned the use of cannabis and cocaine in their e-cigarettes when they are with friends, compared to when they were alone, by saying, "Mostly the Juul brand because I use marijuana mostly with my friends"(female, 17, Black/Non-Hispanic).

Social use of e-cigarettes also proved to be an avenue for expanding the participant's knowledge of e-cigarettes. Participants mentioned discussing with their friends where to purchase e-cigarettes: "They [friends] told me, 'Oh, you can go and get it from Amazon.' And I was like, 'Oh. That's great'" (female, 17, Black/Non-Hispanic). Others mentioned comparing vaping experience from each other's devices, "If someone is using a Juul, and then you're using a vape, you can just give them your own, and then they just give you your own, and see how the hits are like as compared to what you're using" (female, 16, Black/ Non-Hispanic).

Community disapproval for e-cigarettes. Some participants reported hiding their use from adults. A participant specifically mentioned using a small pen-style e-cigarette so it would be easy to hide in their pocket rather than carrying it around in their hand, by stating, "The fact that I can disguise it to a pen and my parents wouldn't know if I'm using, or let's say my teacher, the relatives" (female, 17, Black/Non-Hispanic). There were specific mentions of disapproval of e-cigarette use in the Black community, stating, "I'm Black and my community anyone will straight up tell you, 'What is this, why you're doing this?' So, just to avoid so much judgment and quarrel from people" (female, 16, Black/Non-Hispanic). This participant further explained her strategy to vape without attracting notice from her community: "You just keep it on the low; we smoke somewhere where it won't get noticed like the backyard". In this example, social disapproval of e-cigarettes in the Black community made the participant hide her e-cigarette use from people around her. Yet, she still used e-cigarettes with her narrower community of friends who approved of e-cigarettes.

Nicotine addiction and e-cigarettes

The second major theme was the role of addition in transition to established use of e-cigarettes. Discussion of nicotine addiction

or dependence was prevalent among participants. Addiction presented itself in multiple ways, with participants discussing having a "buzz" or a "craving". One participant described their experience as, "I really have that craving. Right now, even though I have that craving, it's a lot more than the first time I started vaping. It's an addiction" (male, 16, Black/Non-Hispanic). Another said, "I can't resist vaping. That's one thing I'm sure, because I've tried to stop vaping, but I really can't" (male, 16, Black/Non-Hispanic). Some recognized that they are addicted but were grappling with admitting it, saying "I wouldn't say that I'm being addicted, but then having to accept that and seeing it as something that's fun" (male, 17, Black/Non-Hispanic). Thus, discussion about being addicted to nicotine was common across youth interviews.

Addiction to nicotine was often discussed in relation to social influences. For instance, participants mentioned that without social pressure, they used to chase a nicotine high when they started using e-cigarettes. As one participant described it, "so, freshman year…it was a mix of peer pressure to do what everyone was doing. It wasn't really about the nicotine buzz back them. And now… it's addiction at this point" (male, 16, Black/Non-Hispanic).

Participants mentioned their concern from group use shifting from experimentation to dependence on nicotine. This progression influenced them to cut back on their personal use. There was increased awareness of personal dependence as well, with multiple participants showing concern, such as, "But then I'm also trying to check and make sure that I don't like, exhibit dependence" (male, 17, Black/Non-Hispanic).

Changes in e-cigarette use and COVID-19

The onset of the COVID-19 pandemic changed how participants used e-cigarettes, especially regarding place of use, health concerns, and frequency of use. For instance, prior to COVID-19, participants mentioned using e-cigarettes at parties, friends' houses, or at school. Multiple participants mentioned using e-cigarettes in school bathrooms and "we could be in class, after class, we'd go out to smoke" (female, 17, Black/Non-Hispanic). Participants stated that having school remotely made it harder to use e-cigarettes because they were at home with their parents. One participant described, "It was harder because they weren't at school for 6 hours where they could just go to the bathroom" (male, 16, Black/Non-Hispanic). Yet, participants remained creative and would go on walks or hikes with friends to use their e-cigarettes without being detected by their parents or guardians.

Health concerns about vaping and COVID-19 influenced how participants used e-cigarettes. This manifested in not sharing e-cigarettes with friends and being concerned about taking care of their respiratory system to reduce their risk of COVID-19. One participant mentioned they had to "clean it [e-cigarette] thoroughly", and another stated, "I do not share at all these days; it's really dangerous" (female, 17, Black/Non-Hispanic). When there was concern about COVID-19 and sharing e-cigarettes, a participant noted, "I end up maybe asking a friend that is trustworthy that I know she is good at taking care of herself" (female, 17, Black/Non-Hispanic). There were also discussions of health scares, with a participant saying, "We tried to leave that trend because there's a friend of mine who just died early of this year. […] She got lung cancer, and then the doctor told us if we continue smoking, all of us will go that way. So we're trying to leave it" (female, 17, Black/Non-Hispanic).

Frequency of use changed during the pandemic, with some participants using more frequently and some less. Reasons for increased frequency of use were having more free time or boredom, such as, "the first couple months of lockdown was hard because that's all you have to do, sit around, do nothing. So like, why not just get buzzed?" (Identified as other, 16, Asian, White/Non-Hispanic). Another reason was using e-cigarettes to cope with stress or isolation, which multiple participants mentioned, "I'm alone, sometimes I'm stressed out, so I just use my e-vape to reduce the level of stress" (male, 17, Black/Non-Hispanic).

One reason for the decrease in use frequency was that the pandemic decreased buying power (the equity in which someone has to purchase goods) for participants, which affected how and where they could obtain e-cigarettes. Participants also discussed being isolated from friends and their ability to buy or refill products due to pandemic-related shortages, sometimes leading to the rationing of e-cigarettes and supplies. One participant described this as, "I don't vape a lot because my savings are down, because you can't borrow money to vape" (male, 16, Black/Non-Hispanic). Price increases and depleted supplies also led to youth purchasing e-cigarettes online because "it's hard to get that from the stores because when you just get there, they just tell you that they don't have them at the moment" (female, 16, Black/Non-Hispanic). Since some vape shops were closed, a participant mentioned friends who had siblings of legal purchasing age would "buy in bulk and then sell them off his Snapchat story" (Identified as other, 16, Asian, White/Non-Hispanic).

Discussion

Our qualitative study with youth who used e-cigarettes examined their experiences of initiation, social use, addiction, and changes due to COVID-19. Many youth described e-cigarette use due to influences by friends or family members. Specifically, many discussed progressions to social use, with social interactions as an important reason for use and an avenue for expanding one's knowledge of e-cigarettes. Eventually, youth began to recognize that using e-cigarettes socially mattered less, suggesting that they had become addicted. Given the centrality of social interaction in interviews, we will discuss our findings through the lens of the social influence theory and the processes of compliance, identification, and internalization.

Social influence theory states that three main social influence processes shape an individual's beliefs, attitudes, and subsequent behaviors: compliance, identification, and internalization.

Social influence allows changes in attitude and behavior, depending on the changes in processes. Further, changes in behavior may be attributed to the three main processes by which individuals accept influence.[25] Overall, the changes in an individual's beliefs, attitudes, and behaviors occur at various levels, which results in the different processes an individual uses to conform with the person or group that is influencing them.

The initiation of e-cigarette use may be explained through the influence mechanism of compliance. Compliance occurs when individuals accept influence and adopt the influenced behavior to gain rewards or avoid punishments.[25] Satisfaction in compliance is derived from the social effect of accepting influence.[25] This is seen in the discussion of seeing friends and/or family using e-cigarettes, then copying them, as found. Youth e-cigarette use is strongly affected by social norms, so much so that simply seeing peers engage in behavior such as e-cigarette use increases one's willingness to make the behavior seem more normative.[26,27] Moreover, youth with family members who use e-cigarettes are more likely to use e-cigarettes and more likely to obtain e-cigarettes from family members.[28–30] However, there is little research that states explicitly the initiation of e-cigarette use is due to opportunities from a family member.[28–30] With older family members, this may make the youth more open to trying the e-cigarettes because youth tend to follow the behaviors of "older people" to fit in.[31]

The social use of e-cigarettes may be explained by the identification stage of the social influence theory when individuals adopt the behavior to create or maintain a desired or beneficial relationship with either a group or person. The satisfaction in the identification stage is due to the act of conforming.[25] We found that youth engage in this stage through the use of e-cigarettes with their friends, preferring to use with friends in this stage, compared to using alone. The identification stage also includes the process of changing e-cigarette use in order to protect their social identity and avoid social disapproval of e-cigarette use. Youth use e-cigarettes in social settings to fit in or adopt their behaviors in groups.[17,30,32] Youth may use e-cigarettes "to be 'cool'", which furthers the desired relationship and satisfaction due to conforming to the social norm of e-cigarette use.[33]

Progression from social use to nicotine addiction may be viewed from the perspective of internalization in the social influence theory. The internalization process of influence occurs once an individual accepts influence after perceiving that the content of the behavior is rewarding, thus, satisfaction occurs.[25] One interpretation of our data is the physiological reward of nicotine was mutually reinforced by the psychological rewards of social approval from peers. Interviews revealed a pattern where participants began e-cigarette use as a social behavior to have fun with friends, with initiation facilitated by friends and family. Alarmingly, participants often describe how casual social use of e-cigarettes resulted in nicotine addiction and that realizations about addiction occurred when youth were using e-cigarettes by themselves and away from friends. In this sequence, the physiological reward of using nicotine and the psychological reward of social interaction were mutually reinforcing. However, as noted in several interviews, the social reward eventually receded-especially in COVID-19 isolation-leaving the demands of nicotine addiction to be realized in isolation.

The discussion of nicotine dependence and/or addiction was frequent among participants. This may be due to increased education about the health effects of e-cigarette usage, or due to increased awareness of the health effects of e-cigarette usage, as highlighted by the EVALI outbreak.[16,17,34,35] Even though youth are aware of the health effects of e-cigarette usage, they seek the reinforcement that nicotine provides.

The COVID-19 pandemic significantly changed many behaviors, including e-cigarette use. Based on our interviews, school closures reduced the importance of social influences, thus making the cravings and physiological rewards of e-cigarettes more salient. Before the onset of COVID-19, participants discussed the social use of e-cigarettes at parties and in schools, particularly in school bathrooms, even though e-cigarettes were not allowed.[17,36] With schools closed during the pandemic, youth were at home more, so they would find creative ways to use e-cigarettes, such as going on walks or hikes with e-cigarette-using friends. Some implemented health protective behaviors such as not sharing e-cigarettes to reduce the risk of COVID and decreasing their use to protect their respiratory system. However, none specifically mentioned that these changes were precipitated by the belief that using e-cigarettes was linked to an increased risk of contracting COVID-19, which may be due to conflicting messaging at the beginning of the pandemic.[18,19]

The frequency of e-cigarette use changed. Increased use was explained by more free time and belief that e-cigarettes help cope with feelings of stress or isolation, which were common feelings during COVID-19 lockdowns.[37] Youth commonly believe that e-cigarettes help relieve stress or anxiety.[17] In contrast, decreased frequency of e-cigarette use may be due to decreased buying power or availability of e-cigarettes, which may change how youth obtain their e-cigarettes. Youth mentioned not being able to use their e-cigarette as much due to budget constraints, and price increases. This is consistent with literature that discusses not being able to go to vape shops and product availability decreasing during the COVID-19 pandemic.[38] However, youth could still obtain e-cigarettes online.

Limitations include not being representative of all youth e-cigarette users, partially due to the use of snowball sampling. These interviews were conducted online, which may have presented challenges in interpreting the meaning of questions based on limited nonverbal communication. But, conducting these interviews on-line allowed us to reach youth in more diverse locations than would have been possible if in-person interviews were carried out in a single city. A single interviewer, a non-Hispanic white female in her early 30's, conducted all interviews. While this kept the interviews consistent, youth may have shared differently based on their comfort level with the interviewer. Furthermore, the rest of the study team were all professionals with advanced degrees and experience working in tobacco/ENDS and qualitative research and could have introduced personal bias while interpreting the results. With qualitative methods, the goal is to further understand

the topic, and not to generalize findings or draw causal relationships from the research. Because 79% of this interviewed in this study were African-American, it would be worthwhile to conduct further research on a more diverse group of adolescents. It is also important to better understand whether this progression is occurring even when COVID-19 is not changing some of the social dynamics of youth interactions.

Conclusion

COVID-19 changed how youth used e-cigarettes. Youth progressed from initiation due to friends and families, to social use, eventually realizing they had become addicted. When youth became addicted, the social interactions did not matter anymore, which was amplified during COVID-19. Understanding the trajectory of use is vital to creating prevention and cessation strategies for appropriate and timely interventions. Preventing youth nicotine addiction is critical to reducing the life-long harm resulting from the use of tobacco products. Health communications that educate youth about the danger of initiation of e-cigarettes and the progression from a social experience to addiction should be developed and disseminated with the very effective communications about cigarette use.

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