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E-cigarette and combustible cigarette cessation patterns, reasons, and methods among adolescents, young adults, and adults

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ABSTRACT

Research is limited regarding adolescents' and young adults' (AYA) patterns, methods of, and reasons for cigarette or e-cigarette cessation. Further, while adults may try to use e-cigarettes to quit combustible cigarettes, little is known about how adults then quit e-cigarettes. This study utilizes a national, cross-sectional online survey of 6131 diverse participants aged 13–40 years to examine reasons for quitting e-cigarettes or cigarettes, quit methods, and quit attempt outcomes among AYAs and adults. In our sample, 3137 (51.2%) had ever used an e-cigarette, of whom 2310 (37.7%) were aged 13–24 years and 827 (13.5%) were 25–40 years old; 2387 (38.9%) had ever used a combustible cigarette (1440 [23.5%] were 13–24 years old and 947 [15.4%] were 25–40 years old). Among e-cigarette ever-users, 39.4% of 13–24-year-olds intended to quit in the next 6 months, and 36.9% had a serious plan for quitting in the next 30 days; 25.2% wanted to decrease the amount they used while 34.8% wanted to quit completely. Similar rates were found among e-cigarette ever users aged 25–40 years, as well as past 30-day e-cigarette users, cigarette ever-users, and past 30-day cigarette users across all ages. "Cold turkey" (41.0%) followed by "tried to cut down slowly by vaping/smoking less often or fewer puffs" (25.5%) was the most common quit method among e-cigarette ever-users and cigarette ever-users of all ages. Further study of effective tobacco cessation methods to help both AYAs and adults successfully quit nicotine, whether from cigarettes or e-cigarettes, is urgently needed.

1. Introduction

E-cigarettes are the most widely used nicotine product among adolescents and young adults (AYA) (Park-Lee et al., 2022), and are used by a sizeable proportion of adults (Boakye et al., 2022). Despite mounting evidence of frequent e-cigarette use (Gentzke et al., 2022) and nicotine dependence (Lin et al., 2022; Chaffee et al., 2022; Morean et al., 2018; Vogel et al., 2020) among AYAs who use e-cigarettes, and studies addressing individual topics regarding AYA e-cigarette cessation such as desire to quit, reasons for quitting, or quit methods, it remains unknown how AYA cigarette and/or e-cigarette users perceive and utilize different and multiple aspects of cessation. Adults exhibit a different pattern of e-cigarette use compared with AYAs, with some adults initiating e-cigarettes as a method to quit traditional combustible cigarettes (Mayer et al., 2020). However, there is concern that using e-cigarettes to quit cigarette use may lead to prolonged e-cigarette usage or even dual-use (Palmer et al., 2022). Relatively little research explores adults'

attempts to then quit e-cigarette products completely (Dyson et al., 2022).

Both AYAs and adults report a desire to quit e-cigarettes. A study utilizing data from the Wave 4 PATH Study (Population Assessment of Tobacco and Health) showed that 60.7 % of adult e-cigarette users endorsed future plans to quit e-cigarettes, and 15.3 % endorsed a past-year quit attempt (Palmer et al., 2021). The 2021 NYTS data demonstrated that nearly 2/3 of adolescents who used any tobacco product reported seriously thinking about quitting, although NYTS data did not differentiate between e-cigarettes and other tobacco products (Gentzke et al., 2022). Another study found that 54.2 % of adolescent e-cigarette users reported general intentions to quit, 15.3 % reported intention to quit within 30 days, and one-third had a past-year quit attempt (Cuccia et al., 2021). Numerous studies conducted during the COVID-19 pandemic demonstrated that adolescents and young adults (AYA), and some adults, were interested in and did try to quit tobacco, including e-cigarettes, during the pandemic (Benowitz et al., 2022; Gaiha et al.,

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2020). An early focus group study found that the top reason for e-cigarette discontinuation among adolescents was loss of interest; (Kong et al., 2015) however, study data were collected in 2018 while e-ciga-rettes were gaining popularity (Cullen et al., 2018) and there have been many changes in e-cigarette devices and nicotine since, which may make it harder to quit. A few other more recent studies found that the primary reason for AYA wanting to quit e-cigarettes was concern over risk or harm to health (Palmer et al., 2022; Garey et al., 2021; Ahuja et al., 2022), including concerns over lung health, and that the most frequently endorsed cessation intervention methods were those delivered via dig-ital methods (Garey et al., 2021).

Little is known about how AYAs and adults attempt to quit e-ciga-rettes, and why AYA desire to quit e-cigarettes. Current American Academy of Pediatrics (AAP) guidelines place a strong emphasis on anticipatory guidance and screening to prevent AYA tobacco exposure, but notes that scientific evidence for effective AYA cessation from both combustible cigarettes and e-cigarettes remains limited (Groner et al., 2015). Many clinical methods used to support adolescent e-cigarette cessation, such as behavioral therapy or nicotine replacement therapy, are extrapolated from methods used for adult cigarette smokers (Rosen and Sockrider, 2022), but it is currently unclear if cessation patterns and behaviors differ between e-cigarette users versus combustible cigarette users, and between AYAs and adults. Even among adults, there is limited evidence on how to support e-cigarette cessation in a clinical setting (Dyson et al., 2022).

This study utilizes a national, cross-sectional online survey of participants aged 13–40 years to examine reasons for quitting e-cigarettes, methods used to quit, and outcomes of quit attempts among AYAs and adults. Further, we compare reasons and methods used for quitting e-cigarettes to those for combustible cigarettes. Such data are critical to tailor education, prevention, and cessation programs to support a growing population of e-cigarette users who desire to quit.

2. Methods

An anonymous, national cross-sectional online survey was conducted from November 17– December 15, 2021 using Qualtrics panel sampling and survey administration platform. The online survey was fielded by Qualtrics, using the Qualtrics online technology. Quota sampling was used to achieve representation from participants aged 13–17 years, 18–20 years, and 21–40 years, and then further balanced on sex and race/ethnicity using sampling quotas to match the U.S. Census. Participants residing outside the U.S. were excluded from the study; no other exclusion criteria were used. Participants completed the survey in 28 min on average; those who completed the survey in less than half of the median completion time and those who failed attention check questions were excluded from the final convenience sample. Participants were barred from taking the survey multiple times. Further details regarding survey design have been previously published (McCauley et al., 2022; Gaiha et al., 2022).

2.1. Measures

Survey items were based on previously published questions, as noted below. All survey items were developed and pilot tested with 42 AYAs and adults.

Sociodemographic information collected from study participants included age, sex (male, female, non-binary/other, prefer not to say), LGBTQ+ (yes, no, not listed above, prefer not to say), race/ethnicity (Hispanic or Latino; non-Hispanic Asian, Native Hawaiian, or Pacific Islander; non-Hispanic Black or African American; non-Hispanic White; non-Hispanic other or multiracial; and prefer not to say) and financial comfort (do not meet basic expenses, just meet expenses with nothing left over, meet needs with a little left over, live comfortably, prefer not to say) (Williams et al., 2017).

2.1.1. E-cigarette and combustible cigarette use

Ever-use of tobacco products was assessed using the yes/no question, “Have you EVER USED any of these products in your entire life?” with the following product choices: 1) Disposable nicotine vapes like Puffbar or FOGG, even 1 or 2 puffs; 2) Pod-based nicotine vapes like JUUL or Phix, even 1 or 2 puffs; 3) Any other nicotine vape like mods, even 1 or 2 puffs; and 4) Cigarettes, even 1 or 2 puffs. Past 30-day use was assessed with, “During the LAST 30 DAYS, ON ABOUT HOW MANY DAYS did you use each of the following products? (Put zero if you did not use the product in the last 30 days)” with the products listed above. Past 30-day use was collapsed into a binary yes/no variable. Endorsing ever-use of a disposable, pod-based, or mod/other e-cigarette was combined into a singular e-cigarette ever-use variable; similar calculations were made to create a dichotomous past 30-day use category. Ever dual-use was defined as having ever used a cigarette and e-cigarette. Past 30-day dual-use was defined as having used a cigarette and e-cigarette in the past 30 days (McCauley et al., 2022).

2.1.2. Intentions and plans to quit

Participants who have ever used an e-cigarette and/or combustible cigarette were asked about their intention to quit within 6 months with the question, “Are you seriously considering quitting vaping nicotine/ smoking cigarettes within the next 6 months?” with Yes/No/Don't Know as the provided answer choices. Participants were also asked, “Are you planning to quit vaping nicotine/smoking cigarettes in the next 30 days?” Participants could select “Definitely not,” “Definitely yes,”

“Might or might not,” “Probably not,” and “Probably yes,” with “Definitely/Probably not” collapsed into a “No” category and “Definitely/ Probably yes” collapsed into a “Yes” category. Finally, participants were asked, “Which is currently your personal goal concerning vaping nicotine/smoking cigarettes?” with answer choices: “I want to quit completely,” “I want to vape less nicotine/smoke less,” “I do not want to change how much I vape/smoke,” or “I have not decided yet.”

2.1.3. Quit attempts, methods, reasons and outcomes E-cigarette

quit attempts were assessed with the question, “Have you ever tried to quit vaping nicotine?” and combustible cigarette quit attempts were separately assessed with the question, “Have you ever tried to quit smoking cigarettes?” Depending on the product, those who responded “yes” were then asked, “Did you use any of these quitting aids to quit vaping?” or “Did you use any of these quitting aids to quit smoking cigarettes?” The same answer choices were presented for participants who answered “vaping” or “smoking” (choose all that apply): quit lines; text-based app; cold turkey; tried to cut down slowly by vaping less often or fewer puffs; nicotine pouches; nicotine lozenges; nicotine gums; nicotine tablets; nicotine patches; got help from a website or app to quit vaping; got advice from someone (parent, counselor, doctor, friend, etc); medication (e.g., Chantix, Zyban); meditation and breathing exercises; and other (with an open text option).

Those who had attempted to quit e-cigarettes were further asked their reasons for quitting and quit attempt outcomes: “Why did you try to quit/reduce your use/switch?” and “While trying to quit vaping nicotine, which of the following best describes what happened?”

Selected answer choices for both questions are presented in Table 3.

2.2. Data analysis

Descriptive statistics were tabulated for e-cigarette users and combustible cigarette users by age group. Age was collapsed into a binary variable of AYA aged 13–24 years and adults aged 25–40 years, with age 25 being the generally accepted age of completed brain development (Yuan et al., 2015). We summarized e-cigarette vs. combustible cigarette users' intentions and goals for quitting. Among those who have previously attempted to quit either e-cigarettes or combustible cigarettes, we summarized their reasons for quitting and the most common methods used to quit. For those who attempted to quit

e-cigarettes, we also asked about their quit attempt outcomes. Associations between attempting to quit and future quitting as outcomes and various sociodemographic variables were explored through multivariable logistic regression. Secondary analyses on quit patterns by ever and past 30-day dual-use (using both e-cigarettes and combustible cigarettes, ever or in the past 30-days), e-cigarette only, and cigarette only use were also conducted. All analyses were conducted using Stata, version 15.1.

3. Results

In our sample of 6131 participants, 3137 (51.2 %) had ever used an e-cigarette; 2310 (37.7 %) of whom were aged 13–24 years and 827 (13.5 %) were aged 25–40 years. 2387 (38.9 %) participants had ever used a combustible cigarette, with 1,440 (23.5 %) aged 13–24 years and 947 (15.4 %) aged 25–40 years. In our sample, participants identified as female (60.6 %), white/non-Hispanic (49.4 %), heterosexual or straight (62.8 %), and described their financial situation as “live comfortably (42.5 %).” Further demographic information can be found in [Supplemental Table 1](#).

Quit Intentions. Among AYA aged 13–24 years who had ever used an e-cigarette, 25.2 % wanted to decrease the amount they used and 34.8 % wanted to quit completely. In terms of quitting intentions, 39.4 % intended to quit in the next 6 months and 36.9 % had a serious plan for quitting in the next 30 days. For past 30-day e-cigarette users aged 13–24 years, 33.0 % intended to quit in the next 6 months, 29.0 % had a plan to quit in the next 30 days, and 25.0 % wanted to quit completely.

Past 30-day combustible cigarette users aged 13–24 years expressed similar intentions to quit, with 40.8 % intending to quit in the next 6 months, 35.8 % having a plan to quit in the next 30 days, and 39.9 % wanting to quit completely. These proportions were similar to those found among the adults, aged 25–40 years. Among e-cigarette ever users, 40.5 % of the adults intended to quit in the next 6 months, 41.8 %

had a plan to quit in the next 30 days, and 36.6 % wanted to quit completely. Patterns were similar for adult past 30-day e-cigarette users as well as for combustible cigarette ever and past 30-day users, as seen in [Table 1](#).

Quit Attempts and Methods. Out of the 3,137 e-cigarette ever-users in the total sample, 1,495 of those aged 13–24 years and 447 of those aged 25–40 years had attempted to quit e-cigarettes at least once. The most commonly used quit method among those who attempted to quit e-cigarettes or cigarettes was “cold turkey” (41.0–46.8 %) followed by “tried to cut down slowly by vaping/smoking less often or fewer puffs” (18.3–25.5 %), regardless of age category. The next most popular quit methods among e-cigarette users aged 13–24 years were “got advice from someone (parent, counselor, doctor, friend, etc.)” (17.3 %) or “meditation and breathing exercises” (15.7 %), while for e-cigarette users aged 25–40 years it was using nicotine patches (19.7 %) or getting advice from others (parent, counselor, doctor, friend, etc.) (17.4 %). The next most popular methods for combustible cigarette users aged 13–24 years were quit-lines (14.9 %), while for those aged 25–40 years it was nicotine patches (24.0 %).

In a subgroup analysis of those who have attempted to quit e-cigarettes or cigarettes but still used their product in the past 30-days, “cold turkey,” cutting down slowly, and getting advice were still the top three quit methods for e-cigarette and cigarette users aged 13–24. However, past 30-day cigarette and e-cigarette users aged 25–40 were most likely to try quitting “cold turkey” (26.6 %-37.9 %), using nicotine patches (14.4 %-24.1 %), or by cutting down (13.5–22.1 %). Nicotine replacement therapies were not widely used by those aged 13–24, with 9.6 % of past 30-day e-cigarette users trying pouches, 5.7 % trying lozenges, 7.6 % trying gums, 3.4 % trying tablets, and 12.3 % using patches. On the other hand, 10.3 % of past 30-day e-cigarette users aged 25–40 tried pouches, 9.7 % tried lozenges, 7.2 % tried gums, 6.9 % tried tablets, and 24.1 % tried patches to quit ([Table 2](#)).

Since participants were asked about their attempts to quit e-

Table 1
Quit intentions and goals among ever and past-30 day e-cigarette and combustible cigarette users,1 by age group (n, %).

	Ever E-cigarette Users		Past 30-day E-cigarette Users		Ever Combustible Cigarette Users		Past 30-day Combustible Cigarette Users	
	13–24 years (n = 2310)	25–40 years (n = 827)	13–24 years (n = 1638)	25–40 years (n = 618)	13–24 years (n = 1440)	25–40 years (n = 947)	13–24 years (n = 804)	25–40 years (n = 674)
Intention to quit in next 6 months2								
Yes	909 (39.4)	335 (40.5)	540 (33.0)	214 (34.6)	588 (40.8)	368 (38.9)	304 (37.8)	262 (38.9)
No	89 (3.9)	40 (4.8)	59 (3.6)	28 (4.5)	46 (3.2)	32 (3.4)	28 (3.5)	24 (3.6)
Don't know	386 (16.7)	143 (17.3)	288 (17.6)	104 (16.8)	200 (13.9)	142 (15.0)	144 (17.9)	112 (16.6)
Quit attempt goal3								
I want to quit completely	803 (34.8)	303 (36.6)	425 (25.9)	179 (29.0)	575 (39.9)	351 (37.1)	271 (33.7)	236 (35.0)
I want to vape less nicotine/ smoke less	583 (25.2)	215 (26.0)	463 (28.3)	167 (27.0)	274 (19.0)	195 (20.6)	213 (26.5)	164 (24.3)
I do not want to change how much I vape/smoke	506 (21.9)	162 (19.6)	343 (20.9)	115 (18.6)	252 (17.5)	143 (15.1)	141 (17.5)	106 (15.7)
I have not decided yet	518 (22.4)	199 (24.1)	282 (17.2)	110 (17.8)	190 (13.2)	138 (14.6)	85 (10.6)	91 (13.5)
Plan to quit in next 30 days4								
Yes	852 (36.9)	346 (41.8)	475 (29.0)	223 (36.1)	515 (35.8)	307 (32.4)	245 (30.5)	201 (25.0)
No	181 (7.8)	67 (8.1)	155 (9.5)	47 (7.6)	129 (9.0)	108 (11.4)	86 (10.7)	88 (10.9)
Might or might not	67 (2.9)	348 (42.1)	254 (15.5)	74 (12.0)	199 (13.8)	128 (13.5)	152 (18.9)	110 (13.7)

¹ Ever e-cigarette users (total n = 3137), past 30 day e-cigarette users (total n = 2256), ever combustible cigarette users (total n = 2387), past 30-day combustible cigarette users (total n = 1478).
² Assessed with the question: “Are you seriously considering quitting vaping nicotine/smoking cigarettes within the next 6 months?”
³ Assessed with the question: “Which is currently your personal goal concerning vaping nicotine/smoking cigarettes?”
⁴ Assessed with the question: “Are you planning to quit vaping nicotine/smoking cigarettes in the next 30 days?”

Table 2

Quit methods¹ used by those who have attempted quitting e-cigarettes² or cigarettes,³ by age (y24 vs. > 24 years), n (%).

Method	E-cigarettes Ever-Users E-cigarette Past 30- day Users				Combustible cigarettes Ever-Users		Past 30-day Combustible cigarette Users	
	13–24 (n = 1495)	25–40 (n = 447)	13–24 (n = 948)	25–40 (n = 290)	13–24 (n = 884)	25–40 (n = 613)	13–24 (n = 492)	25–40 (n = 436)
Quitlines	151 (10.1)	59 (13.2)	108 (11.4)	44 (15.2)	132 (14.9)	91 (14.8)	61 (12.4)	37 (8.5)
Text-based app	206 (13.8)	72 (16.1)	145 (15.3)	60 (20.7)	98 (11.1)	61 (10.0)	84 (17.1)	42 (9.6)
Cold turkey	613 (41.0)	186 (41.6)	387 (40.8)	110 (37.9)	368 (41.6)	287 (46.8)	194 (39.4)	116 (26.6)
Tried to cut down slowly by vaping/smoking less often or fewer puffs	(25.5)	96 (21.5)	266 (28.1)	64 (22.1)	162 (18.3)	150 (24.5)	115 (23.4)	59 (13.5)
Nicotine pouches	112 (7.5)	38 (8.5)	91 (9.6)	30 (10.3)	41 (4.6)	28 (9.7)	50 (8.2)	57 (11.6)
Nicotine lozenges	67 (4.5)	37 (8.3)	54 (5.7)	26 (2.9)	21 (7.2)	57 (6.4)	20 (6.1)	23 (5.3)
Nicotine gums	96 (6.4)	36 (8.1)	72 (7.6)	(6.9)	49 (5.5)	70 (24.1)	83 (8.7)	14.2 (3.7)
Nicotine tablets	45 (3.0)	26 (5.8)	32 (3.4)	(9.4)			48 (7.8)	68 (13.8)
Nicotine patches	148 (9.9)	88 (19.7)	117 (12.3)			147 (24.0)		
Got help from a website or app to quit vaping	186 (12.4)	63 (14.1)	144 (15.2)	51 (17.6)	79 (8.9)	43 (7.0)	75 (15.2)	39 (8.9)
Got advice from someone (parent, counselor, doctor, friend, etc)	258 (17.3)	78 (17.4)	175 (18.5)	62 (21.4)	111 (12.6)	70 (11.4)	89 (18.1)	43 (9.9)
Medication (e.g. Chantix, Zyban)	105 (7.0)	48 (10.7)	235 (15.7)	75 (7.9)	38 (13.1)	42 (4.8)	41 (14.1)	64 (10.4)
Meditation and breathing exercises	53 (11.9)		155 (16.4)	89 (10.1)		56 (9.1)	30 (6.9)	
I used another method to quit # of Quit Methods Used ¹	158 (10.6)	40 (8.9)	72 (7.6)	17 (5.9)	76 (8.6)	60 (9.8)	27 (5.5)	20 (4.6)
	823 (55.1)	237 (53.0)	476 (50.2)	132 (45.5)	546 (61.8)	325 (53.0)	268 (54.5)	208 (47.7)
2–3	(30.0)	151 (33.8)	178 (31.9)	302 (38.3)	111 (38.3)	231(26.1)	194 (31.6)	154 (31.3)
4+	54 (12.1)	(11.9)	141 (14.9)	44 (15.2)	67 (7.6)	84 (13.7)	54 (11.0)	69 (15.8)

¹ Participants could select more than one quit method. n = 1942.

²

³ n = 1497.

Table 3

Reasons for quitting and quit attempt outcomes among those who attempted quitting e-cigarettes,¹ by age.

	13–24 years (n = 1495)	25–40 years (n = 447)
Quit attempt outcome		
Decreased the amount I vape nicotine Decreased the amount I vape, but decreased the amount I use cigarettes Decreased the amount of marijuana I used Increased the amount I use cigarettes but decreased vaping Increased the amount I vaped nicotine	293 (19.6)	59 (13.2)
Increased the amount of marijuana I used Switched to cigarettes Switched to marijuana Switched to other nicotine products (e.g., nicotine gums)	136 (9.1)	46 (10.3)
	62 (4.1)	18 (4.0)
	146 (9.8)	70 (15.7)
	115 (7.7)	54 (12.1)
	191 (12.8)	33 (12.5)
	(2.2) 202	38 (8.5)
	(13.5) 26	27 (6.0)
	(1.7)	7 (1.6)
There was no change in how much I vape nicotine	257 (17.2)	65 (14.5)
Reasons for quitting		
Because I am home and cannot vape with friends	134 (9.0)	54 (12.1)
Because I am home and my parents will find out that I vape	155 (10.4)	64 (14.3)
Because I can't get my products	160 (10.7)	55 (12.3)
Because I feel addicted	240 (16.1)	46 (10.3)
Because of other health harms from vaping that I worry about	325 (21.7)	88 (19.7)
Because vaping may weaken my lungs	335 (22.4)	95 (21.3)
Other	114 (7.6)	38 (8.5)

¹ n = 1497

cigarettes or combustible cigarettes separately, more granular analyses on quit intentions, quit goals, and quit methods used were conducted on subgroups of ever and past 30-day dual users, e-cigarette only users, and cigarette only users, by age group and other demographic variables. Participants ages 13–24 years were more likely to have ever tried quitting e-cigarettes compared to those aged 25–40 years (AOR 1.70, 95 %CI 1.44–2.00; p < 0.001). Participants who identified their race/ethnicity as “other” (including American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, more than one race, or preferred not to answer) were less likely to have ever tried quitting cigarettes (AOR 0.72, 95 %CI 0.54–0.99; p = 0.042). Participants who lived comfortably compared to those who just met basic needs were more likely to intend to quit using e-cigarettes and cigarettes in the next six months (e-cigarettes AOR 1.29, 95 %CI 1.02–1.63; p = 0.030 and cigarettes AOR 1.33, 95 %CI 1.02–1.73; p = 0.034) and those who identified their race/ethnicity as other (described above) were less likely to intend to quit using e-cigarettes in the next six months (AOR 0.61, 95 %CI 0.44–0.84; p = 0.003). See details in [Supplemental Table 2](#).

Reasons for Quit Attempts. The most common reason for quitting among both AYAs and adults were health related: 22.4 % of AYAs 13–24 years and 21.3 % of adults 25–40 years were concerned that “vaping may weaken [their] lungs,” while 21.7 % of AYAs and 19.7 % of adults had “other health harms from vaping that [they] worry about.”

Quit Attempt Outcomes. Quit attempt outcomes were assessed among those who attempted to quit e-cigarettes. Overall, 17.2 % of AYAs and 14.5 % of adults had no change in the amount they used nicotine e-cigarettes. 19.6 % of AYAs and 13.2 % of adults said they decreased the amount of nicotine e-cigarettes they used while trying to quit, and 13.5 % of 13–24-year-olds switched to cannabis when attempting to quit e-cigarettes versus 6.9 % of those aged 25–40 years. A

similar proportion of 13–24 and 25–40-year-olds in our sample (12.8 vs 12.5 %) increased the amount of cannabis they used; more 25–40-year-olds increased their cigarette use (15.7 %) or switched to cigarettes (8.5 %) when attempting to quit e-cigarettes versus 13–24-year-olds (9.8 % and 2.2 %, respectively).

4. Discussion

This is one of the first large-scale, national studies with a diverse sample to examine both e-cigarette and combustible cigarette cessation goals, quit patterns, methods, and reasons for quitting among both AYAs and adults. In our sample, over 50 % of AYAs and adults who had ever used an e-cigarette had attempted to quit e-cigarettes, and over 60 % of AYAs and adult who had ever used a combustible cigarette had attempted to quit cigarettes. About half of AYA e-cigarette users either wanted to quit completely or use less. With a few exceptions, these proportions were similar to those found in adult e-cigarette users in our study, as well as those in the AYA and adult combustible cigarette user groups. The percentages of those wanting to quit in our study are slightly lower compared to findings from previous studies in adolescents (Gen-tzke et al., 2022; Cuccia et al., 2021) and adults; (Palmer et al., 2021; Rosen and Steinberg, 2020) however, these findings may not be directly comparable due to differences in measurement wording, age categorization, and survey period.

Nonetheless, the high levels of quit intention for both cigarettes and e-cigarettes among all ages may suggest feelings of dependence to these products, as well as readiness for clinical intervention to assist with nicotine cessation. Fortunately, quitting combustible cigarette smoking benefits people of all ages, regardless of how long or how much they smoked before (Smoking Cessation, 2022). Likewise, while the long-term health risks of e-cigarettes are unknown, they are still not risk free, and complete cessation is preferred (Rigotti and Reddy, 2023; Rosen and Sockrider, 2022).

The most common reasons for wanting to quit e-cigarettes were related to potential health risks, as seen in previous qualitative (Alex-ander et al., 2019; Amato et al., 2021) and quantitative (Gaiha et al., 2020; Garey et al., 2021; Gaiha et al., 2022) studies of AYAs. In our study, both AYAs and adults expressed concerns regarding weakened lungs, feelings of addiction, and other health harms associated with vaping. These results lend support to including the health benefits associated with quitting as a critical component of AYA e-cigarette cessation programs, (Bold et al., 2022; Liu et al., 2022; Liu et al., 2020) adult behavioral therapy, (Rigotti, 2023) and clinical counseling.

Given that the most common reasons for quitting e-cigarettes were health related, healthcare providers are uniquely placed to discuss and aid in tobacco cessation. However, screening rates are often low in pediatric settings (Lelaurin et al., 2020; Gorukanti et al., 2022). Further-more, a survey conducted by the American Academy of Pediatrics (AAP) found that while most pediatricians advised their patients to quit tobacco, only a third discussed quit strategies, and even fewer offered quit materials or referral to a cessation program (McMillen et al., 2017).

These AAP findings represent a critical missed opportunity for education about e-cigarettes and cigarettes as well as cessation interventions, and also highlight the need for evidence-based cessation methods. Further, given that e-cigarette harm-related perceptions were prevalent among users intending to quit, widely publicizing public health messaging about health harms of e-cigarette use may potentially dissuade continued use.

Among those adolescents, young adults, and adults in our study who tried to quit e-cigarettes or cigarettes, quitting “cold turkey” and “tried to cut down slowly by vaping/smoking less often” were by far the most common methods used to try to quit either e-cigarettes or combustible cigarettes. These methods likely represent cessation methods with the lowest barriers to entry, but with unknown efficacy (Palmer et al., 2021). Nicotine replacement therapies such as patches and gums, as well as cessation medications, were the least used by AYAs in our sample, at

half the rate compared to adults, possibly because these medications are not FDA approved for use in those under 18. However, it should be noted that there is no biological or cognitive rationale for having 18 years as the cutoff for offering pharmacotherapy, (Groner et al., 2015) and AYAs with symptoms of nicotine dependence may benefit from NRTs (Rosen and Sockrider, 2022). Further research and more empirical data, preferably from RCTs, that assesses the effectiveness of interventions for e-cigarette cessation in adolescents is needed. Similarly, in the adult population, the discussion has largely focused on the efficacy of e-cigarettes as an alternative method for smoking cessation, but there are almost no clinical trials exploring methods to quit e-cigarettes completely (Palmer et al., 2021). However, our data, collected in the post-stay-at-home part of the COVID pandemic, show that even adults are concerned about the health effects of e-cigarettes, and express a desire to quit completely.

The need for and communication about evidence-based cessation methods tailored specifically to e-cigarettes is further emphasized by the variability in quit attempt outcomes seen in our study. Only 13.2 % of adults and 19.6 % of AYA who attempted to quit e-cigarettes decreased the amount they used, while 14.5 % of adults and 17.2 % of AYA had no change in the amount they used e-cigarettes. Of concern is that double the proportion of adolescents switched to cannabis (13.5 % vs. 6.0 %) compared to adults, and a similar proportion of adolescents and adults (12.8 % vs. 12.5 %) increased the amount of cannabis they used when quitting e-cigarettes. Cannabis is the most commonly used federally illicit drug among US adolescents, (Hammond et al., 2021) with use of vaporized cannabis on the rise (Miech et al., 2020). Co-use of cannabis with tobacco and e-cigarettes in particular is also common (Skelton et al., 2022). Increased use of cannabis may be driven by perceptions of decreased risk; (Parker and Anthony, 2018) especially in comparison to traditional tobacco products (Roditis and Halpern-Felsher, 2015).

However, use of cannabis poses health concerns, as cannabis use in adolescents has been associated with multiple negative effects on brain development, including cognitive impairment and increased risk for depression, suicidality, and psychosis (Bukstein, 2023). In addition to the ill health effects of e-cigarette use, preventive health messaging may also include health harms of using cannabis use among AYAs to help them quit e-cigarettes without switching to cannabis.

4.1. Limitations

Our study is subject to several limitations. First, our cross-sectional data come from a convenience sample, thus the findings may not be generalizable, nor can they be used for causal inference. Second, quit outcomes and attempts are self-reported, and may be subject to both recall and social desirability biases. Third, the language used in our measure for quit attempt outcome did not differentiate between “decreased the amount I vaped nicotine” vs. quitting completely, which would have allowed for further granularity in analysis. Finally, since we did not specifically explain in the survey wording, we do not know whether participants interpreted “decreased the amount I vaped nicotine” to mean frequency of use and/or nicotine strength.”

5. Conclusions

Public health discussion on e-cigarettes has largely focused on preventing initiation of AYA e-cigarette use. However, a large proportion of AYAs who have already initiated e-cigarette use express a desire to quit and may have even attempted to quit, with variable success. Further-more, AYAs in particular may turn towards cannabis as a method of quitting e-cigarettes, which presents its own set of health risks. Similarly, a large proportion of adults have indicated a desire to quit e-cigarettes, and express concerns with the health effects of e-cigarettes. Both AYAs and adults primarily try to quit e-cigarettes or combustible cigarettes by going “cold turkey” or cutting down, and may not be using the most effective methods for quitting. This research highlights the urgent

need for dissemination of accurate health messaging and cessation tools by healthcare providers, educators, and others; access to behavioral intervention programs; policies that support funding tobacco cessation; and further study of effective tobacco cessation methods to help both AYAs and adults successfully quit nicotine, whether from cigarettes or e-cigarettes.

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7. Author statement

SMG and BHF designed the study and supervised data collection. CL and SMG conducted data management and analysis. CL drafted the manuscript, and all authors contributed detailed revisions. BHF funded the study. All authors approved the final manuscript.

CRediT authorship contribution statement

Crystal Lin: Conceptualization, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. **Shivani Mathur Gaiha:** Conceptualization, Data curation, Investigation, Methodology, Project administration, Formal analysis, Funding acquisition, Writing – review & editing. **Bonnie Halpern-Felsher:** Conceptualization, Investigation, Methodology, Funding acquisition, Writing – review & editing.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Dr. Bonnie Halpern-Felsher is a paid expert scientist in some litigation against the e-cigarette industry and an unpaid scientific advisor and expert regarding some tobacco-related policies. No other authors have any conflicts to disclose.

Data availability

Data will be made available on request.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.addbeh.2023.107918>.

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