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# Tobacco Cessation Behaviors Among U.S. Middle and High School Students, 2020

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A B S T R A C T

**Purpose:** The landscape of youth tobacco product use has changed dramatically in recent years; however, little is known about current youth cessation behaviors. This study aims to assess prevalence and correlates of quit intentions and past-year quit attempts among U.S. middle and high school students who report current use of any tobacco product, cigarettes, and e-cigarettes.
**Methods:** Data came from the 2020 National Youth Tobacco Survey, a nationally representative cross-sectional school-based survey of students in grades 6–12. Weighed prevalence estimates of quit intentions and past-year quit attempts among users of any tobacco product, cigarettes, and e-cigarettes are presented. Multivariable-adjusted logistic regression with predictive marginals was used to assess sociodemographic correlates of quit intentions and quit attempts for each tobacco product user group.
**Results:** Quit intentions were reported by 62.5% of current users of any tobacco product, 68.1% of cigarette smokers, and 63.9% of e-cigarette users. Similarly, past-year quit attempts were reported by 65.4% of current users of any tobacco product, 65.8% of cigarettes smokers, and 67.4% for e-cigarette users. Harm perceptions toward tobacco, nicotine dependency, and the use of $\geq$2 tobacco products were significantly correlated with quit intentions, quit attempts, or both among different tobacco product user groups.
**Conclusions:** Most students who use tobacco products want to quit and have attempted to do so. Development of youth-focused cessation interventions, particularly those addressing the most commonly used products, could potentially accelerate progress in a comprehensive approach to youth tobacco prevention and control.

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**IMPLICATIONS AND CONTRIBUTION**

Most students who use tobacco products want to quit and have attempted to do so. As part of a comprehensive approach to tobacco prevention and control, the development of youth-focused cessation interventions is warranted and could support progress in protecting our nation's youth from this public health threat.

Most tobacco product use begins during adolescence [1]. In addition to other harmful ingredients, tobacco products contain nicotine, and the Surgeon General has concluded that exposure to nicotine during adolescence can lead to addiction and harm the developing brain [2]. Concerns over youth tobacco product use have heightened in recent years, as the pattern of youth tobacco product use has changed. During 2011–2018, while declines in the use of cigarettes, cigars, smokeless tobacco, and

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pipe tobacco were observed for both middle and high school students, increases in the use of e-cigarettes during this period reversed previous declines in overall tobacco product use [3,4]. From 2019 to 2020, decreases in use occurred across all types of tobacco products including e-cigarettes, yet overall tobacco product use remains high among youth: 23.3% of high school students (3.60 million) and 6.4% of middle school students (760,000) reported current use of any tobacco product in 2020 [5].

Proven population-based strategies, such as price increases and smoke-free policies, are essential as part of a comprehensive approach to prevent initiation of youth tobacco product use [6]. However, given that an estimated 4.38 million students currently use tobacco products [5], efforts to promote cessation are also warranted. Much is known about tobacco cessation in adults, including cessation behaviors and outcomes and interventions scientifically proven to help adults quit smoking [7]. However, research among youth is limited. Studies examining youth cessation behaviors in the U.S. are limited by the lack of recent data, failure to include product-specific cessation measures, or a focus on youth who primarily use cigarettes [7–9]. Although promising clinical interventions continue to be investigated, research on cessation treatments for youth have yet to yield substantial evidence for effective interventions that help youth quit [10,11]. To reduce all forms of tobacco product use among youth, it is important to understand current youth cessation behaviors to inform education and cessation interventions. This study aims to expand current knowledge about youth cessation behaviors in the U.S. by presenting prevalence estimates and correlates of quit intentions and past-year quit attempts among a nationally representative survey of U.S. middle and high school students who reported current use of any tobacco product, cigarettes, and e-cigarettes.

## Methods

### *Data source*

Data were from the 2020 National Youth Tobacco Survey (NYTS), a cross-sectional, school-based, self-administered survey of U.S. middle (grades 6–8) and high school (grades 9–12) students conducted by the U.S. Centers for Disease Control and Prevention and the U.S. Food and Drug Administration [12]. A stratified three-stage cluster sampling procedure, including primary sampling units, schools, and classrooms within schools, was used to generate a nationally representative sample of U.S. students in public and private school. Data were collected using an electronic mode of survey administration, which incorporated logical skip routing and tobacco product images. The survey protocol was approved by the Institutional Review Board of Centers for Disease Control and Prevention.

The 2020 NYTS was conducted from January 16, 2020 to March 16, 2020 and included 14,531 completed surveys (student participation rate: 87.4%) from 180 participating schools (school participation rate: 49.9%) for an overall response rate of 43.6%. Data were weighted to adjust for nonresponse and varying probabilities of selection; weighted estimates are representative of U.S. students attending public or private schools in grades 6–12. Details on the methodology and administration procedures of the National Youth Tobacco Survey are available elsewhere [12].

Analyses were conducted among three nonmutually exclusive analytic samples: current any tobacco product users, defined as use of one or more tobacco products (e-cigarettes, cigarettes, cigars/cigarillos/little cigars, smokeless tobacco [chewing tobacco, snuff, dip; snus; or dissolvable tobacco products], hookah, bidis, or pipe tobacco) on at least 1 day during the past 30 days (n = 2,187); any current (past 30-day) cigarette smokers (n = 453); and any current (past 30-day) e-cigarette users (n = 1,769).

*Quit intentions.* Current any tobacco product users were asked, "Are you seriously thinking about quitting the use of all tobacco products?" Current cigarette smokers were asked, "Are you seriously thinking about quitting cigarettes?" Current e-cigarette users were asked, "Are you seriously thinking about quitting e-cigarettes?" For each question, responses included, "Yes, during the next 30 days," "Yes, during the next 6 months," "Yes, during the next 12 months," "Yes, but not during the next 12 months," and "No, I am not thinking about quitting (the use of all tobacco products; cigarettes; e-cigarettes). Quit intention for each respective product use group was defined as any response other than "No, I am not thinking about quitting" to each question.

*Quit attempts.* Current any tobacco product users were asked, "During the past 12 months, how many times have you stopped using all tobacco products for 1 day or longer because you were trying to quit all tobacco products for good?" Similarly, current cigarette smokers and current e-cigarette users were asked, "During the past 12 months, how many times have you stopped (smoking cigarettes; using e-cigarettes) for 1 day or longer because you were trying to quit (smoking cigarettes; using e-cigarettes) for good?" For each question, response options included, "I did not try to quit during the past 12 months," "1 time," "2 times," "3–5 times," "6–9 times," or "10 or more times." Making a quit attempt was defined as a response other than "I did not try to quit during the past 12 months" to each of these questions.

*Covariates.* Assessed covariates included: sex (female, male); race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, non-Hispanic other); school type (middle school [MS; grades 6–8], high school [HS; grades 9–12]); and household member use of any tobacco product (yes, no). Use of ≥2 tobacco products was defined as current (past 30-day) use of two or more tobacco products (yes, no). Tobacco dependency [13] (yes, no) was defined as an affirmative response to either of the following questions: "How soon after you wake do you want to use a tobacco product?" (a response of "within 5 minutes" or "from 6 to 30 minutes") and "During the past 30 days, have you had a strong craving or felt like you really needed to use a tobacco product of any kind?" (a response of "yes").

Tobacco product-specific covariates of flavor use, exposure to ads/promotions, and harm perceptions also were assessed for outcomes associated with each respective tobacco product use group. For outcomes specific to any tobacco product use, covariates included use of any flavored tobacco product (yes, no, do not know); exposure to ads/promotions to any tobacco product (yes, no); and extent of agreement with the statement "all tobacco products are dangerous" (strongly agree, agree, disagree, strongly disagree). For cigarette-specific outcomes, covariates included flavored (menthol) cigarette use (yes, no, do not know); exposure to ads/promotions for cigarettes and other tobacco products (excluding e-cigarettes) (yes, no); and extent of harm associated with intermittent cigarette use (no harm, little harm,

**Table 1**
Prevalence of quit intentions[a] and quit attempts[b] for all tobacco among U.S. middle and high school students who report current use of any tobacco product[c], 2020 National Youth Tobacco Survey

| | Sample size (n)[d] | Quit intentions | | | Quit attempts | | |
|---|---|---|---|---|---|---|---|
| | | % (95% CI)[e] | *p* value from bivariate chi-square test[f] | aPR (95% CI) from multivariable model[g] | % (95% CI) | *p* value from bivariate chi-square test[f] | aPR (95% CI) from multivariable model[g] |
| Overall | 2,187 | 62.5% (59.4–65.6) | - | - | 65.4% (62.8–68.0) | - | - |
| Sex | | | | | | | |
| Female | 1,073 | 62.2% (57.4–66.7) | .81 | 1.00 (ref) | 65.8% (61.8–69.6) | .78 | 1.00 (ref) |
| Male | 1,111 | 62.9% (59.1–66.5) | | 1.06 (.98–1.16) | 65.0% (61.2–68.6) | | 1.02 (.94–1.11) |
| Race/Ethnicity | | | | | | | |
| White, non-Hispanic | 1,215 | 62.3% (59.2–65.3) | .74 | 1.00 (ref) | 62.1% (58.6–65.6) | **.04** | 1.00 (ref) |
| Black, non-Hispanic | 182 | 64.6% (56.0–72.4) | | 1.06 (.94–1.20) | 71.5% (60.7–80.2) | | **1.20 (1.05–1.37)** |
| Hispanic | 680 | 64.9% (56.9–70.4) | | 1.06 (.94–1.20) | 69.3% (65.5–72.8) | | **1.17 (1.08–1.27)** |
| Other, non-Hispanic | 87 | 56.4% (42.1–69.7) | | .93 (.73–1.18) | 71.5% (59.0–81.4) | | 1.18 (.99–1.39) |
| School type | | | | | | | |
| Middle school | 464 | 61.8% (55.0–68.1) | .81 | 1.00 (ref) | 70.7% (64.8–76.0) | **.04** | 1.00 (ref) |
| High school | 1,716 | 62.6% (59.2–66.0) | | .97 (.85–1.11) | 64.3% (61.5–67.0) | | .95 (.86–1.05) |
| Nicotine dependency[h] | | | | | | | |
| No | 1,347 | 62.5% (58.7–66.2) | .98 | 1.00 (ref) | 60.8% (57.0–64.5) | **<.001** | 1.00 (ref) |
| Yes | 818 | 62.5% (57.8–66.9) | | 1.04 (.95–1.13) | 72.2% (68.1–76.0) | | **1.21 (1.09–1.35)** |
| Any household tobacco use[i] | | | | | | | |
| No | 871 | 61.2% (56.5–65.7) | .51 | 1.00 (ref) | 61.2% (57.4–64.9) | **.005** | 1.00 (ref) |
| Yes | 1,164 | 63.0% (58.8–67.0) | | 1.06 (.97–1.16) | 68.2% (64.9–71.2) | | **1.12 (1.04–1.20)** |
| Exposure to ads or promotions to any tobacco product[j] | | | | | | | |
| Not Exposed | 291 | 64.6% (57.2–71.5) | .64 | 1.0 (ref) | 62.7% (52.5–71.9) | .52 | 1.00 (ref) |
| Exposed | 1,798 | 62.5% (58.9–66.1) | | .93 (.81–1.07) | 66.0% (63.4–68.5) | | 1.02 (.87–1.19) |
| Flavored tobacco product use (any product)[k] | | | | | | | |
| No | 338 | 57.7% (49.8–65.2) | .35 | 1.00 (ref) | 61.6% (54.9–67.9) | .55 | 1.00 (ref) |
| Yes | 1,726 | 63.5% (59.9–67.0) | | 1.13 (.94–1.36) | 66.1% (62.7–69.4) | | 1.05 (.91–1.22) |
| Don't know | 123 | 62.2% (50.8–72.5) | | 1.00 (.73–1.38) | 66.5% (54.3–76.8) | | 1.04 (.85–1.27) |
| Use of ≥2 tobacco products[l] | | | | | | | |
| No | 1,423 | 66.1% (63.0–69.1) | **.008** | 1.00 (ref) | 65.2% (61.8–68.5) | .84 | 1.00 (ref) |
| Yes | 764 | 56.4% (50.4–62.3) | | **.85 (.76–.96)** | 65.8% (61.1–70.2) | | .95 (.86–1.05) |
| Agree with statement, all tobacco products are dangerous[m] | | | | | | | |
| Strongly agree | 513 | 71.7% (66.5–76.4) | **<.001** | 1.00 (ref) | 69.9% (63.9–75.4) | .10 | 1.00 (ref) |
| Agree | 968 | 66.0% (61.3–70.4) | | .92 (.82–1.03) | 65.1% (61.6–68.5) | | .92 (.84–1.01) |
| Disagree | 392 | 52.9% (45.8–59.9) | | **.73 (.62–.86)** | 61.9% (56.9–66.7) | | **.84 (.74–.95)** |
| Strongly disagree | 181 | 41.5% (32.0–51.6) | | **.60 (.46–.78)** | 59.5% (50.2–68.1) | | **.80 (.68–.96)** |

[a] Based on the question, "Are you seriously thinking about quitting the use of all tobacco products?" Responses of "Yes, during the next 30 days," "Yes, during the next 6 months," "Yes, during the next 12 months," and "Yes, but not during the next 12 months" were indicative of having quit intentions. The response, "No, I am not thinking about quitting the use of all tobacco products" was indicative of not having quit intentions. n = 177 respondents are missing data on this outcome and are excluded from the analysis.

[b] Based on the question, "During the past 12 months, how many times have you stopped using all tobacco products for 1 day or longer because you were trying to quit tobacco products for good?" Responses other than "I did not try to quit all tobacco products during the past 12 months" were indicative of having made one or more quit attempts. n = 193 respondents are missing data on this outcome and are excluded from the analysis.

[c] Defined as the use of any product (e-cigarettes, cigarettes, cigars, smokeless tobacco (including chewing tobacco/snuff/dip, snus, or dissolvable tobacco products), hookah, pipe tobacco, or bidis) on at least 1 day during the past 30 days.

[d] Unweighted sample size is based on self-report of use of any tobacco product (e-cigarettes; cigarettes; cigars/cigarillos/little cigars; smokeless tobacco [chewing tobacco, snuff, or dip, snus, or dissolvable tobacco product]; hookah; pipe tobacco; or bidis). For covariates, may not add to total (n = 2,187) owing to missing data.

[e] Percentages (and 95% Confidence Interval [CI]) are based on weighted data.

[f] Based on chi-square test to assess bivariate association between cessation outcomes and each covariate ($p < .05$ considered statistically significant [bolded]).

[g] Adjusted multivariable binary logistic regression with predictive marginal proportions assessed socio-demographic determinants of reporting quit intention and quit attempts; model-adjusted prevalence ratios (aPR) were derived from predicted marginals and are adjusted for all covariates in the table. Bolded numbers denote statistically significant results ($p < .05$).

[h] Nicotine Dependency is based on responses to two questions: (1) "How soon after you wake do you want to use a tobacco product?" and (2) "During the past 30 days, have you had a strong craving or felt like you really needed to use a tobacco product of any kind?". Respondents were categorized as "yes" if they indicated wanting to use a tobacco product within 30 minutes after waking OR if they indicate they had a strong craving or felt like they really needed to use a tobacco product during the past 30 days. Respondents missing data on both measures were excluded from the analysis.

[i] Assessed by the question, "Does anyone who lives with you now…?" Response options of "smoke cigarettes," "smoke cigars, cigarillos, or little cigars," "use chewing tobacco, snuff, or dip," "use e-cigarettes," "smoke tobacco in a hookah or water pipe," "smoke pipes filled with tobacco (not hookah or water pipes)," "use snus," "use dissolvable tobacco products," "smoke bidis (small brown cigarettes wrapped in a leaf)," or "use heated tobacco products" were coded as "yes." The response, "No one who lives with me now uses any form of tobacco" was coded as no.

[j] Exposure to tobacco product marketing (advertisements or promotions) were assessed for four sources: retail stores; Internet; television, streaming sources, or movies; and newspapers or magazines. Exposure was assessed separately for e-cigarettes and cigarettes or other tobacco products. Participants were asked, "When you (are using the Internet; read newspapers or magazines; go to a convenience store, supermarket, or gas station; watch television or streaming services [such as Netflix, Hulu, or Amazon Prime], or go to the movies), how often do you see ads or promotions for (e-cigarettes; cigarettes or other tobacco products)?" Respondents were

categorized as exposed if they responded "sometimes," "most of the time," or "always" or unexposed if they responded "never" or "rarely." Persons who reported "I never go to a convenience stores, supermarket, or gas station," "I do not use the Internet," "I do not watch TV or streaming services or go to the movies," or "I do not read newspapers or magazines" were set to missing. Respondents who indicated they had been exposed to e-cigarette OR cigarette and other tobacco product marketing were categorized as exposed.

[k] Respondents who reported having used each respective tobacco product were asked, "Were any of the [e-cigarettes; cigars, cigarillos, or little cigars; chewing tobacco, snuff, or dip; tobacco in a hookah or water pipe; pipe tobacco (not water pipe); snus; dissolvable tobacco products; bidis; roll-your-own tobacco; heated tobacco products] that you used in the past 30 days flavored to taste like menthol, mint, clove or spice, alcohol (wine, cognac), candy, fruit, chocolate, or any other flavor? For cigarettes, flavored (menthol) smoking was determined from a response of "yes" to the question, "During the past 30 days, were the cigarettes that you usually smoked menthol?" and/or indicating that the usual brand smoked during the past 30 days was either Newport or Kool. Respondents who indicated they had used at least one flavored tobacco product were categorized as flavored tobacco product use.

[l] Respondents who indicated using more than one tobacco product (e-cigarettes, cigarettes, cigars/cigarillos/little cigars; smokeless tobacco [chewing tobacco, snuff, or dip, snus, or dissolvable tobacco product]; hookah, pipe tobacco or bidis) on at least 1 day during the past 30 days were categorized as using ≥2 tobacco products product users.

[m] Assessed by the question, "How strongly do you agree with the statement 'All tobacco products are dangerous'?"

some harm, a lot of harm). For e-cigarette–specific outcomes, covariates included flavored e-cigarette use (yes, no, do not know); exposure to e-cigarette ads/promotions (yes, no); and extent of harm associated with intermittent e-cigarette use (no harm, little harm, some harm, a lot of harm).

### *Analysis*

Analyses were conducted among respondents reporting past 30-day use of any tobacco product, cigarettes, and e-cigarettes. Among current users, prevalence and corresponding 95% confidence intervals (CIs) of self-reported quit intention and quit attempts is reported overall and by covariates; chi-square tests were used to assess bivariate associations between cessation outcomes and each covariate. Unstable estimates (relative standard error >30% or an unweighted denominator <50) are not reported.

Adjusted multivariable binary logistic regression with predictive marginal proportions assessed sociodemographic determinants of reporting quit intention and quit attempts among each tobacco product user group; model-adjusted prevalence ratios (aPRs) were generated, derived from predicted marginals and adjusted for all covariates. For all analyses, $p < .05$ was considered statistically significant. All analyses were conducted using SAS callable SUDAAN version 11 (Research Triangle Institute, Research Triangle Park, NC) to account for the complex sampling design.

## Results

### *Any tobacco product use*

*Quit intentions.* Among students reporting current use of any tobacco product, 62.5% reported intending to quit all tobacco products (MS: 61.8%; HS: 62.6%; Table 1). In adjusted analysis, prevalence of intending to quit all tobacco products was lower among those who reported using ≥2 tobacco products (aPR = .85, 95% CI: .76–.96, vs. single product use) and those who disagreed (aPR = .73, 95% CI: .62–.86) or strongly disagreed (aPR = aPR = .60, 95% CI: .46–.78 vs. strongly agree) with the statement, "all tobacco products are dangerous" (Table 1).

*Quit attempts.* Among students reporting current use of any tobacco product, 65.4% reported attempting to quit all tobacco products (MS: 70.7%; HS: 64.3%; Table 1). In adjusted analysis, prevalence of attempting to quit all tobacco products was higher among those who were black, non-Hispanic (aPR = 1.20, 95% CI: 1.05–1.37) and Hispanic (aPR = 1.17, 95% CI: 1.08–1.27) students compared with white, non-Hispanic students; those who reported nicotine dependency (aPR = 1.21, 95% CI: 1.09–1.35); and those reporting any household tobacco product use (aPR = 1.12, 95% CI: 1.04–1.20) (Table 1). In addition, those who disagreed (aPR = .84, 95% CI: .74–.95) or strongly disagreed (aPR = .80, 95% CI: .68–.96; vs. strongly agree) with the statement, "all tobacco products are dangerous" were less likely to make a past-year attempt to quit all tobacco products.

### *Cigarette use*

*Quit intentions.* Among students reporting current cigarette use, 68.1% reported intending to quit cigarettes (MS: 69.2%; HS: 67.7%; Table 2). In adjusted analysis, those who perceived intermittent cigarette use as having some harm were less likely to report intention to quit cigarettes (aPR = .82, 95% CI: .69–.97, vs. a lot of harm; Table 2).

*Quit attempts.* Among students reporting current use of cigarettes, 65.8% reported attempting to quit cigarettes (MS: 76.4%; HS: 63.0%; Table 2). In adjusted analysis, those who perceived intermittent cigarette use as having low harm were less likely to make a past-year attempt to quit smoking (little harm: aPR = .77, 95% CI: .64–.94; some harm: aPR = .75, 95% CI: .60–.93) as compared with a lot of harm (Table 2).

### *E-cigarette use*

*Quit intentions.* Among students reporting current e-cigarette use, 63.9% reported intending to quit e-cigarette use (MS: 63.2%; HS: 63.9%; Table 3). In adjusted analyses, those who reported using ≥2 tobacco products (aPR = .82, 95% CI: 0.74-0.90, vs. single product use) and having low harm perceptions toward intermittent e-cigarette use (no harm: aPR = .54, 95% CI: .42–.70; little harm: aPR = .77, 95% CI: .68–.88, vs. a lot of harm) were less likely to report intentions to quit e-cigarettes. In addition, men (aPR = 1.11, 95% CI: 1.02–1.20, vs. female) and those who did not know if the e-cigarette they used in the past 30 days was flavored (aPR = 1.40, 95% CI: 1.10–1.77, vs. no flavor use) were significantly more likely to report intention to quit e-cigarettes (Table 3).

*Quit attempts.* Among students reporting current use of e-cigarettes, 67.4% reported attempting to quit e-cigarettes overall (MS: 70.3%; HS: 66.7%; Table 3). In adjusted analysis, those reporting nicotine dependency were more likely to make a past-year attempt to quit e-cigarettes (aPR = 1.17, 95% CI: 1.06–1.29), whereas those who reported using ≥2 tobacco products (aPR = .85, 95% CI: .75–.96; vs. single product use) and those who perceived intermittent e-cigarette use causes no harm

**Table 2**
Prevalence of cigarette specific quit intentions[a] and quit attempts[b] among U.S. middle and high school students who report current use of cigarettes[c], 2020 National Youth Tobacco Survey

| | Sample size (n)[d] | Quit intentions | | | Quit attempts | | |
|---|---|---|---|---|---|---|---|
| | | % (95% CI)[e] | *p* value from bivariate chi-square test[f] | aPR (95% CI) from multivariable model[g] | % (95% CI) | *p* value from bivariate chi-square test[f] | aPR (95% CI) from multivariable model[g] |
| Overall | 453 | 68.1% (62.4–73.3) | - | - | 65.8% (58.6–72.4) | - | - |
| Sex | | | | | | | |
| Female | 207 | 67.9% (60.0–74.9) | .95 | 1.00 (ref) | 65.7% (55.8–74.5) | .98 | 1.00 (ref) |
| Male | 246 | 68.3% (58.6–76.6) | | 1.03 (.86–1.24) | 65.9% (56.3–74.4) | | 1.11 (.90–1.37) |
| Race/Ethnicity | | | | | | | |
| White, non-Hispanic | 243 | 66.2% (58.9–72.8) | .08 | 1.00 (ref) | 62.8% (54.0–70.8) | .31 | 1.00 (ref) |
| Black, non-Hispanic | [h] | [h] | | [h] | [h] | | [h] |
| Hispanic | 147 | 69.1% (59.5–77.4) | | 1.10 (.91–1.32) | 65.6% (55.8–74.2) | | 1.00 (.86–1.16) |
| Other, non-Hispanic | [h] | [h] | | [h] | [h] | | [h] |
| School type | | | | | | | |
| Middle school | 119 | 69.2% (59.3–77.6) | .76 | 1.00 (ref) | 76.4% (63.5–85.8) | .12 | 1.00 (ref) |
| High school | 331 | 67.7% (61.6–73.3) | | 1.05 (.91–1.21) | 63.0% (54.1–71.0) | | .90 (.70–1.14) |
| Nicotine dependency[i] | | | | | | | |
| No | 199 | 69.6% (59.5–78.1) | .68 | 1.00 (ref) | 63.5% (52.1–73.5) | .57 | 1.00 (ref) |
| Yes | 249 | 67.1% (59.6–73.8) | | 1.03 (.87–1.22) | 67.5% (58.1–75.6) | | 1.19 (.96–1.47) |
| Any household tobacco use[j] | | | | | | | |
| No | 136 | 62.1% (50.2–72.6) | .17 | 1.00 (ref) | 60.4% (45.7–73.4) | .29 | 1.00 (ref) |
| Yes | 281 | 70.2% (63.4–76.2) | | 1.17 (.99–1.38) | 68.7% (60.8–75.7) | | 1.14 (.88–1.48) |
| Exposure to ads or promotions to cigarettes and other tobacco products[k] | | | | | | | |
| Not Exposed | 88 | 70.5% (55.3–82.2) | .71 | 1.00 (ref) | 67.4% (53.6–78.7) | .91 | 1.00 (ref) |
| Exposed | 339 | 67.7% (61.8–73.1) | | 1.00 (.81–1.22) | 66.6% (58.2–74.0) | | .90 (.81–1.20) |
| Flavored (menthol) cigarette use[l] | | | | | | | |
| No | 237 | 71.3% (63.4–78.1) | .52 | 1.00 (ref) | 67.0% (59.6–73.7) | .67 | 1.00 (ref) |
| Yes | 180 | 65.4% (56.0–73.8) | | .90 (.75–1.08) | 63.2% (52.9–72.4) | | .94 (.80–1.11) |
| Don't know | [h] | [h] | | [h] | [h] | | [h] |
| Use of ≥2 tobacco products[m] | | | | | | | |
| No | 64 | 73.9% (56.7–86.0) | .43 | 1.00 (ref) | 66.3% (53.9–76.8) | .94 | 1.00 (ref) |
| Yes | 389 | 67.4% (61.8–72.7) | | .93 (.72–1.20) | 65.8% (58.0–72.8) | | 1.02 (.86–1.22) |
| Harm perceptions of intermittent cigarette use[n] | | | | | | | |
| A lot of harm | 140 | 76.8% (67.7–83.9) | .13 | 1.00 (ref) | 82.0% (72.9–88.5) | **<.001** | 1.00 (ref) |
| Some harm | 141 | 66.9% (58.3–74.4) | | **.82 (.69–.97)** | 61.8% (50.5–71.9) | | **.75 (.60–.93)** |
| Little harm | 101 | 63.9% (49.4–76.3) | | .84 (.67–1.05) | 60.4% (48.0–71.6) | | **.77 (.64–.94)** |
| No harm | [h] | [h] | | [h] | [h] | | [h] |

[a] Based on the question, "Are you seriously thinking about quitting cigarettes? (Please choose the first answer that fits)" Responses of "Yes, during the next 30 days," "Yes, during the next 6 months," "Yes, during the next 12 months," and "Yes, but not during the next 12 months" were indicative of having quit intentions. The response, "No, I am not thinking about quitting cigarettes" was indicative of not having quit intentions. n = 32 respondents are missing data on this outcome and are excluded from the analysis.

[b] Based on the question, "During the past 12 months, how many times have you stopped smoking cigarettes for 1 day or longer because you were trying to quit smoking cigarettes for good?" Responses other than "I did not try to quit during the past 12 months" were indicative of having made one or more quit attempts. n = 25 respondents are missing data on this outcome and are excluded from the analysis.

[c] Defined as the use of cigarettes on at least 1 day during the past 30 days.

[d] Unweighted Sample size is based on self-report of use of cigarettes during the past 30 days. For covariates, may not add to total (n = 453) due to missing data.

[e] Percentages (and 95% confidence interval [CI]) are based on weighted data.

[f] Based on chi square test to assess bivariate association between cessation outcomes and each covariate ($p < .05$ considered statistically significant [bolded]).

[g] Adjusted multivariable binary logistic regression with predictive marginal proportions assessed socio-demographic determinants of reporting quit intention and quit attempts; model-adjusted prevalence ratios (aPR) were derived from predicted marginals and are adjusted for all covariates in the table. Bolded numbers denote statistically significant results ($p < .05$).

[h] Statistically unstable estimate; suppressed due to relative standard error > 30% or unweighted denominator <50.

[i] Nicotine Dependency is based on responses to two questions: (1) "How soon after you wake do you want to use a tobacco product?" and (2) "During the past 30 days, have you had a strong craving or felt like you really needed to use a tobacco product of any kind?". Respondents were categorized as "yes" if they indicated wanting to use a tobacco product within 30 minutes after waking OR if they indicate they had a strong craving or felt like they really needed to use a tobacco product during the past 30 days. Respondents missing data on both measures were excluded from the analysis.

[j] Assessed by the question, "Does anyone who lives with you now…?" Response options of "smoke cigarettes," "smoke cigars, cigarillos, or little cigars," "use chewing tobacco, snuff, or dip," "use e-cigarettes," "smoke tobacco in a hookah or water pipe," "smoke pipes filled with tobacco (not hookah or water pipes)," "use snus," "use dissolvable tobacco products," "smoke bidis (small brown cigarettes wrapped in a leaf)," or "use heated tobacco products" were coded as "yes". The response, "No one who lives with me now uses any form of tobacco" was coded as no.

[k] Exposure to cigarette or other tobacco product marketing (advertisements or promotions) were assessed for four sources: retail stores; Internet; television, streaming sources, or movies; and newspapers or magazines. Participants were asked, "When you (are using the Internet; read newspapers or magazines; go to a convenience store, supermarket, or gas station; watch television or streaming services [such as Netflix, Hulu, or Amazon Prime], or go to the movies), how often do you see ads or promotions for cigarettes or other tobacco products?" Respondents were categorized as exposed if they responded "sometimes," "most of the time," or "always" or unexposed if they responded "never" or "rarely." Persons who reported "I never go to a convenience stores, supermarket, or gas station," "I do not use the Internet," "I do not watch TV or streaming services or go to the movies," or "I do not read newspapers or magazines" were set to missing.

[l] For current (past 30-day) cigarette smokers, flavored (menthol) use was determined from a response of "yes" to the question, "During the past 30 days, were the cigarettes that you usually smoked menthol?" and/or indicating that the usual brand smoked during the past 30 days was "Newport" or "Kool."

[m] Respondents who indicated using more than one tobacco product (e-cigarettes, cigarettes, cigars/cigarillos/little cigars; smokeless tobacco [chewing tobacco, snuff, or dip, snus, or dissolvable tobacco product]; hookah, pipe tobacco or bidis) on at least 1 day during the past 30 days were categorized as using ≥2 tobacco products.

[n] Assessed by the question, "How much do you think people harm themselves when they smoke cigarettes some days but not every day?"

**Table 3**
Prevalence of e-cigarette specific quit intentions[a] and quit attempts[b] among U.S. middle and high school students who report current use of e-cigarettes[c], 2020 National Youth Tobacco Survey

| | Sample size (n)[d] | Quit intentions | | | Quit attempts | | |
|---|---|---|---|---|---|---|---|
| | | % (95% CI)[e] | *p* value from bivariate chi-square test[f] | aPR (95% CI) from multivariable model[g] | % (95% CI) | *p* value from bivariate chi-square test[f] | aPR (95% CI) from multivariable model[g] |
| Overall | 1,769 | 63.9% (60.5–67.2) | - | - | 67.4% (63.9–70.7) | - | - |
| Sex | | | | | | | |
| Female | 874 | 62.8% (59.1–66.2) | .37 | 1.00 (ref) | 67.5% (62.8–71.8) | .99 | 1.00 (ref) |
| Male | 892 | 65.0% (60.2–69.5) | | **1.11 (1.02–1.20)** | 67.4% (62.7–71.8) | | 1.04 (.95–1.14) |
| Race/Ethnicity | | | | | | | |
| White, non-Hispanic | 1,061 | 63.7% (59.8–67.5) | .64 | 1.00 (ref) | 65.0% (60.3–69.4) | .10 | 1.00 (ref) |
| Black, non-Hispanic | 87 | 67.2% (51.1–80.1) | | 1.09 (.85–1.41) | 75.5% (61.5–85.6) | | **1.28 (1.08–1.51)** |
| Hispanic | 542 | 62.3% (54.4–69.7) | | 1.02 (.87–1.17) | 69.4% (64.1–74.3) | | **1.16 (1.05–1.29)** |
| Other, non-Hispanic | 67 | 70.4% (54.7–82.5) | | 1.07 (.85–1.35) | 81.3% (65.9–90.7) | | **1.26 (1.04–1.54)** |
| School type | | | | | | | |
| Middle school | 316 | 63.2% (56.5–69.4) | .87 | 1.00 (ref) | 70.3% (64.1–75.9) | .29 | 1.00 (ref) |
| High school | 1,448 | 63.9% (59.8–67.8) | | .94 (.83–1.07) | 66.7% (63.2–70.3) | | .98 (.89–1.08) |
| Nicotine dependency[h] | | | | | | | |
| No | 1,054 | 64.3% (60.3–68.2) | .74 | 1.00 (ref) | 64.2% (60.1–68.1) | **.02** | 1.00 (ref) |
| Yes | 694 | 63.3% (58.0–68.3) | | 1.03 (.95–1.13) | 71.9% (66.2–77.0) | | **1.17 (1.06–1.29)** |
| Any household tobacco use[i] | | | | | | | |
| No | 705 | 66.4% (61.0–71.4) | .09 | 1.00 (ref) | 65.2% (60.1–70.1) | .33 | 1.00 (ref) |
| Yes | 945 | 60.8% (56.7–64.8) | | .95 (.87–1.04) | 68.0% (63.7–72.1) | | 1.07 (.98–1.15) |
| Exposure to e-cigarette ads or promotions[j] | | | | | | | |
| Not Exposed | 394 | 64.4% (58.5–69.9) | .86 | 1.00 (ref) | 66.6% (60.0–72.6) | .64 | 1.00 (ref) |
| Exposed | 1,256 | 63.8% (59.5–67.9) | | .97 (.87–1.08) | 68.2% (64.2–71.9) | | .97 (.89–1.07) |
| Flavored e-cigarette use[k] | | | | | | | |
| No | 218 | 63.5% (54.9–71.3) | .37 | 1.00 (ref) | 66.3% (57.3–74.2) | .80 | 1.00 (ref) |
| Yes | 1,457 | 63.6% (59.9–67.2) | | 1.07 (.91–1.26) | 67.3% (63.1–71.3) | | 1.00 (.84–1.20) |
| Don't know | 72 | 74.3% (56.8–86.4) | | **1.40 (1.10–1.77)** | 72.6% (54.8–85.3) | | 1.15 (.89–1.49) |
| Use of ≥2 tobacco products[l] | | | | | | | |
| No | 1,120 | 69.0% (65.1–72.6) | **<.001** | 1.00 (ref) | 70.9% (66.9–74.5) | **.03** | 1.00 (ref) |
| Yes | 649 | 55.9% (50.1–61.5) | | **.82 (.74–.90)** | 61.9% (55.6–67.8) | | **.85 (.75–.96)** |
| Harm perceptions of intermittent e-cigarette use[m] | | | | | | | |
| A lot of harm | 331 | 69.3% (62.1–75.7) | **<.001** | 1.00 (ref) | 69.7% (61.7–76.7) | **.001** | 1.0 (ref) |
| Some harm | 624 | 75.3% (70.6–79.4) | | 1.05 (.94–1.18) | 72.6% (67.6–77.1) | | 1.04 (.91–1.20) |
| Little harm | 536 | 56.4% (50.8–61.8) | | **.77 (.68–.88)** | 65.2% (58.9–71.1) | | .94 (.82–1.08) |
| No harm | 176 | 40.9% (31.1–51.5) | | **.54 (.42–.70)** | 47.7% (36.7–58.9) | | **.69 (.56–.86)** |

[a] Based on the question, "Are you seriously thinking about quitting e-cigarettes? (Please choose the first answer that fits)" Responses of "Yes, during the next 30 days," "Yes, during the next 6 months," "Yes, during the next 12 months," and "Yes, but not during the next 12 months" were indicative of having quit intentions. The response, "No, I am not thinking about quitting e-cigarettes" was indicative of not having quit intentions. n = 134 respondents are missing data on this outcome and are excluded from the analysis.

[b] Based on the question, "During the past 12 months, how many times have you stopped using e-cigarettes for 1 day or longer because you were trying to quit using e-cigarettes for good?" Responses other than "I did not try to quit during the past 12 months" were indicative of having made one or more quit attempts. n = 143 respondents are missing data on this outcome and are excluded from the analysis.

[c] Defined as the use of e-cigarettes on at least 1 day during the past 30 days.

[d] Unweighted sample size is based on self-report of use of e-cigarettes during the past 30 days. For covariates, may not add to total (n = 1,769) owing to missing data.

[e] Percentages (and 95% confidence interval [CI]) are based on weighted data.

[f] Based on chi square test to assess bivariate association between cessation outcomes and each covariate ($p < .05$ considered statistically significant [bolded]).

[g] Adjusted multivariable binary logistic regression with predictive marginal proportions assessed socio-demographic determinants of reporting quit intention and quit attempts; model-adjusted prevalence ratios (aPRs) were derived from predicted marginals and are adjusted for all covariates in the table. Bolded numbers denote statistically significant results ($p < .05$).

[h] Nicotine Dependency is based on responses to two questions: (1) "How soon after you wake do you want to use a tobacco product?" and (2) "During the past 30 days, have you had a strong craving or felt like you really needed to use a tobacco product of any kind?". Respondents were categorized as "yes" if they indicated wanting to use a tobacco product within 30 minutes after waking OR if they indicate they had a strong craving or felt like they really needed to use a tobacco product during the past 30 days. Respondents missing data on both measures were excluded from the analysis.

[i] Assessed by the question, "Does anyone who lives with you now…?" Response options of "smoke cigarettes," "smoke cigars, cigarillos, or little cigars," "use chewing tobacco, snuff, or dip," "use e-cigarettes," "smoke tobacco in a hookah or water pipe," "smoke pipes filled with tobacco (not hookah or water pipes)," "use snus," "use dissolvable tobacco products," "smoke bidis (small brown cigarettes wrapped in a leaf)," or "use heated tobacco products" were coded as "yes". The response, "No one who lives with me now uses any form of tobacco" was coded as no.

[j] Exposure to e-cigarette marketing (advertisements or promotions) was assessed for four sources: retail stores; Internet; television, streaming sources, or movies; and newspapers or magazines. Participants were asked, "When you (are using the Internet; read newspapers or magazines; go to a convenience store, supermarket, or gas station; watch television or streaming services [such as Netflix, Hulu, or Amazon Prime], or go to the movies), how often do you see ads or promotions for e-cigarettes?" Respondents were categorized as exposed if they responded "sometimes," "most of the time," or "always" or unexposed if they responded "never" or "rarely." Persons who reported "I never go to a convenience stores, supermarket, or gas station," "I do not use the Internet," "I do not watch TV or streaming services or go to the movies," or "I do not read newspapers or magazines" were set to missing.

[k] Current e-cigarette users were asked, "Were any of the e-cigarettes that you used in the past 30 days flavored to taste like menthol, mint, clove or spice, alcohol (wine, cognac), candy, fruit, chocolate, or any other flavor?" (Yes, No, Don't Know).

[l] Respondents who indicated using more than one tobacco product (e-cigarettes, cigarettes, cigars/cigarillos/little cigars; smokeless tobacco [chewing tobacco, snuff, or dip, snus, or dissolvable tobacco product]; hookah, pipe tobacco or bidis) on at least 1 day during the past 30 days were categorized as using ≥2 tobacco products.

[m] Assessed by the question, "How much do you think people harm themselves when they use e-cigarettes some days but not every day?"

(aPR = .69, 95% CI: .56–.86; vs. a lot of harm) were less likely to make a past-year attempt to quit e-cigarettes. In addition, compared with white, non-Hispanic students, black, non-Hispanic (aPR = 1.28, 95% CI: 1.08–1.51), Hispanic (aPR = 1.16, 95% CI: 1.05–1.29), and other, non-Hispanic (aPR = 1.26, 95% CI: 1.04–1.54) students were more likely to make a past-year attempt to quit e-cigarettes (Table 3).

## Discussion

Our findings using data collected in early 2020 provide the most up-to-date information about tobacco cessation behaviors among U.S. youth. Nearly two-thirds of middle and high school students who currently used tobacco products reported wanting to quit, and nearly two-thirds reported attempting to quit in 2020. While little difference in the prevalence of wanting and attempting to quit was observed among youth, this is different from adults, who report a higher prevalence of wanting to quit (68.0%) than attempting to quit (55.4%) [14]. The high youth prevalence of wanting and attempting to quit were consistent across tobacco product use categories. In addition, quit intentions and quit attempts were uniformly high, with little variability, for most demographically defined subgroups. These results reinforce that youth who use tobacco are motivated to quit and could benefit from the development of evidence-based cessation interventions to support youth in quitting the use of tobacco products.

Our findings indicate potential increases in prevalence of youth quit intentions and attempts over time. A study of 2012 NYTS data found that the prevalence of quit intentions (52.8%) and past-year quit attempts (51.5%) among youth reporting any current tobacco product use appear to be lower than estimates reported here [8]. Similarly, the prevalence of quit intentions (56.8%) and past-year quit attempts (52.5%) among youth reporting current cigarette smoking also appear to be lower in 2012 than the current findings [5]. In addition, analysis of data from 2017 NYTS indicates that the prevalence of attempts to quit smoking during the past year was 61.1% among high school students and 67.2% among middle school students [7]. Recent research using data from wave 4 (December 2016 to January 2018) of the Population Assessment on Tobacco and Health study reported 44.5% of youth who used e-cigarettes were seriously thinking about quitting e-cigarette use and 24.9% reported a past-year quit attempt [9]. Comparable NYTS-specific estimates of e-cigarette cessation behaviors for this time period (2016–2018) are not available as these measures were first introduced on the NYTS for e-cigarettes in 2020. Factors that may explain these disparate findings include the question phrasing and survey methodology (school-based survey vs. household survey). In addition, shifts in population-level risk perceptions of e-cigarette use, among other things, may have contributed to an increase in quit intentions and attempts among youth [15].

Taken together, the findings from this study suggest that many youth who use tobacco could benefit from cessation-related support or intervention as part of a comprehensive approach to prevent and reduce youth tobacco product use; not only do most youth who use tobacco want to quit and have attempted to do so, youth who exhibit some indication of nicotine dependency have a significantly higher prevalence of attempting to quit all tobacco and e-cigarettes. However, evidence for effective cessation interventions for youth is limited, and the evidence that exists is largely related to youth cigarette cessation [10,11,16]. The U.S. Preventive Services Task Force concluded there is insufficient evidence for evaluating the efficacy of primary care–based interventions for tobacco cessation among youth, but acknowledges that clinicians should "use clinical judgment to decide how to best help youth who use tobacco"[17]. The U.S. Preventive Services Task Force review found no trials evaluating interventions to help youth quit e-cigarettes [10]. The American Academy of Pediatrics recommends pediatric healthcare providers offer tobacco dependence treatment, including behavioral counseling, to adolescents who want to stop smoking and to tailor support to an adolescent's severity of dependence [18]. In addition, there are emerging resources for youth seeking help in quitting including *Smokefree Teen* [19] and *This is Quitting* [20]; efficacy of these interventions have not been robustly assessed, but high enrollment in such programs aligns with our findings that youth are interested in quitting [21]. More research in this area could inform the development of effective interventions to help youth quit.

Quit attempts varied by race and ethnicity for current tobacco use and current e-cigarette use. Compared to non-Hispanic white youth, non-Hispanic black and Hispanic youth had a higher adjusted prevalence of quit attempts for use of any tobacco product and e-cigarettes. This finding is similar to adult data that shows non-Hispanic black adults who smoke cigarettes are more likely to make past-year quit attempts than their non-Hispanic white counterparts [14]. Adult data additionally suggest non-Hispanic black adults have a lower prevalence of recent successful smoking cessation [14]. Future research could further explore differences in cessation behaviors and the potential drivers of such differences, among youth of different race and ethnicity.

Screening and counseling regarding all tobacco products, including polyproduct use, may be beneficial when providing clinical care to youth. This is supported by our finding that youth who use e-cigarettes and additional tobacco product(s) were less likely to report quit intention and past year attempts to quit using e-cigarettes than youth who exclusively use e-cigarettes. About four in 10 youth who use tobacco use two or more tobacco products [13]. Among students who reported current use of multiple tobacco products in 2020, e-cigarettes were the most commonly used product in combination with other tobacco products [5]. This may partially explain our finding that cessation behaviors associated with any tobacco product use and e-cigarette use are similar. Youth-focused cessation-related messaging might also take polyproduct use into account when considering how best to motivate youth to quit. Similarly, efforts to develop cessation interventions for youth can consider polyproduct use when finding the best treatment methods to help youth quit all tobacco products.

The present study's findings also suggest potential messaging opportunities when communicating with youth about quitting. In the present study, quit intentions and quit attempts were lower among youth with lower perceptions of harm associated with tobacco use. This result was found among students who currently use any tobacco products and those who use e-cigarettes with some evidence among current cigarette smokers. Similar findings were noted in previous studies using 2012 NYTS data [8]. Quitting-related communications targeted to youth and youth influencers (including parents, educators, and healthcare providers) could focus on increasing youth awareness of the harms of tobacco product use. In addition, as most youth report both intentions to quit and quit attempts, cessation-related messaging may benefit from both messages encouraging repeated quit attempts and connection to healthcare providers and other cessation-related services. Further research regarding youth-targeted tobacco communications could further explore how these types of messages change youth attitudes toward quitting.

Finally, the present results suggest that quit attempts among youth who currently use any tobacco might be influenced by tobacco use behaviors of other household members. Further research is warranted to improve our understanding of this relationship.

### *Limitations*

This study is subject to at least three limitations. First, owing to COVID-19 pandemic-related school closures, data collection for the 2020 NYTS was truncated, resulting in an overall lower response rate compared with previous years. However, the weighted sample of respondents yielded nationally representative estimates of students in grades 6–12 who attended public and private schools. Second, data were self-reported and might be subject to recall and response bias. Finally, as data were collected from students enrolled in public or private schools, these findings may not be generalizable to youth who are home schooled, have dropped out of school, are in detention centers, or are enrolled in alternative schools. However, data from the 2018 Current Population Survey indicate that approximately 97% of U.S. youths aged 10–17 years were enrolled in traditional schools [22], suggesting that our findings are generalizable to most middle and high school youth.

## Conclusions

About two thirds of youth who currently use tobacco products report wanting to quit and nearly two thirds report trying to quit; however, evidence for effective tobacco cessation interventions and cessation-related messaging for youth is limited. Given the epidemic levels of youth tobacco product use, the development of youth-focused cessation interventions as part of a comprehensive approach to tobacco prevention and cessation could support progress in protecting our nation's youth from this public health threat.

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