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Tobacco Use Among Middle and High School Students — United States, 2011–2015

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Tobacco use is the leading cause of preventable disease and death in the United States; if current smoking rates continue, 5.6 million Americans aged <18 years who are alive today are projected to die prematurely from smoking-related disease (*1*). Tobacco use and addiction mostly begin during youth and young adulthood (*1*,*2*). CDC and the Food and Drug Administration (FDA) analyzed data from the 2011–2015 National Youth Tobacco Surveys (NYTS) to determine the prevalence and trends of current (past 30-day) use of seven tobacco product types (cigarettes, cigars, smokeless tobacco, electronic cigarettes [e-cigarettes], hookahs [water pipes used to smoke tobacco], pipe tobacco, and bidis [small imported cigarettes wrapped in a tendu leaf]) among U.S. middle (grades 6–8) and high (grades 9–12) school students. In 2015, e-cigarettes were the most commonly used tobacco product among middle (5.3%) and high (16.0%) school students. During 2011–2015, significant increases in current use of e-cigarettes and hookahs occurred among middle and high school students, whereas current use of conventional tobacco products, such as cigarettes and cigars decreased, resulting in no change in overall tobacco product use. During 2014–2015, current use of e-cigarettes increased among middle school students, whereas current use of hookahs decreased among high school students; in contrast, no change was observed in use of hookahs among middle school students, use of e-cigarettes among high school students, or use of cigarettes, cigars, smokeless tobacco, pipe tobacco, or bidis among middle and high school students. In 2015, an estimated 4.7 million middle and high school students were current tobacco product users, and, therefore, continue to be exposed to harmful tobacco product constituents, including nicotine. Nicotine exposure during adolescence, a critical period for brain development, can cause addiction, might harm brain development, and could lead to sustained tobacco product use among youths (*1*,*3*). Comprehensive and sustained strategies are warranted to prevent and reduce the use of all tobacco products among U.S. youths.

The NYTS is a cross-sectional, school-based, self-administered, pencil-and-paper questionnaire administered to U.S. middle school and high school students. Information is collected on tobacco control outcome indicators to monitor the impact of comprehensive tobacco control policies and strategies (*4*) and to inform the FDA's regulatory actions (*5*). A three-stage cluster sampling

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procedure was used to generate a nationally representative sample of U.S. students attending public and private schools in grades 6–12. This report uses data from 5 years of NYTS (2011–2015). Sample sizes and overall response rates for 2011, 2012, 2013, 2014, and 2015 were 18,866 (72.7%), 24,658 (73.6%), 18,406 (67.8%), 22,007 (73.3%), and 17,711 (63.4%), respectively.

Participants were asked about current (past 30-day) use of cigarettes, cigars, smokeless tobacco,* e-cigarettes,† hookahs,§ pipe tobacco,¶ and bidis. Current use for each product was defined as use on ≥1 day during the past 30 days. Current tobacco use was categorized as "any tobacco product use," defined as use of one or more tobacco products in the past 30 days; and "≥2 tobacco product use," defined as use of two or more tobacco products in the past 30 days.** Kreteks (sometimes referred to as clove cigarettes) are no longer legally sold in the United States, and were excluded from the definition of current any tobacco product use, consistent with other recent reports.†† Data were weighted to account for the complex survey design and adjusted for nonresponse; national prevalence estimates with 95% confidence intervals and population estimates rounded down to the nearest 10,000 were computed. Estimates for current use in 2015 are presented for any tobacco product use, use of ≥2 tobacco products, and use of each tobacco product, by selected

* The definition of smokeless tobacco in this report includes chewing tobacco/snuff/dip, snus, and dissolvable tobacco because of limited sample sizes. The definition of smokeless tobacco in previously published NYTS reports included only chewing tobacco/snuff/dip, whereas snus and dissolvable tobacco were reported as separate products.

† In 2015, current use of e-cigarettes was assessed by the question "During the past 30 days, on how many days did you use electronic cigarettes or e-cigarettes." E-cigarette questions were preceded by an introductory paragraph: "The next twelve questions are about electronic cigarettes or e-cigarettes. E-cigarettes are electronic devices that usually contain a nicotine-based liquid that is vaporized and inhaled. You may also know them as vape-pens, hookah-pens, electronic hookahs (e-hookahs), electronic cigars (e-cigars), electronic pipes (e-pipes), or e-vaporizers. Some look like cigarettes and others look like pens or small pipes. These are battery-powered devices that produce vapor instead of smoke. Some brands examples are NJOY, Blu, VUSE, MarkTen, Finiti, Starbuzz, and Fantasia." In 2014, current use of e-cigarettes was assessed by the question "During the past 30 days, on how many days did you use e-cigarettes such as Blu, 21st Century Smoke, or NJOY?"; and in 2011 to 2013, e-cigarette use was assessed by the question "In the past 30 days, which of the following products have you used on at least one day?," and the response option for e-cigarettes was "Electronic cigarettes or e-cigarettes such as Ruyan or NJOY."

§ In 2015, current use of hookahs was assessed by the question "In the past 30 days, which of the following products have you used on at least one day?" and was the fourth response option available to be selected; in 2014, hookah use was the first response option; whereas from 2011 to 2013, hookah was the fourth or fifth response option.

¶ In 2014 and 2015, current use of tobacco pipes was assessed by the question "In the past 30 days, which of the following products have you used on at least one day?" and the response option for pipe tobacco was "Pipe filled with tobacco (not waterpipe)." From 2011 to 2013, tobacco pipe use was assessed by the question "During the past 30 days, on how many days did you smoke tobacco in a pipe?"

** The definition of ≥2 tobacco product use includes the updated definition of smokeless tobacco, thereby analyzing chewing tobacco/snuff/dip, snus, and dissolvable tobacco as a single tobacco product type compared with previously published NYTS reports, which analyzed chewing tobacco/snuff/dip, snus, and dissolvable tobacco as separate products.

†† Kreteks are no longer legally sold in the United States; therefore, data on these products were not collected in the 2014 and 2015 cycles of NYTS. Also, kreteks were not included in the definition of "any tobacco product use" in years when data were collected to assess trends across the study period (2011, 2012, and 2013).

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demographics for each school level (high and middle). Results were assessed for the presence of linear and quadratic trends to determine the overall trend present, adjusting for race/ethnicity, sex, and grade; p-value <0.05 was used to determine statistical significance.[§§] T-tests were performed to examine differences between estimates from 2014 and 2015; p-values <0.05 were considered statistically significant.

In 2015, 25.3% of high school students reported current use of any tobacco product, including 13.0% who reported current use of ≥2 tobacco products. Among all high school students, e-cigarettes (16.0%) were the most commonly used tobacco product, followed by cigarettes (9.3%), cigars (8.6%), hookahs (7.2%), smokeless tobacco (6.0%), pipe tobacco (1.0%), and bidis (0.6%) (Table). Males reported higher use of any tobacco, ≥2 tobacco products, e-cigarettes, cigarettes, cigars, smokeless tobacco, and bidis than did females. Among non-Hispanic white and Hispanic high school students, e-cigarettes were the most commonly used tobacco product, whereas among non-Hispanic black high school students, cigars were most commonly used. Cigarette use was higher among non-Hispanic whites than among non-Hispanic blacks; and smokeless tobacco use was higher among non-Hispanic whites than other races.

Among middle school students, current use of any tobacco product and ≥2 tobacco products was 7.4% and 3.3%, respectively (Table). E-cigarettes (5.3%) were the most commonly used tobacco product by middle school students, followed by cigarettes (2.3%), hookahs (2.0%), smokeless tobacco (1.8%), cigars (1.6%), pipe tobacco (0.4%), and bidis (0.2%). As was the case among high school students, male middle school students reported higher use of any tobacco product than did females. Hispanic middle school students reported higher use of any tobacco product, use of ≥2 tobacco products, and use of e-cigarettes compared with that of other races/ethnicities.

During 2014–2015, current use of hookahs declined among high school students. Use of all other tobacco products, including e-cigarettes, cigarettes, cigars, and smokeless tobacco remained unchanged during this time period among high school students. Among middle school students, e-cigarette use increased from 3.9% in 2014 to 5.3% in 2015. Use of other tobacco products, including cigarettes, cigars, hookahs, and smokeless tobacco remained unchanged.

During 2011–2015, among all high school students, significant nonlinear increases were observed for current use of e-cigarettes (1.5% to 16.0%) and hookahs (4.1% to 7.2%) (Figure 1). Significant linear decreases were observed for current use of cigarettes (15.8% to 9.3%) and smokeless tobacco (7.9% to 6.0%), and significant nonlinear decreases were observed for current use of cigars (11.6% to 8.6%), pipe tobacco (4.0% to 1.0%), and bidis (2.0% to 0.6%). Current use of any tobacco product (24.2% to 25.3%) did not change significantly during 2011–2015. Among middle school students, significant linear increases were observed for current use of e-cigarettes (0.6% to 5.3%) and hookahs (1.0% to 2.0%) (Figure 2). Significant linear decreases were observed for current use of cigarettes (4.3% to 2.3%), cigars (3.5% to 1.6%), and smokeless tobacco (2.7% to 1.8%), and significant nonlinear decreases were observed for current use of pipe tobacco (2.2% to 0.4%) and bidis (1.7% to 0.2%). There was also a significant nonlinear change in the percentage of middle school students reporting current use of ≥2 tobacco products.

In 2015, an estimated 4.7 million middle and high school students were current users of any tobacco product, over 2.3 million of whom were current users of ≥2 tobacco products. Among middle and high school current tobacco users,

Summary

What is already known about this topic?

Tobacco use and addiction mostly begin during youth and young adulthood. Nicotine exposure during adolescence can cause addiction, might harm brain development, and could lead to sustained tobacco product use among youths.

What is added by this report?

In 2015, one in four high school students and one in 13 middle school students reported current use of any tobacco product (≥1 day in the past 30 days). An estimated 4.7 million high school and middle school students reported current use of any tobacco product. During 2011–2015, substantial increases were observed in e-cigarette and hookah use among high school and middle school students, whereas significant decreases were observed in the use of cigarettes, cigars, smokeless tobacco, pipe tobacco, and bidis, resulting in no decline in tobacco use overall. During 2015, electronic cigarettes (e-cigarettes) were the most commonly used tobacco product among middle (5.3%) and high (16.0%) school students.

What are the implications for public health practice?

Use of emerging tobacco products, including e-cigarettes, is on the rise among middle and high school students; therefore, it is critical that comprehensive tobacco control and prevention strategies for youths address all tobacco products and not just cigarettes.

[§§] A test for linear trend is significant if an overall statistically significant decrease or increase occurs during the study period. Data were also assessed for the presence of quadratic trends; a significant quadratic trend indicates that the rate of change accelerated or decelerated across the study period. Trends were only assessed when statistically stable data were available for all 5 years. A significant positive linear trend and nonsignificant quadratic trend signifies the presence of a linear increase; a significant negative linear trend and nonsignificant quadratic trends signifies the presence of a linear decrease; a significant positive linear trend and significant positive or negative quadratic trend signifies the presence of a nonlinear increase; a significant negative linear trend and significant positive or negative quadratic trend signifies the presence of a nonlinear decrease; a nonsignificant linear trend and significant positive or negative quadratic trend signifies the presence of a nonlinear change.

TABLE. Estimated percentage of tobacco use in the past 30 days, by product,* school level, sex, and race/ethnicity — National Youth Tobacco Survey, United States, 2015

	Sex		Race/Ethnicity				Total	
Tobacco product	Female % (95% CI)	Male % (95% CI)	Non-Hispanic white % (95% CI)	Non-Hispanic black % (95% CI)	Hispanic % (95% CI)	Non-Hispanic other race % (95% CI)	% (95% CI)	Estimated number of users†
High school students								
Electronic cigarettes	12.8 (11.0–15.0)	19.0 (16.5–21.7)	17.2 (14.7–19.9)	8.9 (7.4–10.8)	16.4 (14.1–19.0)	18.9 (10.3–32.2)	**16.0 (14.1–18.0)**	**2,390,000**
Cigarettes	7.7 (6.3–9.3)	10.7 (8.9–12.9)	10.2 (8.4–12.3)	5.7 (3.2–10.0)	9.0 (7.0–11.7)	7.5 (5.0–10.9)	**9.3 (7.8–10.9)**	**1,370,000**
Cigars	5.6 (4.7–6.8)	11.5 (10.1–13.1)	8.4 (7.2–9.9)	12.8 (9.5–17.0)	7.3 (5.8–9.1)	5.9 (3.8–9.1)	**8.6 (7.6–9.8)**	**1,270,000**
Hookah	6.9 (5.6–8.4)	7.4 (6.5–8.5)	6.9 (5.6–8.4)	6.4 (4.8–8.5)	8.7 (7.5–10.1)	6.4 (4.6–8.9)	**7.2 (6.3–8.2)**	**1,040,000**
Smokeless tobacco	1.8 (1.2–2.7)	10.0 (8.0–12.5)	7.8 (5.9–10.2)	1.9 (1.1–3.4)	4.8 (3.8–6.1)	2.7 (1.6–4.6)	**6.0 (4.7–7.6)**	**900,000**
Pipe tobacco	0.7 (0.4–1.2)	1.4 (0.9–2.0)	1.0 (0.7–1.6)	—§	1.5 (1.1–2.2)	—	**1.0 (0.8–1.4)**	**150,000**
Bidis	0.4 (0.2–0.6)	0.9 (0.6–1.4)	0.5 (0.3–0.9)	—	—	—	**0.6 (0.4–0.9)**	**90,000**
Any tobacco product use¶	20.3 (18.0–22.9)	30.0 (27.4–32.8)	26.2 (23.2–29.4)	21.9 (18.7–25.5)	25.4 (22.6–28.3)	25.3 (16.9–36.1)	**25.3 (23.1–27.6)**	**3,820,000**
≥2 tobacco product use**	9.6 (8.0–11.6)	16.2 (14.5–18.0)	14.2 (12.0–16.7)	9.5 (6.8–13.0)	13.0 (11.1–15.3)	9.4 (6.8–12.8)	**13.0 (11.5–14.7)**	**1,960,000**
Middle school students								
Electronic cigarettes	4.8 (4.0–5.6)	5.9 (4.7–7.2)	4.4 (3.6–5.5)	4.1 (3.1–5.3)	8.3 (6.8–10.0)	4.6 (2.7–7.7)	**5.3 (4.6–6.2)**	**620,000**
Cigarettes	2.2 (1.6–3.1)	2.3 (1.7–3.1)	2.1 (1.4–3.3)	1.0 (0.6–1.6)	2.8 (2.0–4.0)	2.7 (1.5–4.8)	**2.3 (1.7–3.0)**	**260,000**
Cigars	1.4 (1.0–2.0)	1.8 (1.3–2.5)	1.2 (0.7–1.9)	2.0 (1.4–2.8)	2.2 (1.5–3.1)	—	**1.6 (1.2–2.1)**	**180,000**
Hookah	2.0 (1.4–2.9)	1.9 (1.4–2.6)	1.6 (1.0–2.5)	—	3.2 (2.3–4.4)	—	**2.0 (1.5–2.6)**	**220,000**
Smokeless tobacco	1.1 (0.8–1.7)	—	—	—	2.7 (1.8–4.0)	—	**1.8 (1.1–2.8)**	**210,000**
Pipe tobacco	—	—	—	—	—	—	**0.4 (0.3–0.6)**	**40,000**
Bidis	—	—	—	—	—	—	**0.2 (0.1–0.4)**	**20,000**
Any tobacco product use	6.4 (5.4–7.6)	8.3 (6.7–10.3)	6.3 (4.8–8.2)	6.6 (5.3–8.1)	10.6 (9.0–12.4)	5.6 (3.7–8.5)	**7.4 (6.3–8.7)**	**880,000**
≥2 tobacco product use	3.1 (2.4–3.9)	3.5 (2.7–4.5)	2.6 (1.8–3.7)	2.2 (1.5–3.1)	5.4 (4.3–6.6)	—	**3.3 (2.6–4.0)**	**390,000**

Abbreviation: CI = confidence interval.

* Past 30-day use of cigarettes was determined by asking, "During the past 30 days, on how many days did you smoke cigarettes?"; Past 30-day use of cigars was determined by asking, "During the past 30 days, on how many days did you smoke cigars, cigarillos, or little cigars?"; Smokeless tobacco was defined as use of chewing tobacco/snuff/dip, snus, and/or dissolvable tobacco. Past 30-day use of smokeless tobacco was determined by asking the following question for use of chewing tobacco/snuff/dip: "During the past 30 days, on how many days did you use chewing tobacco, snuff, or dip?," and the following question for use of snus and dissolvable tobacco: "In the past 30 days, which of the following products have you used on at least one day?," and combining responses together to derive use. Past 30-day use of electronic cigarettes was determined by asking, "During the past 30 days, on how many days did use electronic cigarettes or e–cigarettes?"; past 30-day use of hookahs, pipe tobacco (not hookah), and bidis, were determined by asking, "In the past 30 days, which of the following products have you used on at least one day?"

† Estimated total number of users is rounded down to the nearest 10,000.

§ Data are statistically unreliable because sample size <50 or relative standard error >0.3.

¶ Any tobacco product use is past 30-day use of cigarettes, cigars, smokeless tobacco, electronic cigarettes, hookahs, pipe tobacco, and/or bidis on ≥1 day in the past 30 days.

** ≥2 tobacco product use is past 30-day use of two or more of cigarettes, cigars, smokeless tobacco, electronic cigarettes, hookahs, pipe tobacco, and/or bidis on ≥1 day in the past 30 days.

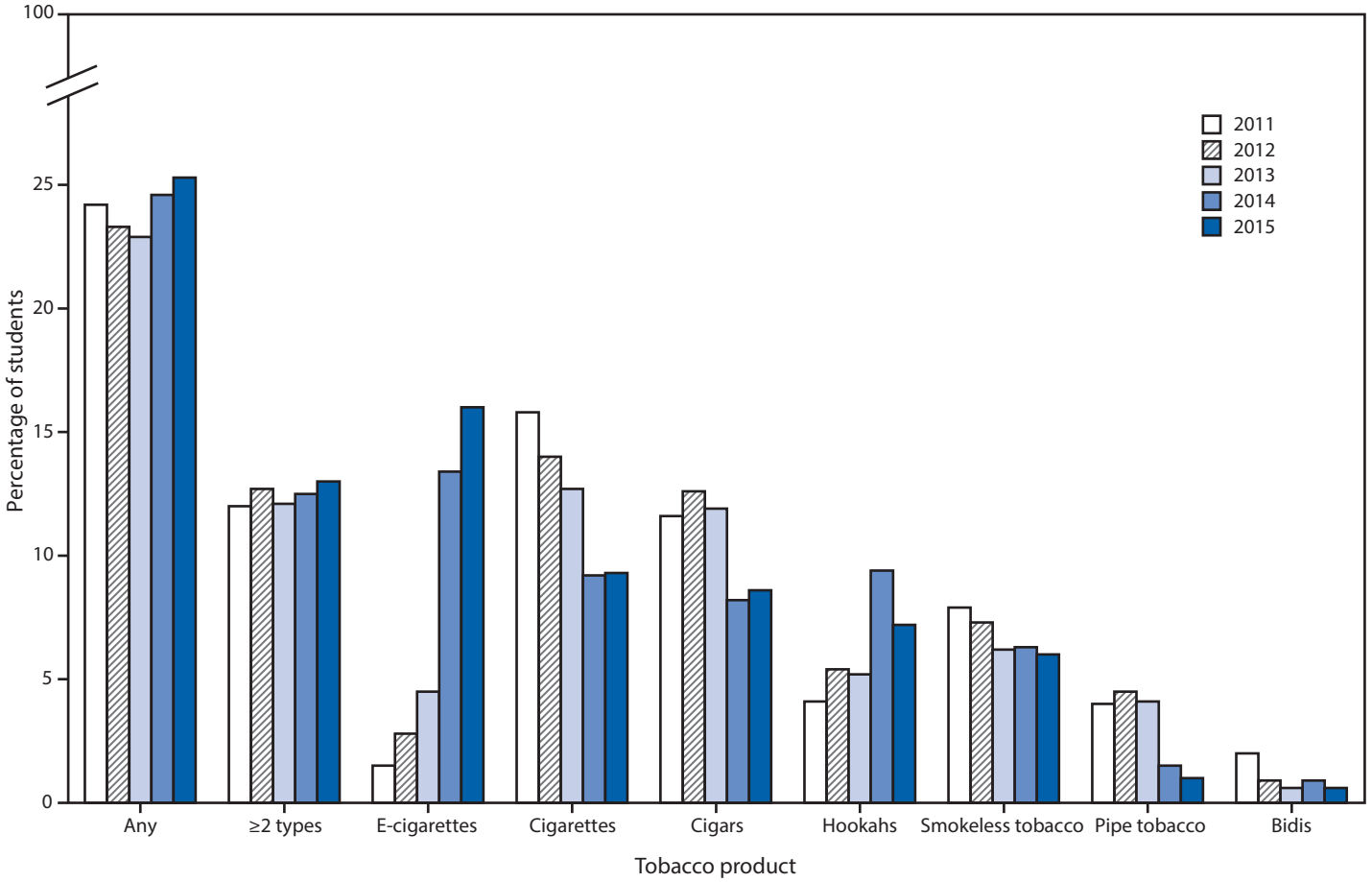
3.0 million used e-cigarettes, 1.6 million used cigarettes, 1.4 million used cigars, 1.2 million used hookahs, and 1.1 million used smokeless tobacco.

Discussion

During 2011–2015, there was no change in current use of any tobacco product among middle and high school students, and in 2015, an estimated 4.7 million U.S. middle and high school students currently used any tobacco product. As in 2014, e-cigarettes were the most used tobacco product among U.S. middle and high school students in 2015. During 2011–2015, substantial increases in current e-cigarette use among middle and high school students were reported, resulting in an estimated total of 3.0 million middle school and high school e-cigarette users in 2015. Although the use of cigarettes and cigars declined during 2011–2015, there was no change in use of these products during 2014–2015, making cigarettes (1.6 million) and cigars (1.4 million) the second and third most commonly used tobacco products among youths in 2015.

Tobacco prevention and control strategies, including increasing tobacco product prices, adopting comprehensive smoke-free laws, and implementation of national public education media campaigns, likely have contributed to the reduction in use of certain tobacco products, including cigarettes, among youths in recent years (*2*). However, the lack of decline in use of cigarettes and cigars from 2014 to 2015 is concerning, as approximately 80% of adult smokers first try smoking by age 18 years (*2*). Furthermore, because of increases in the use of

FIGURE 1. Estimated percentage of high school students who currently use any tobacco products,* ≥2 tobacco products,† and select tobacco products§ — National Youth Tobacco Survey 2011–2015



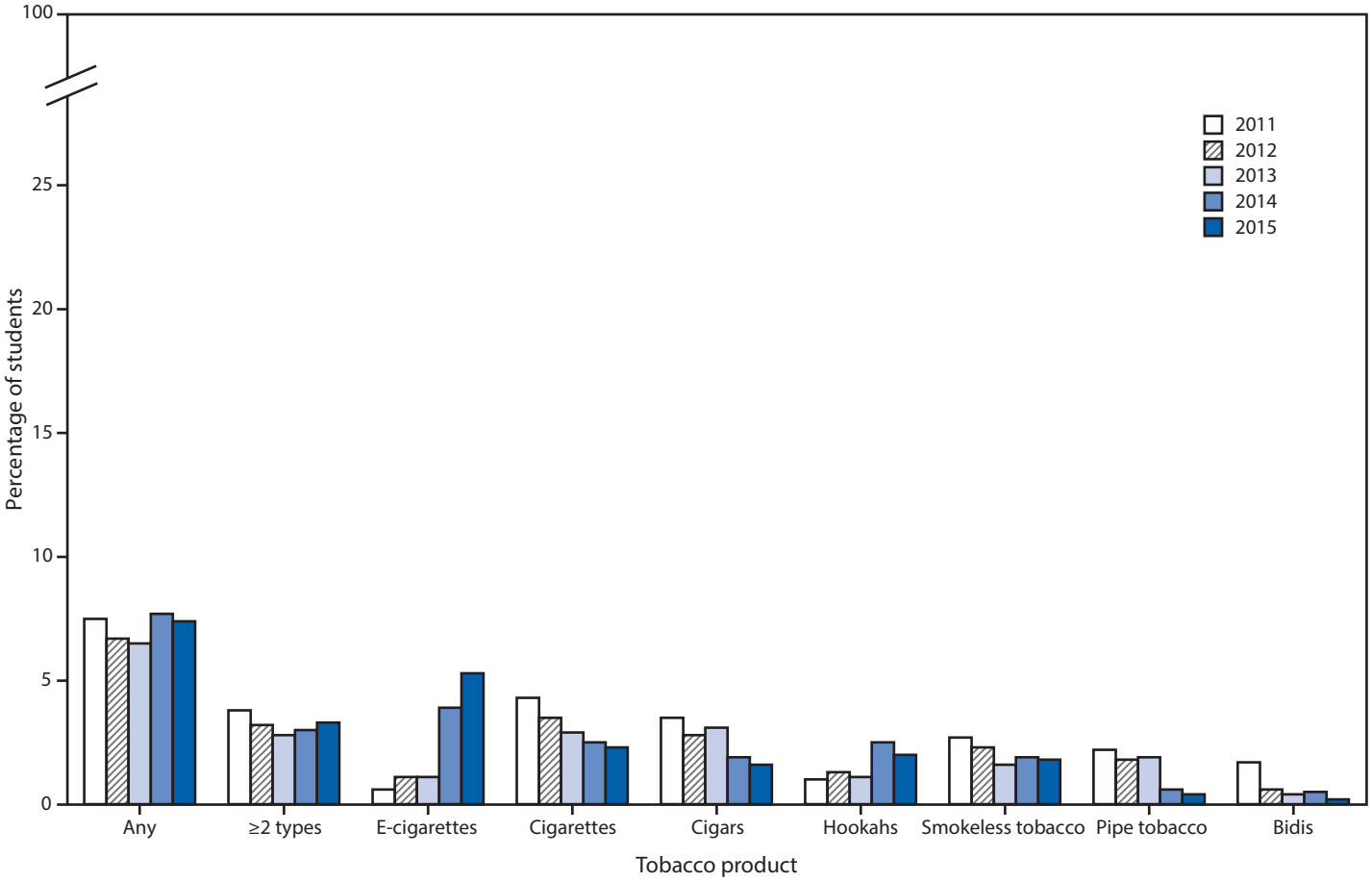
* Any tobacco product use is defined as past 30-day use of cigarettes, cigars, smokeless tobacco, e-cigarettes, hookahs, pipe tobacco , and/or bidis.
† ≥2 tobacco product use is defined as past 30-day use of two or more of the following product types: cigarettes, cigars, smokeless tobacco, e-cigarettes, hookahs, pipe tobacco, and/or bidis.
§ E-cigarettes and hookahs demonstrated a nonlinear increase ($p<0.05$). Cigarettes and smokeless tobacco demonstrated a linear decrease ($p<0.05$). Cigars, pipe tobacco, and bidis demonstrated a nonlinear decrease ($p<0.05$).

emerging tobacco products, including e-cigarettes, no decline occurred in tobacco use overall during 2011–2015.

The findings in this report are subject to at least four limitations. First, NYTS only recruited middle and high school students from public and private schools in the United States; therefore, the findings might not be generalizable to youths who are being home-schooled, have dropped out of school, or are in detention centers. Second, data were self-reported; thus, the findings are subject to recall and response bias. Third, current tobacco use was estimated among students reporting their use status for at least one of the seven tobacco products included in the survey, whereas students with missing responses were considered nonusers of that product, which would result in conservative estimates. Finally, changes in the wording and placement of survey questions about the use of certain products (e.g., e-cigarettes, hookahs, and pipe tobacco) within the 2011–2015 period might have had an impact on reported use of these products; however, this possibility is difficult to assess because usage patterns were changing during this time period. Despite these limitations, overall trends are generally similar to other nationally representative surveys of tobacco use among youths (*6*,*7*).

Sustained efforts to implement proven tobacco control policies and strategies are necessary to prevent youth use of all tobacco products. In April 2014, FDA issued a proposed rule, which when finalized, would give FDA jurisdiction over products made or derived from tobacco, including e-cigarettes, some or all cigars, pipe tobacco, and hookah tobacco (*8*). Regulation of the manufacturing, distribution, and marketing of tobacco products by FDA, coupled with full implementation of comprehensive tobacco control and prevention strategies at CDC-recommended funding levels (*9*) could reduce youth tobacco

FIGURE 2. Estimated percentage of middle school students who currently use any tobacco products,* ≥2 tobacco products,†,§ and select tobacco products¶ in the past 30 days — National Youth Tobacco Survey, 2011–2015



* Any tobacco product use is defined as past 30-day use of cigarettes, cigars, smokeless tobacco, e-cigarettes, hookahs, pipe tobacco, and/or bidis.
† ≥2 tobacco product use is defined as past 30-day use of two or more of the following product types: cigarettes, cigars, smokeless tobacco, e-cigarettes, hookahs, pipe tobacco, and/or bidis.
§ ≥2 tobacco product use demonstrated a nonlinear change ($p<0.05$).
¶ E-cigarettes and hookahs demonstrated a linear increase ($p<0.05$). Cigarettes, cigars, and smokeless tobacco demonstrated a linear decrease ($p<0.05$). Pipe tobacco and bidis demonstrated a nonlinear decrease ($p<0.05$).

initiation and use (*1*,*2*,*9*). Given that the use of e-cigarettes is on the rise among middle and high school students and nicotine exposure from any source is dangerous for youths (*2*), it is critical that comprehensive tobacco control and prevention strategies for youths address all tobacco products and not just cigarettes. In addition, rapid changes in use of conventional and emerging tobacco products among youths, and varying prevalence of certain tobacco products by population groups underscore the importance of enhanced surveillance of all forms of tobacco product use among U.S. youths.

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