

SPECIAL ARTICLE

Tobacco-Product Use by Adults and Youths in the United States in 2013 and 2014

Karin A. Kasza, M.A., Bridget K. Ambrose, Ph.D., Kevin P. Conway, Ph.D., Nicolette Borek, Ph.D., Kristie Taylor, Ph.D., Maciej L. Goniewicz, Pharm.D., Ph.D., K. Michael Cummings, Ph.D., M.P.H., Eva Sharma, Ph.D., Jennifer L. Pearson, Ph.D., M.P.H., Victoria R. Green, B.A., Annette R. Kaufman, Ph.D., M.P.H., Maansi Bansal-Travers, Ph.D., Mark J. Travers, Ph.D., Jonathan Kwan, M.S., Cindy Tworek, Ph.D., M.P.H., Yu-Ching Cheng, Ph.D., Ling Yang, M.D., Ph.D., Nikolas Pharris-Ciurej, Ph.D., Dana M. van Bommel, Ph.D., M.P.H., Cathy L. Backinger, Ph.D., M.P.H., Wilson M. Compton, M.D., M.P.E., and Andrew J. Hyland, Ph.D.

ABSTRACT

BACKGROUND

Noncigarette tobacco products are evolving rapidly, with increasing popularity in the United States.

METHODS

We present prevalence estimates for 12 types of tobacco products, using data from 45,971 adult and youth participants (≥ 12 years of age) from Wave 1 (September 2013 through December 2014) of the Population Assessment of Tobacco and Health (PATH) Study, a large, nationally representative, longitudinal study of tobacco use and health in the United States. Participants were asked about their use of cigarettes, e-cigarettes, traditional cigars, cigarillos, filtered cigars, pipe tobacco, hookah, snus pouches, other smokeless tobacco, dissolvable tobacco, bidis, and kreteks. Estimates of the prevalence of use for each product were determined according to use category (e.g., current use or use in the previous 30 days) and demographic subgroup, and the prevalence of multiple-product use was explored.

RESULTS

More than a quarter (27.6%) of adults were current users of at least one type of tobacco product in 2013 and 2014, although the prevalence varied depending on use category. A total of 8.9% of youths had used a tobacco product in the previous 30 days; 1.6% of youths were daily users. Approximately 40% of tobacco users, adults and youths alike, used multiple tobacco products; cigarettes plus e-cigarettes was the most common combination. Young adults (18 to 24 years of age), male adults and youths, members of racial minorities, and members of sexual minorities generally had higher use of tobacco than their counterparts.

CONCLUSIONS

During this study, 28% of U.S. adults were current users of tobacco, and 9% of youths had used tobacco in the previous 30 days. Use of multiple products was common among tobacco users. These findings will serve as baseline data to examine between-person differences and within-person changes over time in the use of tobacco products. (Funded by the National Institute on Drug Abuse and the Food and Drug Administration.)

From the Department of Health Behavior, Roswell Park Cancer Institute, Buffalo, NY (K.A.K., M.L.G., M.B.-T., M.J.T., A.J.H.); the Office of Science, Center for Tobacco Products, Food and Drug Administration, Silver Spring (B.K.A., N.B., J.K., C.T., Y.-C.C., L.Y., N.P.-C., D.M.B., C.L.B.), National Institute on Drug Abuse (K.P.C., V.R.G., W.M.C.) and Division of Cancer Control and Population Sciences, National Cancer Institute (A.R.K.), National Institutes of Health, Bethesda, and Westat (K.T., E.S.) and Kelly Government Solutions (V.R.G.), Rockville — all in Maryland; the Department of Psychiatry and Behavioral Sciences, Medical University of South Carolina, Charleston (K.M.C.); and the Schroeder Institute for Tobacco Research and Policy Studies, Truth Initiative, Washington, DC (J.L.P.). Address reprint requests to Ms. Kasza at the Department of Health Behavior, Roswell Park Cancer Institute, Elm and Carlton Sts., Buffalo, NY 14263, or at karin.kasza@roswellpark.org.

This article was last updated on February 3, 2017, at NEJM.org.

N Engl J Med 2017;376:342-53.

DOI: 10.1056/NEJMsa1607538

Copyright © 2017 Massachusetts Medical Society.

SMOKING IS RESPONSIBLE FOR MORE U.S. deaths annually than the acquired immunodeficiency syndrome, use of alcohol and illegal drugs, motor vehicle accidents, murders, and suicides combined.¹ With recent data suggesting higher smoking-attributable mortality than previously estimated,² the medical community is urged to make tobacco control a high priority.³ The prevalence of current use of cigarettes has declined during the past 50 years, from 42% of adults in 1965 to less than 20% in 2014,^{4,5} but disparities in cigarette smoking across demographic subgroups (particularly according to race or ethnic group, educational attainment, and socioeconomic status) have widened during the past several decades,^{5,6} and smoking prevalence remains exceptionally high among members of sexual minorities.^{5,7,8} Furthermore, noncigarette tobacco products are rapidly evolving, and their effect on population-level health is unknown.⁹⁻¹¹ Use of electronic cigarettes (e-cigarettes), cigars, smokeless tobacco, and hookah (waterpipe) has risen sharply in the past decade,¹²⁻¹⁵ and the use of two or more tobacco products has increased in recent years, especially among young adults.¹⁶⁻¹⁹

The Family Smoking Prevention and Tobacco Control Act of 2009 gave the Food and Drug Administration (FDA) broad regulatory authority over the manufacture, marketing, and distribution of regulated tobacco products to protect the health of the U.S. population.²⁰ The FDA Center for Tobacco Products uses a robust scientific evidence base to inform and assess the effect of its tobacco regulatory activities.²¹ In 2011, the Population Assessment of Tobacco and Health (PATH) Study was established to generate longitudinal epidemiologic data on tobacco-use behavior and health in the U.S. population.

In contrast to other national studies that have been used for the surveillance of tobacco use,²²⁻²⁷ the PATH Study uses a detailed assessment of tobacco-use behaviors, the inclusion of biomarkers, and a longitudinal design in a comprehensive effort to document tobacco use. Specifically, the design of the PATH Study will allow for examination of between-person differences and within-person changes over time in patterns of use of existing and emerging tobacco products, exposures and related biomarkers, risk perceptions, and health conditions potentially related to tobacco use.²⁸ An additional feature of the PATH Study is the use of pictures to assist re-

spondents in answering questions about their awareness and use of noncigarette tobacco products.²⁹ Respondents in national surveys may not always clearly distinguish between types of tobacco products (e.g., filtered cigars vs. cigarettes, or snus pouches vs. other smokeless tobacco products), which could affect estimates of prevalence.^{12,30}

In this article, we present estimates of the prevalence of tobacco use among adults and youths, on the basis of Wave 1 (2013–2014) of the PATH Study, according to type of tobacco product and category of tobacco use. Three broad categories of tobacco-use behaviors were examined: the prevalence of use of cigarettes, e-cigarettes, any type of cigar, traditional cigars, cigarillos, filtered cigars, pipe tobacco, hookah, smokeless tobacco (including and excluding snus pouches), snus pouches, dissolvable tobacco, bidis (small brown cigarettes wrapped in a leaf and typically tied on one or both ends with string; among youths), kreteks (clove cigarettes; among youths), and any tobacco product according to various categories of use; the prevalence of current use (among adults) or use in the previous 30 days (among youths) for each type of tobacco product according to demographic subgroup; and the prevalence of multiple-product use (i.e., use of two or more tobacco products) and single-product use.

METHODS

STUDY POPULATION

Wave 1 of the PATH Study included 45,971 adults and youths in the United States 12 years of age or older; data were collected from September 12, 2013, through December 15, 2014. This article reports national estimates from 32,320 adult participants (≥18 years of age) and 13,651 youth participants (12 to 17 years of age). Parent interviews were also conducted with one parent of 13,589 of the youth participants (99.5%). The parent interview collected information about the youth that was deemed to be more reliable when obtained from a parent (e.g., certain health information), as well as contextual information about the household and the parent's own use of tobacco. Adult and youth data were collected with the use of an audio computer-assisted self-interview (ACASI), available in English and Spanish.

Address-based, area-probability sampling was

used for recruitment; an in-person household screener selected youths and adults. Adult tobacco users, young adults (18 to 24 years of age), and black persons were oversampled relative to population proportions. Up to 2 youths per household were sampled unless a household included multiple births, in which case additional youths could be selected. Weighting procedures adjusted for oversampling and nonresponse. The weights were further adjusted so that the sums of the weights matched independent population totals for standard demographic groups; these totals were based on U.S. Census Bureau data. (For details on youth sampling and weighting procedures, see the Supplementary Appendix, available with the full text of this article at NEJM.org.) Combined with the use of a probability sample, the weighted data allow estimates produced by the PATH Study to be representative of the civilian, noninstitutionalized U.S. population. The weighted response rate for the household screener was 54.0%. Among screened households, the overall weighted response rate was 74.0% for the adult interview and 78.4% for the youth interview. A nonresponse bias analysis for Wave 1 can be found at <http://doi.org/10.3886/ICPSR36231>.

The PATH Study implemented numerous procedures to protect respondents' privacy and confidentiality, including obtaining written informed consent from adults and written assent from youths; requiring all staff to be certified in data security, confidentiality, and privacy issues and procedures; requiring staff to sign a pledge of confidentiality; storing and transmitting data with the use of advanced data encryption; and identifying survey data and biospecimens with the use of randomly assigned identification numbers and storing identifying information in separate, secure files. Further details regarding the PATH Study design and methods are reported by Hyland et al.²⁹ The study was conducted by Westat, a contract research organization, and approved by its institutional review board.

MEASURES

Types of Tobacco Products

Participants were asked a series of questions about each of the following 12 types of tobacco products: cigarettes, e-cigarettes, traditional cigars, cigarillos, filtered cigars, pipe tobacco, hookah, snus pouches, other smokeless tobacco (i.e., loose snus, moist snuff, dip, spit, or chew-

ing tobacco), dissolvable tobacco, bidis (youths only), and kreteks (youths only). Participants were given a brief description and shown pictures of each type of product (except cigarettes) before being asked about the product. The questionnaires and pictures are available for downloading.³¹

Categories of Tobacco Use

For each type of tobacco product, participants were asked a series of questions, including whether they had heard of the product (except cigarettes, for which universal awareness was assumed); whether they had ever used the product, even one or two puffs or one or two times; whether they had used the product during the previous 30 days; on how many of the previous 30 days they had used the product; and how much of each type of product they had used in their lifetimes. Adult participants were also asked whether they had ever used the product "fairly regularly" and whether they now use the product every day, some days, or not at all (nondaily users of hookah were also asked their frequency of use). Adults who had ever used a product but now use it "not at all" were asked how long it had been since they quit using it (responses were given in days, months, or years).

Various categories of tobacco use were assessed for each type of tobacco product. Current use indicates that the participant now smokes or uses the product every day or some days (for each tobacco product other than hookah; for hookah, current use indicates that the participant now uses the product every day, some days, usually weekly, or usually monthly). Current regular use indicates that the participant has ever smoked or used the product "fairly regularly" and now smokes or uses the product every day or some days (for each tobacco product other than cigarettes and hookah; for cigarettes, current regular use indicates that the participant has smoked ≥ 100 cigarettes in his or her lifetime and now smokes every day or some days; for hookah, current regular use indicates that the participant has ever used the product "fairly regularly" and now uses the product every day, some days, usually weekly, or usually monthly). Table S1 in the Supplementary Appendix presents additional categories of tobacco use that were assessed for each type of tobacco product. In addition, for each use category, use of any cigar was defined as use of at least one type of cigar (traditional cigars, cigarillos, or filtered cigars), use of smokeless

tobacco including snus pouches was defined as use of either product, and use of any tobacco was defined as use of at least one of the 10 (adults) or 12 (youths) types of tobacco products. An exception to the definition of “any tobacco use” was current use of tobacco among adults, which was determined on the basis of current regular use in the case of cigarettes and current use in the case of every other tobacco product. Defining nonuse of any cigars, smokeless tobacco including snus pouches, and any tobacco required complete data on all types of the respective tobacco products assessed.

Multiple-Product and Single-Product Use

Among adults, multiple-product and single-product use was determined according to the “current regular use” definition for cigarettes and the “current use” definition for each other type of tobacco product. Among youths, multiple-product and single-product use was determined according to the “use in the previous 30 days” definition for each type of tobacco product. Complete data for all tobacco products were required to define multiple-product and single-product use. Single-product use was defined by the use of only one type of product (e.g., cigarettes only or e-cigarettes only), whereas multiple-product use was defined by the use of two or more types of products (e.g., both cigarettes and e-cigarettes). All combinations of multiple-product use were determined.

STATISTICAL ANALYSIS

Analyses were conducted with the use of Stata 12 software.³² Prevalence estimates were weighted to represent the U.S. adult and youth populations. Variances were estimated with the method of balanced, repeated replications,³³ with Fay’s adjustment set to 0.3 to increase the stability of estimates.³⁴ The logit-transformation method was used to calculate confidence intervals. The tables show 95% confidence intervals for point estimates.

The prevalences of product awareness and use of each product type, use of any cigar, use of smokeless tobacco including snus pouches, and use of any tobacco were computed according to the use categories shown in Table S1 in the Supplementary Appendix as they pertained to adults and youths, stratified according to age group (12 to 14 years, 15 to 17 years, 18 to 24 years, or ≥25 years). Among adults, the prevalence

of current regular use (cigarettes) or current use (other tobacco products) was also stratified according to sex, age, race or ethnic group, sexual orientation, educational attainment, total annual household income, and U.S. Census region. Among youths, the prevalences of ever use and use in the previous 30 days were also stratified according to sex, age, race or ethnic group, sexual orientation (asked of those ≥14 years of age), educational level, and U.S. Census region.

The prevalences of overall and product-specific single-product use and multiple-product use were determined in the entire adult study population, in the entire youth study population, among adult tobacco users, and among youth tobacco users. Among adult multiple-product users and separately among youth multiple-product users, all combinations of tobacco products used were determined, and each combination that accounted for at least 1% of multiple-product users is presented.

RESULTS

WEIGHTING

The weights were adjusted so that the sums of the weights for various demographic groups matched national population totals. Therefore, weighted distributions of the sample (Table 1, and Table S2 in the Supplementary Appendix) were very close to the population distributions.

TOBACCO USE ACCORDING TO PRODUCT TYPE AND USE CATEGORY

Adults

Among adults, current use of cigarettes was most prevalent, followed by use of cigars, e-cigarettes, hookah, and smokeless tobacco (Table 2). The prevalence of use varied according to the use category, particularly for noncigarette tobacco products (Tables S3 through S6 in the Supplementary Appendix). For example, for cigars, the prevalence of current use was 7.8%, whereas the prevalence of current regular use was 3.2%. Similarly, for e-cigarettes, the prevalence of use in the previous 30 days was 6.7%, whereas the prevalence of current regular use was 2.4%. Similar variations were observed for hookah use: the prevalence of current use was 4.2%, whereas the prevalence of current regular use was 1.4%. (For more on current regular use, see Table S5 in the Supplementary Appendix.) For most tobacco products and most use categories, the prevalence

Table 1. Demographic Characteristics of the Study Participants.*

Characteristic	Adults (N=32,320) unweighted no. (weighted %)	Youths (N=13,651) unweighted no. (weighted %)
Age†		
12–14 yr		6998 (50.5)
15–17 yr		6651 (49.6)
18–24 yr	9,112 (13.0)	
25–44 yr	11,269 (34.3)	
45–64 yr	8,818 (34.5)	
≥65 yr	3,110 (18.2)	
Sex		
Male	16,309 (48.1)	6971 (51.3)
Female	15,982 (51.9)	6641 (48.7)
Race or ethnic group‡		
Non-Hispanic white	19,299 (66.0)	6478 (54.6)
Non-Hispanic black	4,496 (11.2)	1801 (13.7)
Non-Hispanic American Indian or Alaska Native	195 (0.3)	70 (0.4)
Non-Hispanic Asian, Native Hawaiian, or other Pacific Islander	966 (5.3)	394 (4.7)
Non-Hispanic of two or more races	1,269 (1.9)	767 (4.2)
Hispanic	5,536 (15.2)	3880 (22.5)
Sexual orientation§		
Heterosexual	29,369 (95.1)	8215 (93.1)
Bisexual	1,080 (2.1)	346 (3.9)
Gay or lesbian	632 (1.5)	95 (1.0)
Other	470 (1.4)	176 (2.0)
Grade in school¶		
≤5		76 (0.5)
6–8		5141 (37.9)
9–12		7864 (59.6)
Education		
Not high school graduate	4,233 (11.6)	
GED	2,217 (5.1)	
High school graduate	7,548 (24.4)	
Some college or associate degree	11,303 (31.0)	
Bachelor's degree or higher	6,811 (27.9)	
Annual household income		
<\$25,000	12,438 (30.3)	
\$25,000–\$74,999	10,393 (33.4)	
≥\$75,000	6,334 (25.2)	
U.S. Census region		
Northeast	5,048 (18.2)	2045 (16.8)
South	12,225 (37.2)	5169 (37.6)
Midwest	7,689 (21.4)	2957 (21.6)
West	7,358 (23.3)	3480 (24.0)

* Data were collected from September 12, 2013, through December 15, 2014. Black persons and young adults were oversampled; percentages were weighted to represent the U.S. adult and youth populations. The numbers of adult participants with missing data were 29 for sex, 559 for race or ethnic group, 769 for sexual orientation, 208 for education, and 3155 for household income. The numbers of youth participants with missing data were 39 for sex, 261 for race or ethnic group, 305 for education, and 135 for sexual orientation. Except for those with missing data for household income, participants with missing data were not included in the calculation of the weighted percentages. GED denotes general equivalency diploma.

† Eleven participants could be classified only as being 18 years of age or older. Two participants could be classified only as being 12 to 17 years of age.

‡ Race and ethnic group were self-reported.

§ Data are shown for respondents 14 years of age or older.

¶ Weighted percentages include 265 participants who were enrolled in college, enrolled in vocational or technical school, not enrolled in school, attending home school, or attending an ungraded school (weighted percentage, 2.0).

of use was higher among those 18 to 24 years of age than among those 25 years of age or older (Table 2, and Tables S3 through S6 in the Supplementary Appendix).

Two thirds of adults had ever smoked cigarettes; 20.1% of adults were former regular users, and 25.3% were former nonregular users (Tables S3 and S6 in the Supplementary Appendix). The majority of adults had never used other types of tobacco products. Although the prevalence of former regular use was less than 5% for each type of noncigarette tobacco product, the prevalence of former nonregular use ranged from 0.4% (dissolvable tobacco) to 34.1% (cigars).

Youths

The majority of youths were aware of e-cigarettes, pipe tobacco, smokeless tobacco, any cigars, and hookah, whereas less than 10% were aware of dissolvable tobacco, kreteks, and bidis (Table S3 in the Supplementary Appendix). In general, youths 15 to 17 years of age were more likely to be aware of tobacco products than those 12 to 14 years of age. Overall, 21.8% of youths had ever used tobacco, 13.4% had ever used cigarettes, 10.7% had ever used e-cigarettes, 7.5% had ever used cigars (with use of cigarillos being most prevalent at 6.5%), 7.5% had ever used hookah, and 4.8% had ever used smokeless tobacco including snus pouches (Table 2). The prevalence of ever use of these products was higher among those 15 to 17 years of age than among those 12 to 14 years of age. The overall prevalence of tobacco use in the previous 30 days among youths was 8.9%, with prevalences of 4.6% for cigarette use, 3.1% for e-cigarette use, 2.5% for cigar use (with cigarillo use being most prevalent at 2.2%), 1.7% for hookah use, and 1.6% for use of smokeless tobacco including snus pouches. As with ever use, use in the previous 30 days was higher among those 15 to 17 years of age than among those 12 to 14 years of age. Daily use was less than 2% for any tobacco product and followed a pattern that was similar to that for use in the previous 30 days. Cigarettes were the most common product used among daily users.

TOBACCO USE ACCORDING TO PRODUCT TYPE AND DEMOGRAPHIC SUBGROUP

Adults

Men were more likely than women to use any tobacco product (34.8% vs. 20.8%) and to use each type of tobacco product other than dissolv-

able tobacco. Use of any tobacco product also differed according to race or ethnic group, sexual orientation, educational level, income, and region, such that prevalence was higher among non-Hispanic American Indians or Alaska Natives, non-Hispanics of two or more races, and non-Hispanic blacks than among non-Hispanic whites, Hispanics, and non-Hispanic Asians, Native Hawaiians, or other Pacific Islanders; higher among those who identified as bisexual, gay, or lesbian than among those who identified as heterosexual; higher among those with less education and lower incomes than among their counterparts; and higher among those living in the South or Midwest than among those living in the Northeast or West. (For detailed data on current tobacco use among adults according to product type and demographic subgroup, see Tables S7 through S12 in the Supplementary Appendix.)

Youths

In general, the use of tobacco products according to demographic subgroup followed similar patterns for the categories of ever use and use in the previous 30 days. There was a consistent pattern of higher prevalence of tobacco use with increasing age and grade in school. In general, male youths were more likely than female youths to use tobacco, although for many products, differences in prevalence were small. Ever use of tobacco was highest among those who were non-Hispanic of two or more races and lowest among those who were non-Hispanic Asian. Tobacco use was higher among youths who identified as bisexual, gay, or lesbian than among those who identified as heterosexual. In general, prevalence was similar across geographic regions. (For detailed data on ever use and use in the previous 30 days among youths according to product type and demographic subgroup, see Tables S13 through S22 in the Supplementary Appendix.)

PREVALENCE OF MULTIPLE-PRODUCT AND SINGLE-PRODUCT USE

Adults

Among adult tobacco users, the prevalence of multiple-product use was 37.8%, with 76.2% of multiple-product users using cigarettes and at least one other product (Table S23 in the Supplementary Appendix). There were 331 different combinations of products used among adult multiple-product users, with the most common combination being cigarettes plus e-cigarettes

Table 2. Prevalence of Tobacco Use According to Product Type, Use Category, and Age Group.*

Category of Tobacco Use	Any Tobacco	Cigarettes	Any Cigar†	E-Cigarettes	Traditional Cigars†	Cigarillos†	Hookah	Smokeless Tobacco‡	Filtered Cigars†	Pipe Tobacco	Snus Pouches	Dissolvable Tobacco
<i>percent (95% CI)</i>												
Ever use§												
Youths overall	21.8 (20.8–22.8)	13.4 (12.6–14.3)	7.5 (7.0–8.1)	10.7 (10.0–11.4)	2.3 (2.1–2.6)	6.5 (6.0–7.0)	7.5 (6.8–8.2)	4.8 (4.3–5.4)	2.3 (2.0–2.6)	1.9 (1.7–2.2)	1.7 (1.4–2.0)	¶
12–14 Yr	10.7 (9.9–11.6)	6.0 (5.4–6.7)	2.1 (1.7–2.5)	4.8 (4.3–5.3)	0.7 (0.5–1.0)	1.7 (1.3–2.1)	2.0 (1.7–2.4)	2.1 (1.8–2.5)	0.4 (0.3–0.7)	0.7 (0.5–0.9)	0.6 (0.4–0.8)	¶
15–17 Yr	32.8 (31.3–34.4)	21.0 (19.7–22.3)	13.0 (12.0–14.1)	16.7 (15.6–17.8)	4.0 (3.5–4.5)	11.3 (10.4–12.3)	13.0 (11.8–14.2)	7.5 (6.7–8.4)	4.1 (3.6–4.8)	3.1 (2.7–3.6)	2.8 (2.4–3.4)	¶
Use in previous 30 days 												
Youths overall	8.9 (8.3–9.6)	4.6 (4.2–5.0)	2.5 (2.2–2.9)	3.1 (2.8–3.5)	0.7 (0.6–0.9)	2.2 (1.9–2.4)	1.7 (1.4–2.0)	1.6 (1.3–1.9)	0.5 (0.4–0.6)	0.3 (0.2–0.4)	0.5 (0.4–0.6)	¶
12–14 Yr	2.8 (2.4–3.3)	1.4 (1.1–1.7)	0.5 (0.4–0.8)	1.0 (0.8–1.3)	0.2 (0.1–0.3)	0.5 (0.3–0.7)	0.5 (0.3–0.7)	0.5 (0.3–0.7)	¶	¶	¶	¶
15–17 Yr	15.0 (13.9–16.1)	7.9 (7.2–8.6)	4.5 (4.0–5.1)	5.3 (4.7–5.9)	1.3 (1.0–1.6)	3.8 (3.4–4.4)	2.9 (2.4–3.5)	2.7 (2.3–3.1)	0.9 (0.7–1.1)	0.5 (0.3–0.7)	0.8 (0.7–1.0)	¶
Adults overall	29.7 (29.0–30.5)	22.5 (21.9–23.2)	7.2 (6.9–7.5)	6.7 (6.4–7.0)	3.6 (3.4–3.7)	4.4 (4.2–4.7)	2.2 (2.0–2.4)	3.3 (3.1–3.5)	1.8 (1.7–2.0)	0.9 (0.8–1.0)	0.6 (0.6–0.7)	0.1 (0.1–0.2)
18–24 Yr	41.0 (39.2–42.9)	28.8 (27.4–30.2)	15.6 (14.7–16.6)	12.5 (11.6–13.4)	5.7 (5.2–6.2)	12.4 (11.7–13.2)	10.7 (9.8–11.8)	5.3 (4.8–5.9)	3.8 (3.4–4.3)	1.8 (1.5–2.1)	1.6 (1.3–1.9)	0.2 (0.2–0.4)
≥25 Yr	28.0 (27.3–28.7)	21.6 (21.0–22.2)	5.9 (5.6–6.2)	5.8 (5.5–6.1)	3.2 (3.0–3.4)	3.2 (3.0–3.4)	0.9 (0.8–1.1)	3.0 (2.8–3.2)	1.5 (1.4–1.7)	0.7 (0.7–0.8)	0.5 (0.4–0.5)	0.1 (0.1–0.1)
Current use**												
Adults overall	27.6 (26.9–28.2)	18.1 (17.6–18.7)	7.8 (7.6–8.1)	5.5 (5.3–5.8)	4.5 (4.3–4.7)	4.4 (4.2–4.6)	4.2 (3.9–4.4)	3.4 (3.2–3.6)	2.0 (1.9–2.2)	1.1 (1.0–1.2)	0.8 (0.7–0.8)	0.1 (0.1–0.1)
18–24 Yr	37.6 (35.8–39.3)	19.6 (18.4–20.8)	14.1 (13.3–15.0)	8.9 (8.2–9.6)	5.9 (5.4–6.5)	10.7 (9.9–11.5)	18.2 (16.9–19.6)	5.2 (4.7–5.7)	3.5 (3.1–4.0)	2.2 (1.8–2.5)	1.8 (1.5–2.0)	0.2 (0.1–0.3)
≥25 Yr	26.0 (25.4–26.7)	17.9 (17.4–18.4)	6.9 (6.6–7.1)	5.0 (4.8–5.3)	4.3 (4.1–4.5)	3.4 (3.2–3.6)	2.1 (1.9–2.3)	3.1 (2.9–3.4)	1.8 (1.7–2.0)	1.0 (0.9–1.1)	0.6 (0.5–0.7)	0.1 (0.1–0.1)

Daily use†‡	1.6 (1.3–1.9)	0.9 (0.7–1.1)	0.1 (0.1–0.2)	0.2 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.4 (0.3–0.5)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)
Youths overall	1.6 (1.3–1.9)	0.9 (0.7–1.1)	0.1 (0.1–0.2)	0.2 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.4 (0.3–0.5)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)
12–14 Yr	0.2 (0.1–0.4)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)
15–17 Yr	2.9 (2.5–3.5)	1.7 (1.4–2.0)	0.2 (0.1–0.3)	0.3 (0.2–0.5)	0.1 (0.1–0.3)	0.1 (0.1–0.3)	0.1 (0.1–0.3)	0.7 (0.5–1.0)	0.1 (0.1–0.3)	0.1 (0.1–0.3)	0.1 (0.1–0.3)	0.1 (0.1–0.3)
Adults overall	19.7 (19.1–20.3)	16.0 (15.4–16.5)	0.9 (0.8–1.0)	1.2 (1.1–1.3)	0.3 (0.2–0.3)	0.5 (0.4–0.5)	0.1 (0.1–0.1)	1.8 (1.6–1.9)	0.4 (0.3–0.5)	0.1 (0.1–0.1)	0.1 (0.1–0.1)	0.1 (0.1–0.2)
18–24 Yr	18.2 (17.2–19.3)	14.7 (13.8–15.7)	1.1 (1.0–1.4)	1.3 (1.1–1.6)	0.2 (0.1–0.3)	1.0 (0.8–1.2)	0.4 (0.3–0.5)	2.1 (1.8–2.5)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.1 (0.1–0.2)	0.2 (0.1–0.3)
≥25 Yr	19.9 (19.3–20.5)	16.2 (15.6–16.7)	0.9 (0.8–1.0)	1.2 (1.0–1.3)	0.3 (0.2–0.4)	0.4 (0.3–0.4)	0.0 (0.0–0.1)	1.7 (1.6–1.9)	0.4 (0.3–0.5)	0.1 (0.1–0.1)	0.1 (0.1–0.1)	0.1 (0.1–0.2)

* Data were collected from September 12, 2013, through December 15, 2014. The columns in the table are not mutually exclusive; participants who used one product may also have used another product. Percentages were weighted to the U.S. adult and youth populations, and confidence intervals were estimated with the method of balanced, repeated replications. Complete data about every type of tobacco product were required to define nonuse of any tobacco; similarly, complete data about every type of cigar were required to define nonuse of any cigar, and complete data about smokeless tobacco and snus pouches were required to define nonuse of smokeless tobacco including snus pouches. For the descriptions of the types of tobacco products that were provided to participants, see the Supplementary Appendix.

- † Excluded were those who reported using cigars as blunts (i.e., cigars that have tobacco removed and replaced with marijuana) and did not identify as cigar users.
- ‡ Data are for smokeless tobacco including snus pouches.
- § Data are for participants who had ever used the product, even one or two puffs (cigarettes) or one or two times (other products).
- ¶ The estimate was suppressed owing to a relative standard error greater than 30%.
- || Data are for participants who had smoked or used the product (even one or two times) in the previous 30 days.
- ** For each tobacco product other than cigarettes and hookah, current use indicates that the participant now smokes or uses the product every day or some days. For cigarettes, the “current regular use” category was used, which indicates that the participant has smoked at least 100 cigarettes in his or her lifetime and now smokes every day or some days. For hookah, current use indicates that the participant now uses the product every day, some days, usually weekly, or usually monthly.
- †† Daily use indicates that the participant now smokes or uses the product every day. Daily use of any tobacco, any cigar, and smokeless tobacco including snus pouches reflects only those who used at least one of the products that make up the combination group every day.

(22.5%). Figure 1 shows each combination of multiple-product use that accounted for at least 1% of adult multiple-product users; together these 20 combinations accounted for 66.2% of all adult multiple-product users. Among adults who used tobacco, 62.2% used one product, 22.5% used two products, and 15.3% used three or more products (not shown in figure). Among adult single-product users, more than 60% used cigarettes, and less than 10% used each of the other types of tobacco product (Table S23 in the Supplementary Appendix).

Youths

Among youths who had used tobacco in the previous 30 days, the prevalence of multiple-product use was 43.0% (Table S24 in the Supplementary Appendix). Among youth multiple-product users, most used cigarettes (71.4%) and about half used e-cigarettes or cigarillos (53.7% and 46.0%, respectively). Figure 2 shows the 10 combinations of multiple products for which robust prevalence estimates could be determined. Together, these 10 combinations accounted for 54.5% of multiple-product users. The most common combinations of products used were cigarettes plus e-cigarettes (accounting for 15.1% of multiple-product users) and cigarettes plus cigarillos (accounting for 10.1%). Among youths who used tobacco, 57.0% used one product, 23.7% used two products, and 19.3% used three or more products (not shown in figure). Among youth single-product users, approximately 40% used cigarettes, 24% used e-cigarettes, 15% used hookah, and less than 10% used cigarillos or smokeless tobacco (Table S24 in the Supplementary Appendix).

DISCUSSION

Initial (Wave 1) findings from the PATH Study, a nationally representative, longitudinal study of tobacco use and health in the United States, indicate that more than one quarter of adults 25 years of age or older and nearly 38% of young adults (18 to 24 years of age) were current users of a tobacco product in 2013 and 2014. A total of 15% of youths 15 to 17 years of age and nearly 3% of youths 12 to 14 years of age had used at least one type of tobacco product in the previous 30 days. Although cigarette use was the most prevalent in each age group, approximately 40%

of tobacco users used at least two types of products, with cigarettes plus e-cigarettes being the most common combination of products used by adults and by youths.

Several other findings advance the literature and warrant longitudinal assessment of this cohort. The PATH Study enabled the comparison of prevalence estimates for tobacco use across different tobacco products on the basis of varying categories of current and previous use. Findings showed marked differences in identification of tobacco users on the basis of differing categories assessed. For example, the prevalence of e-cigarette use among adults was cut approximately in half when the measure of current use was restricted to those who had ever used e-cigarettes “fairly regularly.” Similar findings emerged for hookah use and cigar use.

Findings also showed substantial differences in tobacco use according to demographic characteristics. Among adults, tobacco use was generally higher among younger adults, men, members of racial minorities, members of sexual minorities, those with lower educational attainment and lower household income, and those living in the South or Midwest than among their counterparts. Among youths, the prevalences of ever use and use in the previous 30 days were higher among older youths, male youths, and members of sexual minorities than among their counterparts. Although these findings are generally consistent with those from other studies,^{4,8,12,16,35-37} the PATH Study data extend these prevalence estimates for a wide array of tobacco products.

Although the PATH Study was designed as a cohort study rather than a national surveillance survey, it nonetheless produced baseline estimates of tobacco-use prevalence that are consistent with similarly defined estimates from national surveys. For instance, estimates of adult cigarette smoking and use of smokeless tobacco were similar in the PATH Study, the 2014 household-based National Survey on Drug Use and Health (NSDUH),²⁴ and the 2013–2014 telephone-based National Adult Tobacco Survey (NATS)⁴ (Table S25 in the Supplementary Appendix). Some differences in estimates of e-cigarette use and cigar use were observed across these studies (e.g., the prevalence of current use of e-cigarettes was 3.3% in NATS vs. 5.5% in the PATH Study, and the prevalence of cigar use in the previous

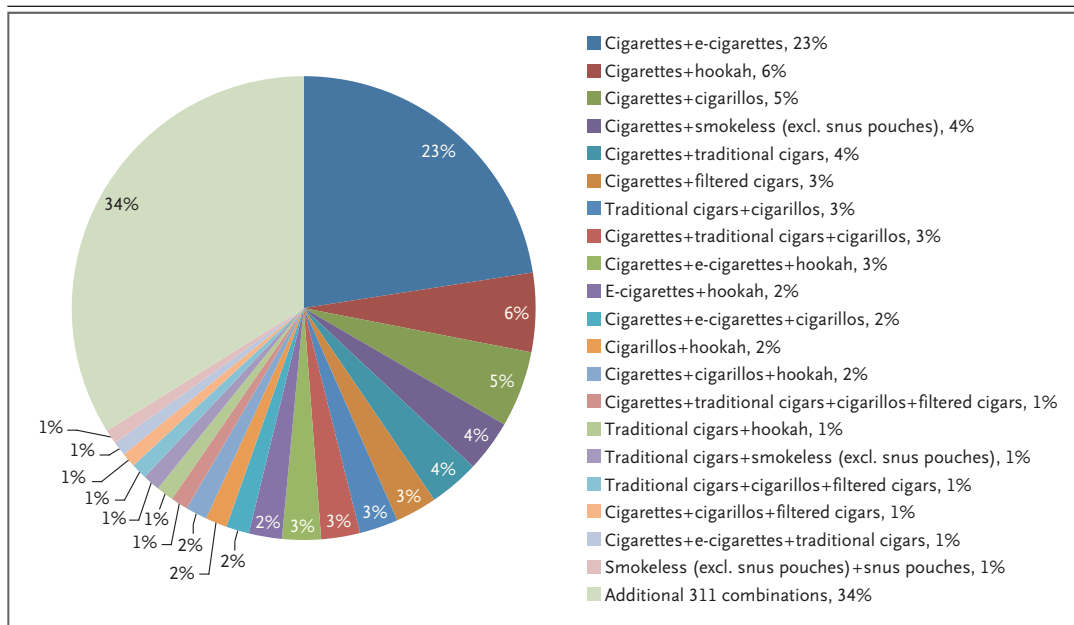


Figure 1. Most Common Combinations of Tobacco Products among Adult Multiple-Product Users.

Prevalences are based on data from 6238 adults who reported current use of two or more types of tobacco products (data were collected from September 12, 2013, through December 15, 2014). Percentages were weighted to the U.S. adult population. Current use was determined according to “current regular use” for cigarettes (the participant has smoked ≥ 100 cigarettes in his or her lifetime and currently smokes every day or some days) and according to “current use” for each other type of tobacco product. Complete tobacco-use data about every product were needed to determine multiple-product use.

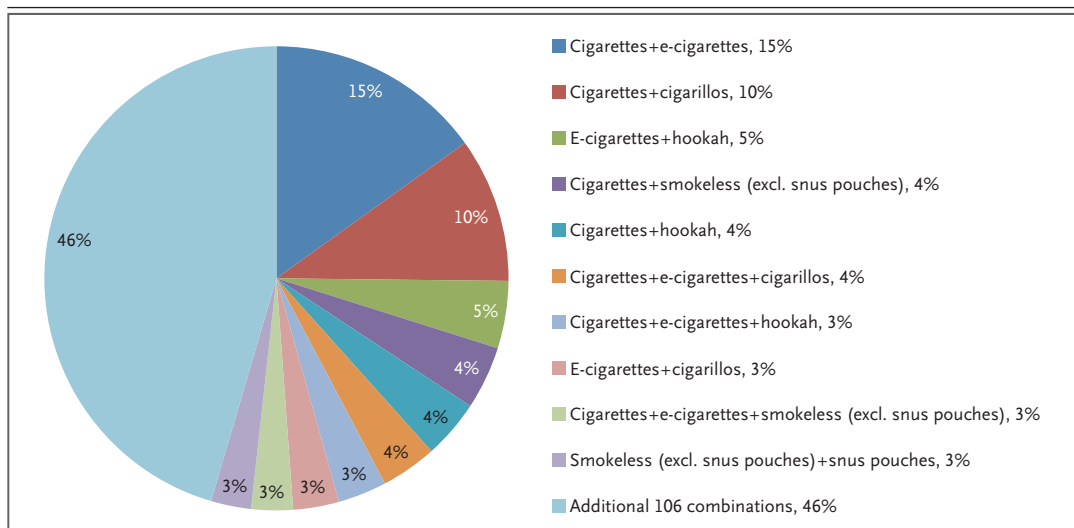


Figure 2. Most Common Combinations of Tobacco Products among Youth Multiple-Product Users.

Prevalences are based on data from 467 youths 12 to 17 years of age who reported having used two or more types of tobacco products in the previous 30 days (data were collected from September 12, 2013, through December 15, 2014). Percentages were weighted to the U.S. youth population. Complete tobacco-use data about every product were needed to determine multiple-product use.

30 days was 4.8% in NSDUH vs. 7.2% in the PATH Study). However, these differences probably result from differences in the way questions were asked and some categories were defined. Cigars, for example, are a heterogeneous class of products: only the PATH Study used pictures of products to help respondents recognize cigar types. In addition, question-response options and lifetime thresholds of use of cigars and e-cigarettes differed across studies, which could further account for observed differences.

Estimates of tobacco-use prevalence among youths from the household-based PATH Study were generally lower than those from school-based national surveys of youths, such as the National Youth Tobacco Survey²⁷ and the Monitoring the Future study,²⁶ and were similar to estimates from the 2014 household-based NSDUH²⁴ (Table S26 in the Supplementary Appendix). These findings are consistent with previous literature citing mode of survey administration as a factor accounting for differences in estimates of tobacco-use prevalence in national surveys of youths.^{38,39} Reasons for differences in estimates owing to survey mode are unclear. Surveys administered in a school-based environment may overestimate tobacco-use behaviors because of peer influences, whereas youths may underreport tobacco-use behaviors in a home-based survey out of fear that their parents will overhear answers or learn about them from the interviewer.^{39,40} Implementation of the PATH Study ACASI instrumentation was intended to reduce this bias through the actual and perceived privacy afforded by having the youths self-administer the questionnaire silently using headphones and a touchscreen to hear or read the questions and record the answers.

Beyond differences in survey mode, the PATH Study youth sample did not include those 18 years of age, whereas the school-based surveys include 18-year-olds, and the data collection periods varied somewhat among surveys. Differences in the mode and timing of the surveys and the age structure of respondents probably contributed to differences in prevalence estimates and the rank-order of products between the PATH Study and the national surveys.

Although the findings reported here document the prevalence of tobacco use at the time of the first wave of the PATH Study, longitudinal

data from future waves will help answer questions about transitions among multiple-product use, single-product use, nonuse of tobacco, and former tobacco use and, in particular, will help determine whether the direction of such transitions favors one type of product or another.

In conclusion, data from Wave 1 of the PATH Study indicate that more than a quarter of adults 18 years of age or older were current users of at least one type of tobacco product in 2013 and 2014 and nearly 1 in 10 youths 12 to 17 years of age used a tobacco product in the previous 30 days, with cigarette use being most prevalent. Multiple-product use was common among tobacco users, with cigarettes plus e-cigarettes being the most common combination of tobacco products used. These foundational estimates of prevalence will serve as a baseline for this longitudinal cohort to address critical research questions such as those related to changes in the use of tobacco products, among existing users as well as those not currently using tobacco products. These data will help inform tobacco regulatory and control efforts aimed at protecting the health of the U.S. population.

The views and opinions expressed in this article are those of the authors only and do not necessarily represent the views, official policy, or position of the U.S. Department of Health and Human Services or any of its affiliated institutions or agencies.

Supported by federal funds from the National Institute on Drug Abuse, National Institutes of Health, and the Food and Drug Administration, Department of Health and Human Services, under a contract (Contract No. HHSN271201100027C) to Westat.

Dr. Cummings reports receiving grant support from Pfizer and fees as a paid expert witness in litigation filed against the tobacco industry; Dr. Goniewicz, receiving fees for serving on an advisory board from Johnson & Johnson and grant support from Pfizer; and Dr. Compton, holding stock in General Electric, the 3M Companies, and Pfizer. No other potential conflict of interest relevant to this article was reported.

Disclosure forms provided by the authors are available with the full text of this article at NEJM.org.

We thank the participants who have volunteered to be a part of the PATH Study, making this work possible; the staff of the National Institute on Drug Abuse (NIDA), the FDA Center for Tobacco Products (CTP), the Centers for Disease Control and Prevention, Westat, and partner organizations for scientific collaboration; and the PATH Study team members who were responsible for the conceptualization, development, implementation, or oversight of PATH Study Wave 1 operations (including, but not limited to, Nahla Hilmi, Heather Kimmel, Elizabeth Lambert, Marushka Silveira and Genevieve Vullo from the NIDA; Corinne Husten, Allison Hoffman, and Greta Tessman from the CTP; and David Maklan, Charles Carusi, Scott Crosse, Tammy Cook, Mary Laidlaw, Ellen Herbold, Vivek Rau, Marsha Hasson, and Lucy Leuchtenburg from Westat); and Wendy Kissin, Yan Zhuang, David Morganstein, and Robert Baskin from Westat for their review of earlier drafts of the manuscript.

REFERENCES

1. Mokdad AH, Marks JS, Stroup DF, Gerberding JL. Actual causes of death in the United States, 2000. *JAMA* 2004;291:1238-45.
2. Carter BD, Freedman ND, Jacobs EJ. Smoking and mortality — beyond established causes. *N Engl J Med* 2015;372:2170.
3. Colditz GA. Smoke alarm — tobacco control remains paramount. *N Engl J Med* 2015;372:665-6.
4. Agaku IT, King BA, Husten CG, et al. Tobacco product use among adults — United States, 2012–2013. *MMWR Morb Mortal Wkly Rep* 2014;63:542-7.
5. The health consequences of smoking — 50 years of progress: a report of the Surgeon General. Atlanta: Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2014.
6. Giovino GA. Epidemiology of tobacco use in the United States. *Oncogene* 2002;21:7326-40.
7. Lee JG, Griffin GK, Melvin CL. Tobacco use among sexual minorities in the USA, 1987 to May 2007: a systematic review. *Tob Control* 2009;18:275-82.
8. Rath JM, Villanti AC, Rubenstein RA, Vallone DM. Tobacco use by sexual identity among young adults in the United States. *Nicotine Tob Res* 2013;15:1822-31.
9. Callahan-Lyon P. Electronic cigarettes: human health effects. *Tob Control* 2014;23:Suppl 2:ii36-ii40.
10. Abrams DB. Promise and peril of e-cigarettes: can disruptive technology make cigarettes obsolete? *JAMA* 2014;311:135-6.
11. Cobb NK, Byron MJ, Abrams DB, Shields PG. Novel nicotine delivery systems and public health: the rise of the “e-cigarette.” *Am J Public Health* 2010;100:2340-2.
12. Corey CG, King BA, Coleman BN, et al. Little filtered cigar, cigarillo, and premium cigar smoking among adults — United States, 2012–2013. *MMWR Morb Mortal Wkly Rep* 2014;63:650-4.
13. Delnevo CD, Wackowski OA, Giovenco DP, Manderski MT, Hrywna M, Ling PM. Examining market trends in the United States smokeless tobacco use: 2005-2011. *Tob Control* 2014;23:107-12.
14. King BA, Patel R, Nguyen KH, Dube SR. Trends in awareness and use of electronic cigarettes among US adults, 2010-2013. *Nicotine Tob Res* 2015;17:219-27.
15. Lee YO, Hebert CJ, Nonnemaker JM, Kim AE. Multiple tobacco product use among adults in the United States: cigarettes, cigars, electronic cigarettes, hookah, smokeless tobacco, and snus. *Prev Med* 2014;62:14-9.
16. Backinger CL, Fagan P, O’Connell ME, et al. Use of other tobacco products among U.S. adult cigarette smokers: prevalence, trends and correlates. *Addict Behav* 2008;33:472-89.
17. Bombard JM, Pederson LL, Nelson DE, Malarcher AM. Are smokers only using cigarettes? Exploring current polytobacco use among an adult population. *Addict Behav* 2007;32:2411-9.
18. Fix BV, O’Connor RJ, Vogl L, et al. Patterns and correlates of polytobacco use in the United States over a decade: NSDUH 2002-2011. *Addict Behav* 2014;39:768-81.
19. Kasza KA, Bansal-Travers M, O’Connor RJ, et al. Cigarette smokers’ use of unconventional tobacco products and associations with quitting activity: findings from the ITC-4 U.S. cohort. *Nicotine Tob Res* 2014;16:672-81.
20. 111th Congress. Family smoking prevention and tobacco control act. H.R. 1256.6-16. 2009.
21. Ashley DL, Backinger CL. The Food and Drug Administration’s regulation of tobacco: the Center for Tobacco Products’ Office of Science. *Am J Prev Med* 2012;43:Suppl 3:S255-S263.
22. Giovino GA, Biener L, Hartman AM, et al. Monitoring the tobacco use epidemic. I. Overview: optimizing measurement to facilitate change. *Prev Med* 2009;48:Suppl:S4-S10.
23. Delnevo CD, Bauer UE. Monitoring the tobacco use epidemic III: The host: data sources and methodological challenges. *Prev Med* 2009;48:Suppl:S16-S23.
24. National Survey on Drug Use and Health (NSDUH). Rockville, MD: Substance Abuse and Mental Health Services Administration (<https://nsduhweb.rti.org/respweb/homepage.cfm>).
25. Youth Risk Behavior Surveillance System (YRBSS). Atlanta: Centers for Disease Control and Prevention (<http://www.cdc.gov/healthyyouth/data/yrbs/index.htm>).
26. Monitoring the future: a continuing study of American youth, 2002–2013. Ann Arbor: University of Michigan, 2014 (<http://www.monitoringthefuture.org/>).
27. National Youth Tobacco Survey (NYTS). Atlanta: Centers for Disease Control and Prevention, 2014 (http://www.cdc.gov/tobacco/data_statistics/surveys/nyts/).
28. Population Assessment of Tobacco and Health (PATH) Study. Washington, DC: Office of Information and Regulatory Affairs, Office of Management and Budget, 2012 (http://www.reginfo.gov/public/do/PRAViewICR?ref_nbr=201208-0925-002).
29. Hyland A, Ambrose BK, Conway KP, et al. Design and methods of the Population Assessment of Tobacco and Health (PATH) Study. *Tob Control* 2016 August 8 (Epub ahead of print).
30. Kozlowski LT, Dollar KM, Giovino GA. Cigar/cigarillo surveillance: limitations of the U.S. Department of Agriculture system. *Am J Prev Med* 2008;34:424-6.
31. National Addiction & HIV Data Archive Program. Population Assessment of Tobacco and Health (PATH) Study [United States] restricted-use files (ICPSR 36231). Ann Arbor, MI: Inter-university Consortium for Political and Social Research, 2016 (<http://www.icpsr.umich.edu/icpsrweb/NAHDAP/studies/36231>).
32. StataCorp. Stata statistical software: release 12. College Station, TX: StataCorp, 2011.
33. McCarthy PJ. Pseudoreplication: further evaluation and applications of the balanced half-sample technique. *Vital Health Stat* 2 1969;2:1-24.
34. Judkins DR. Fay’s method for variance estimation. *J Offic Stat* 1990;6:223-39.
35. Cohn A, Cobb CO, Niaura RS, Richardson A. The other combustible products: prevalence and correlates of little cigar/cigarillo use among cigarette smokers. *Nicotine Tob Res* 2015;17:1473-81.
36. Kaufman AR, Mays D, Koblitz AR, Portnoy DB. Judgments, awareness, and the use of snus among adults in the United States. *Nicotine Tob Res* 2014;16:1404-8.
37. Richardson A, Rath J, Ganz O, Xiao H, Vallone D. Primary and dual users of little cigars/cigarillos and large cigars: demographic and tobacco use profiles. *Nicotine Tob Res* 2013;15:1729-36.
38. Preventing tobacco use among young people: a report of the Surgeon General. Atlanta: Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 1994.
39. Biglan M, Gilpin EA, Rohrbach LA, Pierce JP. Is there a simple correction factor for comparing adolescent tobacco-use estimates from school- and home-based surveys? *Nicotine Tob Res* 2004;6:427-37.
40. Dolcini MM, Adler NE, Ginsberg D. Factors influencing agreement between self-reports and biological measures of smoking among adolescents. *J Res Adolesc* 1996;6:515-42.

Copyright © 2017 Massachusetts Medical Society.