Nicotine & Tobacco Research, 2016, 1596–1605
doi:10.1093/ntr/ntw008
Original investigation
Advance Access publication January 13, 2016

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A Risk-Continuum Categorization of Product Use Among US Youth Tobacco Users

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Abstract

Introduction: To examine prevalence and correlates of five mutually exclusive tobacco-use patterns among US youth tobacco users.

Methods: A nationally representative sample of tobacco users (N = 3202, 9–17 years) was classified into five product-use patterns. Weighted multinominal and multivariate logistic regression models were used to examine prevalence of product-use patterns by gender, race and ethnicity, and grade level; and associations between product-use patterns and perceived accessibility of tobacco products, exposure and receptivity to pro-tobacco marketing, social benefits of smoking, and tobacco-associated risks.

Results: Dual use (ie, use of two product categories) was the most prevalent pattern (30.5%), followed by non-cigarette combustible only (26.7%), polytobacco (ie, use of three product categories; 17.5%), cigarette only (14.9%), and noncombustible only (10.4%) use. Product-use patterns differed by gender, race, and ethnicity. Compared to cigarette only users, dual and polytobacco users were more likely to be exposed to and be receptive to pro-tobacco marketing, and were less likely to acknowledge tobacco-use related risks (Ps < .05).

Conclusions: Curbing tobacco use warrants research on users of more than one tobacco-product categories according to the risk-continuum categorization.

Implications: We present a risk-continuum categorization of product-use patterns among tobacco users not older than 17 years. We classify tobacco users into five mutually exclusive product-use patterns: cigarette only users, non-cigarette combustible only users, noncombustible only users, dual use, and polytobacco use. This categorization overcomes limitations in current literature on tobacco-use patterns, which include exclusion of certain products (eg, e-cigarettes) and product-use patterns (eg, exclusive users of non-cigarette products), and inconsistent classification of tobacco users. It is parsimonious yet complex enough to retain differential characteristics of sub-tobacco users based on number (single, dual, polytobacco) and categories (cigarettes, non-cigarette combustibles, noncombustibles) of tobacco products consumed.

Introduction

Adolescence is a developmental stage when tobacco use is initiated and established. Among ever daily adult smokers, 88.2% tried their first cigarette and 65.1% transitioned to daily smoking by age 18.[1] Among 12–17 years old, current smoking prevalence is 6.6% (3.5% and 14.0% for middle- and high-school students) with 22.0% being daily smokers and 78.0% being intermittent smokers.[2] Studies have marked a decline in cigarette smoking among youth.[1,3] Among

high-school students, prevalence dropped from 37.7% and 34.7% for males and females in 1997 to 19.9% and 16.1% in 2011.[2]

As smoking rates decline, awareness of, willingness to try, and use of non-cigarette tobacco products are on the rise among youth, especially products that are not regulated by the US Food and Drug Administration (FDA).[4–13] According to National Youth Tobacco Survey (NYTS), use of hookah increased among high-school students from 4.1% in 2011 to 5.4% in 2012. Use of e-cigarettes increased among 6–12 grade students from 3.3% in 2011 to 6.8% in 2012. Moreover, at 2.6%, use of multiple tobacco products is evident among 12–17 years old.[1,2,7,14] Increase in use of non-cigarette tobacco products can be attributed to advertising and marketing efforts.[15,16] For example, expenditures on advertising and promotions for smokeless tobacco were $451.7 million in 2011[17] and expenditures on e-cigarette advertising were $18.3 million in 2012.[18] Tobacco companies use advertising and marketing strategies that appeal to minors.[19] Moreover, non-cigarette products attract youth because of their youth-oriented flavors,[20–22] social appeal,[23] low cost and perceived safety relative to cigarettes, and, for noncombustible products, freedom from clean-air policies and social stigma around smoking.[24,25]

As the health risks of non-cigarette tobacco products are investigated,[26–29] some public health professionals are advocating non-cigarette products to reduce tobacco burden. Non-cigarette products could provide alternative nicotine-delivery systems that are less harmful than cigarettes. In conjunction with prevention and cessation efforts, moving tobacco users (especially those who are unwilling or incapable of quitting) to exclusive use of less harmful nicotine-delivery products could reduce tobacco-related morbidity and mortality.[30,31]

A current debate in the public health community focuses on two fundamental concepts: harm reduction and risk continuum.[32] Harm reduction is an alternative approach to complete abstinence where a risky behavior such as consuming less harmful tobacco products is allowed—despite continued exposure to toxicants in such products—to reduce tobacco-related illness and deaths.[33,34] Risk continuum is based on the premise that nicotine and tobacco products fall along a spectrum from most to least risk, which denotes the impact of tobacco use on human health at the individual and population levels. On risk continuum, cigarettes are most harmful and nicotine replacement therapy products are least harmful.[31,35] Harm reduction and risk continuum concepts appeared in reports by the Institute of Medicine (IOM) in the United States[33,34] and the Royal College of Physicians in the United Kingdom.[35] Other articles explored these concepts[31] toward establishing a comprehensive FDA tobacco control policy.[32]

Two limitations characterize current literature on youth tobacco product-use patterns. First, inconsistent categorization of product-use patterns limits comparability and generalizability of results and yields unstable prevalence estimates. Product-use patterns have been defined based on number of single products and/or product categories consumed. For example, Arrazola and colleagues[3] constructed product-use patterns based on single products (eg, cigars only use) and product categories (eg, smokeless tobacco only use, which includes chewing tobacco, snuff, dip). Dual use was defined as use of cigarettes and a single product (eg, cigars) or cigarettes and a product category (eg, smokeless tobacco), whereas polytobacco use was defined as use of cigarettes and at least two single products (eg, cigars and ≥1 other tobacco product) or product categories (eg, smokeless tobacco and ≥1 other tobacco product). Hookah and e-cigarettes were excluded in this analysis.[3] In an updated analysis that included hookah and e-cigarettes, Arrazola and colleagues[4] failed to distinguish between dual and polytobacco use where they only reported use of single products, any tobacco, and at least two products. Further, selection of product combination for dual and polytobacco use has been based on products that belong to same and/or different categories. For example, Lee and colleagues[36] defined dual and polytobacco use across similar (eg, ≥2 noncombustible products) and different (eg, combustible and noncombustible products) product categories. Finally, Arrazola and colleagues[3] and Lee and colleagues[36] enumerated almost all possible combinations of two- and three-product use, which resulted in 12 and 18 product-use patterns, respectively. Accordingly, Arrazola and colleagues[3] did not report characteristics associated with any product-use pattern, whereas Lee and colleagues[36] collapsed product-use patterns into dual (ie, cigarettes and one other product) and polytobacco (ie, cigarettes and ≥2 other products) use when reporting characteristics associated with product-use patterns. They did not report characteristics associated with exclusive non-cigarette products use. The sheer number of tobacco products available nowadays calls into question the practice of examining all possible combinations of tobacco use and its value for monitoring and cessation efforts.

The second limitation of current literature on youth tobacco product-use patterns is the inclusion of youth 18 years or older, which is problematic because legal access to tobacco products differs between minors and youth 18 years or older.[37] Further, prevalence of tobacco use differs between minors and adults. Prevalence of cigarette use is 2.9% and 12.7% among middle- and high-school students[38] compared to 18.5% among those 18–24 years old.[39] Therefore, prevalence of product-use patterns and associated characteristics should be stratified by minor status. However, Arrazola and colleagues[3,4] included youth 18 years or older in examining prevalence of product-use patterns, whereas Lee and colleagues[36] only adjusted for age in examining characteristics associated with dual and polytobacco use.

To overcome pitfalls of past research and better understand product-use patterns, a standardized and parsimonious categorization of tobacco product-use based on a reasonable yardstick is needed. Therefore, we propose a categorization of product-use patterns based on the risk-continuum concept. We classify tobacco users into five mutually exclusive categories: cigarette only users, non-cigarette combustible only users, noncombustible only users, dual use, and polytobacco use. We define single product category use as use of any single product from parent categories (ie, cigarettes, non-cigarette combustibles, noncombustibles) and none of the other products. We define a product category as a collection of single products with a similar nicotine delivery mechanism. Dual use is defined as use of products from any two parent categories, whereas polytobacco use is defined as use of products from all three parent categories (see Figure 1 for product categories and representative single products). A detailed description of the proposed categorization appears under "Measures" and "Discussion" sections.

We examine prevalence of product-use patterns by gender, race/ethnicity, and grade level in a representative sample of US minors. Further, we examine associations of product-use patterns with perceived accessibility of tobacco products, pro-tobacco advertising and promotions, marketing receptivity, and smoking-related beliefs around social benefits of smoking and perceived risks. Previous studies show associations between demographics and product-use patterns especially dual and polytobacco use. For example, polytobacco

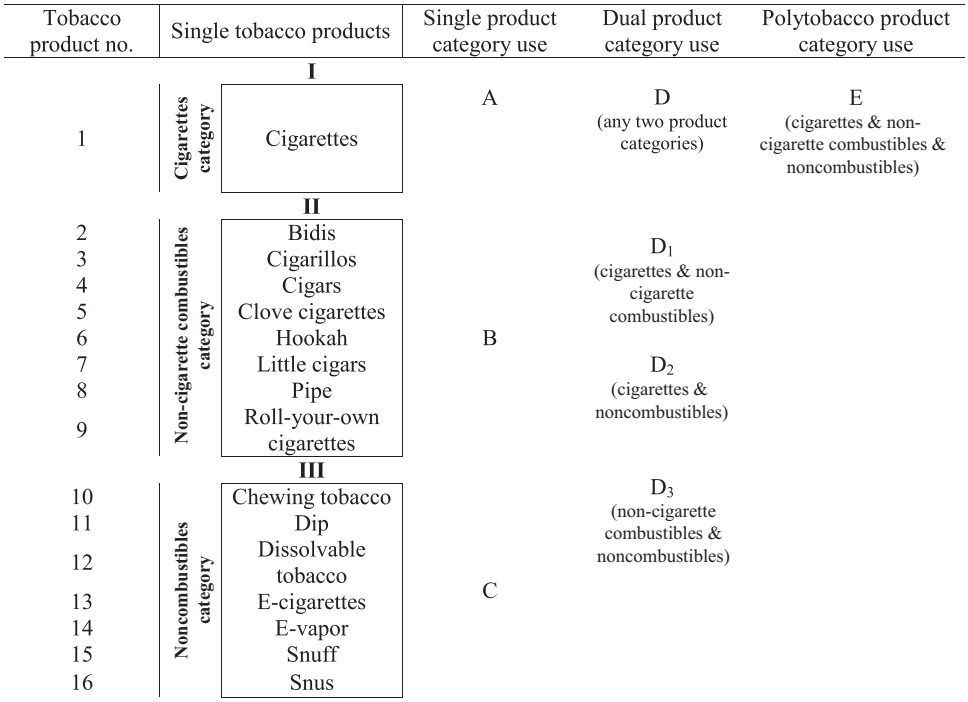

Figure 1. Proposed tobacco product-use pattern categorization scheme based on the risk-continuum concept.

use is associated with being male[36,40] and middle (vs. high) schooler.[40] Among adult tobacco users, studies show that product-use patterns are associated with gender, income, and race/ethnicity.[41] Studies have also shown that perceived accessibility of tobacco products,[42] exposure to pro-tobacco advertising and promotions,[43–50] receptivity to tobacco marketing,[51,52] and endorsing social benefits of smoking and dismissing tobacco-related risks[53,54] are factors associated with tobacco use. However, little is known about whether these factors differ by product-use patterns. Thus, there is a need to examine demographics and sociobehavioral correlates of product-use patterns especially among minors.

Methods

Data were from the 2012 NYTS, a self-administered paper-and-pencil survey of tobacco products knowledge, attitudes, and use among youth. NYTS utilized a three-stage cluster sampling procedure. The first stage included 100 counties stratified by urban versus rural and minority concentration. The second stage included 228 schools (out of 284 with 80.3% response rate) stratified by school size (large, medium, small) and grade level (middle vs. high schools). The last stage included selection of students where non-Hispanic blacks and Hispanics were oversampled with 91.7% response rate.

The 2012 NYTS yielded a nationally representative sample of 24 658 US middle and high-school students with 73.6% overall response rate. A complete description of sampling design, weighing procedure, and response rates is available online.[55] Analyses were limited to current tobacco users 9 to 17 years old (N = 3202) who are not legally allowed to purchase tobacco products in most states.[37]

Measures

Demographics (age, gender, race/ethnicity), grade level, and living with a tobacco user were assessed. Tobacco users were classified into five mutually exclusive categories (Figure 1). Single product category use was defined as use of any single product from the parent category for 1 day or more during the past 30 days and none of the other products: cigarette only users (Category A), non-cigarette combustible (ie, cigars, cigarillos, little cigars, pipe, roll-your-own cigarettes, bidis, clove cigarettes, hookah or waterpipe) only users (Category B), noncombustible (ie, chewing tobacco, snuff, dip, snus, dissolvable tobacco, e-cigarettes) only users (Category C). Dual use was defined as use of products from any two parent categories for 1 day or more during the past 30 days (Category D). Polytobacco use was defined as use of products from all three parent categories for 1 day or more during the past 30 days (Category E).

Accessibility (ie, "How easy do you think it is for kids your age to buy tobacco products in a store?") was recoded "yes" for responses "easy" and "somewhat easy" and "no" for "not easy at all." Exposure to tobacco advertising via the internet, magazines and newspapers, television and movies, point-of-sale, and outdoors (eg, "When you are using the internet, how often do you see any ads or promotions for cigarettes or other tobacco products?") was recoded "yes" for responses "always," "most of the time," and "sometimes" and "no" for "I do not use [medium]," "never," and "rarely". Receipt of coupons and promotional materials (eg, "During the past 30 days, did you receive coupons from a tobacco company through …") was coded "yes" if at least 1 medium (eg, mail, email) was selected and "no" if "I did not receive coupons/any information from a tobacco company" was selected. Marketing receptivity (ie, "How likely is it that you would ever use or wear something—such as a lighter, T-shirt, hat, or sunglasses—that has a tobacco brand name, logo, or picture on it?") was recoded "yes" for responses "very likely," "somewhat likely," and "somewhat unlikely" and "no" for "very unlikely."

Two questions gauged social benefits of smoking: "Do you think smoking cigarettes makes young people look cool or fit in?" and "Do you think young people who smoke cigarettes have more friends?" A "definitely not" response was coded "no," whereas "definitely

yes," "probably yes," and "probably not" were coded "yes." Two questions gauged perceived risks of tobacco use. The first question was "How strongly do you agree with the statement 'All tobacco products are dangerous'?" where "strongly agree" was coded "yes" and "agree," "disagree," and "strongly disagree" were coded "no." The second question was "In the past 30 days, how often have you thought about the harmful chemicals in tobacco products?" where "rarely," "sometimes," "often," and "very often" were coded "yes" and "never" was coded "no." Because of increased social stigma around smoking[24] and social desirability concerns,[56] we adopted this coding scheme where only a firm commitment ("definitely not," "strongly agree," "never" responses) counted as dismissing or acknowledging social benefits of smoking and tobacco-related risks. Our coding is consistent with previous literature.[57]

Analyses

Data were analyzed using SPSS 22.0 Complex Samples.[58] We reported weighted prevalence of product-use patterns by gender, race/ethnicity, and grade level. Adjusted for demographics and living with tobacco user, we used weighted multinomial logistic models to examine associations between demographics and product-use patterns. We used weighted multivariate logistic regression models to examine associations between product-use patterns and the following constructs: perceived accessibility of tobacco products, pro-tobacco advertising and promotions, marketing receptivity, and beliefs around social benefits of smoking and perceived risks.

Results

Prevalence of Product-Use Patterns

At 30.5%, dual use was the most prevalent product-use pattern among US youth tobacco users. The second prevalent pattern was non-cigarette combustible only use at 26.7%, followed by polytobacco use at 17.5%, cigarette only use at 14.9%, and noncombustible only use at 10.4% (Table 1).

Product-use patterns differed by gender and race/ethnicity. Dual use was the highest among males and females (30.0% and 31.2%) followed by non-cigarette combustible only use (24.2% and 30.4%). The third prevalent product-use pattern was polytobacco use among males (20.3%) and cigarette only use among females (21.1%). Multinomial logistic regression showed that, compared to females, males were more likely to be users of only non-cigarette combustible and only noncombustible products, and to be dual and polytobacco users relative to cigarette only use (*P*s < .05; see Table 2 for adjusted odds ratios and confidence intervals).

Non-cigarette combustible only use was the most prevalent product-use pattern among non-Hispanic blacks (50.9%), Hispanics (28.6%), and non-Hispanic Asians (38.9%). Dual use was most prevalent among non-Hispanic whites (32.3%) and American Natives (37.3%). Dual use was the second prevalent pattern among non-Hispanic blacks (26.9%), Hispanics (28.1%), and non-Hispanic Asians (26.4%). The second prevalent pattern was polytobacco use for American Natives (25.0%) and non-cigarette combustible only use for non-Hispanic whites (19.7%). Polytobacco use was the third prevalent pattern among non-Hispanic whites (19.0%), Hispanics (21.4%), and non-Hispanic Asians (14.1%). The third prevalent pattern was cigarette only use among non-Hispanic blacks (11.1%) and non-cigarette combustible only use among American Natives (19.4%; Table 1). Multinomial regression showed that compared to non-Hispanic whites, non-Hispanic blacks were more likely to be non-cigarette combustible only users relative to cigarette only use (*P* < .05). Non-Hispanic blacks were less likely to be polytobacco users and Hispanics were less likely to be noncombustible only users relative to cigarette only use (*P*s < .05; Table 2).

No significant differences were detected by grade level in product-use patterns relative to cigarette use. Non-cigarette combustible only use and dual use were most prevalent product-use patterns among middle (32.2% and 24.0%) and high (25.1% and 32.4%) school students. Common across grade level, polytobacco use was the third prevalent pattern (16.6% and 17.6%; Table 1).

Associations Between Product-Use Patterns and Factors Associated With Tobacco Use

Multivariate logistic regression showed that polytobacco users were more likely to find tobacco products accessible compared to cigarette only users (79.0% vs. 72.4%, *P* < .05). Polytobacco users, compared to cigarette only users, were more likely to be exposed to pro-tobacco advertising on the internet (52.8% vs. 41.7%) and outdoors (68.1% vs. 57.4%) (*P*s < .05; see Table 3 for adjusted odds ratios and confidence intervals).

Both dual (36.2%) and polytobacco (61.6%) users were more likely to receive coupons compared to cigarette only users (24.6%). Dual (19.4%), polytobacco (37.3%), non-cigarette combustible only (17.6%), and noncombustible only (17.0%) users were more likely to receive tobacco promotions compared to cigarette only users (7.8%). Both dual (68.9%) and polytobacco (77.5%) users were more receptive to tobacco marketing compared to cigarette only users (52.7%; *P*s < .05; Table 3).

Compared to cigarette only users (53.8%), non-cigarette combustible only (59.1%) and noncombustible only (62.3%) users were more likely to deny that smoking made someone look cool. Compared to cigarette only users (32.3%), non-cigarette combustible only (38.3%) and noncombustible only (42.8%) users were more likely to deny that smokers had more friends (*P*s < .05). Conversely, dual (29.2%) and polytobacco (25.9%) users were less likely to acknowledge that all tobacco products were dangerous compared to cigarette only users (41.7%). Non-cigarette combustible only users (60.1%) were less likely to have thought about risks related to tobacco use in the past 30 days compared to cigarette only users (69.8%; *P*s < .05; Table 3).

Discussion

Among US youth tobacco users, dual and polytobacco product-use patterns were among the most prevalent overall and within all demographic subgroups. These results are consistent with previous studies that show an uptake in non-cigarette tobacco products[4–12] and prevalence of multiple-product use among youth over time.[3,40,59–63] A holistic approach to research and regulations of youth tobacco use is therefore imperative. Previous research with a narrow focus on single products or product categories missed varied product-use patterns that have been defined inconsistently[64] and used interchangeably.[2]

To fill gaps in current literature, we presented a risk-continuum categorization with standardized labels and definitions of product-use patterns among youth tobacco users. We define product category as a class comprised of any number of single products that share a nicotine delivery mechanism (eg, combustion). Our categorization includes three product categories: (I) cigarettes, (II) non-cigarette combustibles, and (III) noncombustibles (Figure 1). Although

Table 1. Sample Characteristics by Product-Use Patterns Among US Youth Tobacco Users

Tobacco-use pattern	Cigarette only user		Combustible only user (other than cigarettes)		Noncombustible only user		Dual only user		Polytobacco only user	
	n	% (95% CI)	*n*	% (95% CI)	*n*	% (95% CI)	*n*	% (95% CI)	*n*	% (95% CI)
Total	466	14.9 (13.3–16.7)	849	26.7 (24.2–29.3)	329	10.4 (8.4–12.9)	992	30.5 (28.1–32.9)	566	17.5 (15.3–19.9)
Gender										
Male	201	10.9 (9.2–13.0)	467	24.2 (21.6–27.1)	272	14.5 (11.4–18.4)	577	30.0 (27.4–32.7)	389	20.3 (17.6–23.3)
Female	264	21.1 (18.3–24.2)	382	30.4 (27.2–33.9)	57	4.1 (3.0–5.5)	415	31.2 (27.4–35.4)	177	13.2 (10.7–16.1)
Race and ethnicity										
Non-Hispanic white	265	15.8 (13.6–18.3)	332	19.7 (16.9–22.7)	227	13.2 (10.3–16.7)	556	32.3 (29.5–35.3)	328	19.0 (16.2–22.3)
Non-Hispanic black	48	11.1 (7.2–16.7)	216	50.9 (44.1–57.6)	25	6.4 (3.4–11.6)	110	26.9 (22.4–31.9)	24	4.8 (2.7–8.2)
Hispanic	119	15.2 (11.9–19.3)	241	28.6 (25.2–32.4)	56	6.6 (4.8–8.9)	248	28.1 (24.2–32.4)	168	21.4 (18.7–24.5)
Non-Hispanic Asian	8	12.1 (4.4–29.3)	24	38.9 (22.5–58.3)	5	8.5 (3.0–21.7)	17	26.4 (13.6–44.8)	7	14.1 (7.2–25.6)
American Native	10	9.9 (4.7–19.4)	16	19.4 (11.3–31.3)	8	8.5 (4.1–16.8)	34	37.3 (27.1–48.7)	23	25.0 (15.2–38.2)
Grade										
Middle school	110	13.9 (10.4–18.3)	246	32.2 (27.2–37.7)	129	13.3 (10.2–17.1)	226	24.0 (20.3–28.1)	137	16.6 (13.3–20.4)
High school	355	15.2 (13.3–17.4)	603	25.1 (22.3–28.2)	199	9.6 (7.3–12.5)	764	32.4 (29.8–35.1)	422	17.6 (15.1–20.4)

CI = confidence interval; *n* = unweighted *n*. Within rows percentages and 95% CI are shown. Hispanic includes Mexican, Mexican Americans, Chicanos, Puerto Ricans, Cubans, Cuban Americans, and other Hispanics. American Native includes American Indians, Alaska Natives, Native Hawaiians, and Pacific Islanders.

cigarettes are combustible tobacco products, they are assigned a separate category because cigarettes remain the most consumed tobacco product solely and in combination with other products,[14,38,39] users of non-cigarette combustible products (eg, cigars, pipes) have lower mortality ratios for several diseases (eg, lung cancer) compared to cigarette users,[65] and researchers[66,67] and tobacco users[68] compare non-cigarette products to cigarettes. In our categorization, exclusive use of single product categories corresponds to category label: cigarette only use (A), non-cigarette combustible only use (B), and noncombustible only use (C). We use dual-category use (D) and poly-category use (E) to label tobacco users who use at least 1 product from any two versus all three product categories.

With five distinct product-use patterns, this categorization is parsimonious yet complex enough to retain differential characteristics of sub-tobacco users. A fine-grained categorization of dual-category use into cigarette and non-cigarette combustible use (D_1), cigarette and noncombustible use (D_2), non-cigarette combustible and noncombustible use (D_3) increases product-use patterns to a total of seven –less than those presented in past research.[3,36] Our categorization is flexible to accommodate future tobacco products that are likely to emerge under the three product categories with which they share nicotine delivery mechanism. It can also accommodate additional product categories. For example, the noncombustibles category can be broken into subcategories that deliver nicotine through heating (eg, e-cigarettes) or direct contact (eg, chewing tobacco). Our product-use patterns are exhaustive and mutually exclusive, which prevents exclusion of certain products (eg, e-cigarettes),[3] product-use patterns (eg, exclusive users of non-cigarette products),[36] and inconsistent classification of tobacco users. Our categorization would allow public health professionals to distinguish subgroups of tobacco users by number (single, dual, polytobacco) and categories (cigarettes, non-cigarette combustibles, noncombustibles) of tobacco products consumed.

Our categorization allows for comparing users' characteristics and charting health consequences of product-use patterns on the risk continuum. This is consistent with IOM's recommendation of establishing a surveillance system to monitor and evaluate use of nicotine/tobacco products.[34] According to the risk continuum, product categories are ordered from most to least risk as follows: (I) cigarettes, (II) non-cigarette combustibles, and (III) noncombustibles (Figure 1). Thus, it follows that, "all being equal," product-use patterns are ranked from most to least risk as follows: cigarette only use (A), non-cigarette combustible only use (B), and noncombustible only use (C). It is tempting to rank dual (D) and polytobacco-category use (E) as more risky than cigarette only use (A) because cigarettes are a component in two dual-category use patterns (D_1 and D_2) and polytobacco-category use. However, more data are needed on the health risks of dual and polytobacco use before we can accurately rank them on the risk continuum. Further, our ranking of product-use patterns is dependent on all being equal. Research shows that use behavior, mainly frequency and intensity of use, alter the risks associated with nicotine/tobacco products.[34] Our next steps involve incorporating intensity and frequency of tobacco use in determining risk-continuum categorization of product-use patterns. We expect that ranking tobacco users along the risk continuum will depend on the interaction of number of products used, product categories, and use behavior.

Tobacco control efforts have focused primarily on cigarettes.[2] Advocates of harm reduction approach to tobacco control call for a comprehensive approach to regulating production and promotion

Table 2. Multinominal Logistic Regression of Product-Use Patterns by Sample Characteristics

	Cigarette only user n = 466	Combustible only user (other than cigarettes) n = 849	Noncombustible only user n = 329	Dual only user n = 992	Polytobacco only user n = 566
Tobacco-use pattern	*AOR* (95% CI)	*AOR* (95% CI)	*AOR* (95% CI)	*AOR* (95% CI)	*AOR* (95% CI)
Gender[a]					
Male (vs. female)	1.00	1.64 (1.21–2.23)*	7.53 (4.67–12.14)*	2.00 (1.43–2.79)*	3.63 (2.65–4.98)*
Race and ethnicity[b]					
Non-Hispanic black (vs. non-Hispanic white)	1.00	3.65 (2.02–6.59)*	0.61 (0.28–1.31)	1.25 (0.73–2.15)	0.31 (0.13–0.74)*
Hispanic (vs. non-Hispanic white)	1.00	1.49 (0.99–2.25)	0.49 (0.29–0.82)*	1.00 (0.68–1.47)	1.24 (0.85–1.82)
Non-Hispanic Asian (vs. non-Hispanic white)	1.00	2.08 (0.69–6.29)	0.65 (0.10–4.17)	0.91 (0.19–4.17)	0.91 (0.35–2.33)
American Native (vs. non-Hispanic white)	1.00	1.72 (0.62–4.74)	1.26 (0.41–3.84)	1.89 (0.79–4.50)	2.29 (0.77–6.73)
Grade[c]					
High school (vs. middle school)	1.00	0.73 (0.43–1.22)	0.61 (0.36–1.05)	1.19 (0.79–1.80)	1.00 (0.65–1.54)

AOR = adjusted odds ratio; CI = confidence interval; n = unweighted n. Hispanic includes Mexican, Mexican Americans, Chicanos, Puerto Ricans, Cubans, Cuban Americans, and other Hispanics. American Native includes American Indians, Alaska Natives, Native Hawaiians, and Pacific Islanders. "Cigarette only user" is the reference category.

[a]Adjusted for age, race and ethnicity, and living with tobacco user.

[b]Adjusted for age, gender, and living with tobacco user.

[c]Adjusted for gender, race and ethnicity, and living with tobacco user.

*$P < .05$.

of nicotine delivery products. However, while conceptually beneficial, caution should be taken in promoting shifts to exclusive use of tobacco products low on risk continuum. Previous studies suggest that non-cigarette tobacco products might lead to or reinforce cigarette smoking and nicotine dependency[69–74] and, therefore, might not lead to complete shifts from high-risk to low-risk products. Potential safety misperceptions of non-cigarette products among non-tobacco users (especially adolescents and young adults) might lead to an uptake of tobacco use among nonusers.

Exposure to pro-tobacco advertising and marketing and smoking-related beliefs differed between subgroups of tobacco users. Compared to cigarette only users, polytobacco users perceived tobacco products as highly accessible and were more likely to be exposed to pro-tobacco advertising. Further, both dual and polytobacco users were more likely to receive coupons and promotions and were more receptive to tobacco marketing. These results are consistent with previous evidence on associations between perceived accessibility,[42] exposure to pro-tobacco advertising and promotions and marketing receptivity,[43–48,51] and use of tobacco products. One study showed that perceived ease of acquisition at baseline predicted smoking initiation among nonsmokers and progression toward regular smoking among initiators.[42] Exposure to pro-tobacco advertising is associated with favorable attitudes toward advertised products and tobacco companies and tobacco use.[43–48] Higher likelihood of exposure to pro-tobacco advertising among dual and polytobacco users can be attributed to cross-product marketing. One study showed that young adult smokers received coupons for other tobacco products, whereas snus users received coupons for cigarettes.[75] Pro-tobacco marketing has been associated with susceptibility and use uptake in a dose-response fashion,[49] fewer quit attempts, and favorable attitudes toward tobacco companies.[50] Marketing receptivity has been shown to increase susceptibility to tobacco use[51,52] because wearing or willingness to wear tobacco-branded merchandise is an expression of adolescents' emerging identities, which leads to tobacco use.[18]

Smoking-related beliefs differed by product-use patterns. Compared to cigarette only users, polytobacco users were less likely to deny that smoking made people look cool, which is attributed to the fact that polytobacco users in our study used cigarettes. It is also consistent with previous studies where almost 80% of polytobacco users in high school smoked cigarettes.[3] According to prototype willingness model, adolescents' behaviors are driven by favorable images of a prototypical smoker.[76] Further, polytobacco users were less likely to acknowledge risks associated with tobacco use. Perceived risk is an important determinant of cessation intentions and behaviors.[77,78]

Dual and polytobacco users exhibited distinct characteristics from users of single product categories. The associations between dual and polytobacco use and perceived accessibility, exposure to pro-tobacco advertising and marketing, marketing receptivity, and perceived risks of tobacco products highlight a possibly new domain of "hardcore" users in addition to other definitions used in the literature.[79] Dual and polytobacco use could be a manifestation of hardcore tobacco use where users seek nicotine via different delivery systems. Given the proliferation of non-cigarette tobacco products, there is a need to research dual and polytobacco users as an at-risk subgroup for low quit intentions[80] and increased health problems.[1]

Limitations

NYTS is a cross-sectional, self-report survey of tobacco use, which can be biased by factors such as social desirability.[56] However, previous studies showed consistency between self-report and biological markers of tobacco use.[81] NYTS samples in-school youth, which limits generalizability to out-of-school youth. The cross-sectional design does not allow us to chart the trajectories of how tobacco users came to adopt a product-use pattern. We cannot infer whether noncombustible only users have switched from cigarette use to noncombustible products (ie, harm reduction hypothesis) or whether noncombustible users have switched to cigarettes and/or other tobacco products (ie, gateway hypothesis). The study design does not allow us to infer causality regarding factors associated with tobacco use. For example, we cannot show whether exposure to pro-tobacco advertising led to adoption of a product-use pattern or whether tobacco users selectively sought out and paid attention to advertising of products that they use. Lastly, NYTS did not have information on intensity of use for all tobacco products, which prevented us from

Table 3. Multivariate Logistic Regression of Perceptions of Accessibility, Tobacco Advertising and Promotions, Marketing Receptivity, Social Benefits of Smoking, and Perceived Risk by Product-Use Patterns

	Cigarette only user $n = 466$	Combustible only user (other than cigarettes) $n = 849$	Noncombustible only user $n = 329$	Dual user $n = 992$	Polytobacco user $n = 566$
	AOR (95% CI)	*AOR* (95% CI)	*AOR* (95% CI)	*AOR* (95% CI)	*AOR* (95% CI)
Accessibility (vs. inaccessible)	1.00	1.09 (0.81–1.48)	1.15 (0.80–1.65)	1.14 (0.86–1.51)	1.50 (1.09–2.07)*
Yes (*n*, %)	310, 72.4	618, 73.8	220, 72.5	713, 75.4	425, 79.0
No (*n*, %)	132, 27.6	209, 26.2	103, 27.5	256, 24.6	124, 21.0
Exposure to pro-tobacco marketing					
Internet ads (vs. not exposed)	1.00	1.18 (0.88–1.59)	1.39 (0.89–2.15)	1.22 (0.90–1.65)	1.65 (1.15–2.36)*
Yes (*n*, %)	186, 41.7	398, 45.2	161, 47.4	449, 45.2	290, 52.8
No (*n*, %)	259, 58.3	437, 54.8	166, 52.6	525, 54.8	266, 47.2
Newspaper/magazine ads (vs. not exposed)	1.00	1.13 (0.84–1.53)	1.32 (0.91–1.91)	1.09 (0.81–1.48)	1.22 (0.90–1.65)
Yes (*n*, %)	185, 43.5	364, 43.7	157, 46.5	422, 43.1	268, 47.1
No (*n*, %)	261, 56.5	471, 56.3	170, 53.5	549, 56.9	287, 52.9
Point-of-sale ads (vs. not exposed)	1.00	0.72 (0.51–1.01)	1.26 (0.83–1.92)	0.95 (0.72–1.25)	1.09 (0.74–1.60)
Yes (*n*, %)	358, 82.2	625, 74.9	273, 83.9	800, 81.3	459, 81.7
No (*n*, %)	85, 17.8	202, 25.1	53, 16.1	170, 18.7	94, 18.3
Outdoor ads (vs. not exposed)	1.00	0.92 (0.70–1.21)	1.19 (0.81–1.75)	1.11 (0.86–1.44)	1.65 (1.22–2.22)*
Yes (*n*, %)	256, 57.4	456, 53.8	197, 59.6	574, 59.0	376, 68.1
No (*n*, %)	187, 42.6	372, 46.2	129, 40.4	389, 41.0	172, 31.9
Movies and television (vs. not exposed)	1.00	0.96 (0.67–1.39)	1.33 (0.92–1.92)	1.10 (0.82–1.49)	1.26 (0.87–1.83)
Yes (*n*, %)	332, 74.1	597, 71.5	241, 75.2	715, 74.0	424, 76.0
No (*n*, %)	115, 25.9	230, 28.5	86, 24.8	247, 26.0	123, 24.0
Coupons (vs. did not receive)	1.00	1.15 (0.83–1.59)	1.42 (0.86–2.36)	1.91 (1.40–2.59)*	5.27 (3.80–7.32)*
Yes (*n*, %)	107, 24.6	214, 25.4	93, 27.7	368, 36.2	328, 61.6
No (*n*, %)	337, 75.4	618, 74.6	234, 72.3	605, 63.8	226, 38.4
Promotions (vs. did not receive)	1.00	2.46 (1.53–3.94)*	2.48 (1.39–4.44)*	2.95 (1.84–4.72)*	6.41 (3.98–10.33)*
Yes (*n*, %)	35, 7.8	150, 17.6	52, 17.0	194, 19.4	195, 37.3
No (*n*, %)	412, 92.2	678, 82.4	275, 83.0	773, 80.6	353, 62.7
Marketing receptivity (vs. not receptive)	1.00	1.11 (0.81–1.51)	0.90 (0.611–1.35)	1.89 (1.41–2.54)*	2.96 (2.04–4.30)*
Yes (*n*, %)	222, 52.7	459, 55.6	181, 52.4	633, 68.9	401, 77.5
No (*n*, %)	205, 47.3	340, 44.4	135, 47.6	299, 31.1	119, 22.5
Social benefits of smoking					
Denied that smoking makes someone cool (vs. yes)	1.00	1.34 (1.01–1.78)*	1.60 (1.15–2.21)*	0.80 (0.59–1.08)	0.62 (0.47–0.81)*
Yes (*n*, %)	203, 46.2	341, 40.9	129, 37.7	498, 52.3	337, 61.3
No (*n*, %)	237, 53.8	479, 59.1	195, 62.3	459, 47.7	197, 38.7
Denied that smokers have more friends (vs. yes)	1.00	1.43 (1.09–1.88)*	1.60 (1.17–2.18)*	0.95 (0.71–1.25)	0.78 (0.54–1.13)
Yes (*n*, %)	291, 67.7	508, 61.7	192, 57.2	669, 69.1	405, 73.8
No (*n*, %)	145, 32.3	307, 38.3	131, 42.8	286, 30.9	127, 26.2
Perceived risks					
Agreed that "all tobacco products are dangerous" (vs. no)	1.00	1.04 (0.80–1.35)	0.99 (0.68–1.45)	0.58 (0.45–0.76)*	0.55 (0.40–0.75)*
Yes (*n*, %)	184, 41.7	347, 43.7	117, 38.9	283, 29.2	138, 25.9
No (*n*, %)	250, 58.3	461, 56.3	201, 61.1	660, 70.8	388, 74.1
Thought about risk in the past 30 days (vs. no)	1.00	0.67 (0.48–0.93)*	0.83 (0.59–1.18)	1.07 (0.78–1.49)	0.77 (0.56–1.06)
Yes (*n*, %)	296, 69.8	476, 60.1	200, 63.0	659, 70.5	329, 63.3
No (*n*, %)	132, 30.2	329, 39.9	119, 37.0	281, 29.5	192, 36.7

AOR = adjusted odds ratio; CI = confidence interval; *n*: unweighted *n*. Adjusted for age, gender, race and ethnicity, and living with tobacco user. "Cigarette only user" is the reference category.
*$P < .05$.

considering this variable in our categorization. For example, NYTS included a question on number of cigarettes smoked per day in the past 30 days. However, comparable questions were not available for non-cigarette products.

Conclusion

Given that close to half of youth tobacco users are users of more than one tobacco product categories, a holistic approach to tobacco control that addresses multiple tobacco products is warranted. Future research is needed to better understand dual and polytobacco users to inform tailored prevention and cessation programs among youth.

Funding

Funding for this article was provided by the Division of Intramural Research, National Institute on Minority Health and Health Disparities, National Institutes of Health.

Declaration of Interests

None declared.

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