Correlates of poly-tobacco use among youth and young adults: Findings from the Population Assessment of Tobacco and Health study, 2013–2014[*]

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Abstract

Introduction—Poly-tobacco use is common among youth and young adults. This study examined sociodemographic, tobacco-related, and substance use characteristics of poly-tobacco use compared to mono-tobacco use among youth and young adults (12–34 years) in the United States.

Methods—We conducted a descriptive analysis by age group of 12,898 youth (12–17 years), 8,843 younger young adults (18–24 years), and 6,081 older young adults (24–34 years) from the 2013–2014 Population Assessment of Tobacco and Health study. Multiple logistic regression modeling was conducted to assess the sociodemographic, tobacco-related, and substance use associations with current (past 30 days) tobacco use on a binary scale (poly- versus monotobacco use) among tobacco users.

Results—Between 2013 and 2014, 3.6% of youth, 21.7% of younger young adults, and 15.8% of older young adults were current poly-tobacco users in the general population. In the regression analyses, among youth tobacco users, heavy drinking was the only factor associated with higher odds of poly-tobacco use. Factors associated with higher odds of poly-tobacco use among younger young adults included being male, having less than high school diploma or GED, residing in the South, having 2 and 3 quit attempts, heavy drinking, and marijuana use. Residing in the South,

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Conflict of Interest

The authors have no conflicts of interest to declare.

older ages of exposure to tobacco use, and marijuana use were associated with higher odds of poly-tobacco use among older young adults.

Conclusions—Regardless of tobacco product type, poly-tobacco use was common among youth and young adults. Interventions designed to address factors associated with poly-tobacco use among youth and young adults are warranted.

1. Introduction

Poly-tobacco use, the concurrent utilization of two or more tobacco products, is increasingly common among youth and young adults (Harrell et al., 2016; Richardson et al., 2014) who are likely to be poly users of emerging tobacco products such as hookah, little cigars, cigarillos, and electronic cigarettes (e-cigarettes) (Kasza et al., 2017; Lee et al., 2014; Lee et al., 2015; Soneji et al., 2016). The increased use of emerging tobacco products can be partially attributable to the aggressive marketing practices of the tobacco industry (Mejia and Ling, 2010; Regan et al., 2012) and taking advantage of the misperception of lower harm of these products relative to cigarettes (Braun et al., 2012; Pearson et al., 2012; Sterling et al., 2013).

Epidemiological studies in the U.S. show that tobacco use mainly occurs in adolescence, with 9 out of 10 daily cigarette smokers reporting first smoking by age 18 and 99% by age 26 (USDHHS, 2014). The continued use of tobacco products can predispose young people to prolonged nicotine exposure and subsequently nicotine addiction (USDHHS, 2014), because their developing brain's reward system is altered thereby making them more vulnerable to dependence (McQuown et al., 2007). Nicotine dependence may increase the likelihood of young poly-tobacco users maturing into adult poly-tobacco users who delay quitting tobacco compared to adult mono-tobacco users (Henningfield et al., 2002; Soneji et al., 2016). Furthermore, compared to mono-tobacco use, poly-tobacco use may provide challenges for those willing to quit (Bombard et al., 2007; Wetter et al., 2002).

Previous research has examined the use of multiple tobacco products using different definitions ranging from use of cigarettes and any other tobacco product to use of   3 tobacco products, and some did not include e-cigarettes and hookah among tobacco products (Bombard et al., 2009; Bombard et al., 2007; Bombard et al., 2008; Lee et al., 2014; Lee et al., 2015). In this study, we applied an inclusive definition of the concurrent use of   2 tobacco products to show the significance of poly-tobacco use regardless of tobacco product type and emphasize this epidemic among young people in the U.S. We examined the cross-sectional associations between selected characteristics and poly-tobacco use among youth and young adults using data from the Population Assessment of Tobacco and Health (PATH) study.

2. Methods

2.1 Study sample

Data were from the restricted use files of Wave 1 of the PATH study, an ongoing longitudinal study of tobacco use trajectories and health outcomes, with an overall purpose to inform the Food and Drug Administration (FDA)'s regulatory policies on tobacco products (USDHHS, 2017).

A detailed methodology for the PATH study is described elsewhere (Hyland et al., 2016). Briefly, the PATH study is a nationally representative sample of 45,971 youth and adults aged 12 years. Survey responses were weighted to adjust for nonresponse, varying selection probabilities, and oversampling to reflect national estimates (USDHHS, 2017). This study was approved by the Institutional Review Board of Florida International University.

2.2 Measures

2.2.1 Outcome—The PATH Study inquired about cigarettes, e-cigarettes, cigars, cigarillos, little-filtered cigar, pipe, hookah, smokeless tobacco including snus, chewing tobacco, dip, moist snuff, and dissolvable tobacco. Bidis and kreteks were also examined in youth only. We classified subjects into current mono-tobacco users (use of only one tobacco product in the past 30 days) or current poly-tobacco users (concurrent use of 2 tobacco products in the past 30 days). A binary variable was derived to indicate respondents' tobacco status (0 = mono-tobacco use, 1 = poly-tobacco use).

2.2.2 Covariates—Using the PATH's theoretical framework of host, agent, vectors, and environment (Hyland et al., 2016), we selected covariates relevant to the study aim and those established in existing tobacco control literature related to tobacco use among young people (Ambrose et al., 2015; Cohn et al., 2015; Hinds et al., 2017). We classified them into sociodemographic, tobacco-related, and substance use variables.

Sociodemographic variables included age, gender, sexual orientation, race/ethnicity, education (young adults), grade (youth), money received per week (youth), household income (young adults), employment status (young adults), census region, and self-perception of overall health.

Tobacco-related variables examined included age at first exposure to tobacco product (regardless of the specific type first used), tobacco products "come/came in flavors I like/liked", and advert appeal "the advertising for tobacco product appeals/appealed to me". The latter two variables were assessed for all tobacco products except for cigarettes, and single binary variables were derived for each (0 = no; 1 = yes). Quit attempts in the past 12 months were assessed among young adults (18–34 years) and categorized into 0, 1, 2 and 3 attempts.

Substance use variables assessed included marijuana and other drug use (Ritalin, painkillers, cocaine, methamphetamine, and heroin) within the past 30 days. Excessive alcohol consumption was assessed from 1) heavy drinking derived from number of days respondent

had 1 alcoholic drink in last 30 days *(<5/ 5 days)* and coded as no/yes and 2) high-risk drinking derived from average number of drinks per day, which was coded as no (< 4 drinks/day for females and < 5 drinks/day for males), and yes (4 drinks/day for females and 5 drinks/day for males) (USDHHS and USDA, 2015).

2.3 Statistical analyses

The characteristics of study participants were reported by tobacco status (non-, mono-, and poly-tobacco use) separately for youth (12–17 years), younger young adults (18–24 years), and older young adults (25–34 years). Replicate weights provided by the PATH study were used to obtain variance estimates using Fay's Method of Balanced Repeated Replication (BRR) with Fay's coefficient value of 0.3 as recommended by the PATH Study (USDHHS, 2017). Weighted percentages were reported with their confidence intervals (CIs). We reported proportions of common mono-tobacco products and poly-tobacco use combinations by age-groups. Next, we examined differences in proportions of the characteristics for tobacco users only (mono- and poly-tobacco) using Pearson chi-square test by age-groups. Factors with P values <0.10 in the bivariate analyses were included in the binary logistic regression model. Gender stratification was conducted to identify factors associated with poly-tobacco use. We calculated adjusted odds ratios (ORs) with accompanying 95% CIs controlling for sociodemographic, tobacco-related, and substance use variables. A two-sided P value < 0.05 was considered statistically significant. Analyses were conducted using SAS version 9.4 statistical procedures (SAS Institute Inc., Cary, NC, USA), –PROC SURVEYFREQ and PROCSURVEYLOGISTIC with BRR method and Fay's correction of 0.3 – that corrects for the complex survey design of the PATH study (USDHHS, 2017).

3. Results

In the general population, the prevalence of poly-tobacco use was 3.6% among youth, 21.7% among younger young adults, and 15.8% among older young adults. Mono-tobacco use was 4.8% among youth, 18.4% among younger young adults, and 21.1% among older young adults (Tables S1, S2 and S3[1]). Cigarettes were the most common mono-tobacco product, while the most common combination for poly-tobacco use was cigarette and e-cigarette across age-groups (Tables S4, S5 and S6). The characteristics of tobacco users only (mono- and polytobacco use) were also reported for youth and young adults (Tables S7 and S8).

In table 1, we reported the adjusted ORs and 95% CIs for poly-tobacco use compared to mono-tobacco use among youth overall and stratified by gender. Those who identified as other race had lower odds of poly-tobacco use, and heavy drinkers had higher odds of poly-tobacco use. A similar association was observed among males in the stratified analysis.

In table 2, we reported the adjusted ORs and 95% CIs for poly-tobacco use compared to mono-tobacco use among younger and older young adults overall and stratified by gender. Among younger young adults, males, those having completed less than high school or GED, and those residing in the South had higher odds of poly-tobacco use. Additionally, those who reported 2 and 3 quit attempts, heavy drinking, and marijuana use had higher odds of

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[1]Supplementary material can be found by accessing the online version of this paper at http://dx.doi.org and by entering doi:…

poly-tobacco use. In the gender-stratified analysis, among males, being a high school graduate, having 3 quit attempts, heavy drinking and marijuana use had higher odds of poly-tobacco use.

Among older young adults, residing in the South had higher odds of poly-tobacco use, and stating that "*tobacco comes in flavors I like*" had lower odds of poly-tobacco use. Age at first exposure to tobacco product use at 18–24 years and 25–34 years had higher odds of poly-tobacco use. Further, marijuana use had higher odds of poly-tobacco use. In the gender-stratified analysis, in both males and females, age at first exposure to tobacco product use at 25–34 years and marijuana use had higher odds of poly-tobacco use (Table 2).

4. Discussion

This is the first study to examine factors associated with poly-tobacco use in a large, representative sample of U.S. youth and young adults using the FDA-supported PATH study. Approximately 4% of youth, 22% of younger young adults, and 16% of older young adults reported poly-tobacco use in the general population between 2013 and 2014. The most common combination of poly-tobacco use across age-groups was cigarettes and e-cigarettes. Factors associated with higher odds of poly-tobacco use compared to mono-tobacco use varied by age-groups and gender.

Our results are consistent with the rise in tobacco epidemic among young people trending towards poly-tobacco use (Fix et al., 2014), which is concerning because this has been found to increase the risk of illicit drug use and nicotine addiction compared to mono-tobacco use (Bombard et al., 2009). Additionally, the distinct characteristics of poly-tobacco users compared to mono-tobacco users by age-groups in our study suggest where interventions may be applied to address this worrisome issue.

Prior studies report that males have higher odds of tobacco use (Lee et al., 2014; Lee et al., 2015). We extend this observation to poly-tobacco use where males had higher odds of polytobacco use among younger young adults. Although males and females in youth and younger young adults had almost comparable proportions of mono-tobacco use in this study, the proportion of poly-tobacco use was higher among males across age-groups. This finding may follow the known stages of the cigarette smoking epidemic, as earlier stages found that males had higher prevalence rates of cigarette smoking compared to females (Thun et al., 2012). However, as the epidemic advanced, the rates of cigarette use narrowed (Thun et al., 2012). It is possible that the pattern of poly-tobacco use may set the stage for another tobacco epidemic, where females eventually catch up at rates comparable to males.

Our results indicate that young adults residing in the South had higher odds of polytobacco use compared to mono-tobacco use. Prior reports in the U.S. demonstrate that those living in the South tend to use multiple tobacco products (USDHHS, 2014). The regional disparities observed in poly-tobacco use may be due to factors such as demographics, variations in tobacco control programs and policies, and differences in the tobacco industry marketing and promotion practices (King et al., 2012).

A study conducted among cigarette-only smokers and cigarette smokers who use other tobacco products using the 2010–2011 Tobacco Use Supplement to the Current Population Survey demonstrated that dual users were just as likely as cigarette-only users to make a past year quit attempt (Schauer et al., 2016). In the current study, we found that those who had 2 quit attempts among younger young adults had significantly higher odds of poly-tobacco use. The reason for this finding is not particularly clear. However, it may be because younger young adults are still battling life-changing decisions and transitions (Arnett, 2000).

Consistent with literature (Cohn et al., 2017; Wetter et al., 2002), our results show that youth and younger young adult heavy drinkers had higher odds of poly-tobacco use compared to mono-tobacco use. Additionally, young adults had higher odds of marijuana use. Previous research showed that young poly-tobacco users were more likely to engage in heavy drinking and marijuana use than mono-tobacco users (Cohn et al., 2017; Soneji et al., 2016). The utilization of alcohol and marijuana has been shown to contribute to greater nicotine dependence and increased difficulty with quitting in late adulthood (Cohn et al., 2015; Kahler et al., 2009). Because substance and tobacco use often co-occur in young people, this may hinder tobacco control efforts. Therefore, coping mechanisms for dealing with the bait of heavy alcohol consumption and substance use should be incorporated into cessation interventions.

Although "*tobacco comes in flavors I like*" was associated with lower odds of poly-tobacco use among older young adults in our study, the proportion was much higher for poly-tobacco use across age-groups. This provides further evidence on the problem with flavoring of unregulated tobacco products accessible to young people (Ambrose et al., 2015; Harrell et al., 2017). Flavor restrictions do not apply to cigars, e-cigarettes, and hookah, and these may appeal to young people by concealing the harsh taste of tobacco for new and inexperienced smokers (Carpenter et al., 2005; Soneji et al., 2016) and incidentally lead to an increase in tobaaco product use.

Major strengths of this study include the use of a large national sample of youth and young adults, not restricted to high school or college students, and assessment of all tobacco products currently available. There are, however, some limitations to be considered. First, the cross-sectional analysis does not allow for causal inferences on the factors associated with polytobacco use. Second, this study relied on participant s' self-reports of tobacco use and age at first exposure to tobacco product, which predisposes it to recall bias. However, studies show self-reports on tobacco use are reliable and provide valid estimates in the U.S. (Brener et al., 2003). Finally, due to the relatively small sample sizes for non-Hispanic Asians, American Indian/Alaska Natives, Native Hawaiians, Pacific Islanders, and multi-racial groups, these were collapsed into one category. Hence, estimates for these racial groups were not possible in the current study.

Our results demonstrate that poly-tobacco use is common among youth and young adults regardless of tobacco product type. Factors associated with poly-tobacco use varied among youth and young adults and by gender. There is a need for continued surveillance among young people as well as developing targeted control policies responsive to the unique characteristics associated with poly-tobacco use among this subpopulation.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Highlights

- Examined correlates of past 30-day poly-tobacco use among youth and young adults.

- Data were from the Population Assessment of Tobacco and health study, 2013–2014.

- About 4% of youth, 22% younger- and 16% older young adults report poly-tobacco use.

- Most common combination of poly-tobacco was cigarettes and e-cigarettes.

- Correlates of poly-tobacco use differed by age-group.

Table 1

Multivariable associations[¶] for poly-tobacco use compared to mono-tobacco use among youth (12–17 years) past 30days tobacco users overall, and stratified by gender: PATH study, 2013–2014

	Overall	Females	Males
	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)
Socio-demographic variables			
Age, y (Ref: 12–14)			
15–17	3.62 (0.97–13.60)	4.03 (0.45–35.78)	7.89 (0.45–139.42)
Gender (Ref: Female)			
Male	1.78 (1.00–3.16)		
Race/Ethnicity[a] (Ref: Non-Hispanic White)			
Non-Hispanic Black	0.50 (0.15–1.74)	0.32 (0.07–1.51)	0.91 (0.10–8.28)
Other	**0.40 (0.17–0.94)**	0.41 (0.10–1.38)	**0.33 (0.11–0.97)**
Hispanic	0.86 (0.45–1.65)	0.55 (0.22–1.38)	1.34 (0.39–4.61)
Tobacco-related variables			
Age at first exposure to tobacco product (y) (Ref: 14)			
15–17	0.46 (0.16–1.33)	0.22 (0.03–1.39)	0.78 (0.12–5.17)
Advert appeal (Ref: No)			
Yes	0.45 (0.18–1.06)	0.49 (0.15–1.58)	0.41 (0.07–2.35)
Substance use variables			
Heavy drinking (Ref: No)			
Yes	**2.40 (1.39–4.16)**	1.37 (0.62–2.99)	**5.66 (1.67–19.18)**
High-risk drinking (Ref: No)			
Yes	1.75 (0.99–3.08)	1.82 (0.82–4.03)	1.57 (0.63–3.92)

Note: PATH = Population Assessment of Tobacco and Health, CI = confidence interval.

Bold numbers represent P < 0.05.

[¶]Odds ratios were calculated using multiple logistic regression and adjusted for survey weights and all variables.

[a]Other indicates Non-Hispanic American Indian or Alaska Native, Non-Hispanic Asian/Native Hawaiian or Other Pacific Islander and persons with multiple races

Table 2

Multivariable associations[¶] for poly-tobacco use compared to mono-tobacco use among young adults (18–34 years) past 30 days tobacco users overall, and stratified by gender: PATH study, 2013–2014

	18–24 years			25–34 years		
	Overall	Females	Males	Overall	Females	Males
	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)
Socio-demographic variables						
Age, y						
18–20 *(Ref: 21–24)*	1.05 (0.64–1.73)	0.82 (0.31–2.12)	1.11 (0.57–2.16)			
25–30 *(Ref: 31–34)*				1.28 (0.92–1.77)	1.59 (0.76–3.31)	1.26 (0.84–1.88)
Gender (Ref: Female)						
Male	**1.64 (1.04–2.58)**			1.04 (0.67–1.61)		
Sexual Orientation (Ref: Heterosexual)						
Lesbian, gay, bisexual, other				1.08 (0.55–2.13)	1.68 (0.76–3.72)	0.44 (0.15–1.28)
Education (Ref: Bachelor's or advanced degree)						
Less than high School or GED	**3.27 (1.37–7.81)**	6.69 (0.88–50.64)	2.91 (0.90–9.38)			
High school graduate	2.32 (0.98–5.47)	1.82 (0.30–11.22)	**3.24 (1.06–9.83)**			
Some college or associate's degree	1.96 (0.88–4.35)	2.31 (0.41–13.24)	2.03 (0.72–5.75)			
Household income (Ref: $75,000)						
<$25,000	1.30 (0.68–2.49)	1.63 (0.40–6.70)	1.15 (0.51–2.60)	1.43 (0.92–2.22)	1.63 (0.40–6.70)	1.40 (0.87–2.28)
$25,000 to $74,999	1.21 (0.60–2.42)	2.03 (0.41–9.91)	0.95 (0.42–2.13)	1.36 (0.85–2.18)	2.03 (0.41–9.91)	1.48 (0.90–2.42)
U.S Census region (Ref: Northeast)						
Midwest	1.05 (0.51–2.17)	1.21 (0.37–4.01)	1.27 (0.44–3.70)	1.57 (0.99–2.48)	1.85 (0.91–3.78)	1.45 (0.77–2.71)
South	**2.40 (1.11–5.19)**	3.32 (0.86–12.90)	2.59 (0.90–7.44)	**1.94 (1.31–2.89)**	**2.43 (1.04–5.63)**	1.76 (0.98–3.15)
West	1.68 (0.72–3.88)	1.97 (0.47–8.27)	1.58 (0.50–4.99)	1.22 (0.76–1.95)	1.95 (0.70–5.43)	1.05 (0.58–1.90)
Race/Ethnicity[a] (Ref: Non-Hispanic White)						
Non-Hispanic Black				0.91 (0.54–1.54)	0.48 (0.22–1.07)	1.19 (0.56–2.53)
Other				1.48 (0.72–3.06)	0.51 (0.12–2.28)	2.01 (0.90–4.47)
Hispanic				0.85 (0.56–1.28)	0.45 (0.19–1.08)	1.05 (0.66–1.69)

	18-24 years			25-34 years		
	Overall Adjusted OR (95% CI)	Females Adjusted OR (95% CI)	Males Adjusted OR (95% CI)	Overall Adjusted OR (95% CI)	Females Adjusted OR (95% CI)	Males Adjusted OR (95% CI)
Perception of health (Ref: Fair/Poor)						
Excellent	1.35 (0.50–3.65)	1.48 (0.17–12.8)	0.97 (0.20–4.68)			
Very good	1.16 (0.55–2.45)	3.74 (0.97–14.41)	0.53 (0.13–2.15)			
Good	0.98 (0.45–2.11)	1.12 (0.37–3.41)	0.75 (0.19–3.03)			
Tobacco-related variables						
Tobacco comes in flavor I like (Ref: No)						
Yes	1.05 (0.64–1.73)	1.47 (0.57–3.74)	0.91 (0.44–1.48)	**0.73 (0.54–0.99)**	0.62 (0.28–1.35)	0.91 (0.44–1.48)
Age at First exposure to tobacco product (y) (Ref: <18)						
18–24				**2.36 (1.19–4.66)**	3.30 (0.77–14.21)	2.12 (0.97–4.62)
25–34				**3.71 (1.89–7.31)**	**4.96 (1.10–22.48)**	**3.57 (1.70–7.53)**
Quit attempt (Ref: 0)						
1	2.05 (0.93–4.55)	2.62 (0.64–10.78)	1.85 (0.77–4.45)	**0.73 (0.54–0.99)**	0.62 (0.28–1.35)	0.91 (0.44–1.48)
2	**2.49 (1.22–5.09)**	2.92 (0.72–11.90)	2.32 (0.94–5.71)			
3	**3.72 (1.90–7.27)**	3.32 (0.83–13.19)	**5.01 (1.97–12.73)**			
Substance use variables						
Heavy drinking (Ref: No)						
Yes	**1.75 (1.07–2.86)**	1.67 (0.82–3.42)	**1.94 (1.00–3.77)**	1.14 (0.81–1.62)	1.02 (0.51–2.05)	1.15 (0.77–1.73)
High-risk drinking (Ref: No)						
Yes	1.18 (0.76–1.85)	1.28 (0.62–2.66)	1.16 (0.64–2.08)			
Marijuana within the past 30 days (Ref: No)						
Yes	**1.70 (1.05–2.75)**	1.25 (0.57–2.76)	**2.25 (1.22–4.14)**	**2.63 (1.89–3.65)**	**4.46 (2.18–9.13)**	**2.31 (1.53–3.48)**

Note: PATH = Population Assessment of Tobacco and Health, OR= odds ratios, CI = confidence interval.

Bold numbers represent P < 0.05.

¶Odds ratios were calculated using multiple logistic regression and adjusted for survey weights and all variables.

[a] Other indicates Non-Hispanic American Indian or Alaska Native, Non-Hispanic Asian/Native Hawaiian or Other Pacific Islander and persons with multiple races