



Commentary

Patterns and Correlates of Multiple Tobacco Product Use in the United States

Cassandra A. Stanton PhD^{1,2}, Michael J. Halenar MPH¹

¹Westat, Rockville, MD; ²Department of Oncology, Georgetown University Medical Center, Washington, DC

Corresponding Author: Cassandra A. Stanton, PhD, Senior Epidemiologist, Westat, Associate Professor (Adjunct), Department of Oncology, Georgetown University Medical Center, 1600 Research Boulevard, Rockville, MD 20850, USA; E-mail: CassandraStanton@Westat.com

The emergence of new tobacco products in the marketplace over the past several years has contributed to changing patterns of tobacco use in the United States (US). Approximately 40% of youth and adult tobacco users in the US used multiple tobacco products (polytobacco use) in 2013–2014.¹ Diverse factors associated with polytobacco use in the US include younger age, male sex, lower levels of educational attainment, binge-drinking, prior quit attempts, later onset of first tobacco use, first use of tobacco being a noncombustible tobacco product, and high sensation-seeking.^{2–6} Different factors may be associated with different polytobacco use patterns, as suggested by an analysis of 2012 National Youth Tobacco Survey (NYTS) data that found that as the number of tobacco products used increased, nicotine dependence and perceived peer tobacco use increased and quit intentions decreased.⁷ Some combinations of tobacco product use may be driven by addiction or experimentation, whereas other combinations, such as cigarettes with electronic nicotine delivery systems (ENDS) or smokeless tobacco, may reflect partial substitution of cigarettes with another product perceived as less harmful or as a tool for circumventing smoke free laws.⁷

Although studies are reporting high rates of concurrent use of multiple products and increasing rates for some product combinations,^{1–7} there are gaps in our understanding of the implications of polytobacco use on dependence, exposure to tobacco toxicants, and subsequent health consequences. Polytobacco users have been shown to have higher levels of nicotine dependence than nonusers or single product users.^{7–9} In a study of nicotine dependence among US adults drawing from the Population Assessment of Tobacco and Health (PATH) Study, high nicotine dependence was two to three times more likely among polytobacco users relative to dual and single product users.⁹ Analyses of data from the National Health and Nutrition Examination Survey (NHANES) have yielded varied associations with biomarkers of exposure to tobacco toxicants that are dependent on type and quantity of tobacco products used.¹⁰ Studies in this area are equivocal with results from another NHANES study suggesting that dual cigar/cigarette smokers may have higher levels of cotinine and biomarkers of harm than cigar-only users, but slightly

lower levels than cigarette only users.¹¹ Another study reported that cigarette plus other tobacco product users had lower nicotine and carcinogen levels relative to exclusive cigarette smokers.¹² These conflicting results suggest that additional research is needed to better understand how the frequency of use and type of products that are being dual and poly used may impact associations with levels of biomarkers of nicotine and exposure to carcinogens.

The focus of this themed issue is on understanding polytobacco use and its implications for perceptions, use, dependence, appeal, and toxicity that may inform tobacco regulation. The 2009 Tobacco Control Act (TCA)¹³ gave the US Food and Drug Administration (FDA) authority to regulate tobacco product manufacturing, distribution, and marketing, which immediately applied to cigarettes, cigarette tobacco, roll-your-own, and smokeless tobacco. Effective August 8, 2016,¹⁴ the FDA extended the TCA to include ENDS (inclusive of e-cigarettes and vape pens), all cigars (cigarillos, filtered cigars, and traditional cigars), hookah and pipe tobacco, nicotine gels, dissolubles not already under the FDA's authority, and future products that meet the definition of a tobacco product. With this regulatory authority, research interest areas important to tobacco product regulation have become a priority, such as understanding the effect of tobacco product characteristics on addiction and abuse liability, understanding the short- and long-term health effects of tobacco products, and understanding the knowledge, attitudes, and behaviors related to tobacco product use and changes in tobacco product characteristics.¹⁵ This preamble provides an integrated synthesis of the studies included in this special issue and potential implications of findings from these studies for advancing tobacco regulatory science.

Knowledge, Attitudes, and Behaviors

Among studies examining knowledge, attitudes, and behaviors (KAB), an overarching theme is the transient nature of tobacco product use among youth and young adults. In this special issue, Antognoli et al. used qualitative methods to examine and compare current little cigars/cigarillos (LCC)-only users and LCC/cigarette

users (aged 14–28 years) and identified immediate craving reduction as a key reason for LCC users to smoke a cigarette, whereas social and financial reasons were important for cigarette users to smoke a LCC.¹⁶ Mead et al. used ecological momentary assessments to investigate reasons for dual use of cigarettes and cigars among African American young adults.¹⁷ The authors found that cigars and cigarettes are smoked additively, rather than by substitution. Moreover, cigars (used exclusively or with cigarettes) are more likely to be used with others and inside others' homes, whereas cigarettes are more likely to be smoked while alone.¹⁷ Studying youth in North Carolina (NC), Osman et al. found variation in single, dual, and polytobacco use by race/ethnicity over three time points from 2011 to 2015, including variation in the types of tobacco products and combinations used.¹⁸ White and Hispanic youth were found to have higher relative risk for dual and polytobacco use than Black youth; and although types of tobacco products used varied by year and race, in 2015 e-cigarettes were the most commonly used product among single product users from all racial groups in this NC youth sample.¹⁸

Studies on youth also aimed to identify different tobacco product use patterns and characterize the risk profiles of adolescents. Cho et al. followed California high school students in a five-wave longitudinal survey and identified three profiles: (1) tobacco nonusers; (2) polyproduct users with moderate tobacco use prevalence who showed an escalating prevalence of combustible cigarette use but decreasing trajectories of e-cigarette and hookah use; and (3) chronic polyproduct users with the highest prevalence of all tobacco use over time who showed escalating trajectories of combustible cigarette and e-cigarette use.¹⁹ Compared with tobacco nonusers, both polytobacco use groups were associated with increased levels of alcohol, marijuana, and illicit drugs use as well as severity of depression, anxiety, and ADHD.¹⁹ Sutter et al. analyzed weighted data from the 2013 Virginia Youth Survey and identified five classes of use ("Chippers"—low frequency cigarette use, "Moderate Poly-Users," "Cigar Users," "Smokeless Tobacco (ST) Users," and "Heavy Poly-Users"—daily cigarette use, moderate-high probability ST/cigar use) that differed significantly by demographics but not consistently by other tobacco-related factors.²⁰ Heavy Poly-Users were more likely to engage in other substance use, report suicidal ideation, and report being bullied due to gender.²⁰

Using data from the 2011–2015 National Youth Tobacco Survey (NYTS) and corresponding years of the Truth Initiative Young Adult Cohort Study (TIYAC), Johnson et al. reported the most common patterns of past 30-day nicotine and tobacco use over a 5-year period.²¹ Among youth, exclusive cigarette use, exclusive cigar use, exclusive e-cigarette use, dual use of cigarettes and cigars, and exclusive hookah use were the top five patterns.²¹ Young adult top five patterns were similar to youth (exclusive cigarette use, exclusive cigar use, dual use of cigarettes and cigars, exclusive hookah use, and dual use of cigarettes and e-cigarettes).²¹ Adding to the youth studies in this special issue that identified distinct patterns of polytobacco use, Mantey et al. analyzed correlates of different youth patterns using the 2014 NYTS that revealed product marketing exposure was significantly associated with a greater relative risk of dual and polytobacco use, relative to single product use.²² The magnitude of the positive relationship between cumulative tobacco product marketing exposure and number of tobacco products grew from single product to dual/polytobacco use.²² Emerging evidence highlighted in this special issue provides insight into correlates of polytobacco use that should be considered when developing prevention messages and interventions for addressing different tobacco products and use patterns.

Among two studies examining adult patterns of polytobacco use in this special issue, Jones et al. compared dual smokeless and cigarette users with exclusive cigarette smokers using nationally representative data from 2015 to 2016 and found that cigarette smokers who use smokeless are more likely than exclusive smokers to attempt to quit smoking cigarettes using other tobacco products.²³ Kurti et al. analyzed PATH Study data (Waves 1 and 2) to examine how patterns of tobacco product use change among reproductive-aged women over time and when transitioning either into or out of pregnancy.²⁴ Results indicated that, regardless of pregnancy status, patterns of use involving more products were less stable over time, with dual and poly users generally dropping rather than adding products across waves.²⁴ This study also identified that for all women, regardless of pregnancy status, cigarettes were the most common product used and that the majority of polytobacco use included cigarettes plus at least one additional product, with women generally discarding the alternative tobacco product over time and continuing to smoke conventional tobacco cigarettes.²⁴

Addiction and Toxicity

Research is needed to inform our understanding of how tobacco products and changes to tobacco product characteristics affect their potential to cause addiction and subsequent morbidity and mortality. Another group of papers in this special issue focuses on issues of addiction and toxicity within polytobacco use. Analyzing Wave 1 PATH Study data, Kypriotakis et al. performed Latent Class Analysis (LCA) to identify four patterns of tobacco use and examined the association between these patterns with a set of covariates representing socioeconomic status, dependence/addiction, past quit attempts, and withdrawal severity.²⁵ Results showed that exclusive cigarette users were more likely to be older and female, and experience higher dependence and greater withdrawal symptoms.²⁵ In contrast, users of e-cigarettes and hookah were the youngest and most educated of all four use groups and showed the lowest dependency and least withdrawal symptoms.²⁵ Sung et al. analyzed patterns of tobacco use and dependence items from 2012 to 2013 and 2013 to 2014 of the National Adult Tobacco Surveys and found that after controlling for frequency of use and demographic covariates, dependence ratings were higher among polytobacco users compared with exclusive tobacco users and this finding was consistent across all symptom measures for each category of tobacco user.²⁶ Focusing on the products themselves, Reilly et al. examined two brands each of little cigars and filtered cigars, as well as two research cigarettes for carbonyl delivery and found that cigar smokers are exposed to higher levels of carbonyls per cigar than cigarette smokers per cigarette.²⁷ These data advance an understanding of the potential relative harm from carbonyl exposure for cigar-only smokers and the cumulative harm among the population of cigarette-cigar polytobacco users.²⁷

Summary and Implications

The population health impact of polytobacco use is unknown as researchers are still grappling with how to accurately measure and understand different and dynamic patterns of use across products and the associated health impacts. Of the 12 papers in this issue, 6 of the papers defined polytobacco use simply as any use of two or more tobacco products within the past 30 days.^{18, 20-23, 26} Four other papers used different time-based ranges, one looking at past-week cigarillo and cigarette use,¹⁶ one looking at past 6-month use of cigarettes, e-cigarettes, and hookah,¹⁹ and the

other two papers defined polytobacco use as currently using more than one product every day or some days.^{24,25} The remaining two papers do not fit into these categories as one does not define use because they studied the products themselves²⁷ and the other used ecological momentary assessment methods to assess frequency (days smoked) and amount (products smoked per day).¹⁷ As definitions and analytic approaches evolve, results across studies should reveal whether definitions such as concurrent past 30-day use are the most appropriate measures to fully understand the impact of polytobacco use on nicotine dependence, smoking cessation, individual-level health effects, and net population health impact.

Across these studies, the growing prevalence of polytobacco use is noteworthy, with patterns of use and psychosocial predictors dependent on age group and the specific products being used within the same time period. Many gaps remain in what is known about the consequences of multiple tobacco product use on short- and long-term health effects. The same is true concerning abuse liability as the availability and appeal of a wide variety of products may assist smokers in avoiding bans and deter cessation or may provide access to noncombusted forms of nicotine that offer potentially less harmful exposure than combustible tobacco. Although studies in this area are elucidating patterns of polytobacco product use, research is needed to better understand how the intensity and frequency of each product used in a polytobacco use combination is associated with behavioral outcomes. Analytic approaches that take into account varying patterns and types of polytobacco use may provide valuable insight into the ways consumers are using multiple tobacco products to indulge curiosity, maintain addiction, or substitute products for perceived harm reduction or smoking cessation. Attention to these complex associations in the current dynamic tobacco marketplace will advance tobacco regulatory science and accumulate robust empirical evidence on the public health impact of polytobacco use.

Funding

This special issue and Dr. Stanton and Mr. Halenar's effort on this project were supported by the Center for Evaluation and Coordination of Training and Research award (5U54CA189222) from the National Cancer Institute and the U.S. Food and Drug Administration. The content of this paper is solely the responsibility of the authors and does not necessarily represent the official views of Westat, the National Institutes of Health, or the U.S. Food and Drug Administration..

Declaration of Interests

None declared.

Acknowledgments

The authors acknowledge and appreciate Rachel Grana Mayne, PhD, MPH for her support in assembling this collection of studies and her feedback on the preparation of this preamble. Additional gratitude is extended to Miriam Galbraith, MPH for coordination and administrative support compiling this special issue.

Supplement Sponsorship

This supplement was sponsored by the Center for the Evaluation and Coordination of Training and Research for Tobacco Regulatory Science (5U54CA189222).

References

1. Kasza KA, Ambrose BK, Conway KP, et al. Tobacco-product use by adults and youths in the United States in 2013 and 2014. *N Engl J Med*. 2017;376(4):342–353.
2. 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;62:14–19.
3. 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(4):768–781.
4. Sung HY, Wang Y, Yao T, Lightwood J, Max W. Polytobacco use of cigarettes, cigars, chewing tobacco, and snuff among US adults. *Nicotine Tob Res*. 2016;18(5):817–826.
5. Huh J, Leventhal AM. Progression of polytobacco product use patterns in adolescents. *Am J Prev Med*. 2016;51(4):513–517.
6. Soneji S, Sargent J, Tanski S. Multiple tobacco product use among US adolescents and young adults. *Tob Control*. 2016;25(2):174–180.
7. Ali M, Gray TR, Martinez DJ, Curry LE, Horn KA. Risk profiles of youth single, dual, and poly tobacco users. *Nicotine Tob Res*. 2016;18(7):1614–1621.
8. Apelberg BJ, Corey CG, Hoffman AC, et al. Symptoms of tobacco dependence among middle and high school tobacco users: Results from the 2012 National Youth Tobacco Survey. *Am J Prev Med*. 2014;47(2 Suppl 1):S4–14.
9. Strong DR, Pearson J, Ehlke S, et al. Indicators of dependence for different types of tobacco product users: Descriptive findings from Wave 1 (2013–2014) of the Population Assessment of Tobacco and Health (PATH) Study. *Drug Alcohol Depend*. 2017;178:257–266.
10. Choi K, Sabado M, El-Toukhy S, Vogtmann E, Freedman ND, Hatsukami D. Tobacco product use patterns, and nicotine and tobacco-specific nitrosamine exposure: NHANES 1999–2012. *Cancer Epidemiol Prev Biomark*. 2017;26(10):1525–1530.
11. Chen J, Kettermann A, Rostron BL, Day HR. Biomarkers of exposure among US cigar smokers: An analysis of 1999–2012 National Health and Nutrition Examination Survey (NHANES) data. *Cancer Epidemiol Prev Biomark*. 2014;23(12), 2906–2915.
12. Nollen NL, Mayo MS, Clark L, et al. Tobacco toxicant exposure in cigarette smokers who use or do not use other tobacco products. *Drug Alcohol Depend*. 2017;179, 330–336.
13. *Family Smoking Prevention and Tobacco Control Act*, Public Law 111-31, 123 U.S. Statutes at Large 1776, 2009.
14. Food and Drug Administration (HHS). Deeming tobacco products to be subject to the Federal Food, Drug, and Cosmetic Act, as amended by the Family Smoking Prevention and Tobacco Control Act; restrictions on the sale and distribution of tobacco products and required warning statements for tobacco products. Final rule. *Federal register*. 2016;81(90):28973.
15. Food and Drug Administration (HHS). Research Priorities. 2018. <https://www.fda.gov/TobaccoProducts/PublicHealthScienceResearch/Research/ucm311860.htm>. Accessed March 7, 2018.
16. Antognoli E, Gonzalez SK, Trapl E, Cavallo D, Lavanty B, Lim R, Flocke S. Cigarettes, little cigars and cigarillos: Initiation, motivation and decision-making. *Nicotine Tob Res*. 2018;20(Suppl.1):S5–S11.
17. Mead EL, Cen Chen J, Kirchner TR, Butler III J, Feldman R. An ecological momentary assessment of cigarette and cigar dual use among African American young adults. *Nicotine Tob Res*. 2018;20(Suppl.1):S12–S21.
18. Osman A, Kowitz SD, Ranney LM, Heck C, Goldstein AO. Trends and racial disparities in mono, dual, and poly use of tobacco products among youth. *Nicotine Tob Res*. 2018;20(Suppl.1):S22–S30.
19. Cho J, Goldenson NI, Stone MD, McConnell R, Barrington-Trimis JL, Chou C-P, Sussman SY, Riggs NR, Leventhal AM. Characterizing polytobacco use trajectories and their associations with substance use and mental health across mid-adolescence. *Nicotine Tob Res*. 2018;20(Suppl.1):S31–S38.
20. Sutter ME, Everhart RS, Miadich S, Rudy AK, Nasim A, Cobb CO. Patterns and profiles of adolescent tobacco users: Results from the Virginia Youth Survey. *Nicotine Tob Res*. 2018;20(Suppl.1):S39–S47.

21. Johnson AL, Collins LK, Villanti AC, Pearson JL, Niaura RS. Patterns of nicotine and tobacco product use in youth and young adults in the United States, 2011–2015. *Nicotine Tob Res.* 2018;20(Supp.1):S48–S54.
22. Mantey DS, Creamer MR, Pasch KE, Perry CL. Marketing exposure recall is associated with past 30-day single, dual, polytobacco use among U.S. adolescents. *Nicotine Tob Res.* 2018;20(Supp.1):S55–S61.
23. Jones DM, Popova L, Weaver SR, Pechacek TF, Eriksen MP. A national comparison of dual users of smokeless tobacco and cigarettes and exclusive cigarette smokers, 2015–2016. *Nicotine Tob Res.* 2018;20(Supp.1):S62–S70.
24. Kurti AN, Bunn JY, Villanti AC, Stanton CA, Redner R, Lopez AA, Gaalema DE, Doogan NJ, Cepeda-Benito A, Roberts ME, Phillips JK, Quisenberry AJ, Keith DR, Higgins ST. Patterns of single and multiple tobacco product use among u.s. women of reproductive age. *Nicotine Tob Res.* 2018;20(Supp.1):S71–S80.
25. Kypriotakis G, Robinson JD, Green CE, Cinciripini PM. Patterns of tobacco product use and correlates among adults in the Population Assessment of Tobacco and Health (PATH) Study: A latent class analysis. *Nicotine Tob Res.* 2018;20(Supp.1):S81–S87.
26. Sung H-Y, Wang Y, Yao T, Lightwood J, Max W. Polytobacco use and nicotine dependence symptoms among US adults, 2012–2014. *Nicotine Tob Res.* 2018;20(Supp.1):S88–S98.
27. Reilly SM, Goel R, Bitzer Z, Elias RJ, Foulds J, Muscat J, Richie Jr JP. Little cigars, filtered cigars, and their carbonyl delivery relative to cigarettes. *Nicotine Tob Res.* 2018;20(Supp.1):S99–S106.