Progression of Poly-tobacco Product Use Patterns in Adolescents

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Introduction: Diverse patterns of adolescent use and poly-use of tobacco products other than conventional cigarettes are emerging. Data characterizing common patterns of youth tobacco product use and typical transitions among patterns may inform tobacco control policy and prevention. This study identified common patterns of use and poly-use of five popular tobacco products (i.e., conventional cigarettes, electronic [e-]cigarettes, hookah, blunts, and cigars) and progression among patterns across time among ninth-graders using latent transition analysis (analyses conducted in 2015).

Methods: Data were from a longitudinal cohort study of ninth-grade students enrolled in ten public high schools in California (N=3,304; 46.6% male; 48.3% Hispanic; mean age, 14.58 [SD=0.40] years), involving a baseline (2013) and 6-month follow-up (2014). Past 6–month any use of the five tobacco products was assessed.

Results: Poly-use (two or more products) constituted 42% and 50% of tobacco-using teens at baseline and follow-up, respectively. Three common patterns were identified, which reflected successfully greater degrees of low, intermediate, and high diversity of tobacco product use: non-users (baseline prevalence, 0.75; follow-up prevalence, 0.64); e-cigarette/hookah users only (prevalence, 0.21, 0.27); and poly-tobacco product users of all five products (prevalence, 0.04, 0.09). Most typical transitions involved progressing to the next more diverse pattern (non-user → e-cigarette/hookah user [probability=0.13] and e-cigarette/hookah user → poly-tobacco product user [probability=0.19]). Transition from one of the user patterns to non-user status was rare (probability ≤ 0.08).

Conclusions: Adolescent poly-tobacco use is common. E-cigarette and hookah use may reflect an intermediate pattern of tobacco product use progression along a continuum of poly-product use diversity.

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Introduction

Recent epidemiologic surveys estimate that electronic (e-)cigarettes (13.4%) are the most commonly used tobacco product in U.S. adolescents in the past 30 days, followed by hookah (9.4%); cigarettes (9.2%); and cigars (8.2%),[1,2] and poly-tobacco users of two or more products are common (12.7%).[1] Blunts (i.e., marijuana rolled in tobacco)[3] are also rising in popularity among adolescents,[4] particularly among users of other tobacco products.[5]

Prior prevalence estimates of use/co-use have primarily examined pairings of two products at a time and suggest numerous configurations of associations among multiple tobacco products.[6–8] The countless configurations of poly-product use and transitions from one use pattern to another pose challenges for setting priorities for tobacco control policy. Identifying a more parsimonious model that characterizes the most typical patterns of use and progression is needed to highlight whether:

1. single or poly-product tobacco prevention campaigns are warranted and for which products; and
2. certain patterns of use are associated with increased risk of progression to more diverse and harmful

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patterns of poly-tobacco use and therefore warrant increased surveillance and intervention.

In this longitudinal study, tobacco product use was surveyed among teens at the beginning and end of ninth grade. An innovative statistical modeling strategy (latent transition analysis [LTA][9]) was applied to:

1. identify common patterns of use and poly-use of five popular tobacco products; and
2. investigate progression from one pattern to another in 6 months.

Methods

Data were drawn from a longitudinal survey of 3,396 ninth-graders enrolled in ten public high schools in Southern California (46.6% male; 48.3% Hispanic; mean age, 14.58 [SD=0.40] years). Participants with missing data at both waves (n=7) were excluded from the final analytic sample (N=3,389). On-site paper-and-pencil surveys during fall 2013 (baseline) and spring 2014 (follow-up) were conducted. The University of Southern California IRB approved the study.

Measure of Tobacco Product Use

At each wave, items based on the national Monitoring the Future[1] assessed past 6–month any use (yes/no) of:

1. conventional cigarettes (at least one puff);
2. e-cigarettes;
3. hookah (tobacco water pipe);
4. blunts (marijuana rolled in tobacco leaf); and
5. cigars (big/little cigars or cigarillos).

Analytic Strategy

This study used LTA to identify the most parsimonious set of groupings (i.e., latent statuses) of use and co-use among the five tobacco products and transitions from one status at baseline to another status at follow-up without sacrificing meaningful explanatory power.[9–11] Three sets of parameters are estimated in LTA: item–response probabilities (probability of endorsing an item conditional on latent status membership), latent status membership prevalence (proportion of the population belonging to a latent status), and transitional probabilities (probabilities that members belonging to a particular latent status at baseline transition to another latent status at follow-up).[9] The final model was conducted using Mplus, version 7.31 in which maximum likelihood estimation method was used to yield model-based estimates, adjusting for the potential cluster effects of schools. Model fit was determined by evaluating log likelihood, Akaike Information Criterion, and Bayesian Information Criterion. Analyses were conducted in 2015.

Results

E-cigarette use was most common (baseline, 13%; follow-up, 21%) followed by hookah (10%, 14%) and the other products (Table 1). Correlations between use of each of the tobacco products within and across time points varied widely (r=0.16–0.46, Table 1). Poly-tobacco product use constituted 42% (baseline) and 52% (follow-up) of all tobacco product users (Table 2).

Table 1. Prevalence and Bivariate Correlation Among Covariates and Past 6–Month Tobacco Product Use at Baseline and 6-Month Follow-Up[a]

		Correlations (r)								
Variable	**Prevalence (%)**	**1.**	**2.[b]**	**3.[b]**	**4.[b]**	**5.[b]**	**6.[b]**	**7.[b]**	**8.[b]**	**9.[b]**
Use at baseline										
1. Conventional cigarette	3.6									
2. E-cigarette	12.9	**0.29**								
3. Hookah	9.5	**0.23**	**0.37**							
4. Blunt	6.6	**0.38**	**0.41**	**0.41**						
5. Cigar	2.3	**0.47**	**0.26**	**0.40**	**0.40**					
Use at 6-month follow-up										
6. Conventional cigarette	8.3	**0.29**	**0.21**	**0.22**	**0.16**	**0.16**				
7. E-cigarette	20.6	**0.19**	**0.27**	**0.23**	**0.16**	**0.33**	**0.33**			
8. Hookah	13.5	**0.18**	**0.36**	**0.24**	**0.16**	**0.30**	**0.42**	**0.42**		
9. Blunt	10.4	**0.27**	**0.31**	**0.42**	**0.22**	**0.39**	**0.38**	**0.40**	**0.40**	
10. Cigar	4.5	**0.22**	**0.21**	**0.27**	**0.29**	**0.46**	**0.32**	**0.30**	**0.40**	**0.40**

Note: Boldface indicates statistical significance ($p<0.001$).
[a]Ns range from 3,111 to 3,323, depending on bivariate pairings.
[b]These numbers correspond to the tobacco product use at each time point denoted on each row.