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Patterns of Alternative Tobacco Product Use: Emergence of Hookah and E-cigarettes as Preferred Products Amongst Youth

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A B S T R A C T

Purpose: There is a growing public health concern related to the rapid increase in the use of multiple tobacco products among adolescents. This study examined patterns of adolescent use of cigarettes, e-cigarettes, cigars/cigarillo, hookah/waterpipe, and smokeless/dip/chewing tobacco in a population of southern California adolescents.

Methods: Data from 2,097 11th- and 12th-grade participants in the Southern California Children's Health Study were collected via self-report in 2014. Study participants were asked about lifetime and current (past 30 days) use of cigarettes, cigars/cigarillos/little cigars, e-cigarettes, hookah/waterpipe, and smokeless/dip/chewing tobacco. Latent class analysis (LCA) was used to identify patterns of tobacco use.

Results: Hookah/waterpipe tobacco use had the highest current prevalence (10.7%) followed by e-cigarettes (9.6%). The prevalence of use of smokeless/dip/chewing tobacco was lowest, with 2.2% of adolescents reporting current use. The LCA suggested four distinct classes, comprising nonusers (72.3% of the sample), polytobacco experimenters (13.9%), e-cigarette/hookah users (8.2%), and polytobacco users (5.6%). Multinomial logistic regression based on these four classes found that males had double the odds to be polytobacco users relative to nonusers compared to females (odds ratio, 2.3; 95% confidence interval, 1.26–4.25).

Conclusions: By identifying naturally occurring configurations of tobacco product use in teens, these findings may be useful to practitioners and policymakers to identify the need for tobacco control interventions that address specific tobacco products and particular combinations of polytobacco use. LCA can be used to identify segments of the population overrepresented among certain tobacco use classes (e.g., boys) that may benefit most from targeted polyproduct intervention approaches.

IMPLICATIONS AND CONTRIBUTION

Recent research shows a substantial increase in alternative tobacco product use. Use of these products may have significant health implications for youth, although little is known about youth polytobacco use behaviors. To fill this gap, this study examines patterns of polytobacco use among high school–aged adolescents across five products.

There is a growing public health concern related to the rapid increase in the use of multiple tobacco products among adolescents, including traditional tobacco products such as combustible cigarettes and smokeless tobacco and emerging products such as e-cigarettes and hookah/waterpipes (hereafter referred to as polytobacco use). Over the past two decades, there have been

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documented increases in cigar/cigarillo, e-cigarette, and hookah/waterpipe use among youth and young adults [1–4]. The popularity of e-cigarettes, small cigars, and hookah among adolescents can be traced to the marketing of such products with flavorings appealing to youth [5–7], perceptions of public acceptability of e-cigarette and hookah use [5], and beliefs that these products cause less harm than conventional tobacco products (e.g., combustible cigarettes) [8,9]. Because the marketplace provides a variety of traditional tobacco products (cigarettes, cigars, smokeless tobacco) and alternative tobacco products (e-cigs and hookah) that are popular among adolescents, it is not surprising that relatively high rates of current (past 30 days) polytobacco product use have been reported. Data from the 2014 National Youth Tobacco Survey showed that 12.5% of the U.S. high school students had used two or more tobacco products in the past 30 days [3].

Beyond epidemiology, a detailed examination of the patterns of use of multiple tobacco products is important to begin identifying social determinants of particular patterns and assessing health effects of tobacco products used in different combinations. There is variation in the amount of nicotine and other potentially harmful ingredients contained in tobacco products and differences in how products are used (this includes how often and quantity consumed) that lead to the expectation of differences in nicotine dependence potential and toxicity across products [10]. In addition to differences in addiction potential, little is known about the true harm potential of alternate products (hookah and e-cigarettes) relative to combustible cigarettes [5]. For example, there is research that suggests one hookah session could be the equivalent of toxicant exposure of smoking 1 to 50 cigarettes [6]. Furthermore, Eissenberg et al. [11] found that hookah produced a significantly higher carbon monoxide exposure while delivering the same amount of nicotine in a laboratory-controlled experiment compared to cigarettes. Assessments of the harm potential of e-cigarettes are also limited. The e-liquids available for e-cigarettes have a wide variation in nicotine content, and the amount of nicotine in many vials could be fatal if ingested orally or transdermally [12]. Recent studies indicate that e-cigarettes may be less harmful than combustible cigarettes [13,14].

Furthermore, among traditional tobacco products, there may be a perception that flavored and/or small cigar use may be safer than cigarette use based on anticipated usage patterns (nondaily use or fewer cigars smoked than cigarettes) [1]. In addition, hookah and e-cigarette use is not as widely banned as combustible product use, and there are specialized lounges/bars/shops for the use of e-cigarettes, hookah, and cigars which might encourage their use in social situations among youth [5,15]. Thus, the present tobacco use landscape gives cause for concerns about the actual health risk exposure of newer products, perceptions of risk of older products with resurgence in use due to the addition of flavoring, and the health effects of multiple product use.

Methodologically, understanding the patterns of polytobacco use across the five most popular products (cigarettes, e-cigarettes, hookah, cigars, and smokeless tobacco) is challenging using an ad hoc or variable-centered approach to grouping patterns of use. Latent class analysis (LCA) is a person-centered method for identifying homogeneous subgroups of people based on response characteristics, such as likelihood of using individual tobacco products, within a heterogeneous population [16–18]. Instead of subgrouping all possible unitobacco and polytobacco use, LCA can identify a parsimonious set of groupings while accounting for measurement error. In the present study, LCA was used to identify patterns of adolescent use of cigarettes, e-cigarettes, cigars/cigarillo, hookah/waterpipe, and smokeless/dip/chewing tobacco in a population of southern California adolescents enrolled in the Southern California Children's Health Study (CHS). Impacts of different risk factors associated with subgroups (race and gender) suggested by LCA were also investigated using multinomial logistic regression analysis.

Methods

In 2014, data were collected from a cohort of 2,097 11th- and 12th-grade participants in the CHS, who were originally enrolled in 2002–2003 (in kindergarten and first grade) [19,20]. The response rate for this wave and cohort was 87%. The design of the CHS for this cohort was based upon the selection of 12 communities in southern California and recruitment of a representative sample (representative of the community) of youth from schools. Self-administered questionnaires were completed at school under study staff supervision. Of 2,097 respondents, 2,091 were included in the final analysis (6 were missing data on all five tobacco products). The study was approved by the University of Southern California Institutional Review Board. Written parental informed consent and student assent were obtained before data collection; students who were aged $\geq$18 years provided their own written consent.

Tobacco product use assessment

Study participants were asked about age of initiation and current (past 30 days) use of cigarettes, cigars/cigarillos/little cigars, e-cigarettes, hookah/waterpipe, and smokeless/dip/chewing tobacco. To initially determine level of use of each product, participants were asked their age at the first use for each product, and those who indicated they had never used the product in question were coded as never users. Adolescents who provided an age of first use but no use in the past 30 days were classified as ever/lifetime users. Participants who reported current product use were classified as current users of that product. Thus, a variable with three levels (never, ever/lifetime, and current) was created individually for each of the five products (cigarettes, cigars/cigarillos/little cigars, electronic or e-cigarettes, smoking tobacco from a hookah/waterpipe, and smokeless/dip/chewing tobacco).

Analysis

LCA was conducted using Mplus 7.3 [21,22]. Models were run to determine the appropriate number of classes starting with a one-class model followed by a series of models specifying increased number of classes (e.g., two-class, three-class, etc.) representing different patterns of tobacco product use. Optimal model selection was based upon recommended indices including selecting the model with the lowest Akaike Information Criterion and adjusted Bayesian Information Criterion relative to other models and highest entropy/quality of classification (likelihood that respondents are classified in the correct class) [23].

Multinomial logistic regression analyses were conducted using the three-step method available in Mplus [24]. First, the appropriate number of latent classes are identified using the five tobacco use variables. Subsequently, the most likely class membership is identified and finally used in a multinomial logistic model controlling for the error/misclassification in class