



## Hookah use as a predictor of other tobacco product use: A longitudinal analysis of Texas college students



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### HIGHLIGHTS

- Few studies have examined hookah use as a predictor of other tobacco product use.
- Hookah use predicted the subsequent initiation of other combustible tobacco products.
- Hookah use predicted subsequent initiation of ENDS among Texas college students.
- Hookah may prime individuals to use tobacco products, including emergent products.

### ARTICLE INFO

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### ABSTRACT

**Introduction:** Hookah use is particularly prevalent among U.S. college students; however, few studies have investigated whether hookah use is a risk factor for the initiation of other tobacco products. This study examined whether hookah use predicted subsequent initiation of other combustible tobacco products (conventional cigarettes and cigar products) and Electronic Nicotine Delivery Systems (ENDS) among Texas college students during a 2.5-year study period.

**Methods:** This study involved a longitudinal analysis of data from Waves 1–6, with 6 months between each wave, of the Marketing and Promotions Across Colleges in Texas Project (Project M-PACT). Two separate multilevel discrete-time survival analyses were used to model the associations between past 30-day hookah use and subsequent initiation of 1) other combustible tobacco products, and 2) ENDS during the 2.5 year study period, after controlling for demographic, other tobacco use, and risk-taking personality characteristics (i.e. sensation seeking and impulsivity).

**Results:** After controlling for covariates, past 30-day hookah use was associated with significantly higher odds of subsequent initiation of other combustible tobacco products. Past 30-day hookah use also predicted subsequent initiation of ENDS after controlling for covariates.

**Conclusions:** This study is one of the first to demonstrate that hookah use is a predictor of subsequent initiation of other combustible tobacco products and ENDS among college students. These findings suggest that hookah may prime individuals to use other tobacco products, which has important implications for prevention programs and future research.

### 1. Introduction

Hookah is an increasingly popular tobacco product in the United States, particularly among college students. The 2016 National College Health Assessment estimated that 19% of college students had ever used hookah and 3.9% reported current use (American College Health Association, 2016). Other studies have estimated higher prevalence of

hookah use among college students, ranging from 11% to 22% of college students reporting past 30-day use (Heinz et al., 2013; Latimer, Batanova, & Loukas, 2014). The high prevalence of hookah use is concerning because of potential health consequences associated with use. For example, one study found that a one hour hookah session exposes a user to nearly 50 times the amount of smoke as a conventional cigarette, and each puff from the hookah exposes the user to 12.0 times

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the amount of smoke as a single cigarette puff (Eissenberg & Shihadeh, 2009). Additional studies have linked hookah use to pulmonary disease and cardiovascular outcomes (Maziak, 2011; Waziry, Jawad, Ballout, Al Akel, & Akl, 2017).

However, many young adults report misperceptions regarding the harmfulness of hookah. In a recent study of college students, Creamer et al. (2016) found that over a quarter of respondents incorrectly believed there was no tobacco in hookah and 38% believed that hookah did not contain nicotine. In addition, hookah users had significantly lower harm perceptions and perceived addictiveness scores as compared to non-hookah users (Creamer et al., 2016). Research has indicated that decreased hookah harm perceptions and lack of knowledge are associated with hookah use (Berg et al., 2015); and that decreased harm perceptions are associated with using hookah more frequently (Creamer et al., 2016). Other correlates of hookah use include younger age, being male, and current cigarette use (Jarrett, Blosnich, Tworek, & Horn, 2012; Sutfin et al., 2011).

The role of hookah use in priming individuals for future tobacco product use has not been adequately addressed. In one of the few studies to investigate the longitudinal association between hookah use and cigarette smoking, Fielder, Carey, and Carey (2013) found that hookah use prior to college predicted future cigarette use (initiation of use or resuming use) in a sample of female college students over nine months. Furthermore, researchers found that hookah users at baseline smoked significantly more cigarettes and smoked cigarettes on more days at six months follow-up as compared to non-hookah users (Doran, Godfrey, & Myers, 2015). In addition, research involving adolescents echo findings from young adult studies that hookah use predicts future tobacco use. These studies indicate that hookah use at baseline predicted the following cigarette behaviors at follow up: initiation of use, past 30-day use, and intensity of use (Jaber et al., 2015; Soneji, Sargent, Tanski, & Primack, 2015; Watkins, Glantz, & Chaffee, 2018). Importantly, the previous studies examined the potential link between hookah and cigarette smoking but did not examine the role of hookah use in other types of tobacco product use, including ENDS and cigar products. Examining hookah use as a predictor of ENDS use is particularly important as the prevalence of ENDS use has increased rapidly in recent years; over a quarter (26%) of college students reported ever use in 2015 (Miech, Johnston, O'Malley, Bachman, & Schulenberg, 2016). In addition, a recent nationwide study found that young adults aged 18 to 24 comprised the highest proportion of current established cigarillo users (35.9%), and more than one in five (22.1%) reported current established use of non-premium cigars (Corey et al., 2017).

Understanding tobacco use patterns, including how hookah use predicts the use of other tobacco products, in college students is important because emerging adulthood is a distinct period during which behaviors, such as tobacco use, are established and solidified (Arnett, 2000; U.S. Department Health and Human Services, 2012; White, Bray, Fleming, & Catalano, 2009). The purpose of this longitudinal study is two-fold: 1) To determine if past 30-day hookah use predicts subsequent initiation of other combustible tobacco products (conventional cigarettes and cigar products), and 2) To determine if past 30-day hookah use predicts subsequent initiation of ENDS use among Texas college students during a 2.5 year study period. We hypothesized that past 30-day use of hookah would predict subsequent initiation of other combustible tobacco products and ENDS, after controlling for demographic characteristics, other tobacco use behaviors, and risk-taking behaviors (i.e. sensation seeking and impulsivity).

## 2. Material and methods

### 2.1. Study design

This study was a longitudinal analysis of Waves 1–6 of the Marketing and Promotions Across Colleges in Texas Project (Project M-PACT). At Wave 1, participants included college students aged 18 to 29

who were enrolled in four-year colleges and two-year vocational programs in the five counties surrounding Austin, Dallas/Fort Worth, Houston, and San Antonio. Data were collected over a 2.5 year study period, which consisted of six waves spaced six months apart. To be eligible to participate individuals had to be enrolled as full-time or part-time degree or certificate-seeking undergraduate students attending a four-year college or a vocational/technical program at a two-year college. Students who met the eligibility criteria were recruited to participate via e-mail and student consent was obtained online prior to study enrollment. A more detailed description of study methods is described elsewhere (Loukas et al., 2016). Project M-PACT was reviewed and approved by the University of Texas at Austin Institutional Review Board (2013-06-0034).

### 2.2. Study participants

A total of 5,482 young adults participated in Wave 1 of Project M-PACT, and 4,384 participated in Wave 6 (retention = 80%); the overall participation rate for all eligible college students at Wave 1 was 40.0%. Data collection for Wave 1 began in November 2014, and subsequent waves were administered six months apart. As the purpose of the current study was to examine if past 30-day hookah use predicted subsequent initiation of 1) other combustible tobacco product use, and 2) ENDS use, two separate models were conducted. For the first model, analyses were restricted to never users of other combustible tobacco products (cigarettes and cigar products) at Wave 1. For the second model, analyses were restricted to never users of ENDS products at Wave 1. In addition, participants were excluded from both models if they did not participate in at least two study waves ( $n = 418$ ). The final sample sizes included 2,355 participants for the combustible tobacco product initiation analyses (model 1); and 2,590 participants for the ENDS initiation analyses (model 2).

### 2.3. Measures

#### 2.3.1. Dependent variables: other combustible tobacco products and ENDS use initiation

Initiation of other combustible products (cigarettes and cigar products) was assessed at each of the six waves and served as the dependent variables of interest for the first model. For cigarettes, participants were asked: “How many cigarettes have you smoked in your entire life?” Response options ranged from “I have never smoked a cigarette, even 1 or 2 puffs” to “At least 100 or more cigarettes (5 packs or more).” If participants selected a response other than “I have never smoked a cigarette, even 1 or 2 puffs” they were considered a cigarette smoker. For cigars, two items were analyzed that began with the stem, “Have you ever tried either of these cigar product types as intended (i.e. with tobacco), even one or two puffs?”; 1) “Large cigars like Macanudo, Romeo y Julieta, Arturo Fuente, Garcia y Vega, Backwoods, etc” and 2) “Cigarillos or little filtered cigars like Black and Mild, Swisher Sweets, Dutch Masters, Phillie Blunts, Santa Fe, etc.” If participants responded “yes” to either item they were considered cigar users. Ultimately, if participants indicated ever use of cigarettes or cigar products (large cigars, little filtered cigars, or cigarillos) they were classified as combustible product initiators for the first wave in which they indicated use; individuals who did not initiate combustible product use during the study period were right-censored at the last wave in which they participated.

Initiation of ENDS was also assessed at each of the six waves and served as the dependent variable for the second model. Participants were asked “Have you ever used an ENDS product, (i.e. e-cigarette, vape pen, or e-hookah) as intended (i.e. with nicotine cartridges and/or e-liquid/e-juice), even one or two puffs?” Response options were “yes” and “no.” Similar to combustible product initiation, if participants indicated ever use of ENDS products they were classified as initiators for the first wave in which they indicated use; individuals who did not

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