



## Associations between tobacco and nicotine product use and depressive symptoms among college students in Texas



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### ABSTRACT

**Background:** There is a well-established link between cigarette smoking and depression; less is known about the potential association between alternative tobacco products, such as hookah, cigars, smokeless tobacco, and electronic cigarette (e-cigarette use) with depression. The Food and Drug Administration (FDA) is now regulating tobacco products and is interested in tobacco product use among those with mental health problems and other special populations such as college students.

**Methods:** Cross-sectional statewide convenience sample study of 5438 college students in 24 colleges and universities in Texas. Past 30-day use of hookah, cigar, smokeless tobacco, cigarette, and e-cigarette use were measured by self-report. Depressive symptoms were measured by the 10-item short form of the Center for Epidemiologic Studies scale.

**Results:** Only e-cigarette use was positively associated with depressive symptoms, even after accounting for all other tobacco products and socio-demographics. There were no significant interactions between race/ethnicity or gender with each of the tobacco products on depressive symptoms.

**Conclusions:** E-cigarette use was positively associated with depressive symptoms among college students in Texas. Further research is needed to determine causality, which may inform FDA regulatory planning.

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### 1. Introduction

The Food and Drug Administration (FDA) regulates the manufacturing, distribution, and marketing of tobacco products (Food and Drug Administration, 2009) and one of its research priorities is to examine and determine etiological associations in the use of alternative tobacco and nicotine products (hereafter referred to as ATPs), such as electronic cigarettes (e-cigarettes) and hookah, among special populations, such as youth and college students, and vulnerable populations, including those with mental health problems, such as depression (Food and Drug Administration, 2014).

There is a well-established link between cigarette smoking and depression (Prochaska, 2011). However, the exact etiology is not clear. Depressed persons may smoke to alleviate their depressive symptoms or “self-medicate (Gehricke et al., 2007)” or a common factor, such as familial predisposition (Dierker, Avenevoli, Stolar, & Merikangas, 2002) may link cigarette smoking to depression. Alternatively, smoking

could lead to the onset of depression (Boden, Fergusson, & Horwood, 2010).

There is a weaker established link between depression and ATP use, including cigars, smokeless tobacco (Fu, Vaughn, Wu, & Heath, 2014), hookah (Goodwin et al., 2014; Heinz et al., 2013) and e-cigarettes (Cummins, Zhu, Tedeschi, Gamst, & Myers, 2014). One study using the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) found that persons with lifetime mental illness, panic disorder and alcohol use disorder were more likely to be lifetime smokeless tobacco users than persons without a mental illness (Fu et al., 2014). Cummins et al. (2014) found that among a nationally representative sample of adults in the United States, persons with “mental health conditions” were more likely to be e-cigarette users. However, most existing studies are limited to the examination of a single alternative product, even though most tobacco users report use of multiple products (Butler, Ickes, Rayens, Wiggins, & Hahn, 2016). Moreover, most studies have examined the tobacco use–depression association among adults (>18 years old), yet young adults, including college students, report the highest prevalence of ATP use (Johnston, O’Malley, Miech, Bachman, & Schulenberg, 2015).

The purpose of the present study is to test the unique associations between four ATPs (cigars, smokeless tobacco, hookah, and e-

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cigarettes) and depressive symptoms in a young adult college sample. College students are an important population because they constitute 40% of the young adult population (United States Department of Education, 2015) and report transitions in tobacco use behaviors, including initiation of new products and tobacco addiction (White, Bray, Fleming, & Catalano, 2009). Yet, no studies have examined the unique associations between various types of tobacco products and depressive symptoms among young adults, while controlling for cigarette use. We hypothesize that ATPs are uniquely positively associated with depressive symptoms in college students, over and above cigarette use and a variety of socio-demographics.

## 2. Methods

### 2.1. Participants

Participants were 5438 18–29 year old students attending one of 24 colleges in Texas and involved in the baseline wave (November 2014–February 2015) of the Marketing and Promotions across Colleges in Texas Project (Project M-PACT), a rapid response surveillance study. Participants were full- or part-time degree- or certificate-seeking undergraduate students attending a 4-year college or a vocational/technical program at a 2-year college. Recruitment at 2-year colleges was limited to students enrolled in vocational/technical programs (e.g., welding, air conditioning and cooling, etc.) because they have an elevated prevalence of cigarette use (Loukas, Murphy, & Gottlieb, 2008), and in turn use of ATPs (Biener, McCausland, Curry, & Cullen, 2011; McMillen, Maduka, & Winickoff, 2012). Secondly, participants were required to be 18–26 years old if they were a lifetime non-tobacco user or 18–29 years old if they were a lifetime tobacco user. Lifetime tobacco use was defined by having ever smoked at least 100 cigarettes, or at least 20 cigars, or having ever used smokeless/spit/chewing tobacco at least 20 times. Because the study examines transitions in tobacco use, and initiation is unlikely to occur after the age of 26 (United States Department of Health and Human Services, 2012), lifetime non-tobacco users over the age of 26 were excluded from participation.

### 2.2. Procedure

The 24 colleges were located in five counties that included the four largest metropolitan areas in Texas (Austin, Dallas/Fort Worth, Houston, and San Antonio). Students attending the colleges were recruited to participate in the online survey via email invitation (Loukas et al., 2016). Eligible students who wished to participate provided informed consent and then completed the online survey. Upon completion of the survey, each student received a \$10 e-gift card and all students were entered into a drawing to win one of twenty \$50 e-gift cards. >13,000 students ( $n = 13,714$ ) were eligible to participate in the study and of these, 5482 (40%) provided consent and completed the survey. Forty-four students were missing data on the study measures. Thus, the final sample for the present analyses was 5438.

### 2.3. Measures

#### 2.3.1. Socio-demographic covariates

Sex (0 = male; 1 = female), age, type of college (0 = 2-year; 1 = 4-year), and race/ethnicity were included in study models as covariates. Race/ethnicity was measured with two items, one that assessed ethnicity and the other that assessed race. A race/ethnicity variable was created by combining these two questions. Students who reported as Hispanic or Latino/a were coded as Hispanic and the remaining students were given codes that represented the selected race (“White,” “Black or African American,” “Asian,” “American Indian or Alaska Native,” “Native Hawaiian or other Pacific Islander,” and “Other.” Students who indicated more than one race were coded as “other”.

#### 2.3.2. Current cigarette and ATP use

Use of five types of tobacco/nicotine products were examined in the present study. The items were adapted from the Youth Tobacco Survey (Starr et al., 2005) and the Population Assessment of Tobacco and Health Study (National Institutes of Health, 2015), and assessed current or past 30-day use of cigarettes, smokeless/snus tobacco, large cigars/cigarillos/little cigars, hookah, and e-cigarettes. Current use of cigarettes, smokeless tobacco, and hookah were assessed with the questions “During the past 30 days, on how many days did you smoke/use \_\_\_\_?” Current use of large cigars/cigarillos/little cigars and hookah were assessed with questions “During the past 30 days, how many days did you smoke \_\_\_\_ as intended (i.e. with tobacco)?” Current use of e-cigarettes was assessed with the question “During the past 30 days, have you used any ENDS product (i.e., an e-cigarette, vape pen, or e-hookah), even one or two puffs, as intended (i.e. with nicotine cartridges and/or e-liquid/e-juice)?”

#### 2.3.3. Depressive symptoms

Depressive symptoms were assessed with the 10-item short-form Center for Epidemiologic Studies Depression 10 Scale (CES-D 10) (Andresen, Malmgren, Carter, & Patrick, 1994). This scale assesses frequency of symptoms of depression occurring over the past week, including depressed affect, positive affect, and somatic complaints. Each of the items is scored on a scale from 0 “rarely (<1 day)” to 3 “most of the time (5–7 days).” The 10 items were summed and higher scores reflected higher levels of depressive symptoms. A cutoff score of 10 was used to create two groups; one that reported clinically significant symptoms of a depression (score of 10 or more) and one that did not (score of 9 or less). The CES-D 10 is a reliable and valid measure of depressive symptoms for community-based adolescents (Bradley, Bagnell, & Brannen, 2010) and older adults (Andresen et al., 1994). For the present sample, internal consistency reliability was 0.81.

### 2.4. Data analysis

A multilevel logistic regression model was fit using MPlus 7.3 (Muthen & Muthen, 1998–2015) to examine the associations between each of the ATPs and the dichotomous dependent variable of depressive symptom. Each model included current cigarette use and the socio-demographic factors of gender, age, race/ethnicity, and school type (2-year versus 4-year) as covariates, and all four ATPs as predictor variables. Simultaneous inclusion of all ATPs in one model allows for the examination of the unique association of each to depressive symptoms. A multilevel model was conducted to accommodate the non-independence of participants nested within the 24 colleges. Interaction terms between race/ethnicity and gender with each tobacco product were examined in separate models to determine if the associations were consistent across these socio-demographic characteristics.

## 3. Results

Table 1 presents the descriptive characteristics of our study participants. Participants were 20.49 years old ( $SD = 2.36$  years) on average and 63.8% were female. Almost 40% (36.3%) identified as non-Hispanic white, 31.3% as Hispanic, 16.9% as Asian ancestry, 8.1% as non-Hispanic black, and 7.5% identified as other. The majority attended a four-year college (92.6%). Cigarettes were the most commonly used tobacco product and just over 30% of participants (31%) reported a CES-D score of 10 or more.

Results from the multilevel logistic regression model are presented in Table 2. E-cigarettes were the only ATP that were uniquely associated with depressive symptoms. The association was significant even after controlling for current cigarette use, socio-demographic characteristics, and current use of the other three ATPs. None of the interactions between each of the tobacco products and race/ethnicity or gender were significant, all  $p > 0.05$ . The model fit without any interaction terms

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