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## Tobacco Product Use and Mental Health Status Among Young Adults

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### Abstract

**Background**—Individuals with mental health conditions represent a priority population for tobacco control. This population smokes cigarettes at disproportionately higher rates than the general population, but less is known about the relationship between non-cigarette tobacco use and mental health status.

**Method**—In 2013, 2,370 young adults recruited from 11 colleges in North Carolina and Virginia completed an online survey on tobacco use. We compared past 6-month self-reported mental health diagnosis, past 30-day depression score, and past 7-day stress score to past 30-day cigarette, e-cigarette, waterpipe, cigar, and smokeless tobacco use. Models adjusted for age, gender, race, ethnicity, and mother's education. Non-cigarette products were also adjusted for past 30-day cigarette use.

**Results**—Among participants, 249 (10.5%) reported a mental health diagnosis, most commonly depression (5.5%), ADHD/ADD (4.5%), and anxiety (0.8%). Those who reported a mental health diagnosis had greater odds of using cigarettes (AOR=1.55; CI=1.01, 2.27). Mean stress score was 16.0 (SD=6.9) of possible 40. Higher stress scale score was associated with increased odds of e-cigarette (AOR=1.03; CI=1.01, 1.05), waterpipe (AOR=1.04; CI=1.01, 1.06), and cigarette (AOR=1.02; CI=1.00, 1.04) use. Mean depression score was 7.2 (SD=5.6) of possible 33. Higher depression scale score was associated with increased odds for e-cigarette (AOR=1.04; CI=1.01, 1.08) and cigarette (AOR=1.03; CI=1.01, 1.06) use.

**Conclusion**—Findings in this study provide further evidence of a potential relationship between non-cigarette tobacco products and mental health status. Tobacco control efforts aimed at reducing

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### Contributors

JLK conceptualized the current study. BAR conducted statistical analyses. ES and JS oversaw survey design and implementation, and assisted in developing measures. JCR assisted in interpreting findings and writing the manuscript. JLK wrote the first draft of the manuscript and all authors contributed to and approved the final manuscript.

### Conflict of Interest

The authors declare that they have no conflicts of interest.

tobacco use disparities among mental health populations should focus on non-cigarette tobacco products in addition to cigarettes.

## Keywords

Tobacco use; Smoking; Mental Health; College Students

## 1 Introduction

Individuals with mental health conditions represent a priority population for tobacco prevention and control due to disparities in use and subsequent health effects. One in five individuals within the US have a mental health condition, yet this population consumes almost half of all cigarettes sold within the US.<sup>1,2</sup> As a result, individuals with mental health conditions account for more than 40% of tobacco related deaths each year<sup>3,4</sup> and incur additional social constraints such as discrimination and stigma which contribute to increased alienation and poorer mental health.<sup>4-6</sup>

College age represents a time for tobacco product experimentation and increased mental health diagnoses. Mental health conditions account for half of the disease burden for young adults in US<sup>7</sup>, and many psychological disorders first occur in late adolescence or early adulthood,<sup>8</sup> with most before age 24.<sup>9</sup> Further, college represents a developmentally challenging transition to adulthood that may unmask mental health manifestations.<sup>10</sup> Compared to other age groups, 18–24 year olds have the highest rates for using cigars, cigarillos, little cigars, pipe, water pipe, electronic cigarettes (e-cigarettes), and smokeless tobacco.<sup>11</sup> Additionally, 99% of those who initiate tobacco use do so before age 26,<sup>12</sup> in part due to decades of tobacco industry marketing. Industry documents indicate tobacco companies target college students to encourage the transition from experimental to habitual use through advertising and promotions at bars, nightclubs and other social events,<sup>13,14</sup> which may contribute to increased use.<sup>14</sup>

Among college students, increased cigarette use has been associated with Attention Deficit Hyperactive Disorder (ADHD),<sup>15–20</sup> depression,<sup>21–34</sup> and anxiety.<sup>21,35,36</sup> However, the relationship between mental health and non-cigarette tobacco product use is less clear. Three studies have concluded increased e-cigarette use is related to mental health conditions, in particular, depression among high school and college students.<sup>37–39</sup> The relationship between waterpipe tobacco use and mental health status is inconclusive, as one study identified a moderate relationship<sup>40</sup> while two studies found no relationship.<sup>41,42</sup> One study among college students found greater odds for smoking little cigars among those with higher scores on both stress and depressive symptom scales.<sup>43</sup> Increased smokeless tobacco (SLT) use has been linked with anxiety among adults<sup>44</sup>, but studies among college students did not identify a relationship.<sup>37,45</sup> Given the relatively high rates of non-cigarette tobacco product use among college age students<sup>46</sup> and limited studies thus far, we examined whether e-cigarette, waterpipe, cigar, cigarette, or SLT use were associated with mental health status among college students, using three mental health measures.

## 2 Methods

### 2.1 Study overview

Freshmen from nine public and two private colleges in North Carolina and Virginia were initially recruited in fall 2010 to complete a screener survey.<sup>47</sup> The screener survey consisted of 10 questions regarding the college experience, some related to tobacco use and distractor items to blind the goal of the study (e.g., physical activity, sleep, energy drinks, and alcohol use). Participants were eligible if they were at least 18, enrolled full-time, in their first semester of their first year, and had an email address from the school registrar. Across 11 schools, 10,528 freshmen students completed the screener survey, of whom 4,910 were invited to join the cohort, an oversample of smokeless tobacco ever users, current smokers, and males. In 2010, 3,146 freshmen completed the baseline survey and joined the cohort.<sup>48</sup> Other demographic and behavioral characteristics of the cohort are typical of college students in the southeastern U.S., with additional details in Wolfson et al., 2014.<sup>48</sup> Participants were resurveyed in spring 2011, fall 2011, spring 2012, fall 2012, and fall 2013.

In fall 2013 (wave 6), cohort participants were contacted via email to complete an online follow-up survey on tobacco product use. Wake Forest School of Medicine Institutional Review Board (IRB) and three participating college IRBs approved the study protocol. The Department of Health and Human Services provided additional privacy protection via Certificate of Confidentiality. Students were sent an email invitation to participate, which included a link to a secure survey website. The survey took approximately 20 minutes to complete, and participants received a \$40 gift card.

### 2.2 Measures

**2.2.1 Mental health diagnosis**—Participants were asked whether, within the past six months, a doctor had told them they had any health conditions, a list that included depression, ADHD/ADD, or other with fill-in response. Other responses that were mental health conditions were back-coded. The variable was coded two ways. First, participants were coded as either yes/no having a mental health diagnosis. Second, because past research has indicated individuals with multiple mental health diagnoses are at increased risk for tobacco use than those with one diagnosis or no diagnosis,<sup>49</sup> we compared reporting one diagnosis versus none, and two or more diagnoses versus none.

**2.2.2 Stress**—Cohen's 10-item Perceived Stress Scale<sup>50</sup> was used to assess past-30 day stress. Participants were asked how often they felt each way during the last month with response options never (0), almost never (1), sometimes (2), fairly often (3), and very often (4). A higher score represents greater perceived stress. We summed responses and reverse coded as appropriate. The Cronbach's alpha was 0.86.

**2.2.3 Depression**—We used the Center for Epidemiological Studies Depression Iowa Short Form,<sup>51,52</sup> an 11-item measure of recent depressive symptoms. Participants were asked to indicate how often they felt each way during the past week with response options rarely or none of the time (less than 1 day; 0), some or a little of the time (1–2 days; 1), occasionally or a moderate amount of the time (3–4 days; 2), and most or all of the time (5–

7 days; 3). A higher score represents greater depression. We summed responses and reverse coded as appropriate. The Cronbach's alpha was 0.86.

**2.2.4 Tobacco use**—We assessed past 30-day tobacco use for the following products: traditional cigar, cigarillo or little cigar, bidi, kretek (aka clove), Gutkha, e-cigarette or electronic cigarette, waterpipe (aka hookah, shisha, narghile), traditional pipe, verve, chewing tobacco, moist or dry snuff (dip), snus, and dissolvables. Participants were asked if they had ever used each product, with response options further clarifying the time period (past week, past 30 days, past 6 months, past year, more than a year ago, or never). Product descriptions and images were provided for each product, and respondents were instructed to only report use for tobacco, not other substances (e.g., marijuana). Responses were coded as yes/no for past 30-day use of each tobacco product. Due to low use rates, for analyses, verve, chewing tobacco, moist or dry snuff (dip), snus, and dissolvables were combined into Smokeless. Traditional cigar and cigarillo or little cigar were combined into Cigars. Bidi, kretek, and Gutkha were combined with all other products into Any Tobacco.

**2.2.5 Demographics**—We used the following sociodemographics as control variables in the model: age, sex, race, ethnicity, and mother's education. Sex was collected during the screener survey (male/female); age (continuous), race (white/nonwhite), ethnicity (Hispanic/non-Hispanic), and mother's education (high school education or less/some college or more) were collected each survey. These variables have been previously associated with increased tobacco use.<sup>53–55</sup>

### 2.3 Data analysis

Logistic regression models predicting tobacco use were fit for each product and mental health predictor separately. Models adjusted for age, sex, race, ethnicity, and mother's education. For models predicting non-cigarette tobacco use (i.e., e-cigarette, cigar, waterpipe, and smokeless tobacco), we also adjusted for past 30-day use of cigarettes. We used multiple imputations by chained equations to handle missing covariate data.<sup>56</sup> Twenty imputed datasets were generated using ICE in Stata Version 12. Results of the analyses on each dataset were combined using MICOMBINE. Models and prevalences were estimated using the survey data commands in Stata to take design features into account.

## 3 Results

### 3.1 Sample characteristics

Two thousand five hundred participants completed this survey wave, a retention rate of 79.5%. The analyses presented in this paper were restricted to the 2370 individuals that responded to questions on tobacco use. Of these 2370, only 117 (<5%) were missing covariate data. Respondents were 64.1% female, 16.7% were nonwhite, 6.7% were Hispanic, 62.1% reported their mother as college educated, and mean age was 21.1 (SD=0.4; Table 1). The majority of participants (95.5%) were still enrolled in college, most (90.2%) in their senior year. Few respondents were taking a leave of absence (1.7%) or no longer enrolled (2.8%). There were no differences in results based on enrollment status.

### 3.2 Tobacco use

Past 30-day use of any tobacco product was 27.3%. The most commonly reported tobacco product used was cigarettes (15.0%), followed by waterpipe (9.2%), e-cigarettes (5.2%), cigars (5.1%), and smokeless tobacco (3.4%).

### 3.3 Mental health diagnosis

Of the total sample of 2,370 students, 249 (10.5%) students reported a mental health diagnosis, most frequently depression (5.5%), ADHD (4.5%), and anxiety (0.8%). Most (81.5%) of these 249 students reported one mental health diagnosis, while 17.3% reported two, and 1.2% reported three. Those who reported a past 6-month mental health diagnosis had greater odds of reporting past 30-day cigarette use (AOR=1.55; CI=1.01, 2.27), after adjusting for age, sex, race, ethnicity, and mother's education (Table 2). E-cigarettes (AOR=1.55; CI=0.97, 2.48;  $p=0.066$ ) and any tobacco use (AOR=1.54; CI=1.00, 2.38;  $p=0.052$ ) were marginally significant. Waterpipe, cigar, and smokeless use were not related to mental health diagnosis after adjustment for demographics and past 30-day cigarette use.

We also found a dose-response relationship, with those reporting two or more mental health diagnoses at greater odds for reporting using cigarettes (AOR=3.16; CI=1.58, 6.33) and any tobacco product (AOR=2.76; CI=1.14, 6.71) than those not reporting a mental health diagnosis. E-cigarette, waterpipe, cigar, and smokeless tobacco use were not associated with two or more diagnoses. We also did not find any differences between those reporting one diagnosis compared to those reporting none.

### 3.4 Stress scale

Mean stress scale score was 16.0 (SD=6.9), with the highest possible score 40. Higher stress scale score was associated with increased odds for e-cigarette (AOR=1.03; CI=1.00, 1.05), waterpipe (AOR=1.04; CI=1.01, 1.06), cigarette (AOR=1.02; CI=1.00, 1.04), and any tobacco use (AOR=1.02; CI=1.01, 1.04) after adjusting for age, sex, race, ethnicity, mother's education, and past 30-day cigarette use when appropriate (Table 2). Smokeless tobacco and cigar use were not related to stress scale score.

### 3.5 Depression scale

Mean depression scale score was 7.2 (SD=5.6) with the highest possible score 33. Higher depression scale score was associated with increased odds for e-cigarette use (AOR=1.04; CI=1.01, 1.08), cigarette use (AOR=1.03; CI=1.01, 1.06), and any tobacco use (AOR=1.03; CI=1.01, 1.06), after adjusting for age, sex, race, ethnicity, mother's education, and past 30-day cigarette use when appropriate (Table 2). Waterpipe use was marginally related to depression (AOR=1.03; CI=1.00, 1.07;  $p=0.052$ ). Smokeless tobacco and cigar use were not associated with depression scale score.

## 4 Discussion

The purpose of this study was to examine whether various measures of mental health status were associated with past 30-day tobacco use, including both cigarettes and non-cigarette tobacco products. Within this sample of college students, each of the mental health measures

was related to tobacco use, though related tobacco products varied by measure. College students who reported any mental health diagnosis within the past 6 months were more likely to report using e-cigarettes and cigarettes during the past 30-days. Students with higher stress or depression scale scores were more likely to report using cigarettes, e-cigarettes, and waterpipe use during the past 30-days.

Mental health diagnosis, stress scale score, and depression scale score were related to past 30-day cigarette use, which echoes substantial research that cigarettes are related to mental health status in college students.<sup>15–34</sup> The exact reasons for increased tobacco use among this population are unclear, though hypotheses include similar risk factors for tobacco use and mental health conditions, efforts to self-medicate and lessen symptoms, and bidirectional influence between smoking and mental health conditions.<sup>4,57–61</sup>

Two of the three mental health measures were related to e-cigarette use, which is consistent with newer research which links e-cigarette use to mental health status.<sup>37–39,62</sup> A recent longitudinal analysis found depression scale score predicted e-cigarette use, but e-cigarette use did not lead to depression.<sup>39</sup> While e-cigarettes are sometimes considered less harmful than cigarettes at the individual level,<sup>63</sup> monitoring patterns of use will be important, particularly reasons for use among this population. Individuals with mental health conditions may be using e-cigarettes more often in order to obtain nicotine, which has been historically used to treat some mental health conditions.<sup>4</sup> However, long term nicotine exposure during development could exacerbate mental health disorders.<sup>64</sup> E-cigarettes used for cigarette cessation could be beneficial by reducing exposure to combusted carcinogens and nicotine; however, it remains unclear whether e-cigarettes are effective for helping people quit smoking cigarettes, and studies among adolescents suggest that e-cigarette use may lead to cigarette use.<sup>65–67</sup>

In this sample, past 30-day waterpipe use was related to both past 30-day stress scale score and marginally related to past 7-day depression scale score. Past research examining waterpipe use and mental health status has been inconclusive, with one study<sup>40</sup> identifying a relationship while other studies did not.<sup>41,42</sup> In contrast to those studies, past 30-day waterpipe use was lower in the present study, but the stress and depression scales used were more comprehensive than one-item measures used in two of the other studies. Other studies suggested the lack of relationship is due to waterpipe use being a more social behavior,<sup>41,42</sup> which may indicate why the associations we identified were weaker compared to the associations between e-cigarettes and cigarettes and mental health status.

We did not detect relationships between mental health status and smokeless or cigar use. One previous study identified associations between little cigar use and stress and depressive symptoms scores. In that study, 12.1% reported use, compared to 5.1% among our sample. Other studies of smokeless use and mental health status among college students did not detect a relationship. It is possible lower use rates for cigars and smokeless tobacco inhibited our ability to detect an effect. Alternatively, if individuals with mental health conditions are using tobacco products for nicotine delivery, inhaling is often more effective, so smokeless tobacco use may be less common.

These findings are limited by several factors. First, mental health diagnosis was based on self-report which may be subject to error, particularly underestimation as many disorders remain undiagnosed. However, previous studies have reported self-report of mental health diagnosis as an accurate measure.<sup>68</sup> Similarly, the stress scale and depression scale measures within this study are not used for establishing diagnosis, and therefore, should not be considered to represent established mental health condition. Further, we identified small effect sizes with stress and depression scales, so findings should be interpreted with caution. Second, the cross-sectional nature of the study limits causality; therefore, longitudinal studies are needed to establish whether tobacco use precedes various mental health conditions or vice versa. Additionally, a third factor could confound the relationship between tobacco use and mental health disorders. For example, race and education are associated with both increased tobacco use and mental health conditions, and, therefore, were controlled for within analyses. However, additional factors such as alcohol or other substance use are also widely used among both tobacco users and those with mental health conditions, and should be considered within future studies.<sup>4,6</sup> Finally, findings have limited generalizability and may not be representative of young adults not enrolled in college or all college students since the 11 colleges from which students were recruited are from two states within the US and the initial cohort was oversampled for smokeless tobacco users.

With increasing non-cigarette tobacco product use among young adults with mental health conditions, additional monitoring is needed. Future research should examine factors leading to non-cigarette tobacco product use among individuals with mental health conditions, as well as the impact of non-cigarette tobacco product use on mental health outcomes, and whether associations vary based on use frequency and mental health severity. Additionally, efforts should be made to enact college-based policies and programs which reduce likelihood for tobacco product use among this population, including prioritizing cessation as part of mental health treatment strategies and implementing services early within the college trajectory to reduce the likelihood for further addiction. Individuals with mental health conditions have been identified as a priority population for tobacco control, and based on findings in this study, additional efforts should be made to consider other tobacco product use in addition to cigarette use.

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## Abbreviations

<b>ADHD</b>	Attention Deficit Hyperactive Disorder
<b>ADD</b>	Attention Deficit Disorder

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### Highlights

- Cigarette use related to mental health diagnosis, depression score, and stress score
- E-cigarette use related to depression score and stress score
- Waterpipe use related to stress score among college students

**Table 1**

Sample characteristics (weighted prevalences or means).

	<b>Overall N=2370 Mean (SD) or %</b>	<b>Mental Health Diagnosis N=249 Mean (SD) or %</b>	<b>No Mental Health Diagnosis N=2121 Mean (SD) or %</b>
Age	21.1 (0.4)	21.1 (0.6)	21.1 (0.4)
Female	64.1%	67.5%	63.7%
Nonwhite	16.8%	9.3%	17.6%
Hispanic	6.7%	7.9%	6.6%
Mother College Educated	62.0%	71.2%	61.1%
Past 30-day Any Tobacco Use	27.3%	34.4%	26.5%
Past 30-day Cigarettes	15.0%	20.4%	14.5%
Past 30-day E-cigarette Use	5.2%	8.0%	5.0%
Past 30-day Waterpipe	9.2%	11.2%	8.9%
Past 30-day Cigars	5.1%	4.5%	5.2%
Past 30-day SLT	3.4%	3.8%	3.3%
Past 7-day Depression Scale Score	7.2 (5.6)	11.4 (7.2)	6.8 (5.2)
Past 30-day Stress Scale Score	16.0 (6.9)	20.6 (7.5)	15.5 (6.6)

Table 2

Adjusted odds ratios (95% CI) from separate logistic regression models of past 30-day tobacco use as a function of past 6-month mental health diagnosis, past 30-day stress score, and past 7-day depression score.

	Cigarettes AOR (95% CI) p	E-cigarettes AOR (95% CI) p	Waterpipe AOR (95% CI) p	Cigars AOR (95% CI) p	Smokeless AOR (95% CI) p	Any Tobacco AOR (95% CI) p
Mental Health Diagnosis	<b>1.55</b> (1.01, 2.37) <b>p=0.044</b>	1.55 (0.97, 2.48) p=0.066	1.30 (0.56, 3.02) p=0.497	0.82 (0.46, 1.49) p=0.481	1.16 (0.64, 2.10) p=0.594	1.54 (1.00, 2.38) p=0.052
2+ vs 0 Diagnoses	<b>3.16</b> (1.58, 6.33) <b>p=0.004</b>	1.83 (0.80, 4.20) p=0.136	1.50 (0.51, 3.11) p=0.328	0.59 (0.19, 1.80) p=0.314	0.20 (0.02, 2.65) p=0.197	<b>2.76</b> (1.14, 6.71) <b>p=0.029</b>
1 vs 0 Diagnoses	1.28 (0.75, 2.20) p=0.322	1.47 (0.79, 2.74) p=0.197	1.26 (0.51, 3.11) p=0.589	0.88 (0.46, 1.66) p=0.654	1.43 (0.80, 2.56) p=0.203	1.34 (0.83, 2.14) p=0.200
Stress Scale Score	<b>1.02</b> (1.00, 1.04) <b>p=0.041</b>	<b>1.03</b> (1.00, 1.05) <b>p=0.030</b>	<b>1.04</b> (1.01, 1.06) <b>p=0.004</b>	1.00 (0.96, 1.05) p=0.866	0.99 (0.96, 1.03) p=0.778	<b>1.02</b> (1.01, 1.04) <b>p=0.002</b>
Depression Scale Score	<b>1.03</b> (1.01, 1.06) <b>p=0.015</b>	<b>1.04</b> (1.01, 1.08) <b>p=0.022</b>	1.03 (1.00, 1.07) p=0.052	1.01 (0.98, 1.05) p=0.418	0.98 (0.95, 1.00) p=0.087	<b>1.03</b> (1.01, 1.06) <b>p=0.011</b>

Bold indicates significant at  $p < .05$ . All models adjusted for age, sex, race, ethnicity, and mother's education. Non-cigarette tobacco products were adjusted for past 30-day cigarette use.