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Alternative tobacco product use among college students: Who is at highest risk?

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Abstract

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Given the increased prevalence of alternative tobacco product use among young adults and increased marketing of these products, we examined smoking status, other substance use, sociodemographics, and psychosocial characteristics in relation to alternative tobacco product use. In 2010, students at 6 colleges in the Southeast were recruited to complete an online survey assessing tobacco product use (i.e., cigarettes, cigars, little cigars, cigarillos, hookah, chew, and snus), along with alcohol and marijuana use, and other psychosocial variables. Of students who were invited to participate, 20.1% (N=4,849/24,055) returned a completed survey. We created a variable for any alternative tobacco product use in the past 30 days. Bivariate analyses indicated differences in alternative tobacco product use among nonsmokers, nondaily smokers, and daily smokers, as well as in relation to age, gender, number of friends that smoke, living with a smoker, depressive symptoms, attitudes toward smoking, sensation seeking, and alcohol and marijuana use. Multivariate analyses indicated that daily and nondaily smokers were more likely than nonsmokers to use alternative tobacco products in comparison to nonsmokers ($p < .001$), controlling for sociodemographic and psychosocial factors. Among current (past 30 day) smokers, never daily nondaily smokers were three times as likely as former daily nondaily smokers and daily smokers to have used alternative tobacco products ($p < .001$), controlling for other important factors. In both sets of analyses, those who were younger, male, and Black and marijuana users were at increased risk of alternative tobacco product use ($p < .001$). Never daily nondaily smokers represent the group at highest risk for using these products. This is notable given that patterns of use of tobacco products may mirror how cigarettes are consumed among the nondaily smoking population. Intervention strategies might be applicable to polytobacco users who demonstrate this overall pattern of occasional tobacco consumption.

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I. Introduction

Tobacco use remains the leading cause of preventable morbidity and mortality in the United States (U.S. Department of Health and Human Services, 2004) with tobacco-related illness responsible for over 400,000 deaths annually (Goldade et al., 2011; Mokdad, Marks, Stroup, & Gerberding, 2004). More deaths are caused each year by tobacco use than by all deaths from human immunodeficiency virus (HIV), illegal drug use, alcohol use, motor vehicle injuries, suicides, and murders combined (Centers for Disease Control and Prevention, 2008; Mokdad et al., 2004). The predominant form of tobacco use in the U.S. is cigarette smoking, with an estimated 44.5 million adults current cigarette smokers (Backinger et al., 2008; Centers for Disease Control and Prevention, 2005) despite the fact that several studies have linked cigarette smoking to total and cause-specific mortality since the 1950s (Cao et al., 2011). These negative health consequences of cigarette smoking have been well-documented and include multiple cancers, cardiovascular disease, pulmonary disease, adverse reproductive outcomes, and exacerbation of other chronic health conditions (U.S. Department of Health and Human Services, 2004). Interestingly, although the risks of tobacco smoking have been known for decades, the tobacco epidemic continues (Wipfli & Samet, 2009).

Alternative Tobacco Products

Alternative tobacco products, which include cigars, chewing tobacco, and snuff (smokeless tobacco), as well as newer products such as hookah (waterpipe) are highly available in the U.S. market and are increasingly being promoted as potentially less harmful cigarette alternatives (Backinger et al., 2008). These other forms of tobacco product are increasingly being used as a substitute for cigarette smoking or in addition to cigarettes

(Bombard, Pederson, Nelson, & Malarcher, 2007; O'Connor et al., 2007). Recent national surveys on drug use and health suggest that the use of alternative tobacco products (e.g., cigars, smokeless tobacco, pipes) have remained fairly constant despite decreasing trends in cigarette smoking over the past decade (Substance Abuse and Mental Health Services Administration, 2012). A greater tobacco product variety, increased promotion, and explicit or implicit claims of harm reduction may encourage the use of other tobacco products in addition to or as a substitute for cigarettes (O'Connor et al., 2007). O'Connor et al in a study revealed that the use of other tobacco products was most strongly related to beliefs about the reduced harm of these products (O'Connor et al., 2007). Furthermore, policies designed to preserve clean indoor air may further have an impact on the types of tobacco products that smokers choose (Backinger et al., 2008).

Negative Health Effects of Alternative Tobacco Use

All of these tobacco products contain carcinogens and are associated with important health consequences as no tobacco product is free of harm (American Society of Clinical Oncology, 2003; Backinger et al., 2008; Bombard et al., 2007; Prignot, Sasco, Poulet, Gupta, & Aditama, 2008). A typical cigar can deliver as much as ten times the amount of tar, nicotine, and carbon monoxide as a regular cigarette (Backinger et al., 2008; Gilpin & Pierce, 2003). In addition, cigar use has been associated with lung, lip, oral cavity, laryngeal, esophageal, stomach, and pancreatic cancers, as well as chronic obstructive pulmonary disease and heart disease (National Cancer Institute, 1998). Similarly, hookah can deliver up to thirty-six times the amount of tar as in cigarette smoke with accompanying high levels of arsenic, chromium and lead (Shihadeh, 2003; Sutfin et al., 2011). Hookah use has also been associated with lung cancer, respiratory illness, low birth-weight, and periodontal disease

(Akl et al., 2010; Sutfin et al., 2011). Other studies indicate that cigar and water pipe (hookah) smokers have higher overall mortality rates than never smokers (Akl et al., 2010; Backinger et al., 2008; Maziak, Ward, & Eissenberg, 2004; National Cancer Institute, 1998). Chew and snuff use has been associated with oral and pharyngeal cancer in previous epidemiological research (Backinger et al., 2008; U.S. Department of Health and Human Services, 1994).

Concurrent Tobacco Use

Alternative tobacco use, however, occurs more often in combination with cigarette smoking than in isolation (Rigotti, Lee, & Wechsler, 2000). Among college students aged 18–24 years, 51.3% of students who used tobacco reported concurrent use (Backinger et al., 2008; Rigotti et al., 2000). Between 2.5% and 5.0% of U.S. cigarette smokers also use smokeless tobacco (SLT), and 3%–4% concurrently smoke cigarettes and cigars (National Cancer Institute, 1998; O'Connor et al., 2007). In a study by Rigotti et al, among current smokeless tobacco users, 30.6% used only smokeless tobacco, whereas 62.3% also smoked cigarettes. Of current cigar smokers, 33.4% smoked only cigars, whereas 61.4% smoked both cigars and cigarettes (Rigotti et al., 2000). Concurrent users experience higher intermediate levels of mortality, are more likely to ingest more nicotine on a daily basis, and are less likely than single-form users to stop using tobacco (Backinger et al., 2008; Wetter et al., 2002). Data from a world-wide case-control study suggest that, compared with cigarette smokers and other tobacco users, dual users of cigarettes and smokeless tobacco are at higher risk for acute myocardial infarction (Teo et al., 2006), consume larger amounts of alcohol (Accortt, Waterbor, Beall, & Howard, 2002; Backinger et al., 2008), and have a higher prevalence of obesity (Eliasson, Asplund, Nasic, & Rodu, 2004; Klesges et al., 2011). Thus, the

consequences of using multiple forms of tobacco may be additive or synergistic (Backinger et al., 2008; Wetter et al., 2002).

Nondaily Smoking and Alternative Tobacco Product Use

Among the categories of cigarette smokers, nondaily smokers have been shown to be more likely than current or nonsmokers to use alternative tobacco products concurrently (Nasim, Blank, Cobb, & Eissenberg, 2012). Until recently, nondaily smoking including social smoking has not been recognized as an important stable pattern of tobacco use. Nondaily and social smoking may be stable patterns of chronic low-level consumption and comprises about one-fourth of all smokers (and growing) of varying age, ethnicity, socioeconomic status, and educational background (Berg et al., 2012; Centers for Disease Control and Prevention, 2007; Hassmiller, Warner, Mendez, Levy, & Romano, 2003; Schane, Glantz, & Ling, 2009). Furthermore, nondaily smoking may be a transitory condition between daily smoking and quitting (Evans et al., 1992; Okuyemi et al., 2002; Zhu, Sun, Hawkins, Pierce, & Cummins, 2003) or a transitional phase to heavier or regular cigarette use (Berg et al., 2012; White, Bray, Fleming, & Catalano, 2009). Nevertheless, while daily tobacco consumption in the U.S. is declining (Schane et al., 2009; Substance Abuse and Mental Health Services Administration, 2012), nondaily smoking (smoking on some days but not every day) is increasing in prevalence (Pierce, White, & Messer, 2009; Schane et al., 2009). Even more concerning is research findings suggesting that alternative tobacco product use rates are highest among nondaily cigarette smokers consequently exhibiting a higher risk of mortality (Nasim et al., 2012). Results from a recent study revealed that relative to daily cigarette smokers, daily use of smokeless tobacco is more prevalent among nondaily cigarette smokers and is highest among cigarette smokers who average 10 or fewer cigarettes per day (Nasim et

al., 2012). Epidemiological evidence suggests that social smokers face increased health risks, exhibit nicotine dependence well before the onset of daily smoking and progress rapidly to regular smoking (Hoek, Maubach, Stevenson, Gendall, & Edwards, 2012) possibly as a result of the increased dual and concurrent use of alternative tobacco products among this subgroup of smokers.

Despite what is known currently about alternative tobacco product use among differing subsets of smokers, very little is known about differences in alternative tobacco product use among subsets of nondaily smokers – that is, those nondaily smokers who were previously daily smokers (i.e., former daily nondaily smokers [FDNS]) versus those nondaily smokers who were never daily smokers (i.e., never daily nondaily smokers [NDNS]). FDNS make up as many as half of nondaily smokers and have been linked with increased readiness to quit cigarette smoking when compared to NDNS (Pinsker et al., 2012). However, prior studies have reported similar smoking behaviors among FDNS and NDNS across all situations regardless of whether the situations were social and sporadic or more routine (Nguyen & Zhu, 2009).

II. Literature Review

Tobacco Use among Young Adults

In 2011, young adults aged 18 to 25 had the highest rate of current use of a tobacco product (39.5%) and the highest usage rates of each of the specific tobacco products as well (Substance Abuse and Mental Health Services Administration, 2012). Current usage rates for past month use among these young adults were 33.5% for cigarettes, 10.9% for cigars, and 5.4% for smokeless tobacco (Substance Abuse and Mental Health Services Administration, 2012). Data from a California study suggest that cigar use is increasing most rapidly among

young adults, who had the lowest rates of cigar use before 1990 (Rigotti et al., 2000). Other studies reveal a growing trend in hookah use (Maziak, 2011) and the use of other tobacco products both independently and concurrently with cigarettes (O'Connor et al., 2007) especially among young adults (Substance Abuse and Mental Health Services Administration, 2012).

The smoking behavior of college students have been documented as a useful index of tobacco use among young adults (Rigotti et al., 2000). Colleges and universities thus continue to remain important settings for reaching youth and young adult populations in the U.S. (Centers for Disease Control and Prevention, 1997). Data from the CDC show that more than 12 million students are currently enrolled in the nation's 3,600 colleges and universities (Centers for Disease Control and Prevention, 1997), and of these students, 57% (approximately 7.1 million) are aged 18-24 years. Similarly, of all persons aged 18-24 years in the U.S., one fourth are currently either full- or part-time college students (Centers for Disease Control and Prevention, 1997), and of all persons aged 20-24 years, more than half have attended college (Centers for Disease Control and Prevention, 1997).

Youths generally increase their substance use, including smoking, during emerging adulthood (the stage in the life cycle following high school but before the adoption of adult roles; the period from the late teens through the twenties) (Arnett, 2000; White et al., 2009). Tobacco smoking, alcohol, cannabis and polysubstance use are common behaviors among these young adults (Redonnet, Chollet, Fombonne, Bowes, & Melchior, 2012). Across the U.S. in a nationally representative study, 5.4% of college students had used smokeless tobacco during the 30 days preceding the survey (i.e., current smokeless-tobacco use) with students aged 18 – 24 years being more likely to report this behavior than older students.

Similarly, nearly one-third (32.4%) of these college students reported either current cigarette use or current smokeless-tobacco use (i.e., current tobacco use) (Centers for Disease Control and Prevention, 1997). A study by Nancy Rigotti found that most college students who have used tobacco also used more than one product (Rigotti et al., 2000). Further analyses revealed that among those who use tobacco, 51.3% used more than one tobacco product in the past year (36.3% used 2 tobacco products, 14.4% used 3 products, and 0.6% used all 4 products), and the most frequent combinations were cigarettes and cigars (19.7%). In contrast however, 77.5% of current tobacco use was restricted to a single product (Rigotti et al., 2000). Recent CDC youth surveillance data indicate a growing prevalence of alternative tobacco use among adolescents (Centers for Disease Control and Prevention, 2012). Nationwide, 7.7% of high school students had used smokeless tobacco (e.g., chewing tobacco, snuff, or dip) while 13.1% had smoked cigars, cigarillos, or little cigars and 18.1% had smoked cigarettes during the 30 days before the survey (i.e. current smokeless tobacco use, current cigar use and current cigarette use). The overall current tobacco use (current cigarette use, current smokeless tobacco use, or current cigar use) was reported to be 23.4% of high school students (Centers for Disease Control and Prevention, 2012). Another study by Gilpin and Pierce revealed that 51.9% of adolescent cigarette smokers surveyed had used alternative tobacco products within the past month (Gilpin & Pierce, 2003), with cigars being the most prevalent alternative tobacco product used at 42.9% (Bombard, Rock, Pederson, & Asman, 2008; Gilpin & Pierce, 2003; Nasim et al., 2012).

Alcohol and Marijuana Use Among Young Adult Tobacco Users

In other worldwide studies, findings show that tobacco together with alcohol and marijuana are among the most commonly used substances (Hendricks, Delucchi, Humfleet,

& Hall, 2012), with alcohol consumption and smoking often carried out as paired activities in young adults (McKee, Hinson, Rounsaville, & Petrelli, 2004). This age group has the highest rates of co-morbid tobacco and alcohol use (Falk, Yi, & Hiller-Sturmhofel, 2006; Harrison & McKee, 2011). A few studies have linked increased alcohol consumption to the use of alternative tobacco products (Bombard et al., 2007; Rigotti et al., 2000; Sutfin et al., 2011). The relationship between drinking and daily smoking has also been well characterized in young adults (Bobo & Husten, 2000; Hendricks et al., 2012; Schorling, Gutgesell, Klas, Smith, & Keller, 1994; Weitzman & Chen, 2005). Along the same line of thinking, nondaily smokers have also been shown to be more likely than nonsmokers to drink more alcohol, to drink more frequently, and to be current drinkers (Sutfin et al., 2012). In one of the few studies that reported concurrent alcohol use among daily and nondaily smokers in young adults, nondaily smokers were more likely to be hazardous drinkers and more likely to meet criteria for an alcohol use disorder than daily smokers (Harrison & McKee, 2011; Rocha et al., 2010).

Similarly, U.S. youth and young adults who use multiple tobacco products are more likely to use marijuana and illicit drugs than cigarette-only users (Bombard, Pederson, Koval, & O'Hegarty, 2009; Coogan, Geller, & Adams, 2000; Everett, Giovino, Warren, Crossett, & Kann, 1998; Everett, Malarcher, Sharp, Husten, & Giovino, 2000; Rantao & Ayo-Yusuf, 2012; Wickholm, Galanti, Soder, & Gilljam, 2003). A growing literature has also further documented the substantial prevalence of and putative mechanisms underlying co-occurring (i.e., concurrent or simultaneous) cannabis and tobacco use (Peters, Budney, & Carroll, 2012). In the same line of thought, simultaneous use of cannabis and tobacco (i.e., at the same time) is an increasingly popular practice (Akre, Michaud, Berchtold, & Suris, 2010; Golub, Johnson, & Dunlap, 2005), with an estimated 25% to 52% of tobacco smokers using

cannabis, and as many as 29% use cannabis at least weekly (Leatherdale, Ahmed, & Kaiserman, 2006; Peters et al., 2012).

Sociodemographic Correlates of Alternative Tobacco Product Use

Few studies have characterized the correlates for alternative tobacco products use both independently and concurrently with cigarettes. One of such studies revealed that total tobacco use was higher in men than in women (37.9% vs. 29.7%), despite nearly identical current cigarette smoking rates between both sexes (28.5% for women vs. 28.4% for men). This may be due to greater use of cigars (current prevalence, 15.7% vs. 3.9%) and smokeless tobacco (current prevalence, 8.7% vs. 0.4%) by men (Rigotti et al., 2000). Other studies have documented similar association between males and the use of other tobacco products concurrently with cigarettes (Backinger et al., 2008; Bombard et al., 2008) or as a single product (Rigotti et al., 2000; Sutfin et al., 2011).

Similarly, studies have reported that adults, non-Hispanic Whites and American Indians (Spangler et al., 2001) are more likely than their comparison groups to engage in multiple and alternative tobacco product use (Rigotti et al., 2000). A more recent study by Backinger et al. on the prevalence and correlates of multiple tobacco use among current U.S. adult smokers, demonstrate that multiple tobacco use tends to predominate among the young non-Hispanic White population with the strongest correlates for use being male and non-Hispanic White (Backinger et al., 2008). People of low socioeconomic status and those living in rural Southeastern U.S., Midwest, South, or West are also more likely than their comparison groups to engage in multiple and alternative tobacco use (Backinger et al., 2008; Bombard et al., 2008; Spangler et al., 2001; Wetter et al., 2002). This suggests that income

and geographic region are important correlates for alternative tobacco use (Backinger et al., 2008).

Psychosocial Correlates of Alternative Tobacco Product Use

Prior research has documented an association between social factors and alternative tobacco use (Rigotti et al., 2000). In a study on the prevalence and patterns of all tobacco use among college students, total tobacco use was significantly higher among students whose priorities were social rather than educational or athletic (Rigotti et al., 2000). In addition, cigar use was associated with students who rate fraternities and sororities and attending sporting events as important, while smokeless tobacco use was more commonly associated with intercollegiate athletes (Rigotti et al., 2000). Smokeless tobacco and their concurrent use with cigarettes have also been associated with depression in adults and adolescents (Coogan et al., 2000; Rantao & Ayo-Yusuf, 2012). Similarly, studies have documented a bidirectional relationship between depression and cigarette smoking, with depression increasing the risk for cigarette tobacco use (Carmody, 1989; Dierker, Avenevoli, Stolar, & Merikangas, 2002; Gilbert, 1979) and nicotine consumption having a neurochemical impact on the brain that increases the risk for depression (Choi & Dinitto, 2011; Dierker et al., 2002; Paperwalla, Levin, Weiner, & Saravay, 2004). Multivariate analysis in another study on multiple tobacco correlates revealed that use of more than one tobacco product was associated with being able to obtain cigarettes from a retailer and being subject to peer influence (Bombard et al., 2008). More recent findings documents that the use of alternative tobacco products such as hookahs and smokeless tobacco is associated with peer use of these products (Nasim et al., 2012). Having favorable beliefs about tobacco and perceptions of reduced harm of other tobacco products has also been associated with alternative tobacco product use.(Bombard et

al., 2008; O'Connor et al., 2007; Sutfin et al., 2011). Similarly, willingness to use tobacco promotional items and exposure to tobacco advertisements has been associated with the use of alternative tobacco products (Bombard et al., 2008). Understanding the correlates of alternative tobacco product use both independently and among current cigarettes smokers can aid in the development of strategies for tobacco prevention and cessation.

Justification and Study aim

Recent increases in the prevalence of alternative tobacco product use among young adults and an increased marketing of these products targeting this population has made it necessary to better understand the determinants of alternative tobacco product use among young adults. This would enable targeted intervention programs to be directed at specific determinants of alternative tobacco product use within the young adult population. Similarly, given the increased risk of mortality in individuals who use more than one tobacco product (Backinger et al., 2008; Wetter et al., 2002), understanding what category of smokers present the highest risk for alternative tobacco product use would inform cessation intervention programs targeting individuals who exhibit similar patterns of tobacco consumption, thus decreasing the risk of mortality from the possible synergistic effect of these tobacco products. Very few studies have examined the factors that influence the risk for alternative tobacco product use among this high risk population. Studies so far have been limited in the extent of associative variables used to examine the risk for alternative tobacco product use and the spectrum of alternative tobacco products considered. Moreover, some studies have yielded conflicting results on the relationship between certain sociodemographic factors including ethnicity and the use of alternative tobacco products among young adults. In addition, limited research to date has investigated the associations between cigarette smoking

status, alcohol use, marijuana use, and psychosocial factors in determining the risk for alternative tobacco product use among college students. Thus, this study aims to: (1) examine concurrent use of cigarettes, alternative tobacco products, and marijuana among college students; and (2) examine smoking status (i.e., nonsmoker, nondaily smoker [former daily vs. never daily], daily smoker) in relation to alternative tobacco product use, controlling for other substance use, sociodemographics, and psychosocial characteristics among college students. By so doing, the current research will identify the categories of college students at highest risk for alternative tobacco use. We hypothesize that risk factors for alternative tobacco product use will be nondaily smoking, alcohol and marijuana use, being male, and being non-Hispanic White.

III. **Methods**

A. Participants

Participants in this study were recruited from six colleges in the South East. Random samples of 5,000 students at each school (with the exclusion of two schools that had enrollment less than 5,000) were invited to complete the survey. In the schools that had less enrolment, all students were invited to participate in the study (total invited $N = 24,055$). Of the students who received the invitation to participate, 4,840 (20.1%) returned a completed survey. However, only the college students who were 18 – 25 years of age and had complete data on their smoking behavior were included in this study ($N = 4,348$) (Berg, Nehl, et al., 2011).

B. Measures

The measures used in this study were part of an online survey containing 230 questions assessing a variety of health topic areas, which took approximately 20–25 min to

complete (Berg, Nehl, et al., 2011). For the current investigation, only questions related to sociodemographic characteristics, alternative tobacco use, smoking behavior, psychosocial factors, and alcohol and marijuana use were included.

Sociodemographics. Sociodemographic characteristics assessed included students' age, gender, ethnicity, and school type. Ethnicity was categorized as non-Hispanic White, Black, or Other due to the small numbers of participants who reported other race/ethnicities (Berg, Nehl, et al., 2011). Type of school was categorized as four-year or two-year (community college) depending on the type of degree program predominantly offered (Labov, 2012).

Smoking Behaviors. To assess smoking status, students were asked, "In the past 30 days, on how many days did you smoke a cigarette (even a puff)?" This question has been used to assess tobacco use in the American College Health Association (ACHA) surveys, National College Health Risk Behavior Survey, and Youth Risk Behavior Survey, with well documented reliability and validity (ACHA, 2008; Berg, Nehl, et al., 2011; Centers for Disease Control and Prevention, 1997; Pinsker et al., 2012). They were also asked, "Have you ever smoked cigarettes daily, that is, at least one cigarette every day for 30 days?" Students were considered current smokers if they reported smoking at least once in the past 30 days of the past month. Among the current smokers, students were categorized as daily smokers if they reported smoking on all the 30 days of the past month versus nondaily smokers (i.e., those who smoked from 1 to 29 days of the past 30 days). This is consistent with how ACHA, Substance Abuse and Mental Health Association, and others have defined "daily smokers" (ACHA, 2009; Berg, Nehl, et al., 2011; Substance Abuse and Mental Health Services Administration, 2006). In addition, using these questions we further created four subgroups: 1) nonsmokers; 2) nondaily smokers who had never been daily smokers (i.e.,

never daily nondaily smokers [NDNS]); 3) nondaily smokers who were former daily smokers (i.e., former daily nondaily smokers [FDNS]); and 4) daily smokers. Similar smoking categorizations have been used in prior studies to assess smoking behaviors (Nguyen & Zhu, 2009; Pinsker et al., 2012).

Alternative Tobacco Use. The alternative tobacco products assessed in the survey were chewing tobacco, snuff, dip, cigars, little cigars, cigarillos, water pipe tobacco (hookah), snus and electronic cigars. They were asked, “During the past 30 days, on how many days did you: (1) use chewing tobacco, snuff, or dip, such as Beechnut, Skoal, Skoal Bandits, or Copenhagen? (2) Smoke cigars? (3) Smoke little cigars (such as Black and Milds)? (4) Smoke cigarillos (such as Swisher Sweets cigarillos)? (5) Smoke tobacco from a water pipe (hookah)? (6) Use snus?” These questions have been used to assess alternative tobacco use in the American College Health Association (ACHA) surveys, National College Health Risk Behavior Survey, and Youth Risk Behavior Survey, with well documented reliability and validity (ACHA, 2008; Centers for Disease Control and Prevention, 1997). They were categorized as users if they answered ‘yes’ to any of the questions, whereas nonusers were those who did not use any of the alternative tobacco products in the last 30 days.

Social Aspects of Smoking. To assess participants social experiences with smoking, students were asked “Out of your 5 closest friends, how many of them smoke?” (Berg, Nehl, et al., 2011; Maibach, Maxfield, Ladin, & Slater, 1996) and “Do you live with anyone who smokes cigarettes?” (Goldade et al., 2011).

Smoking Attitudes. Attitude toward smoking was assessed using the Smoking Attitudes Scale (Shore, Tashchian, & Adams, 2000). The Smoking Attitudes Scale is a 17-item questionnaire that asks participants to rate on a 7-point scale how strongly they agree (1=*strongly disagree*, 7 = *strongly agree*) with 17 smoking-related statements across four dimensions – interpersonal relationships with smokers, laws and societal restrictions on smoking in public places, health concerns, and the marketing and sale of cigarettes (Berg, Nehl, et al., 2011; Shore et al., 2000). Examples of questions in the scale include “all forms of cigarette advertising should be illegal,” “second-hand smoke is a legitimate health risk,” “nonsmokers should be more tolerant of smokers,” and “restricting smoking in public places is unfair to smokers.” Higher scores indicate more negative attitudes regarding smoking. The scale has good construct validity with significantly different scores produced for smokers and nonsmokers, such that smokers consistently report more favorable attitudes toward smoking (Berg, Nehl, et al., 2011; Shore et al., 2000). The scale has good construct validity and subscale alphas ranging from 0.69 to 0.88 in this sample, which is similar to prior research (Shore et al., 2000).

Classifying a Smoker Scale. The Classifying a Smoker Scale (Berg, Nehl, et al., 2011) is a 10-item scale designed to assess the rigidity or inclusiveness of individual schemas of what constitutes the label of “smoker”. Participants are asked to describe the extent to which they agreed with statements regarding which criteria needed to be met for an individual to be considered a smoker in terms of (a) smoking frequency; (b) contextual factors, such that smoking alone indicates being a smoker rather than smoking among others; (c) time since initiation; (d) whether one purchases or borrows cigarettes; (e) addiction and being able to easily quit; (f) whether smoking is habitual; and (g) personality and physical characteristics (1=*strongly disagree*, 7 = *strongly agree*) (Berg, Nehl, et al., 2011). Scale scores range from 10-70

with higher scores indicating stricter criteria in classifying a smoker. Higher Classifying a Smoker Scale scores were also related to being nondaily versus daily smokers and were significant predictors of current smoking (Berg, Nehl, et al., 2011). The scale yielded a Cronbach's alpha of 0.91 with a good construct, face, and concurrent validity (Berg, Nehl, et al., 2011).

Depression. Students were asked to fill out items from the Patient Health Questionnaire-2 (PHQ-2). The PHQ-2 is a two item version of the PHQ depression module based on the DSM-4 diagnostic criteria. The stem question is, "Over the last 2 weeks, how often have you been bothered by any of the following problems?" The 2 items are "little interest or pleasure in doing things" and "feeling down, depressed, or hopeless." Response options for each item are given a score of 0 (not at all) to 3 (nearly every day). The overall score ranges from 0 to 6 with a total score ≥ 3 signifying clinical depression (Kroenke, Spitzer, & Williams, 2003). The construct and criterion validity of this scale as a measure for depression screening has been well established (Kroenke et al., 2003).

Sensation Seeking. The Brief Sensation Seeking Scale-4 was used to assess sensation seeking among participants. Participants were asked to indicate the extent to which they agree or disagree with items on the scale on a 5-point likert scale (1=*strongly disagree* to 5=*strongly agree*). Higher scores indicate a greater tendency to be a sensation seeker. The reliability and validity of this scale for screening and large scale surveys have been documented (Stephenson, Hoyle, Palmgreen, & Slater, 2003). Cronbach's alpha in this study was 0.75.

Alcohol and Marijuana Use. To assess the use of alcohol and binge drinking, participants were asked "in the past 30 days, on how many days did you drink alcohol?" and

“In the past 30 days, on how many of those days did you drink more than 5 alcoholic drinks on one occasion?” Drink was explained to mean a can or bottle of beer, a glass of wine or a wine cooler, a shot of liquor, or a mixed drink with liquor in it and not how many times individuals had a sip or two from a drink. Marijuana use was assessed using the question “During the last 30 days, on how many days did you use marijuana (pot, weed, hashih, hash oil)?” Participants were categorized as marijuana users if they had used marijuana at least once in the last 30 days and non-marijuana users if they had not used marijuana in the last 30 days. These questions have been used to assess alcohol and marijuana use in the American College Health Association (ACHA) surveys, National College Health Risk Behavior Survey, and Youth Risk Behavior Survey, with well documented reliability and validity (ACHA, 2008; Centers for Disease Control and Prevention, 1997).

C. Procedure

Students at six colleges in the Southeastern U.S. were randomly recruited to complete an online survey in October 2010 (Berg, Nehl, et al., 2011). Students received an E-mail containing a link to the consent form with the alternative of opting out. Students who consented to participate were directed to the online survey. To encourage participation, students received up to three E-mail invitations to participate. Online survey took about 20-25 minutes to complete. As an incentive for participation, all students who completed the survey received entry into a drawing for cash prizes of \$1,000 (one prize), \$500 (two prizes), and \$250 (four prizes) at each participating school (Berg, Nehl, et al., 2011). The present study focused on students aged 18–25 years who had complete smoking data. The analyses were conducted on a final sample size of $N = 4,348$. The Emory University Institutional Review Board approved this study, IRB# 00030631 (Berg, Nehl, et al., 2011).

D. Analysis

Participant characteristics were summarized using descriptive statistics. Bivariate comparisons utilizing a *two-tailed* test of significance between alternative tobacco product users and nonusers were conducted using *chi-square* test for categorical variables and *t-test and ANOVA* for continuous variables. To examine concurrent use of cigarettes, alternative tobacco products, and marijuana, we summarized the proportions of past 30 day use of various tobacco products and marijuana and examined their concurrent use using descriptive statistics. Sequential logistic regression analyses were conducted to examine the association between current smoking status and alternative tobacco product use. The crude regression model (Model A) examined the relationship between alternative tobacco product use and cigarette smoking status (daily vs. nondaily). Potential influence of confounders on the primary outcomes of interest (alternative tobacco use and non-use) was subsequently controlled for by entering age, gender, ethnicity, type of school, number of friends that smoke, living with a smoker, depressive symptoms, attitudes toward smoking, classifying a smoker scale scores, sensation seeking, number of days of alcohol use in past 30 days, and any marijuana use in the past 30 days into the adjusted model (Model B). To further examine the associations between subgroups of cigarette smokers and alternative tobacco product use, the categories of nondaily cigarette smokers (FDNS and NDNS) and daily smokers were entered into a regression, excluding nonsmokers. Sequential multiple logistic regression analysis estimated the effect of the association between alternative tobacco products use and smoking subcategories among smokers (model A: crude model; model B: adjusted model). Odd ratio estimates and confidence intervals were reported. This study utilized the non-interaction logistic regression model in its analyses. PASW 19.0 statistical software was used for all data analyses. Significance level was set at $\alpha = 0.05$ for all statistical tests.

IV. Results

Table 1 presents participant characteristics and bivariate comparisons between alternative tobacco product users and nonusers. Average age of students who participated in the study was 23.5 years (SD=7.1 years). Males comprised 28.7% of total participants and females 71.3%. Overall, 18.0% (n=781) of all participants reported use of alternative tobacco products within the last 30 days (users). The most common alternative tobacco product used was little cigars (10.0%), followed by cigarillos (5.0%), hookah (4.3%), cigars (3.7%), chew (2.9%), and snus (0.9%).

Bivariate Analyses

There was a statistically significant difference between alternative tobacco product users versus nonusers in relation to smoking status, such that current smokers vs. nonsmokers were more likely to use alternative tobacco products ($p<0.001$). Other predictors of using alternative tobacco products included being younger ($p<0.001$), being male ($p<0.001$), having more friends that smoke ($p<0.001$), living with a smoker ($p<0.001$), significant depressive symptoms ($p<0.001$), lower attitudes toward smoking scores ($p<0.001$, exhibiting less negative attitudes toward smoking), higher classifying a smoker scale scores ($p<0.001$, exhibiting stricter criteria for classifying smokers), higher sensation seeking scores ($p<0.001$), more frequent alcohol consumption ($p<0.001$), and greater likelihood of binge drinking ($p<0.001$) and marijuana use ($p<0.001$).

Concurrent Tobacco Use

Table 2 examines concurrent past 30 day use of various tobacco products and marijuana among participants. Results show that 66.9% of chew or snus users; 57.2% of

cigars, little cigars, cigarillos users; 61.4 % of hookah users; and 50.4% of marijuana users were also concurrent cigarette smokers. Similarly, participants who reported using one form of tobacco product also concurrently used other alternative tobacco products. For example, 36.3%, 13.6%, and 30.3% of chew or snus users concurrently used cigars, little cigars, cigarillos; hookah; and marijuana, respectively. Similarly, 10.7%, 49.2%, and 46.5% of hookah users concurrently used chew or snus; cigars, little cigars, cigarillos; and marijuana, respectively.

Multivariate Analyses

Sequential logistic regression examining factors associated with alternative tobacco product use among all participants are reported in Table 3. The crude model (Model A) examined the association between the outcome variable – alternative tobacco product use – and the exposure variable – smoking status, demonstrating that nondaily and daily smokers were at increased risk of alternative tobacco use (OR=9.70, 95% Confidence [CI]: 7.87-12.07; $p<0.001$; OR=4.33, CI: 3.39-5.54; $p<0.001$, respectively). After adjusting for the aforementioned covariates (Model B), the odds of using alternative tobacco products was higher among nondaily smokers and daily smokers in comparison to nonsmokers (OR=6.43, CI: 4.92-8.40; $p<0.001$; OR=2.79, CI: 1.92-4.05; $p<0.001$, respectively). In addition, younger age ($p<0.001$), being male ($p<0.001$), being Black ($p<0.001$), lower attitudes towards smoking scores ($p<0.001$), higher sensation seeking scores ($p=0.008$), higher classifying a smoker scale scores ($p=0.004$), more frequent alcohol use ($p<0.001$), and recent marijuana use ($p<0.001$) were all significantly associated with alternative tobacco product use.

Table 4 presents the binary logistic regression examining factors associated with alternative tobacco product use among current smokers. Alternative tobacco product use

was associated with being NDNS vs. FDNS (OR=0.47, CI: 0.31, 0.73, $p=0.001$) or daily smokers (OR=0.34, CI: 0.21, 0.54, $p<0.001$), after controlling for all possible covariates in the adjusted model (Model B). In addition, younger age ($p<0.001$), being male ($p<0.001$), being Black ($p<0.001$), and any marijuana use in the past 30 days ($p=0.002$) were associated with alternative tobacco product use among current smokers.

V. Discussion

A. Findings

Despite decreasing trend in cigarette use, other forms of tobacco products have emerged in the U.S. market and have become increasingly popular especially among young adults (Bombard et al., 2007; O'Connor et al., 2007; Substance Abuse and Mental Health Services Administration, 2012). If this current trend persists, it may reverse major public health successes in tobacco control and cessation. To effectively address this current trend in alternative tobacco use among young adults, we must identify the factors that influence the use of these tobacco products among this population. Prior studies have extensively documented cigarette smoking predictors among young adults (Backinger et al., 2008; Centers for Disease Control and Prevention, 1997; Rigotti et al., 2000; Wetter et al., 2002). This study therefore presents novel findings on alternative tobacco product use among college students. Specifically, the current research indicates that NDNS are the group of current smokers most at risk for alternative tobacco product use, with FDNS and daily smokers being more at risk than nonsmokers. We also identified other important psychosocial factors (e.g., schemas of a smokers) not previously examined in relation to alternative tobacco product use.

Smoking Status

In terms of smoking status, first we examined the prevalence of alternative tobacco product use among different categories of smokers and nonsmokers. We found that the use of alternative tobacco was predominantly highest among nondaily smokers. Over half of nondaily smoking participants (52.2%) reported using other forms of tobacco within the last 30 days compared with about a third of daily smokers and approximately a tenth of nonsmokers. This is consistent with prior research findings indicating that alternative tobacco product use is most prevalent among nondaily and social smokers (Nasim et al., 2012; Sutfin et al., 2012). Second, we investigated the association between smoking categories and alternative tobacco product use. We also found that, among current smokers, NDNS were significantly more likely to use alternative tobacco products than FDNS and daily smokers.. This suggests that smokers who had never smoked daily but continue chronic low level cigarette consumption or social smoking have the highest association with alternative tobacco use. NDNS may be exposed to higher levels of tobacco and nicotine consumption through using alternative tobacco products concurrently, thus potentially increasing their risk of progressing to regular or daily tobacco use (Hoek et al., 2012; Rigotti et al., 2000; Wetter et al., 2002). FDNS, on the other hand, may represent part of a labile continuum between daily smoking and becoming former smokers (Berg et al., 2012; Evans et al., 1992; Okuyemi et al., 2002; Zhu et al., 2003). This category of nondaily cigarette smokers presents a greater odd for using other tobacco products compared with daily cigarette smokers. This may increase the chances of daily cigarette smoking relapse among this population of nondaily smokers (Rigotti et al., 2000). One explanation for the findings documented may be that college students who are NDNS present the group with the highest tendency to experiment with other forms of tobacco. Prior studies have documented that

young adults continue to experiment with multiple forms of tobacco or initiate use into their 20s (Backinger et al., 2008; Hammond, 2005). Similarly, nondaily smokers have been shown to perceive smoking as less harmful when compared with daily smokers and are less likely to consider themselves as smokers (Berg, Nehl, et al., 2011). It is therefore possible that this category of smokers may possess similar perceptions towards alternative tobacco products and may thus be readily willing to try out other forms of tobacco being marketed as less harmful. Future longitudinal studies should aim to determine the direction of the relationship between smoking and alternative tobacco product use.

Concurrent Tobacco Use

Our investigation reveal that participants using one form of tobacco product were also consuming other forms of alternative tobacco products. Cigarettes were the most common tobacco products used in general and in combination with other forms of tobacco products. This is consistent with prior studies that have shown that alternative tobacco products are predominantly used concurrently with cigarettes (Rigotti et al., 2000). Consistent with prior studies, we found that among participants who used cigars, little cigars, and cigarillos were the second most prevalent tobacco product concurrently used (Rigotti et al., 2000), closely followed by hookahs. Recent prevalence data from national surveys have shown similar distribution in tobacco product usage among young adults (Substance Abuse and Mental Health Services Administration, 2012). Although young adults within this age group have been shown to experiment with multiple forms of tobacco (Hammond, 2005), increased marketing of these alternative tobacco products as less harmful alternatives to cigarettes (Backinger et al., 2008) may encourage multiple use among susceptible individuals. Moreover, the erroneous perception of reduced harm may have led to an increased social acceptability of alternative tobacco products and the proliferation of their use among young

adults (Sutfin et al., 2011). Furthermore, it is possible that the onset of nicotine dependence following initiation of tobacco use may foster the concurrent use of multiple forms of tobacco in order to maintain the threshold for dependency. This in addition to policies that promote rising cost of cigarettes through increased cigarette taxation (Baumgardner et al., 2012; Bombard et al., 2007) may motivate college cigarette smokers to gravitate towards using other less expensive tobacco products in combination with cigarettes. Our findings thus serve to inform future qualitative research on the reasons underlying concurrent tobacco use among college students.

Alcohol and Marijuana Use

This study reveals that participants who used alternative tobacco products on the average consumed alcohol on more number of days than non alternative tobacco products users. Similarly a higher proportion of alternative tobacco users reported binge drinking within the last month. Consistent with prior research alcohol use on more number of days was significantly associated with alternative tobacco product use (Bombard et al., 2007). Previous studies have linked increased alcohol consumption to cigar, smokeless tobacco (Rigotti et al., 2000), and hookah use (Sutfin et al., 2011). This study stands out in that it utilizes a wider variety of alternative tobacco products and includes important sociodemographic and psychosocial characteristics in its analysis. In addition, our categorization of alternative tobacco use allowed us to explore this pattern of use as a distinct category of tobacco use different from cigarette smoking. Moreover, the relationship between drinking and cigarette smoking has been well characterized in the literature (Bobo & Husten, 2000; Hendricks et al., 2012; Rigotti et al., 2000; Sutfin et al., 2012). Prior research has documented that alcohol is directly associated with cigarette smoking (Bobo & Husten, 2000; Sutfin et al., 2012; Weitzman & Chen, 2005) and increases the urge to smoke especially

among nondaily smokers (Epstein, Sher, Young, & King, 2007). Perhaps this increased urge to smoke following alcohol consumption may also apply to the use of alternative tobacco products, serving to motivate college students to use a variety of readily available tobacco products. On the other hand, tobacco use and nicotine administration have been shown to increase alcohol consumption (Barrett, Tichauer, Leyton, & Pihl, 2006; Campbell, Bozec, McGrath, & Barrett, 2012). Research has documented a reciprocal relationship between alcohol use and tobacco smoking, with each drug increasing the reinforcing properties of the other (Harrison & McKee, 2011; Rose et al., 2004). Longitudinal studies are needed to determine the direction of association between alternative tobacco use and the frequency of alcohol consumption. However, it is important to note that, contrary to our findings in the sample of nonsmokers and smokers, the relationship between alternative tobacco product use and frequency of alcohol consumption was not significant among college cigarette smokers. These complex relationships are difficult to explain and deserve further research.

In addition, we assessed for associations between marijuana use and the use of alternative tobacco products. Interestingly, marijuana use was the second greatest predictor of alternative tobacco use next to nondaily cigarette smoking in the combined student population and among college students who smoked cigarette. Prior studies have documented similar associations with individual tobacco products including hookah (Sutfin et al., 2011), cigars, and smokeless tobacco (Rigotti et al., 2000). This study presents novel findings utilizing a variety of alternative tobacco products. Similar previous documentation demonstrates that heavier marijuana use is associated with heavier tobacco use (Ramo, Delucchi, Hall, Liu, & Prochaska, 2013). Prior studies have also documented that the effects of marijuana could either be substitution (where tobacco use is replaced with marijuana) or facilitation leading to increased tobacco consumption (Ramo et al., 2013). In addition, it is

highly likely that cigar papers and pipes are being used to deliver both tobacco and marijuana, perhaps within the same smoking session. Unfortunately, youths have been shown to most likely relapse into tobacco use while smoking marijuana (Amos, Wiltshire, Bostock, Haw, & McNeill, 2004; Ramo et al., 2013). The mechanisms for these effects and the association seen in this study may not be completely understood. However, it is possible that reduced inhibition from cannabis smoking may predispose young adults to initiate and continue using multiple forms of tobacco products. It is also important to note that a reverse causal relationship may exist between marijuana use and alternative tobacco use. In fact, studies have implicated tobacco use as a gate way drug to the use of marijuana and other illicit drugs (Beenstock & Rahav, 2002; Ramo et al., 2013). The temporal relationship between alternative tobacco use and marijuana thus deserves further research in future longitudinal studies.

Psychosocial factors

Concerning young adult's schemas regarding a smoker, we found that college students who exhibited stricter criteria for classifying smokers had higher odds of using alternative tobacco products. No previous study has investigated the relationship between young adult schemas for classifying smokers and alternative tobacco product use. Berg et al in 2011 documented similar findings with relation to cigarette smoking (Berg, Nehl, et al., 2011). One possibility for this finding may be that young adults who use alternative tobacco products like their nondaily cigarette smoking counterparts do not perceive themselves to be smokers; therefore, they hold stricter criteria for defining smokers. These criteria thus exclude them from meeting the requirements to self identify as a smoker.

Consistent with previous studies on attitude towards smoking (Pinsker et al., 2012; Shore et al., 2000), we found that a more favorable attitude toward smoking related topics

among college students was associated with the use of alternative tobacco products. Similar results from studies on hookah use have documented that positive perceptions towards hookah smoking are a significant predictor of current hookah use (Nasim et al., 2012). One explanation may be that young adults may perceive alternative tobacco products as less harmful. This may explain the similarity in findings seen between the use of alternative tobacco product and cigarette tobacco use as regards attitudes towards smoking related topics. Given the increased marketing of alternative tobacco product targeting young adults, intervention programs that change the belief and attitude of college students towards smoking may be pivotal in reducing the use of alternative tobacco products and tobacco use in general.

The current findings also show that a greater proportion of participants who reported significant levels of depressive symptoms used alternative tobacco products. However, after controlling for confounding variables, no relationship was found between depression and alternative tobacco use. This is contrary to previous documentations that have associated depression with smokeless tobacco use, the dual use of smokeless tobacco and cigarettes (Coogan et al., 2000; Rantao & Ayo-Yusuf, 2012), and cigarette only use (Carmody, 1989; Dierker et al., 2002; Gilbert, 1979). Other studies have also documented a bidirectional association between depression and cigarette use (Choi & Dinitto, 2011; Dierker et al., 2002; Paperwalla et al., 2004). This study adds to the sparse literature on the associations that exists between depression and alternative tobacco product use. Further research is needed to clarify this relationship. Findings in this study highlight the importance of tailoring tobacco cessation programs to specific types of tobacco use as predictors of alternative tobacco product use may differ completely from predictors of cigarette tobacco

use. Therefore, cessation interventions targeting cigarette smoking may not be effective for users of alternative tobacco products.

Sociodemographics

Consistent with previous research, a younger age was significantly associated with the use of alternative tobacco products (Backinger et al., 2008; Bombard et al., 2007; Sanchez, 2001). Prior studies have also linked younger age with marijuana and other substance use (Ramo & Prochaska, 2012; Substance Abuse and Mental Health Services Administration, 2010). However, a similar study conducted on the same population of college students reported associations between being older and cigarette smoking for both two-year and four-year colleges (Berg, Nehl, et al., 2011). One explanation for this might be that younger college students may find alternative tobacco product use more appealing than cigarette smoking. Alternatively, youths at a younger age may exhibit personality traits that make them more adventurous and vulnerable to adopting negative health behaviors including the use of alternative tobacco products. In addition, similar work done on the relationship between gender and tobacco consumption (Backinger et al., 2008; Bombard et al., 2007; Nasim et al., 2012; Rigotti et al., 2000), support the current research findings that males were significantly more associated with the use of alternative tobacco products than females. However among cigarette smokers, gender showed a weak association with alternative tobacco product use, with females demonstrating a slightly weaker tendency toward alternative tobacco product use than males. This suggests that gender may be a less effective predictor of alternative tobacco product use among college students who smoke cigarettes than in the general population of students. Furthermore, the current study reveals that Blacks were significantly more likely to use alternative tobacco products compared with Whites and other ethnicities.

B. Conclusion

Alternative tobacco product use is an increasingly common practice among college students in the United States. Specifically the present findings indicate that younger Black males who are never-daily nondaily smokers and use marijuana are the group of current college smokers with the highest risk for alternative tobacco product use. Future public health and clinical interventions should identify and target this pattern of tobacco use in its tobacco cessation efforts. In addition, targeting populations with the highest risk for alternative tobacco use may present a reasonable strategy to leverage existing tobacco control initiatives.

C. Limitations

Despite the important findings reported, the current study has some limitations. First, the response rate of 20.1% reported in this study may raise concerns about responder bias. However, several studies have documented similar response rates (29-32%) with internet surveys (Kaplowitz, 2004) among the general population and a wide range of response rates (17-52%) among college students (Crawford, 2008). We were unable to determine students who had inactive E-mail accounts or did not open the invitation E-mail. This may have impacted the true “denominator” for what this response rates might have been. In addition, studies have shown that internet surveys despite its low response rates are comparable to mail and phone surveys, producing similar statistics regarding health behaviors (An et al., 2007; Kaplowitz, 2004). Second, the survey sample was made up largely of females and selection of participants was limited to colleges in the Southeast. Although this sample was reflective of the characteristics of each schools population, our results may not generalize to other college populations in the United States (Berg, Nehl, et al., 2011).

This study is further limited in the self reported nature of its data. The possibility for socially desirable responses cannot be excluded due to the sensitive nature of reporting one's smoking and other substance use behavior. We also recognize that the large sample size although desirable for increased power to detect statistical differences may have influenced our ability to identify significant associations even though these associations may be subtle or otherwise insignificant. The current study also did not assess the possibility of obtaining different effect estimates with varying categories of a predictor variable. This interaction effect should be explored in future studies. In addition, this study was limited in the number of confounding variables assessed. Nicotine dependence and socioeconomic status may be important confounders for future consideration. Finally, the current study is limited in its ability to infer causation due to the cross sectional nature of the study design. Consequently, the temporal relationship and direction of associations reported could not be determined.

E. Implications for Research and Practice

Alternative tobacco product use is becoming increasingly popular among US college students and young adults (Bombard et al., 2007; O'Connor et al., 2007; Substance Abuse and Mental Health Services Administration, 2012). This study's novel findings present evidence to show that alternative tobacco product use among college students is a distinct pattern of tobacco use that differs from cigarette smoking. Furthermore, the findings demonstrate contrasting differences in predictors associated with alternative tobacco use and those previously reported for cigarette smoking. However, most existing tobacco control interventions primarily address cigarette smoking and do not address the use of other tobacco products (Bombard et al., 2007; Task Force on Community Preventive Services, 2001). This suggests that current tobacco programs may be limited in their efficacy when

applied to a population of alternative tobacco users. In addition, future tobacco control programs may be required to increasingly target other forms of tobacco use given the recent proliferation of alternative tobacco products such as hookah use among US young adults (Maziak, 2011; Primack, Aronson, & Agarwal, 2006; Substance Abuse and Mental Health Services Administration, 2012; Sutfin et al., 2011). Current clinical and public health tobacco interventions should therefore identify alternative tobacco use as a distinct category of tobacco consumption and incorporate effective measures addressing its use across the usage continuum from initiation to cessation. This has the potential to increase the effectiveness of future tobacco control and cessation interventions.

The current research also provides evidence to support multiple tobacco use among college students. Young adults who concurrently use more than one tobacco products are at an increased risk for developing tobacco related morbidity and mortality than single tobacco users and cigarette only users (Backinger et al., 2008; Wetter et al., 2002). In addition to increasing the population burden of lung cancers and other tobacco related illnesses, multiple users have the potential to cause increased economic burden resulting from tobacco related hospitalizations and morbidity. Tobacco control interventions should therefore prioritize and target these young adult multiple users in its tobacco cessation efforts.

This study provides evidence to suggest that college students who use alternative tobacco products may not consider themselves to be smokers. Similarly, young adult perceptions toward alternative tobacco product use may differ from perceptions toward cigarette smoking. However, previous smoking scales measuring individual attitudes towards smoking (Shore et al., 2000), social aspects of smoking (Berg, An, et al., 2011; Maibach et al., 1996) and schemas for classifying a smoker (Berg, Nehl, et al., 2011) have been particularly inclined towards cigarette smoking. Future researchers may consider refining the existing

language used in these smoking scales or incorporate measures specific to alternative tobacco use in the development of scales measuring tobacco smoking constructs. This may provide further validation for these scales.

Finally, current legislative, marketing and environmental tobacco control policies should consider including non-cigarette tobacco products restrictions to complement existing tobacco control initiatives. This may discourage the use of alternative tobacco products in situations when cigarettes cannot be used (Bombard et al., 2007). In addition, the relationship between marijuana and tobacco consumption should be considered by policy makers when enacting marijuana laws. The current study shows a strong association between marijuana use and alternative tobacco product consumption. Young adults may therefore initiate and increase the use of tobacco products while consuming marijuana (Amos et al., 2004; Ramo et al., 2013). In the event that increased cannabis consumption accompanies legislation to legalize marijuana, corresponding increased tobacco consumption among young adults may have a huge impact on current tobacco control efforts and the population burden of tobacco related diseases. Alternatively, public health interventions may seek to identify and target marijuana use as a risk factor for the use of alternative tobacco products. Future longitudinal research is however necessary to understand this relationship further.

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Table 1. Participant characteristics and bivariate comparisons between alternative tobacco product users and nonusers

Variable	All participants N = 4,348 (100.0%)	No alternative tobacco product use N = 3,567 (82.0%)	Alternative tobacco product use N = 781 (18.0%)	p-value
<i>Sociodemographics</i>				
Age (SD)	23.50 (7.10)	23.78 (7.32)	22.25 (5.79)	<.001
Gender (%)				<.001
Male	1,247 (28.7)	875 (24.5)	372 (47.6)	
Female	3,101 (71.3)	2,692 (75.5)	409 (52.4)	
Ethnicity (%)				.30
White	1,984 (45.6)	1,611 (45.2)	373 (47.8)	
Black	1,692 (38.9)	1,407 (39.4)	285 (36.5)	
Other	672 (15.5)	549 (15.4)	123 (15.7)	
School Type (%)				.16
Four-year	2,710 (62.3)	2,206 (61.8)	504 (64.5)	
Two-year	1,638 (37.7)	1,361 (38.2)	277 (35.5)	
<i>Tobacco use, past 30 days</i>				
Smoking status (%)				<.001
Nonsmoker	3,323 (76.4)	2,984 (83.7)	339 (43.4)	
Nondaily smoker	581 (13.4)	278 (7.8)	303 (38.8)	
Daily smoker	444 (10.2)	305 (8.6)	139 (17.8)	
Chew	125 (2.9)	--	--	--
Snus	39 (0.9)	--	--	--
Cigars	162 (3.7)	--	--	--
Little cigars	436 (10.0)	--	--	--
Cigarillos	216 (5.0)	--	--	--
Hookah	186 (4.3)	--	--	--

Psychosocial factors

Number of friends that smoke (SD)	1.47 (1.57)	1.33 (1.52)	2.10 (1.63)	<.001
Live with a smoker (%)				<.001
No	3,267 (75.1)	2,739 (76.8)	528 (67.6)	
Yes	1,081 (24.9)	828 (23.2)	253 (32.4)	
Attitudes Toward Smoking (SD)	88.08 (18.07)	90.23 (17.41)	78.24 (17.78)	<.001
Classifying a Smoker Scale (SD)	39.02 (16.74)	38.09 (17.17)	40.97 (14.48)	<.001
PHQ-2: Depressive symptoms (%)				<.001
No	3588 (91.4)	3003 (92.2)	585 (87.6)	
Yes	336 (8.6)	253 (7.8)	83 (12.4)	
Sensation Seeking (SD)	3.32 (0.90)	3.26 (0.90)	3.59 (0.86)	<.001
<i>Substance use, past 30 days</i>				
Number of days of alcohol use (SD)	3.28 (5.16)	2.71 (4.65)	5.86 (6.43)	<.001
Any binge drinking (%)				<.001
No	3371 (77.5)	2927 (82.1)	444 (56.9)	
Yes	977 (22.5)	640 (17.9)	337 (43.1)	
Any marijuana use (%)				<.001
No	3738 (86.4)	3281 (92.4)	457 (56.8)	
Yes	588 (13.6)	268 (7.6)	320 (41.2)	

Table 2. Concurrent past 30 day use of various tobacco products and marijuana

Tobacco Product (%)	Cigarettes N = 1,025 23.6%	Chew or snus N = 148 3.4%	Cigars, little cigars, cigarillos N = 605 13.8%	Hookah N = 186 4.3%	Marijuana N = 588 13.6%
Cigarettes	--	9.5	33.6	11.1	29.3
Chew or snus	66.9	--	36.3	13.6	30.3
Cigars, little cigars, cigarillos	57.2	8.8	--	15.2	45.9
Hookah	61.4	10.7	49.2	--	46.5
Marijuana	50.4	7.3	46.9	14.5	--

Note: Column proportions indicate proportion of users represented by column header (e.g., 66.9% of chew or snus users are also cigarette users).

Table 3. Binary logistic regression model indicating factors associated with alternative tobacco product use among college students

Variable	Model A			Model B		
	OR	CI	p	OR	CI	p
Smoking status						
Nonsmoker	Ref	--	--	Ref	--	--
Nondaily smoker	9.74	7.87, 12.07	<.001	6.43	4.92, 8.40	<.001
Daily smoker	4.33	3.39, 5.54	<.001	2.79	1.92, 4.05	<.001
Age				0.96	0.94, 0.98	<.001
Gender						
Male				Ref	--	--
Female				0.41	0.33, 0.51	<.001
Ethnicity						
White				Ref	--	--
Black				1.73	1.37, 2.24	<.001
Other				1.36	1.01, 1.84	.02
Type of school						
Four-year				Ref	--	--
Two-year				0.95	0.75, 1.22	.71
Number of friends that smoke				1.06	0.98, 1.15	.13
Live with a smoker						
No				Ref	--	--
Yes				0.87	0.68, 1.11	.26
Attitudes Toward Smoking				0.98	0.97, 0.99	<.001
Classifying a Smoker Scale				1.02	1.01, 1.03	.004
PHQ-2: Depressive symptoms						
No				Ref	--	--
Yes				1.15	0.83, 1.60	.41
Sensation Seeking				1.14	1.02, 1.27	.008
Number of days of alcohol use, past 30 days				1.05	1.03, 1.07	<.001
Marijuana use, past 30 days				4.00	3.13, 5.12	<.001

Model A: Nagelkerke $R^2 = 0.195$; Model B: Nagelkerke $R^2 = 0.351$

Table 4. Binary logistic regression model indicating factors associated with alternative tobacco product use among current smokers

Variable	Model A			Model B		
	OR	CI	p	OR	CI	p
Smoking status						
Never daily nondaily smoker	Ref	--	--	Ref	--	--
Former daily nondaily smoker	0.45	0.31, 0.65	<.001	0.47	0.31, 0.73	.001
Daily smokers	0.31	0.22, 0.44	<.001	0.34	0.21, 0.54	<.001
Age				0.93	0.91, 0.96	<.001
Gender						
Male				Ref	--	--
Female				0.29	0.21, 0.41	<.001
Ethnicity						
White				Ref	--	--
Black				2.86	1.81, 4.54	<.001
Other				1.29	0.81, 2.07	.29
Type of school						
Four-year				Ref	--	--
Two-year				1.04	0.73, 1.50	.82
Number of friends that smoke				1.05	0.93, 1.18	.47
Live with a smoker						
No				Ref	--	--
Yes				1.08	0.77, 1.51	.66
Attitudes Toward Smoking				0.99	0.98, 0.99	.05
Classifying a Smoker Scale				1.01	1.00, 1.02	.13
PHQ-2: Depressive symptoms						
No				Ref	--	--
Yes				1.10	0.69, 1.77	.68
Sensation Seeking				1.12	0.94, 1.35	.21
Number of days of alcohol use, past 30 days				1.00	0.98, 1.03	.96
Marijuana use, past 30 days				1.78	1.24, 2.57	.002

Model A: Nagelkerke $R^2 = 0.076$; Model B: Nagelkerke $R^2 = 0.290$