

Prevalence of alternative forms of tobacco use in a population of young adult military recruits[☆]

Mark W. Vander Weg^{a,b,*}, Alan L. Peterson^{c,d}, Jon O. Ebbert^e, Margaret DeBon^f,
Robert C. Klesges^{f,g}, C. Keith Haddock^h

^a Center for Research in the Implementation of Innovative Strategies in Practice (CRIISP), VA Medical Center,
601 Highway 6 West, Mail Stop 152, Iowa City, IA 52246, United States

^b University of Iowa Carver College of Medicine, Department of Internal Medicine, 200 Hawkins Drive,
Iowa City, IA 52242, United States

^c University of Texas Health Sciences Center at San Antonio, Department of Psychiatry, 7703 Floyd Curl Drive,
San Antonio, Texas 78229, United States

^d Wilford Hall Medical Center, 59th Medical Wing, 2200 Bergquist Dr. Suite 1, Lackland AFB, TX 78236, United States

^e Mayo Clinic College of Medicine, 200 First Street SW, Rochester, MN 55905, United States

^f University of Tennessee Health Science Center, 66 N. Pauline Street, Suite 633, Memphis, Tennessee 38163, United States

^g St. Jude Children's Research Hospital, 332 N. Lauderdale Memphis, TN 38105, United States

^h University of Missouri — Kansas City, Department of Informatic Medicine and Personalized Health,
Western Missouri Mental Health Center, 1000 East 24th Street, Kansas City, MO 64108, United States

Abstract

Recent evidence suggests that the popularity of certain alternative forms of tobacco may be increasing in adolescents. Little is known, however, about the use of these products among young adults. This study examined the use of alternative tobacco products including bidis, cigars, kreteks (clove cigarettes), pipes, and smokeless tobacco in a large sample of young adult military recruits ($N=31\,107$). Overall, 18.5% of participants were using some form of alternative tobacco product prior to entry into Basic Military Training. Results revealed a relatively high prevalence of cigar (12.3%) and smokeless tobacco use (6.7%). Use of other products was less common, including 1.1% for pipes, 2.0% for bidis, and 3.0% for kreteks. With the exception of kreteks, which did not differ

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* Corresponding author. VA Medical Center, 601 Highway 6 West, Mail Stop 152, Iowa City, IA 52246, United States. Tel.: +1 319 338 0581x7717; fax: +1 319 887 4932.

E-mail addresses: mark.vanderweg@va.gov (M.W. Vander Weg), peterona3@uthsca.edu (A.L. Peterson), ebbert.jon@mayo.edu (J.E. Ebbert), mdebon@utm.edu (M. DeBon), bob.klesges@stjude.org (R.C. Klesges), HaddockC@umkc.edu (C.K. Haddock).

by gender, the prevalence of use of alternative tobacco products was greater for males than for females ($p < .001$). Patterns of use also differed according to other demographic characteristics including race, ethnicity, age, and income. Implications for surveillance and tobacco control efforts are discussed.

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1. Introduction

Tobacco use remains the leading preventable cause of disease and death in the United States, accounting for an estimated 440 000 deaths each year (Mokdad, Marks, Stroup, & Gerberding, 2004; US DHHS, 2004). The prevalence of cigarette smoking among young adults in the U.S. declined substantially over the past four decades, dropping from 45.5% in 1965 to 24.4% in 2005 (American Lung Association, 2006; CDC, 2006a). Over this same time period, however, an increase in the use of several alternative tobacco products was observed, particularly among youth (Baker et al., 2000; CDC, 2003; Nyman, Taylor, & Biener, 2002; Soldz, Huyser, & Dorsey, 2003). These findings suggest that cigarettes may be getting substituted or replaced, at least in part, by other forms of tobacco use. Even more concerning is the possibility that individuals who would otherwise not be exposed to tobacco from cigarettes are now increasing their health risks due to the use of these other products (Soldz et al., 2003), or that alternative forms of tobacco use might serve as an initial pathway to nicotine addiction that eventually culminates with cigarette smoking.

Smokeless tobacco (ST) refers to tobacco that is typically consumed orally and is not burned. A variety of types of ST are consumed throughout the world. In the United States, the principal types of ST are chewing tobacco (cut tobacco leaves) and snuff (moist ground tobacco). In Sweden, “snus” (finely ground moist tobacco) is used. In India, ST contains tobacco leaf mixed with other ingredients, such as areca nut, and lime (Critchley & Capewell, 2003). ST was among the first non-cigarette tobacco products to demonstrate an increase in prevalence in the U.S. over the last several decades, particularly among young males. From 1970 to 1991, the prevalence of moist snuff or chewing tobacco use among U.S. men age 18 to 24 rose from 2.2% to 8.4% (Giovino et al., 1994). Recent estimates indicate that the prevalence of ST use in young adult males is even higher, with 9.7% reporting some use during the past 30 days (SAMHSA, 2006). ST use has also increased recently among those in the military (Bray et al., 2006). Results from the 2005 Department of Defense (DoD) Survey of Health Related Behaviors among Active Duty Military Personnel revealed a past 30-day prevalence of ST use among males aged 18 to 24 of 21.6% (Bray et al., 2006).

Cigar smoking is another form of tobacco use for which substantial increases were observed during the 1990s among both adults and adolescents (Baker et al., 2000; Gilpin et al., 2003; Nyman et al., 2002). Although nationally representative data are lacking, results from the California and Massachusetts Tobacco Control Programs indicate that cigar usage among young adult males increased threefold during this period of time (Gilpin et al., 2003; Nyman et al., 2002). Pipe smoking is the only well-established tobacco product to demonstrate a significant decline in recent years. From 1965 to 1991, the prevalence of pipe smoking in men declined from 14.1% to 2.0% while remaining very uncommon (0.03%) among women (Nelson, Davis, Chrismon, & Giovino, 1996).

Although cigars, pipes, and smokeless tobacco have all been commercially produced in the U.S. for many decades, bidis and kreteks are relatively new additions to the available forms of tobacco. Bidis are small, brown, hand-rolled tobacco cigarettes rolled in tendu or temburni leaves and usually tied with a

string at one end. They are primarily produced in India and Southeast Asia. Bidis are often flavored with chocolate, strawberry, vanilla or cherry when they are imported into the U.S. (Fisher, 2000). In some countries, such as India, bidi smoking is the most commonly used form of tobacco (Gupta & Sankar, 2003). Kreteks (clove cigarettes) first appeared in the U.S. around 1980 after first achieving popularity in Indonesia and Australia (Guidotti, Laing, & Prakash, 1989). Levels of use peaked in the mid-1980s, but declined thereafter due to widespread publicity about their potential health risks (Council on Scientific Affairs, 1988; Guidotti et al., 1989). Kreteks contain approximately 60% tobacco and 40% ground clove buds. Most kreteks sold in the U.S. are produced in Indonesia and imported to this country.

The largest and most comprehensive study on the use of cigarettes and alternative tobacco products is the National Youth Tobacco Survey (NYTS; CDC, 2006b). The NYTS includes middle and high school students from 246 participating schools across the U.S. Results from the 2001–2002 survey revealed that, among high school students, 28.2% reported use of a tobacco product in the past 30 days (CDC, 2006b). Cigarettes were the most common form of tobacco use (22.5%), followed by cigars (11.6%), smokeless tobacco (5.9%), pipes (3.2%), kreteks (2.7%), and bidis (2.6%). Overall tobacco use rates were lower for middle school students (13.3%), as was use of cigarettes (9.8%), cigars (6.0%), smokeless tobacco (3.5%), pipes (3.5%), bidis (2.4%), and kreteks (2.0%) (CDC, 2006b).

A factor that may play a role in the increasing popularity of certain tobacco products is the belief that they are associated with fewer health risks (Shaper, Wannamethee, & Walker, 2003). One study found that cigar smokers were roughly three times as likely as those who do not smoke cigars to believe cigars are a safer alternative to cigarettes (Nyman et al., 2002). Similarly, a recent survey of middle and high school students revealed that they thought that bidis were safer than conventional cigarettes (Hrywna, Delnevo, Pevzner, & Abatemarco, 2004). Although many perceive other tobacco products to be a safe alternative to cigarettes, available data do not support this belief. Cigar smoke contains significantly higher concentrations of toxic and carcinogenic compounds than cigarettes (Baker et al., 2000). Compared with never smokers, pipe and cigar smokers have been found to be at significantly higher risk for a variety of health problems including coronary heart disease, stroke, lung cancer, bladder cancer, periodontal disease, and tooth loss (Albandar, Streckfus, Adesanya, & Winn, 2000; Boffetta et al., 1999; Higgins, Mahan, & Wynder, 1988; Jacobs, Thun, & Apicella, 1999; Krall, Garvey, & Garcia, 1999; Pitard et al., 2001; Shaper et al., 2003; Shapiro, Jacobs, & Thun, 2000; Wald & Watt, 1997).

Recently, much attention has been given to the potential of ST to serve as a harm reduction substitute for cigarettes, an issue that has been actively debated among researchers and health care professionals (Bates et al., 2003; Hatsukami, Lemmonds, & Tomar, 2004). Nicotine pharmacokinetics (distribution, peak concentration, and elimination) are similar for both cigarette and ST use, but overall nicotine absorption from single doses of ST may be greater than for cigarettes (Benowitz, Porchet, Sheiner, & Jacob, 1988; Ebbert, Carr, & Dale, 2004; Russell, Jarvis, Devitt, & Feyerabend, 1981). Available literature suggests that adverse health consequences may vary by the type of ST use, which is strongly associated with geography (i.e., United States, Sweden, and India). ST use in the U.S. has been associated with periodontal disease (Ernster et al., 1990; Fisher, Taylor, & Tilashalski, 2005) and precancerous oral lesions (Mattson & Winn, 1989). ST use has also been associated with oral and extra-oral cancer (Goodman, Morgenstern, & Wynder, 1986; Henley, Thun, Connell, & Calle, 2005; Muscat, Hoffmann, & Wynder, 1995; Stockwell & Lyman, 1986) as well as cardiovascular and cerebrovascular disease (Henley et al., 2005; Teo et al., 2006). Evidence also suggests that smokeless tobacco may be a gateway drug for smoking initiation in adolescent and young adult males (Haddock et al., 2001; Severson, Forester, & Biglan, in press; Tomar, 2003a), although conflicting results have been reported in other studies (O'Connor, Kozlowski, Flaherty, & Edwards, 2005).

Somewhat less research has been conducted on the health risks of bidis and kreteks. Concentrations of nicotine, tar, and other toxic elements of tobacco smoke have been found to be present in equal or higher amounts in bidis than traditional cigarettes (Malson, Lee, Moolchan, & Pickworth, 2002; Malson, Sims, Murty, & Pickworth, 2001; Rahman & Fukui, 2000). The acute physiologic and biochemical effects of bidis have also been shown to be similar to conventional cigarettes (Malson & Pickworth, 2002). Further, the risk for oral cancer is significantly elevated among bidi smokers compared to never smokers (Rahman, Sakamoto, & Fukui, 2003). Kreteks have also been shown to possess all of the hazards associated with smoking all-tobacco cigarettes (Council on Scientific Affairs, 1988; Guidotti et al., 1989). In addition, inhaling kretek smoke has been associated with severe lung injury in a few susceptible individuals, and also increases the risk of other forms of respiratory illness (Council on Scientific Affairs, 1988). These effects appear to be largely due to the anesthetic action of eugenol (the active ingredient in cloves), which can impair the gag reflex, leading to pulmonary aspiration (Council on Scientific Affairs, 1988; Guidotti et al., 1989). Smoke yields from standardized machine-smoking analysis of clove cigarettes also indicated they deliver more nicotine, carbon monoxide, and tar than conventional cigarettes (Clark, 1989, 1990; Malson, Lee, Murty, Moolchan, & Pickworth, 2003).

While there are good estimates of alternative forms of tobacco use in youth, few studies have investigated the use of these products among adults. The primary exception to this is ST, which is included in the annual National Household Survey on Drug Use and Health. To date, only one study has been published on young adult use of bidis. In that study, Delnevo, Pevzner, Hrywna, and Lewis (2004) investigated the prevalence and correlates of bidi use among 5 324 young adults aged 18–24 using on data from the Behavioral Risk Factor Surveillance System (BRFSS). Overall, 1.4% and 16.5% of young adults aged 18 to 24 in this sample were regular and lifetime bidi users, respectively. No recent epidemiologic data are available on kretek or pipe tobacco use among adults in the U.S. Such studies are greatly needed because the success of tobacco control efforts is dependent upon reliable surveillance data in order to develop appropriate intervention strategies and monitor progress in reducing tobacco use (Bray et al., 2006; Tomar, 2003b).

The present study was designed to evaluate the use of several different alternative tobacco products (bidis, cigars, kreteks, pipes, and ST) in a large sample of young adults who are particularly vulnerable to tobacco use given their age and military status (Bray et al., 2006). Prevalence of use was investigated both for the population as a whole, and separately according to demographic characteristics including gender, race and ethnicity, education level, marital status, and income.

2. Methods

2.1. Study overview

The data presented here were obtained at baseline as part of a randomized clinical trial investigating the efficacy of forced tobacco cessation as part of Basic Military Training (BMT) combined with a targeted tobacco use prevention and cessation program for Air Force recruits (Klesges et al., 2006).

2.2. Participants and procedures

Participants for the present study consisted of 31 107 active duty recruits who entered Air Force BMT during the one-year period from October 1999 to September 2000. One additional recruit who entered active duty service during this period was excluded due to missing demographic data. Data were collected

during the second week of BMT, prior to the start of the tobacco control intervention. Survey administration occurred in a group setting of two “flights” (the approximate Air Force equivalent of “platoons”) with approximately 50 recruits per flight. Research staff answered questions and surveys were checked for thoroughness before the flight departed. The study was approved by the review boards of the participating universities (University of Memphis, University of Minnesota, and University of Missouri — Kansas City) and by the Wilford Hall Medical Center’s Clinical Investigations Directorate. Participants signed a written consent document prior to the completion of the questionnaire.

2.3. Measures

Data were obtained using a 68-item questionnaire assessing a variety of behavioral health risk items covering four general domains including demographics, tobacco use history, potential risk factors for tobacco use, and other health risk behaviors. In terms of demographics, participants were asked to provide information pertaining to age, race and ethnicity, marital status, educational attainment, and family income. The following variables were dichotomized for purposes of analysis: age (<20-years-old vs. ≥20-years-old), education (high school or GED vs. post high school), and marital status (single, divorced, separated or widowed vs. married or living together).

Because all tobacco use is strictly prohibited during the six weeks of BMT, tobacco use was assessed retrospectively to determine participants’ status and history immediately prior to entering BMT (approximately two weeks prior to survey administration). Therefore, tobacco use was assessed in the following manner (using clove cigarettes [kreteks] as an example): “What was your history of clove cigarette smoking just prior to Basic Military Training?” Participants were asked to select from among the following response options: (1) “I have never smoked clove cigarettes, not even one puff,” (2) “I smoked clove cigarettes only on one or two occasions in the past,” (3) “I smoked clove cigarettes regularly (at least once per day), but quit in the past 6 months,” (4) “I smoked clove cigarettes regularly (at least once per day), but quit between 6 months and one year ago,” (5) “I smoked clove cigarettes regularly (at least once per day), but quit more than a year ago,” (6) “I smoked clove cigarettes occasionally, but not every day,” and (7) “I smoked clove cigarettes every day.” Each of the other forms of tobacco use was assessed in a similar manner using the same response choices. Participants who reported either occasional (Group 6) or daily (Group 7) use of a given tobacco product were coded as current users of that product. Those who reported using the product on only one or two occasions (Group 2) were considered experimental users, while those who had previously used the product regularly but had subsequently quit using (Groups 3 through 5) were coded as former users. Those who reported no history of using a given product were considered to be non-users (Group 1).

2.4. Approach to data analysis

Descriptive statistics were used to estimate the prevalence of tobacco use just prior to entering BMT according to various demographic characteristics. The relationships between cigarette smoking and other forms of tobacco use were examined by calculating univariate logistic regression odds ratios. The independent association between demographic characteristics and use of alternative forms of tobacco was assessed using multivariable logistic regression analyses (Hosmer & Lemeshow, 1989). Gender, race and ethnicity, age, educational attainment, income, and marital status were included in each model using a forced entry procedure in which all variables were simultaneously entered into the equation and retained

in the model. In order to adjust for multiple comparisons, a Bonferroni correction was applied to arrive at a significance level of .008 (.05/6 comparisons).

3. Results

3.1. Participant characteristics

The majority of the sample was male and 64.3% of participants were under the age of 20 years (Table 1). Ethnic minorities comprised 36.5% the sample. Nearly one-third of the participants smoked cigarettes just prior to entering BMT.

3.2. Prevalence of alternative tobacco use

The prevalence of current use (daily or occasional) of alternative tobacco products just prior to entering BMT is presented in Table 2. Rates of use were highest for cigars (12.3%) and smokeless tobacco (6.7%) followed by kreteks (3.0%), bidis (2.0%), and pipes (1.1%). Rates of lifetime use (i.e., experimental, regular, or former) were considerably higher. Over half of all participants (51.3%) reported that they had

Table 1
Characteristics of study participants ($N=31\,107$)

Variable	<i>n</i> (%)
Gender	
Female	7 826 (25.2)
Male	23 281 (74.8)
Age	
<20-years-old	20 008 (64.3)
≥20-years-old	11 099 (35.7)
Race and ethnicity	
Caucasian	19 751 (63.5)
African American	5 826 (18.7)
Hispanic	3 129 (10.1)
Asian American or Pacific Islander	1 255 (4.0)
Native American	234 (0.8)
Other	912 (2.9)
Family income	
≤\$25,000	8 088 (26.0)
\$25,001–\$45,000	8 046 (25.9)
\$45,001–\$70,000	7 847 (25.2)
>\$70,000	7 126 (22.9)
Education	
High school graduate or GED	24 547 (78.9)
Some college	6 560 (21.1)
Marital status	
Single, separated, divorced, or widowed	27 675 (89.0)
Married or living together	3 432 (11.0)
Current cigarette smoker	10 165 (32.7)

Table 2
Prevalence of current alternative tobacco use among military recruits

Characteristic	Kreteks (<i>N</i> =31 103) % (99% CI)	Pipes (<i>N</i> =31 107) % (99% CI)	Cigars (<i>N</i> =31 106) % (99% CI)	Bidis (<i>N</i> =31 105) % (99% CI)	Smokeless (<i>N</i> =31 107) % (99% CI)	Any (<i>N</i> =31 103) % (99% CI)
Gender						
Male	3.1 (2.8–3.4)	1.4 (1.2–1.6)	14.9 (14.3–15.5)	2.3 (2.0–2.5)	8.8 (8.3–9.2)	22.3 (21.6–23.0)
Female	2.7 (2.2–3.1)	0.1 (0.0–0.3)	4.6 (4.0–5.2)	1.4 (1.0–1.7)	0.4 (0.2–0.6)	7.3 (6.6–8.1)
Race/ethnicity						
African American	1.1 (0.7–1.4)	0.4 (0.2–0.7)	9.2 (8.2–10.2)	2.9 (2.3–3.5)	0.5 (0.3–0.8)	11.1 (10.0–12.2)
Asian/Pacific Islander	1.8 (0.8–2.7)	0.8 (0.2–1.4)	5.7 (4.0–7.4)	1.4 (0.5–2.2)	1.7 (0.7–2.6)	8.5 (6.5–10.6)
Caucasian	3.6 (3.2–3.9)	1.4 (1.2–1.6)	14.6 (14.0–15.2)	1.8 (1.5–2.0)	9.7 (9.2–10.2)	22.7 (21.9–23.5)
Hispanic	3.0 (2.3–3.8)	0.6 (0.2–0.9)	6.8 (5.7–8.0)	2.0 (1.3–2.6)	1.9 (1.2–2.5)	10.7 (9.3–12.1)
Native American	3.0 (0.1–5.9)	1.7 (0.0–3.9)	8.6 (3.8–13.3)	2.6 (0.0–5.3)	8.1 (3.5–12.8)	18.0 (11.4–24.5)
Other	3.8 (2.2–5.5)	1.4 (0.4–2.4)	11.2 (8.5–13.9)	3.7 (2.1–5.4)	3.0 (1.5–4.4)	16.0 (12.9–19.1)
Age						
<20 years-old	2.9 (2.6–3.2)	1.0 (0.8–1.2)	12.6 (12.0–13.2)	2.1 (1.9–2.4)	6.3 (5.9–6.8)	18.4 (17.7–19.1)
≥20 years-old	3.2 (2.8–3.6)	1.3 (1.0–1.6)	11.7 (10.9–12.5)	1.9 (1.6–2.2)	7.2 (6.6–7.9)	18.7 (17.8–19.7)
Education						
High school or GED	3.0 (2.7–3.3)	1.1 (0.9–1.3)	12.5 (11.9–13.0)	2.1 (1.9–2.4)	6.9 (6.4–7.3)	18.7 (18.0–19.3)
Post high school	2.9 (2.4–3.5)	1.1 (0.8–1.4)	11.6 (10.6–12.6)	1.8 (1.4–2.2)	6.0 (5.2–6.7)	17.9 (16.6–19.1)
Income						
≤\$25,000	2.8 (2.3–3.3)	1.0 (0.7–1.3)	10.3 (9.5–11.2)	1.8 (1.4–2.2)	5.4 (4.7–6.0)	16.1 (15.0–17.1)
\$25,001 to \$45,000	2.2 (1.8–2.6)	1.0 (0.7–1.3)	11.2 (10.3–12.1)	1.8 (1.4–2.1)	6.0 (5.3–6.7)	16.8 (15.7–17.9)
\$45,001 to \$70,000	3.0 (2.5–3.5)	0.9 (0.7–1.2)	12.3 (11.4–13.3)	2.0 (1.6–2.4)	6.9 (6.2–7.6)	18.4 (17.2–19.5)
≥\$70,000	4.0 (3.4–4.6)	1.4 (1.0–1.8)	15.8 (14.7–16.9)	2.7 (2.2–3.2)	8.6 (7.8–9.5)	23.3 (22.1–24.6)
Marital status						
Single	2.9 (2.7–3.2)	1.1 (0.9–1.2)	12.4 (11.9–12.9)	2.1 (1.9–2.3)	6.7 (6.3–7.1)	18.5 (17.9–19.1)
Married/living with partner	3.6 (2.8–4.4)	1.5 (0.9–2.0)	11.7 (10.3–13.1)	1.8 (1.2–2.3)	6.5 (5.4–7.6)	18.3 (16.6–20.0)
Total	3.0 (2.7–3.2)	1.1 (0.9–1.2)	12.3 (11.8–12.8)	2.0 (1.8–2.3)	6.7 (6.3–7.0)	18.5 (17.9–19.1)

smoked a cigar at least once in their life, and approximately one-quarter had used smokeless tobacco (26.0%) and kreteks (24.8%). The prevalence of lifetime bidi and pipe use was 14.7% and 10.4%, respectively.

3.3. Association between cigarette smoking and other forms of tobacco use

Significant positive associations were observed between current cigarette smoking and all other forms of tobacco. Relative to non-cigarette smokers, those who smoked cigarettes were significantly more likely to smoke kreteks (Odds ratio [OR] and 99% Confidence Interval [CI]=10.53, 99% CI: 8.41, 13.20, $p<.001$), pipes (OR=7.71, 99% CI: 5.48, 10.85, $p<.001$), cigars (OR=6.90, 99% CI: 6.25, 7.62, $p<.001$), and bidis (OR=12.49, 99% CI: 9.35, 16.69, $p<.001$). In addition, cigarette smokers were more likely to use ST (OR=3.31, 99% CI: 2.93, 3.73, $p<.001$). Use of any type of alternative tobacco product was also greater among cigarette smokers compared to non-cigarette smokers (OR=6.07, 99% CI: 5.60, 6.59, $p<.001$).

3.4. Demographic correlates of alternative tobacco use

We next examined the demographic correlates of alternative tobacco use based on multivariable logistic regression analyses. Results for each form of tobacco are presented below, followed by the correlates of using any form of alternative tobacco product.

3.4.1. Kreteks

Rates of kretek use were similar for males and females. There was a significant overall effect for race. Although kreteks are traditionally thought of as Asian products, Asians and Pacific Islanders in this sample were approximately half as likely as Caucasians to have smoked them prior to entering BMT (OR=0.50, 99% CI: 0.29, 0.88, $p=.002$). African Americans also were less likely to have used kreteks than Caucasians (OR=0.31, 99% CI: 0.22, 0.44, $p<.001$). Individuals with a combined family income of \$25,001 to \$45,000 were marginally less likely than those with a total income of \leq \$25,000 to report smoking kreteks (OR=0.79, 99% CI: 0.60, 1.03, $p=.02$), while those with a family income of $>$ \$70,000 had a significantly greater odds of having used kreteks than those whose family income was \leq \$25,000 (OR=1.42, 99% CI: 1.11, 1.81, $p<.001$). Recruits who were married or living with a significant other were slightly more likely than those who were single, separated, divorced, or widowed to report having smoked kreteks before BMT, although this difference was not statistically significant (OR=1.27, 99% CI: 0.97, 1.66, $p=.02$). No differences in the likelihood of kretek use were observed based on age or education level.

3.4.2. Pipes

Overall use of pipes in this population was very low for all demographic groups. Rates were significantly higher for males than for females (OR=9.28, 99% CI: 4.20, 20.48, $p<.001$). Differences in the prevalence of pipe use also were observed according to race and ethnicity. African Americans (OR=0.38, 99% CI: 0.22, 0.65, $p<.001$) and Hispanics (OR=0.44, 99% CI: 0.24, 0.84, $p=.001$) were significantly less likely than Caucasians to have smoked pipes. No significant differences in pipe use were observed according to age, marital status, education or income level.

3.4.3. Cigars

Overall, males were 3.42 times as likely as females (99% CI: 2.95, 3.97, $p<.001$) to report that they were cigar smokers prior to BMT. Significant differences also were observed across racial and ethnic groups. Relative to Caucasians, the likelihood of cigar use was significantly lower among Asians and Pacific Islanders (OR=0.38, 99% CI: 0.27, 0.52, $p<.001$), African Americans (OR=0.68, 99% CI: 0.60, 0.78, $p<.001$), and Hispanics (OR=0.47, 99% CI: 0.38, 0.56, $p<.001$), and marginally lower among Native Americans (OR=0.61, 99% CI: 0.33, 1.13, $p=.04$). In addition, recruits who were over the age of 20 were slightly less likely to have smoked cigars (OR=0.91, 99% CI: 0.81, 1.01, $p=.018$), although this difference was not large (prevalence rates of 12.6 vs. 11.7% for those <20 years of age and ≥ 20 years of age, respectively) and did not achieve statistical significance. Finally, recruits with a family income of $>$ \$70,000 per year were 1.35 times as likely to have used cigars as those with a total annual income of \leq \$25,000 (99% CI: 1.19, 1.54, $p<.001$). Rates of cigar smoking did not differ based on education or marital status.

3.4.4. Bidis

The odds of bidi smoking were significantly greater for males relative to females (OR=1.77, 99% CI: 1.34, 2.34, $p<.001$). Significant differences in bidi use also were observed across racial and ethnic

groups. Contrary to findings for other tobacco products, African American recruits were significantly more likely than Caucasians to report having smoked bidis prior to BMT (OR=1.87, 99% CI: 1.46, 2.40, $p<.001$). Recruits who designated their racial and ethnic group status as “Other” also were 2.33 times more likely than Caucasians to have smoked bidis (99% CI: 1.45, 3.74, $p<.001$). Although bidis, like clove cigarettes, are usually imported from India and other countries in Southeast Asia, rates of use were not any higher among Asians and Pacific Islanders than among other racial and ethnic groups. Finally, recruits with an annual family income of $>\$70\,000$ per year were 1.53 times as likely to have smoked bidis as those with a total family income of $\leq \$25\,000$ (99% CI: 1.14, 2.05, $p<.001$). Rates of bidi cigarette use did not differ according to age, education, or marital status.

3.4.5. Smokeless tobacco

Male recruits were significantly more likely than females to report having used ST prior to BMT (OR=20.67, 99% CI: 12.94, 33.02, $p<.001$). Relative to Caucasians, Asians and Pacific Islanders (OR=0.17, 99% CI: 0.10, 0.30, $p<.001$), African Americans (OR=0.06, 99% CI: 0.04, 0.10, $p<.001$), Hispanics (OR=0.19, 99% CI: 0.13, 0.27, $p<.001$), and those who characterized their racial and ethnic status as “Other” (OR=0.32, 99% CI: 0.19, 0.53, $p<.001$) all were significantly less likely to have used ST. Participants who had attained some education beyond high school were marginally less likely to report having used ST (OR=0.87, 99% CI: 0.74, 1.03, $p=.035$). Household income level demonstrated a positive association with ST use, such that those with a total annual family income of $\geq \$70\,000$ were 1.21 times as likely to report having used ST as those with an income of $\leq \$25\,000$ (99% CI: 1.01, 1.44, $p=.006$). Those who were at least 20 years old were significantly more likely than younger participants to have used ST (OR=1.21, 99% CI: 1.05, 1.39, $p=.001$). Smokeless tobacco use did not differ significantly according to marital status.

Table 3
Summary of demographic correlates of alternative tobacco use based on multivariable logistic regression analyses

Characteristic Kreteks		Pipes	Cigars	Bidis	Smokeless	Any
Gender		Males>Females	Males>Females	Males>Females	Males>Females	Males>Females
Race/ ethnicity	Asians and Pacific Islanders< Caucasians	African Americans< Caucasians	Asians and Pacific Islanders< Caucasians	African Americans> Caucasians	Asians and Pacific Islanders< Caucasians	Asians and Pacific Islanders< Caucasians
	African Americans< Caucasians	Hispanics< Caucasians	African Americans< Caucasians	Others> Caucasians	African Americans< Caucasians	African Americans< Caucasians
			Hispanics< Caucasians		Hispanics< Caucasians	Hispanics< Caucasians
					Others< Caucasians	Others< Caucasians
Age					≥ 20 yr<20 yr	
Education						
Income	$>\$70\,000$ > $\leq \$25\,000$		$>\$70\,000$ > $\leq \$25\,000$	$>\$70\,000$ > $\leq \$25\,000$	$>\$70\,000$ > $\leq \$25\,000$	$>\$70\,000$ > $\leq \$25\,000$
Marital status						

3.4.6. Any alternative tobacco product

Finally, we examined the correlates of using any type of alternative tobacco product. Overall, males were 3.35 times as likely as females to use one or more alternative tobacco product (99% CI: 2.97, 3.78, $p < .001$). Significant differences in alternative tobacco use also were found according to race and ethnicity. Compared to Caucasians, Asian Americans (OR=0.34, 99% CI: 0.26, 0.44), African Americans (OR=0.49, 99% CI: 0.43, 0.55), Hispanics, (OR=0.44, 99% CI: 0.37, 0.51), and those who identified their racial/ethnic group as “Other” (OR=0.72, 99% CI: 0.56, 0.91) were less likely to use some form of alternative tobacco (all p values $< .001$). Income was also related to the use of alternative tobacco products. Participants with an annual family income of greater than \$70 000 were 1.31 times as likely as those with an income of \leq \$25 000 to use at least one alternative form of tobacco (99% CI: 1.17, 1.46, $p < .001$).

A summary of the significant demographic correlates of each form of alternative tobacco use is provided in Table 3.

4. Discussion

In this study, we found that alternative forms of tobacco use were quite common among young adult Air Force recruits prior to enrolling in military service. Nearly one in five participants reported using at least one form of alternative tobacco product, while one in three were cigarette smokers. Rates of regular and lifetime use were highest for cigars and ST. Overall, rates of ST and cigar use tended to be higher than those observed in studies conducted among adult civilian samples, while the prevalence of pipe use was similar (Ebbert et al., 2004; Giovino et al., 1994; Rigotti, Lee, & Weschler, 2000; Tomar, 2003b). Rates of bidi use (2.0%) are also similar to those observed among a sample of young adults from 15 states participating in the BRFSS (1.4%), which is the only other source of published data on bidi use in adults (Delnevo et al., 2004).

Consistent with previous studies (Delnevo et al., 2004; Gilpin & Pierce, 2003; Hatsukami & Severson, 1999; Hrywna et al., 2004; Nelson et al., 1996; Nyman et al., 2002; Soldz et al., 2003; Tercyak & Audrain, 2002), cigarette smoking was associated with other forms of tobacco use in this study population. Cigarette smokers were significantly more likely than non-cigarette smokers to use all of the alternative tobacco products that were assessed. Because of the cross-sectional nature of the study, we were not able to distinguish whether cigarette use preceded or followed these other types of tobacco use, nor were we able to determine the context of their use, such as whether certain forms of tobacco were serving as substitutes for cigarettes. These issues have important implications for tobacco control efforts, and should be the focus of future investigation.

In the present study, use of alternative tobacco products was consistently higher for males than for females. Similar gender differences have been observed in other studies on the use of alternative tobacco products among adults (Delnevo et al., 2004; Giovino et al., 1994; Tomar, 2003b). The one exception was kreteks, for which prevalence rates did not differ significantly by gender. Rates of use also differed by race and ethnicity. For most products, higher levels of use were reported for Caucasians than for African Americans. The prevalence of bidi use, however, was greater among African Americans than Caucasians. Delnevo et al. (2004) also reported greater lifetime use of bidis among African American young adults relative to Caucasians, although the difference for current use was not statistically significant. Relative to Asians and Pacific Islanders, Caucasians demonstrated more frequent use of kreteks, cigars, and ST. Rates of use were higher for Caucasians than for Hispanics for pipes, cigars, and ST.

Younger recruits were marginally more likely to report cigar use, but less likely to report use of ST. Use of alternative tobacco products in this sample did not differ significantly according to education level. Delnevo et al. (2004) observed higher rates of lifetime bidi use among those with some college or a college degree relative to those with a high school education or less, although the rates of current bidi use did not differ according to education level. Contrary to studies investigating socioeconomic correlates of cigarette smoking (Bray et al., 2006; CDC, 2006a,b; Stronks, van de Mheen, Looman, & Mackenbach, 1997), the use of alternative tobacco products in the present sample tended to be more common among those with the highest family income level. It may be that higher income individuals who enter the military are a unique subgroup that is more inclined toward risk taking behavior. Results from the California Adult Tobacco Use Survey also indicated a positive association between income level and cigar use (US DHHS, 1998). Data on the association between other tobacco products and income are limited. Finally, although recruits who were married or living with a significant other were marginally more likely than single participants to use kreteks, use of the other tobacco products did not differ by marital status.

Several limitations to the present study should be acknowledged. First, the sample consisted entirely of Air Force recruits. Generalizability to civilian populations, as well as those in other branches of military service, is uncertain. Second, tobacco use was based on self-report, with no biochemical verification. Evidence suggests, however, that self-reports generally are valid for assessing smoking status in most epidemiologic studies of this type (Velicer, Prochaska, Rossi, & Snow, 1992). Finally, although this study examined the prevalence of several different forms of tobacco use, other tobacco products that have become more visible in recent years, such as waterpipe and herbal cigarettes, were not included. Future surveillance studies should address the prevalence of use for these products to better determine the extent of their use.

5. Conclusions

Rates of alternative forms of tobacco were fairly common in this large sample of young adult military recruits. Our findings, along with those from other epidemiologic studies of tobacco use among adolescents, illustrate the importance of continuing to assess the use of these other forms of tobacco. Evidence suggests that some alternative forms of tobacco products, such as bidis, clove cigarettes, and cigars may be increasing among young people. Such an increase in use among adolescents is likely to translate into higher levels of use during the adult years as members of these cohorts age. Therefore, tobacco control efforts, including prevention and cessation programs, should extend beyond cigarettes to include other forms of tobacco use.

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