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Characteristics of users of cigars, bidis, and kreteks and the relationship to cigarette use

Stephen Soldz,^{a,b,*} Dana Joy Huyser,^a and Elizabeth Dorsey^{a,b}

^a *Social Science Research and Evaluation, Inc., Brookline, MA, USA*

^b *Boston Graduate School of Psychoanalysis, Brookline, MA, USA*

Abstract

Background. In the 1990s, youth use of alternative tobacco products including cigars, bidis, and kreteks increased. This article discusses the prevalence of youth use of cigars, bidis, and kreteks, and characteristics of users.

Methods. The Cigar Use Reasons Evaluation (CURE)—a questionnaire assessing alternative tobacco use and associated attitudes and behaviors—was administered to middle and high school students from 12 school districts across Massachusetts.

Results. Males were more likely to use all forms of alternative tobacco and females more likely to smoke cigarettes. Hispanics were less likely to smoke kreteks or use smokeless tobacco. Urban students were more likely to smoke bidis or use smokeless tobacco than suburban or rural youth. Most smokeless and alternative tobacco users were lifetime cigarette smokers. There was, however, a significant group of cigar smokers, associated with higher parental education, who were not current cigarette smokers.

Conclusions. Use of alternative tobacco poses a risk to the success of tobacco control efforts. While many alternative tobacco users smoke cigarettes, some alternative tobacco users are current cigarette smokers. Cigar use thus constitutes a potential serious risk for youth who otherwise might not be exposed to tobacco.

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Introduction

After an increase in the American youth cigarette smoking rate in the early 1990s [1–3], youth smoking rates have begun to decline [3–7]. Similarly, youth use of smokeless tobacco has exhibited recent declines [3,6]. However, starting in the mid 1990s, tobacco control specialists were surprised by an apparently new phenomenon in the United States: youth experimentation with alternative forms of tobacco, including cigars, bidis (small hand-rolled cigarettes imported from India), and kreteks (also known as “cloves,” i.e., clove-flavored cigarettes). Currently there is limited information on the extent of youth use of these alternative substances and very little information on characteristics of the young users of these products.

In the 1990s, data on cigar smoking among adults indicated a dramatic increase in sales [8] and use [9]. According

to the Behavioral Risk Factor Surveillance System, the median lifetime (ever) cigar smoking rate among adults in 1998 was 39.0% and the past month rate was 5.2% [10]. In the first major national examination of the prevalence of cigar smoking among youth [11], 26.7% of U.S. youth aged 14–19 reported smoking at least one cigar in the past year, including 37.0% of males and 16.0% of females. This study reported that black youth smoked cigars less than white or Hispanic youth, and cigar smoking was negatively associated with school performance. Further, cigarette smokers were considerably more likely (54.1% vs. 14.2%) to have smoked cigars in the past year. The 2001 Youth Risk Behavior Survey reported a past-month cigar smoking rate of 15.2% among students in grades 9 through 12, as well as replicating findings of higher smoking rates among males and lower rates among blacks as compared with whites [7].

The Department of Health and Human Services Office of the Inspector General (OIG) [12] conducted a focus group study of 227 teens about their knowledge, attitudes, and behavior regarding cigars. In addition to describing widespread cigar use among youth, the OIG found greater social

* Corresponding author. Boston Graduate School of Psychoanalysis, 1581 Beacon Street, Brookline, MA 02446, USA. Fax: +1-617-277-0312. E-mail address: ssoldz@bgsp.edu (S. Soldz).

acceptability of cigars compared to use of cigarettes or smokeless tobacco. This finding suggests that the characteristics of cigar smokers may be different than those of users of cigarettes and smokeless tobacco [13].

The 1999 National Youth Tobacco Survey (NYTS) [14] was the first national survey to report prevalence rates for bidis and kreteks, in addition to cigars. In that survey, current (past month) cigar use among middle school students was 6.1%, bidi use 2.4%, and kretek use 1.9%. Among high school students, the rates were 15.3%, 5.0%, and 5.8%, respectively. A further report based on the NYTS [15] found lifetime cigar use rates to be 21.8% among middle school and 40.5% among high school students. While use was greater among males (26.0% middle school and 48.6% high school), female students reported surprisingly high rates of lifetime cigar use in that study (17.6% middle school, 33.0% high school).

In Massachusetts, the statewide 1996 Massachusetts Prevalence Study [6] found current cigar use among middle schools students to be 7.6% and 14.5% among high school students. By 1999, these rates had declined to 4.2% and 11.1%, respectively. The Massachusetts Youth Risk Behavior Survey [16] found somewhat higher rates of current cigar use among high school students (15.6% in 1999 and 13.1% in 2001). A third Massachusetts study of a convenience sample of urban students found bidi use to be alarmingly prevalent [17]: 44% of respondents in grades 7 through 12 reported lifetime bidi use, and 16% reported current bidi use, with no significant differences by sex, grade, or race/ethnicity.

Youth use of cigars, bidis, and kreteks is of concern for two reasons. First, alternative tobacco products present a serious health threat. In addition to the addictive properties of nicotine [18], use of cigars has been associated with cancers of the oral cavity, larynx, esophagus, and lung [19–21], bladder cancer [22], coronary heart disease [23], and chronic obstructive pulmonary disease [24]. Further, a relationship has also been established between teenage cigar use and marijuana use [25].

Less research has been conducted on the health effects of bidis and kreteks. Bidis have been associated with cancer-causing effects on the body [26], including oral cancers [27], laryngeal, esophageal, and liver cancers [28,29], lung cancer [30,31], and stomach cancer [32]. Bidis have also been associated with pulmonary disorders [33] and thromboangiitis obliterans, a disease of the blood vessels in the lower extremities [34]. Kreteks, which contain the potentially toxic substance eugenol, have been associated with such symptoms as fluid and blood in the lungs, bronchospasm, respiratory tract infections, and other severe lung injury [35–39].

Second, use of alternative tobacco products may also contribute to a lifelong nicotine addiction, with or without cigarette initiation. Cigars contain a substantial amount of nicotine [18]; the nicotine in bidis is more concentrated than in cigarettes, and they are more addictive [40,41]. Given the

allure of cigars as a status symbol [42,43], they may appeal to youth who would not otherwise smoke cigarettes. In addition, informal conversations with young people suggest that some youth believe that kreteks are more “natural” and therefore healthier than cigarettes. Thus, it is important to clarify the relationship between use of cigarettes and of alternative tobacco products, including the degree to which users of alternative tobacco products also smoke cigarettes and the relative ages of initiation for those who smoke both cigarettes and cigars, bidis, and/or kreteks.

If effective prevention strategies are to be designed, it is essential to identify characteristics of users of these products. For example, do the same demographic and problem behaviors (e.g., truancy or low academic success) that predict cigarette, alcohol, and other drug use [44–48] also predict use of alternative tobacco products? Are there systematic differences between users of regular (large) cigars and those who use little cigars and cigarillos? For example, might the little cigars be relatively more popular among girls than the regular cigars?

So far, we have identified no studies of the characteristics of bidi and kretek users beyond the basic demographics available in prevalence reports and only one published study examining characteristics of youth cigar smokers [49]. That study, of adolescent children of the Nurses Health Study II, found that cigar smoking was strongly associated with use of cigarettes and alcohol. The authors also found that cigar smokers of both genders were more likely to exhibit high social self-esteem than nonsmokers, while male cigar smokers were specifically more likely to exhibit high athletic self-esteem than were nonsmokers and were also more likely to possess tobacco promotional items.

The present study is intended to further the meager knowledge presently available regarding the characteristics of users of alternative tobacco products, as well as the relationship between cigarette smoking and their use. While the focus of this study is on use of cigars, bidis, and kreteks, we report data on youth use of cigarettes and smokeless tobacco as a comparison to the alternative tobacco products and to make the data publicly available. We report on rates of use in our sample, the characteristics of users, the relative age of initiation for those students who report use of two tobacco products, and the extent to which use of alternative tobacco products overlaps with current or lifetime cigarette smoking. Further, we explore whether there are systematic gender differences between users of regular cigars and cigarillos or little cigars. This study also addresses a methodological issue that has plagued most previous studies of youth cigar use: possible confusion between cigars as a tobacco product and use as a hollowed-out delivery system for marijuana, referred to by youth as a “blunt” [12,50–51]. Elucidation of these issues should aid educators, policy makers, and prevention planners in evaluating whether efforts should be targeted at reducing youth use of cigars, bidis, and/or kreteks.

Methods

Participants

Middle and high schools were recruited by a letter to the more than 500 health coordinators of public middle and high schools throughout Massachusetts, supplemented by letters and phone calls to selected other public and parochial school personnel, seeking their school's agreement to conduct the survey. In exchange for participation in the study, schools were offered feedback on the prevalence of tobacco and other substance use in their school. This approach resulted in the participation of one parochial and 11 public schools geographically dispersed throughout the state, constituting about 2% of the middle and high schools in the state. While the schools represent a convenience sample of schools in Massachusetts, they are reasonably representative of the state as they include schools from urban (4 schools; 47.0% of participating students), suburban (5 schools; 33.5% of students), and rural communities (3 schools; 19.5% of students) geographically dispersed throughout the state. Further, the schools are roughly equally distributed between communities scoring in the top, middle, and bottom thirds on the statewide Massachusetts Comprehensive Assessment System test.

Where possible, we sought to survey all students in grades 6 through 12 in each school. In several instances, this was not possible due to other demands on the schools. In these instances, we were offered the opportunity to survey all students in certain classes, primarily health and physical education classes that were required of all students. Thus, while certain grades were overrepresented, no systematic informative bias was introduced.

As preliminary analyses found virtually no reported alternative tobacco use among the 6th graders in our sample, the present report is limited to the 5016 students from grades 7 through 12. Of these, 48.9% percent were male, 81.2% white (not Hispanic), 2.1% black (not Hispanic), 8.4% Hispanic, 3.7% Asian/Pacific Islander, and 4.7% Other race/ethnicity (Table 1). The grade distribution was weighted toward grades 8 (23.2%) and 9 (23.5%), with an underrepresentation of both 7th (16.4%) and 12th graders (8.1%).

CURE survey

The Cigar Use Reasons Evaluation (CURE) survey consists of 229 items assessing use of cigarettes, alternative tobacco products, alcohol, and marijuana, as well as associated attitudes and behaviors, various potential risk factors, and personality traits. The CURE was developed through examining various other substance use surveys, including the Monitoring the Future instrument and the Youth Risk Behavior Survey, as well as a number of substance use prevalence surveys previously conducted or analyzed by the authors [1,53,54]. One distinguishing feature of the CURE

Table 1
Demographics

	CURE sample	
	N	%
Gender		
Male	2451	48.9%
Female	2565	51.1%
Race/ethnicity		
White (not Hispanic)	4029	81.2%
Black (not Hispanic)	104	2.1%
Hispanic/Latino	415	8.4%
Asian/Pacific Islander	182	3.7%
American Indian/Alaskan Native	29	0.6%
Other	201	4.1%
Grade		
7	823	16.4%
8	1162	23.2%
9	1178	23.5%
10	818	16.3%
11	631	12.6%
12	404	8.1%
Town size		
Urban	2356	47.0%
Suburban	1682	33.5%
Rural	979	19.5%

Note. CURE, Cigar Use Reasons Evaluation.

was a systematic attempt made to distinguish cigar smoking from use of cigars as a blunt or marijuana delivery device [52], to avoid possible overreporting of cigar use by blunt users [50]. Questions about blunt use were placed before those about cigar use, and all cigar questions contained explicit instructions not to include blunts when responding.

The items used in the present study are as follows: Demographics: gender, grade, race/ethnicity, and type of community in which the school was located (urban, suburban, rural); family characteristics: two-parent family, and parents' education (highest level of education completed by either mother or father, coded as less than high school, high school, some college, college completed, graduate program completed); academic functioning: self-reported grade point average (GPA); a dichotomous variable assessing truancy in past year; school attachment (liking school, four levels from "not at all" to "a lot"); and planning to attend college after high school; life satisfaction: one item on a seven-point scale from "completely dissatisfied" to "completely satisfied"; tobacco use: cigarette, regular cigar, little cigar (including cigarillo), cigar (combining regular and little cigars), bidi, kretek, and smokeless tobacco use coded as a three-level ordinal variable including no use, lifetime use, and current (past month) use; and age of initiation for each of cigarettes, cigars (combining regular and little cigars), bidis, and kreteks.

Procedure

Passive consent from parents was obtained through a mailing. Only one parent requested that her child not par-

Table 2
Rates of lifetime and current use

	Lifetime use % (95% CI) ^a					Current use % (95% CI)				
	All	Sex		School level		All	Sex		School level	
		Male	Female	Middle	High		Male	Female	Middle	High
All cigars	18.2 (16.7–19.9)	27.0 (24.5–29.6)	9.9 ^c (8.5–11.5)	9.7 (8.3–11.3)	23.9 ^c (21.9–26.0)	5.9 (5.1–6.7)	9.3 (8.0–10.8)	2.6 ^c (2.0–3.4)	3.1 (2.4–4.0)	7.7 ^c (6.6–8.9)
Regular cigars	16.4 (14.9–18.0)	25.1 (22.7–27.8)	8.1 ^c (6.8–9.5)	7.9 (6.6–9.3)	22.0 ^c (20.1–24.1)	4.7 (4.1–5.4)	7.8 (6.6–9.1)	1.8 ^c (1.3–2.4)	2.2 (1.7–2.9)	6.3 ^c (5.4–7.4)
Little cigars/ cigarillos	11.9 (10.7–13.2)	17.5 (15.6–19.6)	6.5 ^c (5.5–7.8)	6.3 (5.2–7.7)	15.5 ^c (13.9–17.3)	3.4 (2.8–4.0)	5.1 (4.2–6.2)	1.7 ^c (0.7–1.6)	2.2 (1.6–3.0)	4.2 ^c (3.4–5.0)
Bidis	6.5 (5.6–7.5)	8.3 (6.9–9.9)	4.7 ^c (3.8–5.8)	2.9 (2.2–3.8)	8.8 ^c (7.5–10.4)	1.7 (1.3–2.1)	2.3 (1.8–3.1)	1.1 ^c (0.7–1.6)	0.9 (0.6–1.4)	2.2 ^c (1.7–2.9)
Kreteks	8.9 (7.8–10.1)	9.9 (8.4–11.6)	7.9 ^b (6.6–9.4)	5.0 (3.9–6.4)	11.4 ^c (9.9–13.1)	2.6 (2.1–3.1)	3.1 (2.4–3.9)	2.1 ^b (1.6–2.8)	1.7 (1.2–2.4)	3.1 ^c (2.5–4.0)
Smokeless tobacco	4.6 (4.0–5.4)	8.4 (7.0–9.9)	1.1 ^c (0.8–1.6)	2.3 (1.6–3.2)	6.2 ^c (5.2–7.3)	1.7 (1.3–2.2)	3.2 (2.4–4.3)	0.3 ^c (0.1–0.6)	0.6 (0.3–1.1)	2.5 ^c (1.8–3.3)
Cigarettes	33.7 (31.5–36.0)	33.3 (30.6–36.1)	34.2 (31.6–36.9)	23.6 (20.8–26.7)	40.4 ^c (37.7–43.1)	14.4 (13.0–15.9)	13.4 (11.7–15.3)	15.4 (13.7–17.3)	9.8 (8.2–11.8)	17.4 ^c (15.6–19.4)

^a CI, confidence interval.

^b $P < 0.05$.

^c $P < 0.01$.

participate. The CURE was administered by teachers who followed a script provided to them. Students completed the surveys anonymously in class. For the six schools where we had exact classroom enrollment data, response rates of usable surveys averaged 83.5% (range: 74.9% to 97.8%).

Data analysis: general issues

Analyzing school survey data has its special challenges, due to the nonindependence of observations. In the current instance, two students in the same classroom are likely to be more similar in their patterns of use than are two random students selected from the state. The effect of this nonindependence is frequently to inflate the actual standard errors above those reported by standard statistical software. A common strategy adopted to deal with this problem is to use the Huber-White, or robust variance estimator [55–57], which adjusts the standard errors for clustering of observations. All standard errors and significance tests reported in this study used the robust variance estimator, implemented with Stata, version 7, and its cluster options for statistical modeling commands for such procedures as logistic regression and ordinal logistic regression [58].

Results

Rates of use

Table 2 reports the rates of lifetime and current use for cigarettes, smokeless tobacco, and the alternative tobacco products that are the focus of this study. The rates of lifetime use were 11.9% for little cigars, 16.4% for regular cigars, 18.2% for all cigars, 6.5% for bidis, 8.9% for kreteks, 4.6% for smokeless tobacco, and 33.7% for cigarettes. Rates of current use were as follows: little cigars, 3.4%, regular cigars, 4.7%, all cigars, 5.9%, bidis, 1.7%, kreteks, 2.6%, smokeless, 1.7%, and cigarettes, 14.4%.

All forms of tobacco were more likely to be used by high school than by middle school students. All forms of alter-

native tobacco were more likely to be used by males than females, while there was no gender difference in rate of cigarette smoking.

Types of cigars

It was speculated that girls might be more likely to use little cigars than regular cigars. This question was investigated by a pair of logistic regressions in which either lifetime or current use of little cigars was predicted from gender with lifetime (or current) use of regular cigars and grade as covariates. For neither lifetime ($z = -1.28$, $P = 0.199$) nor current use ($z = -1.73$, $P = 0.08$) was there an association between gender and little cigar use after use of regular cigars was controlled. Thus, little and regular cigars are combined for all subsequent analyses.

Characteristics of users

Univariate analyses

Table 3 contains the univariate associations of each correlate with lifetime use of each of the five tobacco products, controlling only for grade and (except for gender itself) gender. Each of these variables was associated with lifetime use of several forms of tobacco. With the exception of gender, all significant associations were in the same direction across forms of tobacco. Females were more likely to smoke cigarettes, and less likely to use all forms of alternative tobacco. Race/ethnicity was associated with use of cigarettes, cigars, and kreteks; Hispanics, blacks, and those designating “other” race/ethnicity were more likely to smoke cigarettes when compared with whites, and Hispanics were less likely to smoke kreteks or use smokeless tobacco. Those students from urban communities were more likely to smoke bidis or use smokeless tobacco than suburban or rural youth.

Parents’ education was negatively associated with cigarette and kretek use, while living in a two-parent family was negatively associated with use of all forms of tobacco, except smokeless tobacco. Life satisfaction and all four

Table 3
Univariate predictors of tobacco use

Predictor	Lifetime use of substance OR (95% CI)				
	Cigarettes	Cigars	Bidis	Kreteks	Smokeless
Race/ethnicity ^b	40.3 ^e	10.05 ^c	4.38	17.12 ^d	6.66
Black	1.64 ^e (1.05–2.58)	0.74 (0.40–1.38)	1.38 (0.66–2.86)	0.65 (0.24–1.78)	0.63 (0.21–1.89)
Hispanic	1.39 ^d (1.09–1.78)	0.93 (0.67–1.29)	0.93 (0.58–1.49)	0.32 ^d (0.16–0.62)	0.45 ^c (0.21–0.95)
Asian	0.86 (0.59–1.24)	0.72 (0.45–1.15)	1.04 (0.54–1.99)	0.68 (0.36–1.27)	0.60 (0.25–1.46)
Other race	1.94 ^e (1.47–2.55)	1.54 ^c (1.07–2.21)	1.63 (0.99–2.68)	1.48 (0.97–2.27)	1.13 (0.60–2.11)
Community type ^b	5.17	0.14	11.49 ^d	2.85	7.55 ^c
Suburban	0.97 (0.80–1.17)	1.00 (0.81–1.23)	0.88 (0.63–1.23)	0.78 (0.59–1.04)	0.65 ^d (0.47–0.88)
Rural	1.25 (0.99–1.58)	1.04 (0.83–1.30)	0.49 ^d (0.32–0.74)	0.90 (0.67–1.22)	0.79 (0.50–1.25)
Two parent family	0.57 ^e (0.48–0.67)	0.67 ^e (0.55–0.81)	0.56 ^e (0.44–0.72)	0.65 ^e (0.51–0.81)	1.02 (0.72–1.45)
Parent's education	0.80 ^e (0.76–0.85)	0.94 (0.88–1.01)	0.84 ^e (0.77–0.92)	0.92 ^c (0.85–1.00)	0.96 (0.85–1.07)
GPA ^a	0.42 ^e (0.38–0.45)	0.54 ^e (0.49–0.59)	0.45 ^e (0.40–0.52)	0.52 ^c (0.47–0.59)	0.65 ^c (0.56–0.76)
College planned	0.37 ^e (0.31–0.43)	0.51 ^e (0.42–0.63)	0.39 ^e (0.30–0.50)	0.43 ^e (0.33–0.55)	0.62 ^d (0.46–0.85)
Truancy	3.17 ^e (2.78–3.62)	2.77 ^e (2.37–3.23)	2.93 ^e (2.26–3.79)	3.39 ^e (2.73–4.20)	2.27 ^e (1.66–3.11)
School attachment	0.57 ^e (0.52–0.62)	0.57 ^e (0.52–0.63)	0.55 ^e (0.48–0.63)	0.56 ^c (0.49–0.63)	0.64 ^c (0.55–0.75)
Life satisfaction	0.78 ^e (0.75–0.81)	0.85 ^e (0.81–0.90)	0.79 ^e (0.74–0.85)	0.79 ^e (0.74–0.84)	0.78 ^e (0.71–0.85)

^a OR, odds ratio; CI, confidence interval; GPA, grade point average.

^b Significance tests for race/ethnicity and community type are omnibus Wald χ^2 with *df* of 3 and 2, respectively.

^c $P < 0.05$.

^d $P < 0.01$.

^e $P < 0.001$.

school functioning variables (GPA, college plans, school attachment, and truancy) were associated with use of all forms of tobacco; i.e., those with better school functioning and greater life satisfaction were less likely to use all forms of tobacco.

Multivariate analyses

To further examine the characteristics of users of each form of tobacco, we conducted a set of multivariate analyses, one for each type of tobacco, to examine the unique contributions of each variable. The outcome in each case was the three-level ordinal use variable. Initial exploratory analyses examined various ordinal regression models, including the proportional odds model and the generalized ordinal regression model [59,60]. These analyses suggested that the proportional odds assumption—that the odds of being a lifetime or current user versus being a nonuser is equal to the odds of being a current user versus the odds of being a non- or lifetime user—of traditional ordinal logistic regression was a reasonable one. In the cases where the proportional odds assumption was violated, the only variable that had a significant difference between the two levels of use, as assessed by a Wald test, was the race/ethnicity, where the differences were due to the low rates of blacks in the current use cells. Therefore, the simpler (because it contains fewer parameters) proportional odds model was adopted for all multivariate analyses.

As each variable examined was associated with at least some forms of tobacco use in the univariate analyses, all variables were entered into multivariate ordinal logistic regression model, where the outcome was a three-level variable: no use, lifetime use, and current use of that form of

tobacco (Table 4). Several variables—grade, GPA, truancy, and life satisfaction—exhibited significant associations with use of all five forms of tobacco. Those students in higher grades, with lower GPA, who were truant, or who reported lower life satisfaction were more likely to use all forms of tobacco. Having plans to go to college was associated with lower rates of cigarette and bidi use. Unlike in the univariate analysis, female gender was associated with greater use of cigarettes; it was also associated with lower use of cigars, bidis, and kreteks. Living in a two-parent family was only associated with reduced odds of cigarette use, and higher parent education was associated with increased odds of cigar use.

Type of community was associated with use of bidis, kreteks, and smokeless tobacco, with those living in suburban and rural communities having lower use than those in urban communities (the reference group). Only for kreteks was there an association with race/ethnicity, with black and Hispanic students using less than whites (the reference group).

Age of initiation

The mean age of initiation of each form of tobacco (except smokeless tobacco, for which this question was not asked) was examined (Table 5). Cigarettes had the youngest age of initiation (mean = 12.6 years, SD = 1.9), followed by cigars (mean = 13.5 years, SD = 1.8), then bidis (mean = 13.9 years, SD = 2.0) and kreteks (mean = 14.1 years, SD = 1.7). Potential differences in age of initiation between tobacco forms also were examined using robust tests of the significance of mean differences in these ages among par-

Table 4
Ordinal logistic regression of tobacco use on youth characteristics

	Cigarettes OR (95% CI) ^a	Cigars OR (95% CI)	Bidis OR (95% CI)	Kreteks OR (95% CI)	Smokeless OR (95% CI)
Gender	1.27 ^d (1.09–1.48)	0.27 ^e (0.23–0.33)	0.57 ^e (0.44–0.74)	0.84 (0.66–1.07)	0.11 ^e (0.07–0.17)
Grade	1.36 ^e (1.30–1.43)	1.43 ^e (1.35–1.52)	1.53 ^e (1.36–1.70)	1.43 ^e (1.32–1.55)	1.44 ^e (1.27–1.63)
Race/ethnicity ^b	8.80	8.00	3.33	18.03 ^a	6.74
Black	1.08 (0.66–1.77)	0.55 (0.27–1.09)	0.91 (0.36–2.27)	0.51 (0.18–1.48)	0.59 (0.18–1.92)
Hispanic	0.82 (0.64–0.94)	0.88 (0.63–1.25)	0.65 (0.39–1.07)	0.20 ^e (0.09–0.45)	0.37 ^e (0.16–0.87)
Asian	0.86 (0.58–1.27)	0.69 (0.43–1.11)	0.89 (0.38–2.08)	0.51 (0.21–1.23)	0.77 (0.31–1.92)
Other race	1.45 ^e (1.04–2.01)	1.27 (0.83–1.93)	1.13 (0.67–1.90)	1.04 (0.64–1.68)	1.07 (0.53–2.14)
Community type ^b	3.57	3.41	22.95 ^e	17.02 ^e	18.84 ^e
Suburban	0.84 (0.70–1.01)	0.85 (0.68–1.05)	0.68 ^e (0.48–0.97)	0.60 ^e (0.46–0.78)	0.47 ^e (0.33–0.67)
Rural	0.97 (0.78–1.21)	0.81 (0.63–1.05)	0.30 ^e (0.19–0.50)	0.58 ^d (0.42–0.80)	0.50 ^d (0.30–0.83)
Two parent family	0.83 ^e (0.70–0.98)	0.88 (0.71–1.08)	0.82 (0.63–1.08)	0.83 (0.65–1.06)	1.25 (0.84–1.84)
Parent's education	0.97 (0.91–1.04)	1.11 ^d (1.03–1.20)	1.00 (0.87–1.13)	1.05 (0.95–1.16)	1.08 (0.94–1.23)
GPA ^a	0.51 ^e (0.46–0.57)	0.61 ^e (0.54–0.69)	0.55 ^e (0.46–0.67)	0.65 ^e (0.55–0.77)	0.70 ^e (0.57–0.85)
College planned	0.75 ^d (0.63–0.90)	1.04 (0.83–1.30)	0.77 (0.54–1.09)	0.87 (0.63–1.22)	1.05 (0.74–1.51)
Truancy	2.20 ^e (1.92–2.53)	2.02 ^e (1.72–2.39)	1.79 ^e (1.34–2.41)	2.52 ^e (1.99–3.19)	1.83 ^e (1.32–2.53)
School attachment	0.83 ^e (0.76–0.91)	0.75 ^e (0.66–0.84)	0.78 ^d (0.65–0.93)	0.80 ^d (0.68–0.94)	0.82 (0.68–0.98)
Life satisfaction	0.82 ^e (0.76–0.89)	0.96 (0.87–1.05)	0.86 ^e (0.76–1.03)	0.82 ^e (0.73–0.91)	0.73 ^e (0.63–0.86)
Wald χ^2	828.08 ^e	731.37 ^e	291.92 ^e	377.61 ^e	243.23 ^e

^a OR, odds ratio; CI, confidence interval; GPA, grade point average.

^b Significance tests for race/ethnicity and community type are omnibus Wald χ^2 with *df* of 3 and 2, respectively.

^c $P < 0.05$.

^d $P < 0.01$.

^e $P < 0.001$.

Participants reporting lifetime use of both forms of tobacco (Table 5). On average, cigarettes were first smoked approximately 0.98 ($P < 0.001$) years before cigars, and cigars were smoked 0.54 ($P < 0.001$) years before bidis and 0.67 ($P < 0.001$) years before kreteks. These differences were all significant. There was no significant difference in age of initiation between bidis and kreteks.

Further examination of the ages of initiation revealed that 55.4% of those who smoked both cigarettes and cigars initiated cigarettes before cigars, while 14.5% initiated cigars first, and 30.1% began smoking both substances at the same age (Table 6). For cigarettes and bidis the rates were 70.0% smoked cigarettes first, 10.9% smoked bidis first, and 19.1% initiated cigarettes and bidis at the same age; for cigarettes and kreteks the rate were 71.7% cigarettes first,

7.5% kreteks firsts, and 20.8% same age. Thus, most students who smoked cigarettes and one of the alternative tobacco products smoked cigarettes first, but there was a small number who started smoking alternative tobacco products first and a significant fraction who initiated both cigarettes and alternative tobacco use at approximately the same age.

Overlap between use of cigarettes and alternative tobacco

The relation between alternative tobacco use and cigarette use was explored by examining, for each form of tobacco, (1) the percentage of lifetime users of that tobacco product who were also lifetime users of cigarettes, and (2) the percentage of current users of that tobacco product who were lifetime users and current users of cigarettes (Table 7). While over 80% of both lifetime and current users of smokeless and alternative tobacco were lifetime cigarette smokers, 42.0% of current cigar smokers and 39.8% of current smokeless tobacco users were not current cigarette smokers. The comparable rates for bidis and kreteks were lower, 17.9% and 24.2%, respectively.

Discussion

The rates of alternative tobacco use reported here were somewhat lower than those seen in other national and Massachusetts surveys. For example, the rates of current cigar

Table 5
Differences in age of initiation of tobacco products^a

First tobacco product	Age Mean (SD)	Second tobacco product Δ Mean (SE)		
		Cigars	Bidis	Kreteks
Cigarettes	12.64 (1.92)	0.98 ^b (0.06)	1.51 ^b (0.12)	1.69 ^b (0.10)
Cigars	13.47 (1.80)		0.54 ^b (0.11)	0.67 ^b (0.10)
Bidis	13.90 (1.95)			0.10 (0.11)
Kreteks	14.08 (1.73)			

^a Mean age difference is the difference between the age of initiation for the tobacco product on the vertical axis and that on the horizontal for those who smoked both products. The age column is the mean age for all users of a product.

^b $P < 0.001$.

Table 6
Smoking initiation precedence

First tobacco product	Second tobacco product % (95% CI) ^a			
	Cigars	Bidis	Kreteks	Cigarettes
Cigars	—	45.1 (38.7–51.6)	49.7 (43.9–55.4)	14.5 (12.2–17.2)
Bidis	18.9 (14.2–24.6)	—	30.1 (24.0–37.1)	10.9 (7.6–15.3)
Kreteks	17.8 (13.5–23.0)	23.9 (17.8–31.2)	—	7.5 (5.3–10.6)
Cigarettes	55.4 (51.7–59.1)	70.0 (64.8–74.7)	71.7 (67.0–75.9)	—

Note. Entries represent only smokers of both substances.

^a CI, confidence interval.

use found in the present study, 3.1% [95% confidence interval (CI) 2.4–4.0%] for middle school students and 7.7% (95% CI 6.6–8.9%) for high school students, were somewhat below the 4.2% for middle and 11.1% for high school students found in the 1999 Massachusetts Prevalence Study [6] or the 13.1% for high school students found in the 2001 Massachusetts Youth Risk Behavior Survey [16]. It can, however, be difficult directly to compare rates of use across surveys due to differences in design, precise question wording, and other design details, as exemplified in the differences between the current cigar use estimates of the two statewide probability samples. Nonetheless, the lower rates in the CURE sample suggest that the sample may have been somewhat biased toward nonusing students. Other limitations of the study that should be kept in mind when interpreting the findings are that the sample is drawn from only one state and is a convenience sample that may not completely adequately represent that state. These sampling issues and the modest differences in prevalence from other studies should not threaten the validity of the other analyses here reported, however, as these analyses involve correlates of use and relative age of initiating use within individuals, and are likely relatively robust to sampling issues. It should also be kept in mind that, like most school-based surveys, all the data are based on self-report and are not independently validated.

Table 7
Alternative tobacco users who smoked cigarettes

Alternative tobacco use	Cigarette use % (95% CI)	
	Current use	Lifetime use
Current use		
Cigars	58.0 (52.1–63.8)	83.2 (78.6–87.0)
Bidis	82.1 (73.2–88.6)	90.5 (82.5–95.0)
Kreteks	75.8 (67.0–82.8)	94.5 (88.9–97.3)
Smokeless	60.2 (50.0–69.6)	84.5 (75.5–90.6)
Any alternative tobacco	62.1 (57.0–67.0)	84.8 (80.8–88.1)
Lifetime use		
Cigars	42.5 (38.9–46.2)	80.7 (77.7–83.4)
Bidis	65.3 (59.8–70.5)	91.3 (87.8–93.9)
Kreteks	61.6 (56.6–66.5)	90.8 (87.8–93.2)
Smokeless	46.7 (40.2–53.4)	83.5 (77.8–87.9)
Any alternative tobacco	44.6 (41.4–47.9)	81.4 (78.8–83.8)

^a CI, confidence interval.

Both the univariate and the multivariate models suggested that, overall, the characteristics of alternative tobacco users strongly resemble those of cigarette users. Thus, in the univariate model, with exception of gender, all variables that present significant associations with use of various forms of tobacco had associations in the same direction. These findings suggest that, to a great extent, use of alternative tobacco products is part of a constellation of risky behaviors engaged in by many youth, with worse school performance and less attachment to school, and with lower overall life satisfaction [44,46]. These associations are thus consistent with problem behavior theory postulating that substance use, including, presumably, alternative tobacco use, is one of a constellation of problem behaviors likely to be engaged in by certain youth [61].

In the multivariate model, females were more likely than males to smoke cigarettes and less likely to use smokeless tobacco and all forms of alternative tobacco. These results are consistent with recent findings that cigarette rates among girls have risen to rates equal to or greater than those of boys [1,6]. They also suggest that alternative tobacco use, so far, is a greater problem among boys than girls, though female rates of kretek use is nearing the levels found among boys. Other than the gender-cigarette relationship, the one correlate of tobacco use that suggests that alternative tobacco use is not simply one of a number of potential risky behaviors that high-risk youth may engage in is the positive association in the multivariate model between parents' education and the odds of a youth smoking cigars.

Examination of the overlap between alternative tobacco use and cigarette smoking indicated that most alternative tobacco users were also lifetime cigarette smokers and many currently smoke cigarettes. Examination of the relative ages of initiation suggested a tendency toward a lawful progression among many youth from cigarette smoking, through cigar use, to bidi and/or kretek use among many youth. Future work using such techniques as latent transition analysis may help clarify the factors predicting progression and the processes involved [62,63].

At the same time, our results indicated that there is a subgroup of youth who smoke cigars but are not currently cigarette smokers. These youth tended to be the cigar smokers with higher grade point averages. This finding, together

with the positive association between parents' education and cigar use in the multivariate model, suggests that certain adolescents may view cigars as more acceptable than cigarettes. Possibly, youth from more educated families may be exposed to more positive images of cigars, either in the home or from such sources as *Cigar Aficionado* magazine and other elements of popular culture. For a proportion of academically well-functioning youth who do not smoke cigarettes, cigars may pose an alternative pathway to nicotine exposure, with all the attendant potential health risks [64], including potential nicotine addiction. The latter is of special concern, given recent findings suggesting that some youth may become addicted to tobacco within a short period of initiation [65]. Thus even small amounts of cigar smoking could pose a significant danger to especially vulnerable youth. Tobacco control programs may need to develop anticigar interventions explicitly targeted toward this group and researchers need to examine the attractions of cigar smoking for these youngsters.

Unlike the pattern for cigars, the overwhelming majority of bidi and kretek users were currently smoking cigarettes. For these substances, the degree of risk posed by the alternative tobacco depends on the relative frequency and quantity of cigarette versus alternative tobacco use. Future studies should strive to clarify these issues. Even if the degree of risk posed by the additional smoking of alternative tobacco by cigarette users is relatively low, tobacco control efforts aimed at alternative tobacco products may help prevent further increases in their use and possible substitution of these products for cigarettes by more youths.

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