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Trends in alternative tobacco use among light, moderate, and heavy smokers in adolescence, 1999–2009☆

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Abstract

Objective—To examine trends in alternative tobacco product (ATP) use (smokeless tobacco, cigars, and bidis/cloves) among a national sample of adolescent cigarette smokers (light, moderate, and heavy) during 1999–2009.

Method—A secondary analysis of data from the 1999–2009 National Youth Tobacco Survey was performed to investigate the tobacco behaviors of 6th through 12th graders enrolled in public and private schools in the United States. Long-term trends in ATP use were analyzed using logistic regression – controlling for sex, grade, and race/ethnicity – and simultaneously assessing linear and higher order time effects and their interaction with cigarette smoking status.

Results—During 1999–2009, increases in smokeless tobacco use and decreases in bidis/cloves use were observed across all smoking groups. For cigars, declines were observed for heavy and moderate smokers, but levels returned to baseline levels in 2009. Cigar use among light smokers was less variable. Rates of any ATP were highest among heavy smokers and lowest among light smokers.

Conclusion—Trends in cigarette and SLT use increased dramatically in the past decade, and this increase is evident across all cigarette smoker types. Implications for tobacco surveillance, prevention and cessation programs, and tobacco control policies are discussed.

Keywords

Adolescents; Smokers; Alternative tobacco use

☆All work was performed at Virginia Commonwealth University.

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Contributors

Author Nasim designed the study and wrote the first draft of the manuscript. Author Khader undertook the statistical analysis. Authors Blank, Cobb and Eissenberg provided feedback and edits to the manuscript. All authors contributed to and have approved the final manuscript.

Conflict of interest statement

The authors declare no conflicts of interest.

1. Introduction

Trends in adolescent cigarette smoking over the past 20 years show that light smoking (<5 cigarettes per day) has increased (+15.3%) and heavy smoking (>11 cigarettes per day) has decreased (-56.6%; Jones, Kann, & Pechacek, 2011). Light smoking, at least among adults, has been associated with increased susceptibility to alternative tobacco product (ATP) use (e.g., smokeless tobacco [SLT], cigars, bidis, and cloves; Cooper et al., 2010; Peterson et al., 2007; Rae Olmsted, Bray, Reyes Guzman, Williams, & Kruger, 2011; Tomar, Alpert, & Connolly, 2010); and, concomitant cigarette and ATP use even among light smokers is related to increased nicotine dependence severity (Timberlake, 2005, 2009). Interestingly, the relationship between cigarette smoking intensity (i.e., light, moderate, and heavy smoking) and ATP use in adolescence has not been explored. Also unknown is the extent to which adolescent cigarette smokers consumed other products like SLT, cigars, and bidis/cloves during a decade in which cigarette use prevalence declined sharply.

Since 2002, adolescent cigarette use has decreased by 36% compared to a significant increase or no change in other tobacco product uses (e.g., SLT and cigars; Substance Abuse and Mental Health Services, 2011). Concomitantly, U.S. consumer sales data (2000–2007) show a drop in cigarette consumption (-18%) and an increase in the sale of small cigars and moist snuff (+115% and +33%, respectively; Connolly & Alpert, 2008). Perhaps most alarming is the national survey data that reveal that adolescent smokers are more likely to report ATP use than nonsmokers (Bombard, Rock, Pederson, & Asman, 2008). Not only do ATPs pose significant health risks when used alone (Baker et al., 2000; Raad et al., 2011; Yadav & Thakur, 2000), the combined use of cigarettes and ATPs may exacerbate further the risk of morbidity and mortality (Chao et al., 2002; Ferrence & Stephens, 2000).

The current study describes trends in SLT, cigar, and bidi/clove use among a national sample of high school students who smoked cigarettes during 1999–2009. In addition, this study examines ATP use rates by adolescents' age, gender, race/ethnicity, and smoking status for the most recent year. Importantly, most tobacco surveillance systems (e.g., National Youth Tobacco Survey) fail to assess emerging tobacco products adequately (e.g., cigars; Nasim, Blank, Berry, & Eissenberg, 2012) or not at all (e.g., dissolvables, e-cigs, Snus, and waterpipe or hookah). Findings from this study will provide important insight on the concomitant trends of cigarette and ATP use in adolescence. This work also will inform health professionals, policy experts, and prevention scientists about the need to assess emerging and increasingly popular ATP uses (e.g., waterpipe) among adolescent cigarette smokers.

2. Methods

The National Youth Tobacco Survey (NYTS; Centers for Disease Control and Prevention [CDC]) is a component of the tobacco surveillance system for the National Tobacco Prevention and Control Program (TPCP); and, assesses tobacco use behaviors of adolescents enrolled in U.S. middle schools and high schools. The NYTS was first administered during fall 1999 and since then has been conducted in 2000, 2002, 2004, 2006, and 2009. The NYTS uses a stratified three-stage cluster sample design to produce a nationally representative sample of all middle school and high school students in the U.S. Sample sizes ranged from 15,508 to 22,679. A complete description of the NYTS can be found here: http://www.cdc.gov/tobacco/data_statistics/surveys/nyts/. This study draws from a representative sample of adolescent cigarette smokers who completed the NYTS during these survey years. As reported previously by the CDC (see CDC, 2010), in 2000, 11.0% of middle school students and 28.0% of high school students reported current cigarette

smoking (past 30-day use). In 2009, 5.2% of middle school students and 17.2% of high school students reported current cigarette use.

The current study included items from the 1999 to 2009 NYTS that were worded exactly for *cigarette smoking frequency* (“During the past 30 days, on how many days did you smoke cigarettes?”), *cigarette smoking intensity* (“During the past 30 days, on the days you smoked, how many cigarettes did you smoke per day?”), and past 30-day use of alternative tobacco products (ATP) including *SLT* (“chewing tobacco, snuff, or dip”), *cigars* (“cigars, cigarillos, or small cigars”), *bidis* (“small brown cigarettes from India made from tobacco wrapped in a leaf tied with thread”), and *cloves* (“cigarettes containing tobacco and clove extract”). Current smokers were categorized into three groups according to cigarette smoking intensity [as in Jones et al., 2011]: light smokers (<1–5 cigarettes per day), moderate smokers (6–10 cigarettes per day), and heavy smokers (>11 cigarettes per day). Demographic variables included in this study were: *age*, *gender*, *race/ethnicity* (NH-White, NH-Black, Hispanic/Latino), and *grade level* (6th through 12th grades).

Data were weighted to provide national estimates and SPSS Statistics 19 was used for all data analyses. Long-term trends in ATP use were analyzed using logistic regression – controlling for sex, grade in school, and race/ethnicity – and simultaneously assessing linear and higher order time effects and their interaction with cigarette smoking status. Because the interaction between time and smoking status was significant for all ATPs, linear and quadratic trends were presented according to cigarette smoking status. Linear trends suggest a significant increase or decrease over time. Quadratic trends suggest a significant but nonlinear trend in data over time. When the trend includes significant linear and quadratic components, the data demonstrate some nonlinear variation (e.g., leveling off or change in direction) in addition to a linear effect. A *p*-value of <0.05 was considered statistically significant for all analyses.

Differences in the 2009 prevalence rates of ATPs according to age, gender, race/ethnicity and cigarette smoking status were analyzed using chi-square test. Separate multivariate logistic regression models (one for each ATP use) were used to analyze the differences in the 2009 ATP use according to age, gender, and smoking status for each race/ethnicity (excluding others). Analyses were stratified by race/ethnicity based on recent research showing that cigarettes per day (cpd) may be a more important predictor of ATP use for White/European American adolescents than for youth of other descent populations (Nasim, Blank, Cobb, & Eissenberg, in press).

3. Results

3.1. Trends in alternative tobacco use among adolescent cigarette smokers

Among adolescent cigarette smokers, the relative percentage of light smokers increased by 6.5%, from 73.8% in 1999 to 78.6% in 2009. During this same period, the percentage of moderate cigarette smokers fell by 23%, from 13.0% in 1999 to 10.0% in 2009. Similarly, there were fewer adolescent heavy smokers in 2009 (11.2%) than in 1999 (13.0%).

For each ATP, there was a significant interaction between linear and/or quadratic time effects and cigarette smoking status ($p < 0.05$) after adjusting for gender, school grade, and race/ethnicity. Fig. 1 (panels A–C) demonstrates these long-term trends in SLT, cigar, and bidi/clove use as a function of light, moderate, and heavy smoking. In all survey waves, ATPs were significantly more common in heavy cigarette smokers compared to moderate and light cigarette smokers ($p < 0.005$).

For SLT use among heavy and light smokers, there were significant linear ($p<0.005$) and quadratic ($p<0.005$) trends in their prevalence rates. The rate in heavy smokers generally decreased between 1999 and 2004 and then started to increase after 2004. In light smokers, the rate increased between 1999 and 2002 and decreased in 2004 after which the rate continued to increase. In moderate smokers, the rate increased linearly from 14.9% in 1999 to 26.7% in 2009.

For cigar use, there was a significant linear trend in light smokers ($p<0.005$), with little variations in prevalence observed over time. Results also revealed significant quadratic ($p<0.005$) and linear ($p<0.005$) trends in moderate and heavy smoker groups. In heavy cigarette smokers, cigar use prevalence decreased linearly from 60.5% in 1999 to 53.5% in 2002; increased in 2004 and 2005; and decreased to 59.4% in 2009. In moderate smokers, prevalence rates decreased from 48.3% in 1999 to 39.8% in 2000 and increased over time until it reached 49.8% in 2006 and then declined to 41.1% in 2009. For bidi/clove use, prevalence decreased between 1999 and 2004 in all cigarette smoker groups. The rates were observed to increase in 2006, but then decreased again to the lowest levels observed during surveillance ($p<0.005$).

3.2. Characteristics of ATP use among adolescent cigarette smokers, 2009

In 2009, approximately half (51.7%) of adolescent cigarette smokers reported use of an ATP during the previous 30 days: 32.0% reported one, 14.7% reported two, and 5.0% reported three ATPs. Of these respondents, 22.5% used SLT, 39.6% used cigars, and 15.5% used bidis/cloves. Males were more likely to use ATPs than females (31.7% versus 8.6% for SLT; 46.6% versus 30.1% for cigars; 16.3% versus 13.5% for bidis/cloves, $p<0.01$ for each ATP). Compared to students aged ≤ 16 years, students aged >16 years were more likely to report SLT use (22.7% versus 20.9%; $p<0.01$) and less likely to report cigar use (39.0% versus 39.7%; $p<0.01$) and bidi/clove use (12.9% versus 16.7%; $p<0.01$). While the rate of SLT was the highest in NH-Whites (24.2%), the rate of cigar was the highest in Hispanics (43.3%) and the rate of bidis/cloves was the highest in NH-Blacks (21.0%). The rates of each ATP increased as cigarette use increased: heavy smokers (40.0% for SLT; 60.4% for cigars; 32.3% for bidis/cloves) versus moderate smokers (26.5% for SLT; 40.7% for cigars, and 16.1% for bidis/cloves) versus light smokers (18.7% for SLT; 36.5% for cigars; 12.7% for bidis/cloves).

Table 1 shows the multivariate analysis of the differences in the ATP use among adolescents of different race/ethnic groups according to gender, age, and cigarette smoking status in 2009. For NH-Whites and Hispanics, males were significantly more likely to report all ATP use than females ($p<.01$). Among NH-Blacks, females were significantly more likely to report all ATP use than males ($p<.01$). Age of >16 years was significantly associated with increased odds of smokeless tobacco use and cigar use among NH-Whites and associated with decreased odds of these ATP use among NH-Blacks and Hispanics ($ps<.01$). Compared to age of ≤ 16 years, older age was associated with increased odds of bidi/clove use among NH-Blacks and decreased odds among NH-whites and Hispanics ($ps<.01$). Compared to light smokers, NH-Black moderate smokers were more likely and Hispanic moderate smokers were less likely to report smokeless tobacco and cigar use ($ps<.01$). On the other hand, bidi/clove use was more common in Hispanic moderate smokers and less common in NH-Black moderate smokers as compared to light smokers. Among all races, heavy cigarette smokers were significantly more likely to report ATP use compared to light cigarettes smokers ($ps<.01$).

4. Discussion

As with previous work (Jones et al., 2011), survey results revealed an increase in light cigarette smoking and a decrease in heavy cigarette smoking from 1999 to 2009. Additionally, ATP rates followed a general pattern of increased SLT use and decreased bidi/clove use. These patterns were observed for all smoker types (i.e., light, moderate, and heavy cigarette smokers), resulting in an overall SLT increase of 42.0% and an overall bidi/clove decrease of 36.5% by the end of this decade. In contrast, cigar use declined significantly in both heavy and moderate smokers, though rates returned to baseline levels for heavy smokers by 2009. Cigar use among light smokers exhibited a minimal, yet significant linear increase over time.

Tobacco industry marketing of SLT to current cigarette smokers may explain the overall increase in prevalence among this population. The tobacco industry explicitly targeted cigarette smokers by promoting SLT as an alternative to cigarettes, not in an effort to support quitting but rather to augment their cigarette smoking behaviors when confronted with smoking restrictions (Carpenter, Connolly, Ayo-Yusuf, & Wayne, 2009). Such marketing approaches may have been effective in lowering perceptions about the harm of these products among adolescent and young adult smokers (e.g., Haddock, Lando, Klesges, Peterson, & Scarinci, 2004), with little or no differences between lighter and heavier smokers (O'Connor, Hyland, Giovino, Fong, & Cummings, 2005). As a likely outcome, trends in dual cigarette and SLT use increased dramatically over the past decade (relative to other types of concomitant tobacco use), and this increase appears consonant across adolescent cigarette smoker types.

Increased SLT prevalence during the past decade also may reflect adolescent smoker's attempts to curb their cigarette use by consuming tobacco products perceived as less harmful ATPs. Such harm reduction strategies among adolescents are likely motivated by an awareness of the risks associated with cigarette use and the lack of awareness and knowledge about the harms of ATPs such as SLT. This is an idea supported by SLT research with Australian youth (Gartner & Hall, 2009); however, SLT as a substitute for cigarette smoking may not be a perception shared by youth in the U.S. (Timberlake, 2009).

Like cigarette and SLT trends, concomitant cigarette and cigar uses also may be accounted for by targeted tobacco industry advertising. It is important to note that despite legislation in 1997 banning tobacco advertising and promotions targeting youth (i.e., Master Settlement Agreement; MSA, 1998), industry advertising and promotional expenditures on direct mailings, public entertainment, and the Internet increased 60–291% between 1997 and 2001 (Lewis, Yulis, Delnevo, & Hrywna, 2004). Previous studies reveal the tobacco industry's comprehensive marketing strategies to promote cigar smoking to current users of cigarettes (Delnevo & Hrywna, 2007). The tobacco industry also has engaged in targeted advertising among racial/ethnic minorities and young women. For instance, NH-Blacks and Hispanics are exposed to a high volume of pro-tobacco advertising messages in their communities (Pucci, Joseph, & Siegel, 1998; Stoddard, Johnson, Sussman, Dent, & Boley-Cruz, 1998), and in media (Primack, Bost, and, & Fine, 2007); and, such exposure is linked to increased tobacco use behaviors (Choi, Ahluwalia, Harris, & Okuyemi, 2002; DiFranza et al., 2006). This effect of exposure to pro-tobacco messaging may be especially relevant for NH-Black female smokers who reported higher rates of concomitant cigarette and ATP use than NH-Black males. Whether this finding is a reflection of their increased exposure to female cigar smoking portrayals in women-oriented magazines (Feit, 2001), in other media (e.g., television and Internet) or venues (i.e., specialty shops) is not entirely clear.

The affordability of other tobacco products also may account for increased prevalence among adolescents who smoke cigarettes regularly. Sales of SLT and cigar products (e.g., especially little cigars; Kozlowski, Dollar, & Giovino, 2009) increased substantially over the past decade in part due to lower prices compared to cigarettes (Delnevo, Hrywna, Foulds, & Steinberg, 2004). In addition, the sensory characteristics (e.g., pleasant smell and taste) of SLT and cigars render these products especially appealing to youth populations (Soldz & Dorsey, 2005). Importantly, although the Family Smoking Prevention and Tobacco Control Act of 2009 authorized the FDA to regulate all tobacco products (see <http://www.gpo.gov/fdsys/pkg/PLAW-111publ31/pdf/PLAW-111publ31.pdf>), some restrictions apply only to cigarettes. For example, ATPs such as cigars, waterpipes, and SLTs are still permitted to contain additives or “flavorings” (i.e., herbs, spices, cinnamon, and cherry), characteristics which promote their continued use among adolescent smokers. As concurrent use of cigarettes and ATPs increases the risk of nicotine dependence (Donny & Dierker, 2007; Timberlake, 2005, 2009) and adverse health consequences (Chao et al., 2002; Ferrence & Stephens, 2000), polytobacco users are more likely than cigarette-only users to experience tobacco-caused disease and death.

This study should be viewed in light of its limitations. The current study focused on youth who attended public school. Thus, these results may not be representative of all youth within the age groups sampled and may not generalize to populations outside the U.S. The reliance on self-report also may have influenced study findings, though evidence suggests adolescent self-report data to be valid and reliable (Brenner et al., 2002; Wills & Cleary, 1997). Additionally, overall estimates of ATP use are likely underestimated, especially in later survey years, due to lack of surveillance of emerging tobacco products like waterpipe tobacco smoking (WTS) and electronic cigarettes. Consequently, tobacco surveillance systems that do not capture trends in product use accurately can affect public policy, education, and intervention programs adversely.

Despite these limitations, these results have implications for tobacco surveillance systems, school-based prevention and cessation programs, and tobacco control policies. Tobacco surveillance measures should include items that assess the use of traditional and novel ATPs (e.g., WTS, Snus, electronic cigarettes) and can be used to estimate national prevalence of ATP use among adolescent populations. Tobacco prevention programs and counter-industry marketing campaigns should develop innovative curricula and messaging strategies to educate the youth about the risks associated with novel tobacco products, including the risk of maintaining cigarette-caused nicotine/tobacco dependence. For instance, recent evidence suggests that the integration of graphics-enhanced messages in standard educational materials may increase adolescents' knowledge and perceived risks of ATPs (e.g., cigars; Strasser et al., 2011). Also, gaps in existing legislation pertaining to unevenly taxed tobacco products (e.g., see State Children's Health Insurance Program; SCHIP; 2009) and the lack of restrictions on product constituent ingredients for ATPs (see Family Smoking Prevention and Tobacco Control Act, 2009) should be addressed. To this end, future work might examine the impact of 2009 legislative achievements on concurrent trends in adolescent cigarette and ATP use.

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Fig. 1.
Secular trends in alternative tobacco use among adolescents according to cigarette smoking status, 1999–2009.

Table 1

The multivariate analysis of the differences in the alternative tobacco use among adolescents of different race/ethnic groups according to gender, age, and cigarette smoking status in 2009.

	Race/ethnicity		
	NH-White	NH-Black	Hispanic
	OR (95% confidence interval)	OR (95% confidence interval)	OR (95% confidence interval)
<i>Past month SLT use</i>			
Gender (males vs. females)	8.21 (8.13, 8.28)	0.84 (0.82, 0.86)	2.03 (2.00, 2.06)
Age (>16 years vs. 16 years)	1.19 (1.18, 1.20)	0.39 (0.38, 0.40)	0.55 (0.54, 0.56)
Cigarette smoking status			
Light	1.0	1.0	1.0
Moderate	1.68 (1.67, 1.70)	2.71 (2.60, 2.81)	0.81 (0.79, 0.84)
Heavy	1.30 (1.29, 1.32)	11.07 (10.76, 11.38)	7.65 (7.52, 7.79)
<i>Past month cigar use</i>			
Gender (males vs. females)	2.23 (2.21, 2.24)	0.98 (0.96, 0.99)	1.86 (1.84, 1.88)
Age (>16 years vs. 16 years)	1.04 (1.03, 1.04)	0.57 (0.56, 0.58)	0.77 (0.76, 0.78)
Cigarette smoking status			
Light	1.0	1.0	1.0
Moderate	1.29 (1.27, 1.30)	2.26 (2.20, 2.33)	0.74 (0.72, 0.75)
Heavy	1.87 (1.85, 1.89)	10.52 (10.20, 10.86)	3.16 (3.11, 3.21)
<i>Past month bidi/clove use</i>			
Gender (males vs. females)	1.18 (1.17, 1.19)	0.82 (0.80, 0.83)	1.45 (1.43, 1.47)
Age (>16 years vs. 16 years)	0.73 (0.73, 0.74)	1.52 (1.49, 1.55)	0.44 (0.43, 0.44)
Cigarette smoking status			
Light	1.0	1.0	1.0
Moderate	1.31 (1.30, 1.33)	0.84 (0.80, 0.87)	2.05 (2.00, 2.10)
Heavy	1.82 (1.80, 1.84)	9.86 (9.60, 10.12)	9.13 (8.97, 9.29)

P-value < 0.005 for all variables in the three logistic regression models.

All ORs are significant at p<.01.