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Caffeinated Energy Drink Use by U.S. Adolescents Aged 13-17: A National Profile

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Abstract

The present study examined the national prevalence and distribution of adolescent use of caffeinated energy drinks, assessing variations in sociodemographic characteristics, personality traits, lifestyles, and patterns of alcohol and caffeine use. A cross-sectional survey was conducted in May 2014, using a nationally representative sample of 1,032 U.S. early (aged 13–15; $n=602$) and middle adolescents (aged 16–17; $n=430$). Nearly two thirds of teens reported ever using energy drinks; 41% had done so recently, i.e., in the past three months. Middle adolescents reported higher prevalences of both lifetime and recent use of energy drinks than early adolescents. Common situational contexts for use (e.g., compensating for lack of sleep or playing sports) differed by both gender and age cohort. In hierarchical logistic regression analyses, gender and geographic region significantly predicted both lifetime and recent use for early adolescents only, whereas age and race were significant predictors only for middle adolescents. For both age cohorts, odds of both lifetime and recent use increased with sensation-seeking score, lifetime alcohol use, and recent caffeinated soft drink use. Among early adolescents, GPA predicted lifetime use only, whereas coffee and caffeine pill use predicted recent use only. Among middle adolescents, impulsivity and past sports participation predicted lifetime but not recent use. Our findings show that adolescent energy drink use is widespread and varies as a function of demographic, psychosocial, lifestyle, and substance use characteristics. Future research is needed to assess whether differences between early and middle adolescent use patterns are primarily developmental or cohort effects.

Keywords

energy drinks; caffeine; adolescents; substance use

About half of U.S. young adults and one third of minor teens report using caffeinated energy drinks (Mintel Group Ltd., 2013). Since their arrival on the United States commercial

market in 1997, these beverages have been the subject of recurrent waves of public concern. Among young adults, policy proposals and media attention have largely revolved around the high-risk practice of consuming alcohol mixed with energy drink (AmED) cocktails (e.g., Arria et al., 2009; USFDA, 2010). In contrast, public health advocacy on behalf of younger adolescents has focused on the safety and marketing of energy drinks themselves. But whereas a substantial and growing body of research has emerged to examine the implications of young adult AmED use, non-alcoholic energy drink use by U.S. teens under the age of 18 remains significantly understudied.

Concerns about teen use of energy drinks.

Excessive caffeine intake has been demonstrated to produce a range of adverse health effects that are particularly pronounced in adolescents (Wikoff et al., 2017), including high blood pressure and cardiac arrhythmias (Sanchis-Gomar et al., 2016; Savoca et al., 2005), sleep disturbances (Orbeta et al., 2006), anxiety (Nawrot et al., 2003), and caffeine intoxication and withdrawal (Seifert et al., 2013). High doses may also exacerbate underlying conditions such as cardiovascular dysfunction, ADHD, or eating disorders (Seifert et al., 2011). Caffeine effects are dose-dependent; while the health impacts of low doses are largely innocuous or even beneficial, higher doses become increasingly toxic (Sepkowitz, 2013). Children are more susceptible to caffeine toxicity than adults due to their lower body mass and faster metabolism of caffeine in the bloodstream. This sensitivity is exacerbated by the fact that some of the bodily systems disrupted by caffeine use, most notably sleep, are especially critical during the developmental period of adolescence (Visram et al., 2016).

In addition to concerns related to the physiological effects of caffeine, its effects on behavior have come under scrutiny. In young adults, energy drink use has been linked to a pattern of behavioral risk-taking that includes hazardous drinking, unsafe sexual activity, aggression, and driving while intoxicated (Arria et al., 2010; Arria et al., 2016; Buchanan & Ickes, 2015; Meredith et al., 2015; Miller, 2008a; Woolsey et al., 2014; Velazquez et al., 2012). Similarly, studies of minor adolescents have found links between energy drink use and elevated likelihood of other substance use (Azagba et al., 2014; Emond et al., 2014; Gallimberti et al., 2013; Mann et al., 2016; Miller et al., 2016; Miyake & Marmorstein, 2015; Polak et al., 2016; Terry-McElrath et al., 2014).

Prevalence and correlates of teen energy drink use.

A few studies have begun to flesh out our understanding of early and middle adolescent energy drink use. However, estimates of lifetime use, derived from regional samples, vary considerably. Miller et al. (2016) found that 43% of Western New York State teens aged 13–15 years had ever consumed energy drinks, whereas Reid et al. (2017) reported lifetime use rates of 57% for 12–14 yr olds and 69% of 15–17 yr olds in a non-probability consumer panel of Canadian youth. Polak et al. (2016) found even higher rates in a suburban Virginia public school; 65% of 8th graders, 74% of 10th graders, and 77% of 12th graders had consumed an energy drink at least once. Across multiple studies, estimates of past-month use have ranged from 20% to 40% (Azagba et al., 2014; Polak et al., 2016); estimates of

past-week use have ranged from 13% to 20% (Emond et al., 2014; Mann et al., 2016; Reid et al., 2015).

Most studies of U.S. adolescent energy drink use have relied on regional convenience samples of public school students (Mann et al., 2016; Miller et al., 2016; Miyake & Marmorstein, 2015; Polak et al., 2016). To date, there have been only two nationwide assessments of U.S. teen energy drink use. In a national sample of 15–17-year-olds, Emond et al. (2014) found that 13.3% reported energy drink use in the previous week. Terry-McElrath et al. (2014), using nationally representative data from the gold-standard Monitoring the Future study, found that energy drink use was more prevalent among 8th-grade students than their older peers; 35.4% of 8th grade students, 30.2% of 10th grade students, and 31.3% of 12th grade students reported any use of energy drinks or energy shots. Eighth graders also reported consuming significantly more energy drinks daily on average (.47 drinks) than 10th graders (.33 drinks) or 12th graders (.32 drinks). It should be noted that these studies examined only current energy drink use and did not include measures of use over longer time periods. Also, each used a sampling frame that excluded significant segments of the target population - teens younger than 15 years of age (Emond et al., 2014) or nonstudent and school-absent teens (Terry-McElrath et al., 2014) - and both employed data collected in 2010.

Most researchers (but not all; see Polak et al., 2016) have found that boys are more likely than girls to consume caffeinated energy drinks (Azagba et al., 2014; Gallimberti et al., 2013; Mann et al., 2016; Miller et al., 2016; Terry-McElrath et al., 2014; Visram et al., 2016). Because lifetime use prevalence is cumulative, more older teens report any experience with energy drink use than younger teens. However, one study of public junior and high school students in Atlantic Canada found that the prevalence of past-year consumption declined over the course of adolescence, leading the researchers (Azagba et al., 2014) to speculate that energy drink use may be an early and transient experimental phase in the substance use trajectory of teens. This explanation is consistent with findings by Reid et al. (2017) that, while a majority of teens aged 12–17 in their Canadian sample had tried energy drinks, about two thirds were “experimental” (i.e., reporting five or fewer drinks in their lifetimes) rather than habitual consumers.

Several other demographic and lifestyle characteristics have been linked to energy drink use. Miller (2008b) found that African American college students were less likely than White peers to report use of non-alcoholic energy drinks, whereas Hispanic students were more likely than non-Hispanics to use AmEDs. However, in the few studies to examine racial/ethnic patterns in younger adolescent energy drink use, significant differences were not found (Emond et al., 2014; Terry-McElrath et al., 2014). Prior studies have not explicitly examined the rapidly growing category of mixed-race teens, despite evidence that the multiracial population in the U.S. is growing at a rate three times as fast as the population as a whole (Pew Research Center, 2015) and that teens who identify as mixed-race have higher substance use rates than their single-race peers (So, 2017).

Energy drink use has been found to correlate negatively with healthy BMI and activity levels (Reid et al., 2015; Visram et al., 2016) and may also be a marker of sensation-seeking

personality or propensity for risk taking (Azagba et al., 2014; Miller, 2008b; Miyake & Marmorstein, 2015). Because these drinks contain a psychoactive drug (albeit a mild and entirely legal one), they may attract users who seek out the associated buzz. If such a selection effect exists, it is likely reinforced by advertisers' routine glamorization of energy drinks' recreationally stimulative properties (Terry-McElrath et al., 2014) and promotion of impulsive and risk-oriented lifestyles (Miller, 2009). Because of energy drinks' stimulant properties, it is also possible that some teens use them to self-medicate for depression or sleep deprivation.

The present study.

The goals of this study were twofold. First, we sought to describe the prevalence (lifetime, past-month), frequency, and contexts of caffeinated energy drink use among minor adolescents in the U.S. Second, we sought to identify sociodemographic and lifestyle characteristics, personality traits, and patterns of alcohol and caffeine use associated with energy drink use, as well as unique predictors (from among these characteristics) that might point toward potential targets for preventive intervention.

Our adolescent sample included a five-year age range, from 13 to 17, which spans an ambitious developmental trajectory in the life of a U.S. American teen. In particular, the age of 16 is often seen as a watershed transition in mid-adolescence, signifying the first meaningful step toward adulthood. We therefore examined our sample as two separate cohorts, for early (age 13–15) and middle (age 16–17) adolescents, constructing a nationally representative portrait of the extent and parameters of energy drink use separately in these cohorts. For both cohorts, we expected that examining correlates of lifetime use would yield insight into the characteristics of teens who try energy drinks as least once, relative to those who have never done so. In contrast, examining correlates and characteristics of recent use was expected to strengthen our understanding of persistent use of these beverages. Together, these results have the potential to inform prevention efforts focused on both experimental and regular use of such beverages by teens.

To this end, we examined differences between lifetime users vs. nonusers as well as differences between teens who had used energy drinks recently (i.e., in the past three months) and those who had not (i.e., had used only in the past, or not at all), on four dimensions: demographic differences (e.g., age or race), psychosocial characteristics (e.g., sensation-seeking personality or depression), lifestyle (e.g., GPA or employment status), and substance use behavior (alcohol and other caffeine). Also, to identify variables that may have a causal role in the onset or continuation of energy drink use and thus constitute potential intervention targets, we conducted hierarchical logistic regression analyses to determine which demographic, psychosocial, lifestyle, and substance use characteristics uniquely predicted lifetime or recent energy drink use, controlling for other significant influences. Although these analyses were largely exploratory, findings in the existing literature led us to the following hypotheses.

- 1) Demographic characteristics would be predictive of lifetime energy drink use. That is, boys would be more likely than girls to have used energy drinks, mixed-

race teens would report higher rates of energy drink use whereas other teens of color would report lower rates, and age would be positively associated with lifetime use but not with recent use.

- 2) Controlling for demographic characteristics, sensation-seeking and impulsivity scores would be positively associated with both lifetime and recent energy drink use, whereas depression score would be positively associated only with use in the past three months.
- 3) Controlling for demographic and psychosocial characteristics, students with higher GPAs would be less likely to report recent use.
- 4) Controlling for demographic, psychosocial, and lifestyle characteristics, lifetime alcohol use would be positively associated with lifetime energy drink use and recent alcohol and caffeine use would be positively associated with recent energy drink use.

Methods

During May 2014, we surveyed a nationally representative sample of the U.S. minor adolescent population about their use of caffeinated energy drinks and alcohol. The Caffeinated Energy Drinks and Alcohol (CEDA) Study included 1,032 minor adolescents (50% female), ranging in age from 13 to 17 ($M=14.9$, $SD=1.4$).

An implicitly stratified sample was drawn from KnowledgePanel, a probability-based online non-volunteer access research panel pre-recruited and maintained by the commercial survey research firm GfK (formerly Knowledge Networks; Menlo Park, California). Randomly sampled households are contacted via a series of mailings, followed by telephone calls to nonresponders, with an invitation to join the panel and take part in periodic web-based surveys. New members are continuously recruited in order to compensate for panel attrition and maintain a standing roster of 50,000 to 60,000 panel members. Demographic profile information collected for all new KnowledgePanel members is used to determine eligibility and selection for specific surveys.

To accommodate the rapidly growing population of wireless-only households (now more than half of all U.S. homes, including 51% of adults and 61% of children under age 18; Blumberg & Luke, 2017), panel recruitment relies on address-based sampling (ABS). The sample frame includes all U.S. households with a postal address (about 97%). Census blocks with high-density minority communities are oversampled to ensure adequate representation of all major racial and ethnic groups. Because not all households are Internet-capable, those lacking home web access are provided with a laptop computer, Internet service, and technical support for the duration of their panel membership. Since participants are actively recruited rather than allowed to opt in voluntarily, and because the sampling strategy includes both non-Internet-enabled and cell-phone-only households, the panel is resistant to some of the selection biases conventionally associated with web-based research (Baker et al., 2010; Dennis et al., 2011).

The sample for the present analysis was drawn from among active KnowledgePanel members aged 13–17, using a probability proportional to size (PPS) weighted sampling approach (Dennis, 2012). Teens in 37% of contacted households completed the survey. Parents/guardians of prospective participants in 2,786 KnowledgePanel households were asked for permission to invite their children to participate in the study. Of those contacted, 1,050 parents responded and gave permission. Eighteen teens declined the invitation; the remaining 1,032 were directed to a restricted-access website where they provided informed assent and completed a 15-minute online questionnaire. Participants received a monetary credit from KnowledgePanel worth five dollars (\$5.00 USD). The study protocol was approved by the University at Buffalo's Social and Behavioral Sciences Institutional Review Board for the protection of human subjects.

Measures

Energy drinks, shots, and mixes.

Participants reported how often in their lives they had used energy drinks (e.g., Red Bull), energy shots (e.g., 5 Hour Energy), or energy mixes (liquid or powdered caffeinated energy drink flavor concentrates that the user adds to water, e.g., MioEnergy). To facilitate accurate reporting, participants viewed a "What Counts" graphic with definitions and visual examples of energy drinks, shots, and mixes, and were instructed to exclude soft drinks, noncaffeinated sports drinks, protein drinks, or vitamin waters from their reports. Those who endorsed lifetime use were also asked about their recent use (i.e., past three months), including frequency of use, how many servings of each type (drinks, shots, and mixes) they drank on a typical day when they drank energy drinks, what brands they had used, and in what circumstances they used them (e.g., playing video games or compensating for lost sleep).

Because most mainstream brands contain comparable caffeine doses, the reported caffeine content in the most popular brands of energy beverages were used to estimate the typical amount of caffeine in a serving: 80mg per 8oz. serving of Red Bull or Monster energy drink, 200mg per 2oz serving of 5 Hour Energy shot, and 60mg per ½ teaspoon serving of Mio Energy mix (Center for Science in the Public Interest, n.d.). Total caffeine intake from energy sources was then calculated by multiplying the typical number of servings of each drink type consumed by the number of days used in the past three months.

Participants also reported lifetime and recent frequency of AmED use as well as the number of AmED drinks they would consume on a typical drinking occasions. Those who endorsed AmED use were asked what AmED cocktails they had consumed in the past three months.

Sociodemographic characteristics.

To generate a detailed profile of adolescent energy drink consumers, we collected data on several sociodemographic characteristics of our participants, including their age, gender, race, and ethnicity. Race was coded in four mutually exclusive categories: White, African American, other race (Asian, Pacific Islander, or Native American), and mixed race (i.e., 2 or more races reported). Hispanic ethnicity was measured separately; participants of any race who reported Hispanic or Latino heritage (e.g., Mexican American, Puerto Rican, or

Cuban) were dichotomously classified as Hispanic. In order to explore the possibility that energy drink use varies by region, perhaps due to cultural differences, we also assessed geographic region of residence. Using the standard U.S. Census classification system (U.S. Census, 2017a), region was coded as four mutually exclusive categories: Northeast (9 states), Midwest (12 states), South (16 states and the District of Columbia), and West (13 states).

Psychosocial characteristics.

Because previous studies have found strong associations between energy drink use and certain personality traits, we assessed sensation-seeking and impulsivity. To measure sensation seeking, we administered the 8 items of the Brief Sensation Seeking Scale (BSSS; Hoyle et al., 2002). Participants indicated the extent of their agreement with a series of questions (e.g., “I would like to explore strange places”), with responses ranging from 1 (strongly disagree) to 6 (strongly agree). Impulsivity was measured with an 8-item subset of the Barratt Impulsiveness Scale (BIS; Barratt, 1959), including items such as “I act on the spur of the moment,” with response options from 1 (“rarely or never”) to 4 (“almost always or always”). For both variables, a higher numeric response indicated stronger endorsement of the personality trait. Depression was assessed with a 5-item subset (Shrout & Yager, 1989) of the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977), assessing mood states over the past week. For each item (e.g., “I felt depressed”), response options ranged from 1 (“rarely or never/less than 1 day”) to 4 (“almost always or always/5–7 days”), again with a higher numeric response indicating more frequent depressive symptoms. Individual item scores were summed to construct summary scale measures for sensation seeking (range: 8–48), impulsivity (range: 8–32) and depression (range: 5–20). Depression scores were then rescaled for consistency with the standard CES-D-20 scale typically used to diagnose clinical depression, in order to apply a conventional cutoff score of 16 or higher out of 60 (Shrout & Yager, 1989).

Lifestyle characteristics.

Participants reported their school enrollment status and GPA as well as their employment status and past or present participation in organized sports.

Substance use.

Participants reported lifetime and recent frequency of alcohol use as well as the number of drinks consumed on a typical day when they drank alcohol. Recent drinkers also indicated how often in the past three months they had engaged in heavy episodic (“binge”) drinking (X or more drinks of alcohol in two hours or less), gotten buzzed (light-headed or tipsy), and gotten drunk (not just buzzed) on alcohol. The number of drinks indicated in the binge drinking question was calibrated by gender and age: five drinks for males aged 16–17, four drinks for boys aged 14–15, and three drinks for boys aged 13 and girls 13–17 (Donovan, 2009).

Because caffeine is not unique to energy drinks, participants were also asked to report on the frequency and typical daily quantity of their use of caffeinated soft drinks (primarily colas),

coffee, tea, and caffeine pills (e.g., No Doz) during the past three months. For the present analysis, each of these recent-use measures was dichotomized (any use vs. no use).

Data Analyses

Two sets of analyses were conducted: bivariate analyses describing energy drink use patterns by gender and age categories, and multivariate analyses identifying unique predictors of energy drink use in two time frames (lifetime and recent) for each age cohort (early and middle teens).

Energy drink use was compared across demographic categories using contingency table analyses. Contingency table analyses were also used to compare the prevalence of lifetime and recent energy drink use among early and middle adolescents across demographic, psychosocial, lifestyle, and substance use characteristics. In order to facilitate these descriptive comparisons, continuous measures of sensation-seeking, impulsivity, depression, and GPA were dichotomized. We employed median splits for each of the two personality trait scales. We rescaled our depression measure to give it a conventional CES-D-20 scoring range and then established a outpoint of 16 or higher, typically employed as a formal diagnostic criterion for self-depression (Shrout & Yager, 1989). Grade point average was dichotomized as A- or higher vs. B+ or lower, both because of the common (if arbitrary) cultural distinction made between the academic achievement standards of A students and all others, and because nearly half of the teens in our sample reported GPAs in the A range, making this a practical (if again arbitrary) dividing point.

Effect sizes for all significant results were calculated using Cramer's phi (for 2×2 designs) or Cramer's V (for 2×3-or-more designs), with effects interpreted as small if less than .30, medium if between .30 and .49, and large if .50 or greater (Sheskin, 2011). Sample weights were constructed based on U.S. Census Bureau benchmarks for age, gender, race, ethnicity, and geographic region to adjust for probability of selection (Dennis, 2012). In order to ensure that our descriptive profile of adolescent energy drink use was nationally representative on these key characteristics, all bivariate analyses were conducted on the weighted data.

Next, we conducted hierarchical logistic regression analyses on the unweighted data in order to predict any lifetime use and any recent use of energy drinks for each age cohort. Variables were entered in four blocks: (1) demographics, (2) psychosocial traits/states, (3) lifestyle characteristics, and (4) substance use, specifically the use of alcohol and other caffeine. Whereas the descriptive bivariate analyses used several explicitly dichotomized variables to maximize intuitive interpretability, these predictive multivariate analyses used the full continuous range of available data on those variables. We built our regression models by examining each category in turn, as a variable block. As the most clearly exogenous set of influences, demographics were entered into the equation first. Nonsignificant demographic predictors were then deleted from the equation before adding the next block of variables. At each block, before proceeding to the next category, the equations were again examined for variables that did not reach statistical significance as predictors, and these variables were removed for the sake of parsimony. This hierarchical approach was used to ensure that the

reported values for variables at each block controlled for the effects of variables in all preceding blocks.

Two-tailed hypothesis tests were conducted for all analyses with p -values $< .05$ considered statistically significant. In the contingency table analyses, the family-wise Type I error rate for significance testing multiplicity was controlled by Holm-adjusted p -values (Holm, 1979), and only the adjusted p -values are reported. Except where otherwise indicated, all effect sizes were small (Cramer's ϕ .29 or lower). There were no adjustments in the logistic regression analyses. All analyses, except for the Holm adjustments, were carried out using IBM SPSS version 24.

The Holm adjustments were computed in R (R Core Team, 2018).

Results

Descriptive Analyses

Characteristics of the sample.—The sample was consistent with population benchmarks for gender, age, and geographic distribution (U.S. Census, 2017a, 2017b, but diverged from population norms in three respects (see Table 1). Because our original sample slightly underrepresented teens of color, corrective weighting was applied to ensure demographic representativeness of the U.S. adolescent population as a whole. One in five participants (21.5%) reported clinically significant depression scores of 16 or above, somewhat less than the 29% found by Rushton et al. (2002) in the nationally representative National Longitudinal Study of Adolescent Health (AddHealth). Reported alcohol use prevalence was also somewhat lower than the national average. According to the most recently available Monitoring the Future data, 62% of 12th-grade students, 42% of 10th-graders, and 23% of 8th-graders reported ever having used more than a few sips of alcohol (Miech et al., 2018). Among CEDA sample participants in these grades, lifetime alcohol use was reported by 52%, 36%, and 19%, respectively.

Descriptive Analyses: Patterns of Energy Drink Use

Although almost two thirds of adolescents reported at least some energy drink use, most were not habitual consumers (Table 2). Only one in thirteen adolescents (7.6%) reported using energy drinks on a weekly basis, and fewer than half of all users had done so on ten or more occasions. Compensating for a sleep deficit was the most commonly cited context for use, followed by academic (e.g., studying) and recreational contexts (e.g., playing video/computer games).

Among recent users, median caffeine intake from energy drinks, shots, or mixes (on a typical day when energy beverages were consumed) was 160mg (data not shown in tabular form), or two servings — the equivalent of five cans of cola or two cups of brewed coffee. Unsurprisingly, use of AmEDs by this underage sample was far less common than use of energy drinks alone; 6.8% of teens reported ever drinking AmEDs, and 4.4% reported doing so recently. High endorsement rates for Red Bull & vodka and Jagerbombs (a mixture of Red Bull and Jägermeister liqueur) mirrored the popularity of these two AmED cocktails among older users (Miller et al., 2015).

Patterns of energy drink use by gender.—Contrary to most previous studies, we found no significant gender differences in the prevalence of lifetime or recent energy drink use, reported habitual use, or brand preferences. However, boys were significantly more likely to report use in recreational contexts, while girls were more likely to use energy drinks to make up for lost sleep. While male and female teens did not differ in prevalence of lifetime or recent AmED use, there were marked gender differences in AmED cocktail preferences; a third of female recent AmED users (but no boys) consumed AmED cocktails other than the industry leaders Red Bull & vodka and Jagerbombs. This difference yielded a medium effect size, although the small sample sizes for male and female AmED users require caution in interpretation of the results.

Patterns of energy drink use by age cohort.—Unsurprisingly, middle adolescents reported more lifetime and recent use of both energy drinks and AmEDs than early adolescents. Although middle adolescents reported more frequent lifetime use overall, they were no more likely than their younger peers to report habitual (weekly) use (22.4% vs. 15.1%, respectively). Situational contexts for use differed by age cohort, with middle adolescents more likely to report use as an adjunct to school-related activities. Most early teen AmED users reported consuming Red Bull & vodka only, whereas middle teen users were more diversified in their tastes. The associated medium effect size must again be interpreted cautiously, given the low number of AmED users.

Patterns of AmED use by race and ethnicity.—Several differences in AmED use did emerge with respect to both race and ethnicity (results not shown). AmED use was highest among mixed-race teens, followed by African American, White, and other-race teens, for lifetime use (14.5%, 9.3%, 5.6%, and 2.9%, respectively; $p < .01$) and recent use (9.1%, 7.9%, 3.4%, and 1.4%, respectively; $p < .01$). Hispanic teens also reported higher rates of both lifetime (5.4% vs. 11.8%, $p < .01$) and recent AmED use (3.0% vs. 9.5%, $p < .001$) than nonHispanic teens.

Prevalence of Energy Drink Use by Early and Middle Adolescents

In our sample, experience with energy drink use was significantly more common among older adolescents. Lifetime use was reported by 53.4% of 13-year-olds, 57.5% of 14-year-olds, 64.3% of 15-year-olds, 65.2% of 16-year-olds, and 79.5% of 17-year-olds. Recent use also increased across this five-year age span (30.5%, 35.5%, 43.2%, 42.4%, and 53.0%, respectively). Because the cumulative likelihood of lifetime energy drink use increases with age, we divided our sample into early (age 13–15) and middle adolescents (age 16–17) to examine other use correlates. Table 3 presents the prevalence of both lifetime and recent energy drink use within each age cohort across a range of demographic, psychosocial, and substance use characteristics. No comparisons between age cohorts are made in this set of analyses.

Lifetime energy drink use.—Demographic characteristics did not predict lifetime energy drink use in these bivariate analyses. Lifetime use was associated with higher scores on sensation seeking as well as (for middle adolescents only) impulsivity and depression. Adolescents with higher GPAs were less likely than lower-GPA peers to report lifetime

energy drink use. Among early teens, employment was associated with higher lifetime use prevalence. In both cohorts, lifetime and recent alcohol use were associated with higher lifetime prevalence of energy drink use. Among recent alcohol users in the middle adolescent cohort only, reports of getting mildly intoxicated (i.e., “buzzed”) were associated with higher lifetime prevalence of energy drink use, although reports of more severe problem drinking, i.e., binge drinking or getting drunk, were not. Recent use of caffeinated soft drinks, coffee, and pills were associated with higher lifetime use prevalence in both cohorts; tea drinking was not. All effect sizes for characteristics associated with lifetime energy drink use were small, with the exception of lifetime alcohol use by middle adolescents, which produced a medium effect size.

Recent energy drink use.—When age cohorts were examined separately, the prevalence of recent energy drink use varied by race for middle adolescents only, with the highest use by mixed-race and African American teens and the lowest use by other-race teens. Higher scores on sensation-seeking were associated with higher prevalence of recent use across both age cohorts; however, differences in depression scores were statistically significant only for middle teens, whereas differences in impulsivity scores were not significant for either cohort. Among middle (but not early) teens, students with lower GPAs (B+ or lower) were almost twice as likely as their higher-achieving counterparts to have used energy drinks in the past three months. For both early and middle teens, recent energy drink use was about twice as common among those who had used alcohol (lifetime or recent use) but not significantly associated with measures of problem drinking by recent alcohol users. Relationships between other caffeine use and higher recent prevalence of energy drink use were significant for caffeinated soft drink use (middle adolescents only), coffee use (early adolescents only), and caffeine pill use (both cohorts). Effect sizes were small with the exception of the relationship between recent energy drink use and lifetime alcohol use by middle adolescents, which produced a medium effect size.

Predicting Lifetime Energy Drink Use: Hierarchical Logistic Regression Analyses

Early adolescents.—Odds of lifetime use were lower for girls than for boys and lower for residents of Northeastern states than for Midwestern teens. Sensation-seeking score was positively associated with odds of lifetime use, but neither impulsivity nor depression scores were significant predictors. Academic grade point average and odds of lifetime energy drink use were inversely related. Both lifetime alcohol use and recent caffeinated soft drink use were associated with heightened odds of having used energy drinks.

Middle adolescents.—Seventeen year olds were twice as likely as 16 year olds to have ever used energy drinks. Odds of use were markedly lower for other race teens than for Whites. Both sensation-seeking and impulsivity scores were positively associated with use. Teens who reported past (but not current) organized sports were more than twice as likely to have tried energy drinks as those with no athletic history. GPA was inversely related to the odds of use. Teens who reported lifetime alcohol use and/or recent use of caffeinated soft drinks were markedly more likely to have used energy drinks at least once in their lives.

Predicting Recent Energy Drink Use: Hierarchical Logistic Regression Analyses

Early adolescents.—The odds of having used energy drinks in the past three months were lower among girls than among boys, lower among residents of Northeastern and Southern states than among residents of Midwestern states, and higher among participants with higher sensation seeking scores. Teens with lifetime histories of alcohol use and recent histories of caffeinated soft drink, coffee, and caffeinated pill use were also more likely to have consumed energy drinks in the past three months. Age, race, impulsivity and depression scores, and lifestyle characteristics were not significantly associated with recent energy drink use.

Middle adolescents.—Other-race teens were less likely than their peers to have used energy drinks in the previous three months. Odds of recent energy drink use were positively associated with age, sensation-seeking score, lifetime history of alcohol use, and recent history of caffeinated soft drink use. Academic GPA was inversely associated.

Discussion

The objectives of this research were to construct a nationally representative descriptive profile of U.S. minor adolescent energy drink users and to identify individual-level characteristics associated with energy drink use that might suggest potential targets for preventive intervention. To our knowledge, this study is the first to examine both recent and lifetime energy drink use in a large, representative sample of adolescents 13 to 17 years of age.

In examining individual-level characteristics associated with energy drink use, we found mixed support for each of our four hypotheses. Significant gender and regional differences for early adolescents (i.e., lower odds of use by girls and teens living in Northeast states) gave way to significant differences by age and race in the older group (i.e., lower odds of use by 16-year-olds and “other race” teens). Contrary to expectation, no significant pattern of heavier use by mixed-race teens was found. Sensation-seeking was universally associated with higher odds of energy drink use, but depression was not, and impulsivity was associated with lifetime use by middle adolescents only. Students with higher GPAs were less likely to report recent (middle adolescents only) or lifetime use (both cohorts). Although a history of lifetime alcohol use and recent caffeinated soft drink use strongly predicted energy drink use across the board, other forms of caffeine use (i.e., coffee or pills) were predictive only for recent energy drink use by early teens.

Our descriptive profile of teen energy drink users was consistent with some of the findings of previous studies. We found that, contrary to manufacturer assurances that these products are primarily geared to a young adult consumer demographic, energy drinks are quite popular among younger users (Mintel Group Ltd., 2013). Nearly two-thirds of adolescents aged 13–17 reported use at least once in their lifetimes and nearly 40% reported use in the past three months, rates that fall within the broad ranges established in other recent research. A small segment of our sample (7.1% of all users) reported consuming these beverages 100 or more times, and 18.6% of recent users (including 15.1% of early and 22.4% of middle adolescents) reported habitual (at least weekly) consumption. These heavy users may

constitute a population in need of closer examination to assess their heightened risk for adverse consequences.

As expected (since lifetime use is cumulative with age), middle adolescents reported higher prevalence and greater frequency of lifetime energy drink use than their younger counterparts. Middle adolescents also were significantly more likely than their younger peers to report using energy drinks in the past three months. Previous research had led us to anticipate less recent use by older relative to younger teens. In U.S. junior high and high school students (Terry-McElrath et al., 2014), 8th graders had higher prevalence and quantity of energy drink use than their 10th and 12th grade peers, and in two samples of Canadian teens (Azagba et al., 2014; Reid et al., 2017), prevalence of recent consumption declined over the course of adolescence, suggesting that energy drink might be a transitory experimental form of substance use for most teens. It is possible that our examination of multiple time frames and age cohorts revealed patterns missed by prior researchers. Alternatively, the difference may indicate that teen energy drink use patterns have changed in recent years, perhaps in response to these beverages now being seen as less of a novelty and more of a routine component of the adolescent diet.

Past studies generally have found that energy drink use is more common among boys than girls. In our sample, neither lifetime nor recent use prevalence rates differed by gender in simple bivariate analyses. However, controlling for other demographic variables, gender was a significant predictor of energy drink use for early adolescents, with higher odds of both lifetime and recent use by boys than by girls. A disproportionately male user population was to be expected given the androcentric tendencies of typical advertising in this industry (Miller, 2008a, 2009), although it is notable that these differences were not present in middle adolescents.

Past studies have also found contradictory racial/ethnic patterns, with African American young adults reporting less energy drink use (and Hispanics more AmED use) than the population mean (Miller, 2008b) and younger teens reporting no significant differences at all (Emond et al., 2014; Terry-McElrath et al., 2014). In contrast, we found a high prevalence of recent energy drink use by African American and mixed-race adolescents and low prevalence by other-race middle adolescents (Table 3) compared to their White peers.

Consistent with past research, adolescent energy drink use in our sample was significantly associated with lifetime and recent alcohol use. Middle adolescent lifetime energy drink users were also more likely than nonusers to have been “buzzed” on alcohol in the past three months. Most teen alcohol use does not take the form of AmEDs, as indicated by the prevalence rates for our sample; 30.9% of our teens had ever used alcohol and 16.7% had done so in the past three months, compared to only 6.8% and 4.4% respectively for AmED use.

Participants reported using energy drinks most often in situations where they needed to compensate for sleep deprivation and secondarily in situations that called for performance enhancement associated with video/computer games or sports participation. This pattern of instrumental use is concerning. Using caffeine as a substitute for sleep may contribute to

chronic sleep disturbance at a point in the developmental trajectory when sleep is especially crucial for proper brain formation (Grandner et al., 2015; Orbeta et al., 2006). Using it to enhance sports performance is a more acute health hazard, in that the diuretic effects of caffeine can exacerbate dehydration. Furthermore, as a vasoconstrictor, caffeine may place additional strain on the cardiovascular system when used in conjunction with strenuous exercise. Despite their potential ergogenic benefits, therefore, the National Federation of State High School Associations (2011) strongly recommends against adolescent energy drink use during sports.

Limitations and suggestions for future research.

Although demographically representative for the most part, our sample was relatively high achieving (i.e., nearly half of teens reported GPAs in the A range) and relatively low in depression and lifetime alcohol use prevalence. In addition, data were drawn from retrospective self-reports, without validation by outside sources. However, confidence in our findings is enhanced by their overall consistency with those of previous studies. Our cross-sectional design also was a limitation in that it provided only a single snapshot of a rapidly evolving phenomenon. Longitudinal research is needed to highlight changing patterns of energy drink, both developmentally and across cohorts, and to assess whether and how the consumption of energy drinks affects concurrent and subsequent substance use and other risk behaviors. Also needed are studies that use event-level designs to establish co-occurrence of energy drink use and other risk behaviors. Finally, additional targeted research will be needed to test hypotheses about energy drink use in low-incidence populations such as Native American, school dropout, sexual minority, and eating-disordered adolescents, and to examine trajectories of initiation and continued use of AmEDs across the early to middle teen years.

Public health implications.

The American Academy of Pediatrics has recommended against any consumption of energy drinks by children (Committee on Nutrition and the Council on Sports Medicine and Fitness, 2011), and the American Medical Association supports a ban on the marketing of energy drinks to children under the age of 18 (Latif, 2013). Given the near- universal popularity of caffeinated beverages across the life span, an outright ban is unlikely. However, the findings of the present study may be used to inform two potential intervention approaches. First, prevention strategies to reduce or minimize energy drink use might include targeted media campaigns encouraging parents to delay early initiation of energy drink habits, addition of caffeine to existing substance use-related health education curricula, and promotion of healthy alternative outlets for sensation-seeking, such as sports participation or other high-energy activities. Second, harm reduction strategies to discourage use in high-risk contexts might emphasize education on the health-compromising side effects of caffeine in conjunction with alcohol, during strenuous exercise, and/or at times of the day that disrupt normal sleep cycles.

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Table 1.

Weighted sample: Participant characteristics (N=1,032)

	N (Percentage)	Mean (SD)
Age		15.04 (1.43)
Gender		
Male	529 (51.2%)	
Female	503 (48.8%)	
Race/ethnicity		
White, non-Hispanic	580 (56.2%)	
Black, non-Hispanic	139(13.4%)	
Other race, non-Hispanic	35 (3.4%)	
2+ races, non-Hispanic	58 (5.6%)	
Hispanic	221 (21.4%)	
Geographic region		
Northeast	177(17.2%)	
Midwest	226 (21.9%)	
South	386 (37.4%)	
West	243 (23.5%)	
Sensation-seeking score		22.19 (3.78)
Impulsivity score		16.93 (4.49)
Depression score		8.20(10.29)
Employment status		
Not employed	791 (76.7%)	
Employed	240 (23.3%)	
Organized sports participation		
No, never	391 (37.9%)	
Only in the past	241 (23.3%)	
Yes, currently	400 (38.8%)	
Ever used alcohol	319(30.9%)	
Used alcohol, past 3 months	172(16.7%)	
Binge drank, past 3 months	70 (41.0%)	
Got buzzed, past 3 months	100 (57.9%)	
Got drunk, past 3 months	59 (34.3%)	
Used caffeinated soft drinks, past 3 months	931 (90.3%)	
Used coffee, past 3 months	486 (47.1%)	
Used tea, past 3 months	624 (60.5%)	
Used caffeine pills, past 3 months	57 (5.5%)	

Table 2.

Energy drink use patterns by age cohort and by gender (N=1,032).

	<u>Whole Sample</u>		<u>Gender</u>		P	<u>Age Cohort</u>		P
	N	(%)	Male	Female		Early	Middle	
			%	%		%	%	
Whole sample	N=1,032		n=528	n=504		n=352	n=311	
Energy drink use, lifetime	663	(64.3)	66.1	62.3	.999	58.3	72.6	.000
Energy drink use, recent	424	(41.1)	43.5	38.7	.999	36.4	47.8	.004
AmED use, lifetime	70	(6.8)	6.8	6.7	.999	4.0	10.7	.001
AmED use, recent	45	(4.4)	4.5	4.2	.999	2.7	6.5	.040
Lifetime ED users only	n=663		n=349	n=314		n=219	n=205	
Frequency of lifetime energy drink use					.999			.002
1-9 times	352	(53.1)	53.9	52.1		59.9	45.3	
10-19 times	110	(16.5)	14.3	19.0		16.2	16.7	
20-49 times	105	(15.8)	14.6	17.1		14.5	17.4	
50-99 times	50	(7.5)	8.3	6.7		5.7	9.6	
100+ times	47	(7.1)	8.9	5.1		3.7	10.9	
Energy drink use situations ^b								
Normal routine on not enough sleep	175	(26.4)	21.2	32.2	.026	23.3	30.1	.513
All-nighter for school/work project	133	(20.1)	19.5	20.8	.999	15.1	25.6	.011
Playing video/computer games	116	(17.6)	27.8	6.1	.000	16.2	19.2	.999
Playing sports	108	(16.3)	20.9	11.5	.020	17.0	15.4	.999
Attending school	108	(16.3)	13.4	19.4	.476	11.1	22.1	.002
Studying	107	(16.2)	14.9	17.5	.999	14.0	18.6	.947
Recent ED users only	n=424		n=230	n=194		n=17	n=28	
Frequency of recent energy drink use					.064			.947
Once a month or less	225	(53.1)	54.3	51.5		57.1	48.8	
2-3 times/month	120	(28.3)	22.6	35.1		27.9	28.8	
At least once a week	79	(18.6)	23.0	13.4		15.1	22.4	
Brand used ^a								
Monster	259	(61.1)	61.7	60.3	.999	58.9	63.4	.999
Red Bull	148	(34.9)	30.0	40.5	.352	34.2	35.4	.999
Rockstar	111	(26.2)	21.4	31.4	.305	21.0	31.7	.158
Amp	72	(17.1)	15.2	19.5	.999	13.2	21.0	.405
5Hr Energy Shot	50	(11.8)	11.8	11.8	.999	9.6	14.1	.999
Mio Energy Mix	90	(21.2)	25.3	16.4	.352	22.4	20.0	.999
Crystal Light Energy Mix	49	(11.5)	10.9	12.3	.999	13.2	9.8	.999
Recent AmED users only	n=45		n=24	n=21		n=16	n=28	
Red Bull & vodka [†]	26	(57.3)	75.0	38.1	.195	88.2	37.9	.008
Jagerbombs	15	(33.2)	41.7	23.8	.999	17.6	42.9	.737
Other AmED ^{††}	7	(16.5)	0.0	33.3	.010	0.0	25.0	.110

[†] Medium effect sizes for age cohort difference: Cramer's Phi = .37

^{††} Medium effect size for gender difference: Cramer's Phi = .46

Note: Gender and age cohort comparisons are across columns, not within columns. E.g., boys are significantly more likely than girls to report using energy drinks while playing sports (20.9% vs. 11.5%, $p=.020$). p-values were adjusted for the 22 gender comparison tests and separately for the 22 age cohort comparison tests.

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Table 3.

Prevalence of lifetime and recent energy drink use by participant characteristics for (age 13-15; n=602) and middle adolescents (age 16-17; n=430).

	<u>Lifetime use</u>				<u>Recent use</u>			
	<u>Early</u>		<u>Middle</u>		<u>Early</u>		<u>Middle</u>	
	%	P	%	P	%	P	%	P
All	58.3		72.6		36.4		47.8	
Demographics								
Gender		.584		.999		.352		.999
Male	61.8		72.1		40.3		47.9	
Female	54.6		73.0		32.1		47.6	
Race		.658		.468		.282		.021
White	56.1		70.3		33.3		45.6	
African American	64.7		79.6		37.3		63.3	
Other race	52.3		68.0		42.2		24.0	
2+ races	70.2		89.7		55.3		65.5	
Ethnicity		.999		.999		.999		.999
Not Hispanic	59.6		72.8		36.7		47.4	
Hispanic	54.1		71.6		35.3		48.9	
Geographic region		.636		.999		.072		.999
Northeast	55.1		77.2		32.7		41.8	
Midwest	68.0		75.2		47.2		48.0	
South	55.0		67.8		29.6		50.0	
West	57.9		73.1		40.7		48.5	
Psychosocial traits/states								
Sensation-seeking		.006		.001		.002		.000
Low (8-21)	51.7		63.7		29.2		35.8	
High (22-48)	66.1		80.4		44.3		58.8	
Impulsivity		.293		.005		.370		.434
Low (8-16)	54.2		64.1		32.5		42.7	
High (17-32)	62.9		79.4		40.6		51.7	
Depression		.999		.025		.999		.005
Subclinical (0-15)	58.2		68.6		36.5		42.3	
Clinical (16-60)	60.6		82.9		37.1		61.5	
Lifestyle								
GPA		.015		.000		.594		.000
B+ or lower	64.9		81.5		40.1		59.9	
A- or higher	51.7		62.6		33.2		34.5	
Employment status		.023		.985		.519		.999
Not employed	56.0		70.8		34.9		46.7	
Employed	73.3		76.0		45.3		49.7	
Organized sports		.999		.468		.999		.999

	<u>Lifetime use</u>		<u>Recent use</u>	
	Early	Middle	Early	Middle
No, never	56.1	71.9	32.7	50.3
Only in the past	60.7	81.2	41.0	50.5
Yes, currently	59.1	67.7	37.0	47.7
Substance use				
Alcohol use, lifetime	.001	.000 [†]	.000	.000 ^{††}
No	54.2	56.8	31.2	30.5
Yes	74.4	91.8	56.0	68.6
Alcohol use, recent	.004	.000	.000	.000
No	55.9	65.0	32.8	39.4
Yes	79.7	93.8	69.5	70.8
Among recent alcohol users only (n=424):				
Binge drank, recent	.999	.700	.999	.167
No	80.0	91.0	69.4	62.7
Yes	79.2	97.8	66.7	82.6
Got buzzed, recent	.293	.044	.594	.160
No	70.6	85.0	60.6	56.4
Yes	92.3	98.6	80.8	78.4
Got drunk, recent	.818	.700	.797	.059
No	76.1	91.0	65.2	61.2
Yes	92.3	97.8	84.6	84.8
Caffeinated soft drink use, recent	.000	.000	.090	.003
No	31.0	41.9	20.7	21.4
Yes	61.1	76.0	37.9	50.6
Coffee use, recent	.008	.001	.000	.167
No	52.2	63.8	28.9	42.0
Yes	66.2	80.7	46.0	53.4
Tea use, recent	.168	.615	.204	.434
No	52.5	67.9	30.7	42.1
Yes	62.4	75.5	40.2	51.3
Caffeine pill use, recent	.028	.010	.015	.018
No	57.2	70.7	35.1	45.5
Yes	87.0	94.1	69.6	73.5

[†]Medium effect size: Cramer's Phi = .39

^{††}Medium effect size: Cramer's Phi = .38

Note: Comparisons are made within, not between, age cohorts (i.e., within columns, not across columns). E.g., among early adolescents only, employment is associated with higher prevalence of lifetime energy drink use (73.3% of employed early adolescents report ever having used energy drinks, compared to 56.0% of nonemployed early adolescents, $p < .01$). P -values were adjusted for the 19 tests within each of the four columns separately.

Table 4.

Predicting adolescent lifetime energy drink use.

	Early adolescents (n=624)		Middle adolescents (n=374)	
	OR	95% CI	OR	95% C
BLOCK 1: Demographics				
Age 14 ^d			---	-----
Age 15 ^d			---	-----
Age 17 ^e	---	-----	2.04 ^{**}	(1.28-3.24)
Female ^f	.65 ^{**}	(.47- .90)		
RE: African American ^g			.84	(.36-1.94)
RE: Other race (Asian/PI/NA) ^g			.39 [*]	(.17- .88)
RE: Mixed race (2+) ^g			1.38	(.53-3.59)
Hispanic ethnicity ^h				
GEO: Northeast ⁱ	.56 [*]	(.34- .94)		
GEO: South ⁱ	.73	(.49-1.11)		
GEO: West ⁱ	.80	(.50-1.28)		
Nagelkerke R ²		.03		.06
BLOCK 2: Psychosocial ^a				
Sensation-seeking	1.06 ^{***}	(1.04-1.09)	1.05 ^{**}	(1.02-1.08)
Impulsivity			1.08 ^{**}	(1.02-1.14)
Depression				
Nagelkerke R ²		.10		.15
BLOCK 3: Lifestyle ^b				
GPA	.71 [*]	(.52- .97)	.57 [*]	(.34- .94)
Employed				
SP: Played sports, past ^l			2.16 [*]	(1.09-4.28)
SP: Play sports, currently ^j			1.37	(.79-2.40)
Nagelkerke R ²		.11		.18
BLOCK 4: Substance use ^c				
Used alcohol, ever	2.48 ^{***}	(1.53-4.02)	6.55 ^{***}	(3.40-12.6)
Used alcohol, recent				
Used caffeinated soft drinks, recent	2.63 ^{**}	(1.47-4.71)	2.53 [*]	(1.13-5.71)
Used coffee, recent				
Used tea, recent				
Used caffeine pills, recent				

	Early adolescents (n=624)		Middle adolescents (n=374)	
	OR	95% CI	OR	95% C
Nagelkerke R ²		.17		.33
		.17		.33

*** p<001

** p< 01

* p< 05

^aBlock 2 (Psychosocial) includes demographic variables (not shown).

^bBlock 3 (Lifestyle) includes demographic and psychosocial variables (not shown).

^cBlock 4 (Substance use) includes demographic, psychosocial, and lifestyle variables (not shown).

^dReference group is 13-year-olds.

^eReference group is 16-year-olds.

^fReference group is males.

^gReference group is Whites.

^hReference group is non-Hispanics.

ⁱReference group is Midwest geographic region.

^jReference group is no past or present participation in organized sports.

Table 5.

Predicting adolescent recent energy drink use.

	Early adolescents (n=642)		Middle adolescents (n=374)	
	OR	95% CI	OR	95% CI
BLOCK 1: Demographics				
Age 14 ^d			---	-----
Age 15 ^d			---	-----
Age 17 ^e	---	-----	1.63 [*]	(1.07-2.48)
Female ^f	.68 [*]	(.49-.94)		
RE: African American ^g			1.10	(.52-2.36)
RE: Other race (Asian/PI/NA) ^g			.21 ^{**}	(.07- .63)
RE: Mixed race (2+) ^g			1.46	(.66-3.25)
Hispanic ethnicity ^h				
GEO: Northeast ⁱ	.54 [*]	(.32- .91)		
GEO: South ⁱ	.57 ^{**}	(.38- .87)		
GEO: West ⁱ	.73	(.46-1.17)		
Nagelkerke R ²			.03	.06
BLOCK 2: Psychosocial ^a				
Sensation-seeking	1.06 ^{***}	(1.03-1.08)	1.06 ^{***}	(1.03-1.08)
Impulsivity				
Depression				
Nagelkerke R ²			.09	.13
BLOCK 3: Lifestyle ^b				
GPA			.67 [*]	(.46-.96)
Employed				
SP: Played sports, pas ^j				
SP: Play sports, currently ^j				
Nagelkerke R ²				.14
BLOCK 4: Substance use ^c				
Used alcohol, ever	2.95 ^{***}	[*] (1.66-5.23)	3.38 ^{***}	(2.11-5.41)
Used alcohol, recent				
Used caffeinated soft drinks, recent	2.70 ^{**}	(1.32-5.51)	2.67 [*]	(1.16-6.12)
Used coffee, recent	1.62 [*]	(1.12-2.34)		
Used tea, recent				

	Early adolescents (n=642)		Middle adolescents (n=374)	
	OR	95% CI	OR	95% CI
Used caffeine pills, recent	2.85 [*]	(1.19-6.81)		
Nagelkerke R ²			.18	.25

p<001

**
p< .01

*
p< .05

^aBlock 2 (Psychosocial) includes demographic variables (not shown).

^bBlock 3 (Lifestyle) includes demographic and psychosocial variables (not shown).

^cBlock 4 (Substance use) includes demographic, psychosocial, and lifestyle variables (not shown).

^dReference group is 13-year-olds.

^eReference group is 16-year-olds.

^fReference group is males.

^gReference group is Whites.

^hReference group is non-Hispanics.

ⁱReference group is Midwest geographic region.

^jReference group is no past or present participation in organized sports.