Symptoms Attributed to Consumption of Caffeinated Beverages in Adolescents

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Purpose: Pediatric caffeine use has become increasingly prevalent. The American Academy of Pediatrics discourages caffeine use by children and adolescents due to its adverse impact on sleep and blood pressure. The objective of this study was to measure prevalence of physical and emotional symptoms related to caffeine consumption among adolescents receiving primary care.

Methods: A convenience sample of patients ($N=179$; 73% female) aged 12–17 presenting for routine primary care completed the Composite International Diagnostic Interview Substance Abuse Module questionnaire, which included questions regarding use of caffeine. Descriptive statistics were used to summarize prevalence of caffeine use and caffeine-related symptoms. Associations of number of caffeine-related symptoms with age, gender, and race/ethnicity were also analyzed.

Results: Sixty-seven percent of participants ($n=120$) reported past 30-day caffeinated beverage consumption. Of those, 68% ($n=82$) reported at least one symptom or problem attributed to caffeine use or withdrawal, including caffeine cravings, 24% ($n=29$); frequent urination, 21% ($n=25$); difficulty falling asleep, 18% ($n=22$); and feeling anxious, 3.3% ($n=4$).

Conclusions: In our sample, caffeinated beverage consumption by adolescents was frequently associated with physical and emotional symptoms, as well as problems attributed to use.

Introduction

CAFFEINE IS THE MOST WIDELY USED psychoactive substance used among all age groups¹ and ethnic backgrounds.² Up to 85% of adolescents have reported drinking caffeine through teas, coffees, and sodas.³ At present, there are no U.S. guidelines for recommended maximum daily intake of caffeine, but because there are potential health risks associated with caffeine intake, the American Academy of Pediatrics advises against the consumption of highly caffeinated drinks by children and adolescents.⁴

Although caffeine consumption by children and adolescents is not new,⁵ caffeine is now added in higher doses to beverages and also added to a broad range of products that were previously caffeine free, including certain brands of bottled water, candy, gums, breath mints, and cosmetics.^{6,7} Overall, caffeine consumption

in U.S. adolescents remained stable from 2000 to 2010.⁸ However, although caffeine consumption from soda decreased, intake of higher concentration caffeine products such as coffee and energy drinks increased rapidly, suggesting that the total dose of caffeine consumed by adolescents may be on the rise.⁹

Caffeine consumption has been extensively studied in adults.^{10–14} In moderation, caffeine use results in improved attentiveness and reaction time, decreased feeling of fatigue, and increased productivity in various settings.¹⁰ Moderate doses of caffeine may produce similar benefits in children and adolescents, though these effects have not been studied in these age groups.⁴ High caffeine consumption in adults can lead to insulin insensitivity, hypertension, and headaches, as well as cardiovascular, gastrointestinal, and kidney dysfunction. In children and adolescents, caffeine doses of 100–400 mg lead to increased reports of nervousness, jitteriness, and

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fidgetiness and there is a dose-dependent relationship with increased diastolic blood pressure.¹⁵ A dose-response relationship has been found between consumption of caffeinated sugar-sweetened beverages and physical complaints in 10–12 year-olds.¹⁶

The objective of this study was to determine rates of caffeine-related physical and emotional symptoms and problems among adolescents presenting for routine healthcare.

Methods

Participants and procedures

As part of a project designed to validate an electronic screening tool for substance use in adolescents,¹⁷ we recruited a convenience sample of patients aged 12–17 years presenting for a routine (primary care) medical visit to an adolescent medical clinic or pediatric primary care clinic of an urban children's hospital in the Northeast. Patients were excluded if they were non-English speaking ($n=11$), medically or emotionally unstable on the day of the appointment ($n=75$, as determined by their healthcare provider), were developmentally not able to assent or complete the survey ($n=11$), or had been in residential treatment for a substance use disorder in the past 3 months ($n=1$). Eligible patients were invited to participate at the end of a primary care appointment. Overall, 62% of 287 eligible participants agreed to participate in the study for a final sample of 179. The most common reasons for refusal included lack of time ($n=95$) or interest ($n=10$). The study was granted a Certificate of Confidentiality from the National Institutes of Health and was approved by the hospital Institutional Review Board with a waiver of parental permission.

Measures

A detailed description of the methods has been published previously.¹⁷ Briefly, participants answered questions on a research eligibility form, including gender, self-identified

race/ethnicity, and age in years. They then completed the Composite International Diagnostic Interview Substance Abuse Module (CIDI-SAM) version 4.1, a structured interview that has been validated against DSM-IV diagnostic criteria for substance use disorders,^{18,19} which was modified for DSM-5 criteria. Participants were asked if they had consumed a caffeinated beverage within the past 30 days. According to the CIDI-SAM protocol, those who answered “yes” to this question then responded to (1) 8 yes/no questions about ever experiencing withdrawal symptoms due to recent reduction or cessation of caffeine (e.g., caffeine cravings, headaches), (2) 11 questions on physical and emotional symptoms due to caffeine use (e.g., frequent urination, trouble falling asleep, feeling anxious), and (3) 8 yes/no questions about ever experiencing problems associated with the use of caffeine (e.g., continued use despite physical or psychological harm, drinking more caffeine than intended), which were adapted from the DSM-IV criteria for substance dependence. Examples of questions included “Within 24–48 hours of reducing or going without caffeinated beverages or switching to decaffeinated drinks, did you have X withdrawal symptom” and “Other than withdrawal symptoms, did caffeinated beverages ever cause you to have physical problems like X symptom.”

Data analysis

We used descriptive statistics to summarize caffeine use, caffeine-related physical and emotional symptoms and problems.

Results

The sample was primarily female (73%, which was reflective of the clinic population overall) and ethnically diverse, with a median age of 16 years (Table 1). Two-thirds of participants (67%) reported caffeinated beverage consumption in the past 30 days, and of those participants, 68% reported ever having at least one physical or emotional

TABLE 1. DESCRIPTION OF SAMPLE DEMOGRAPHIC CHARACTERISTICS BY CAFFEINE USE AND CAFFEINE-RELATED SYMPTOMS AND PROBLEMS

<i>Demographic characteristics</i>	<i>N (%)</i>	<i>Caffeine use in past 30 days, N (%)</i>	<i>Any lifetime symptom or problem related to caffeine, N (%)^a</i>	<i>p-Value</i>
All	179 (100.0)	120 (67.0)	82 (68.3)	
Age, median (range), years	16 (12–17)	16 (12–17)	16 (12–17)	0.25
Gender				
Female	131 (73.2)	90 (50.3)	64 (53.3)	0.26
Male	48 (26.8)	30 (16.8)	18 (15)	
Race/ethnicity				
Black non-Hispanic	64 (35.8)	49 (27.4)	32 (26.7)	
White non-Hispanic	43 (24.0)	27 (15.1)	19 (15.8)	0.87
Hispanic	55 (30.7)	31 (17.3)	21 (17.5)	
Other	17 (9.5)	13 (7.3)	10 (8.3)	

^aPercentage among past 30-day caffeine users ($n=120$).

TABLE 2. DISTRIBUTION OF PHYSICAL OR EMOTIONAL SYMPTOMS RELATED TO CAFFEINE USE AND WITHDRAWAL

	N (%)
Craving	29 (24.2)
Frequent urination	25 (20.8)
Trouble falling asleep	22 (18.3)
Stomach problems	15 (12.5)
Tired	14 (11.7)
Headaches	11 (9.2)
Trouble with concentration	9 (7.5)
Fast or irregular heartbeat or chest pain	6 (5.0)
Anxious, jittery, or nervous	4 (3.3)
Muscle twitching or weakness	4 (3.3)
Angry	3 (2.5)
Increased appetite	3 (2.5)
Chills or sweating	2 (1.7)
Sleep problems	2 (1.7)
Paranoia	1 (0.8)
Anxious or depressed	1 (0.8)
Nausea	1 (0.8)
Weight loss	0
Flushed face	0

symptom or psychological problem related to caffeine use or caffeine withdrawal (Table 1).

Physical and emotional symptoms

Table 2 shows the number and percent of caffeine drinkers that attributed each of the physical and emotional symptoms related to caffeine use and withdrawal. Rates of endorsement varied from 0% to 24% (Table 2). The most commonly reported physical and emotional symptoms were caffeine cravings, frequent urination, and difficulty falling asleep. Physical and emotional symptoms were not associated with age, gender, or race/ethnicity.

Problems associated with caffeine use

The number and percent of caffeine drinkers that endorsed symptoms (taken from DSM-IV criteria for substance dependence) attributed to caffeine use varied from 0.08% to 35% (Table 3). As with physical and emotional symptoms, caffeine-related problems were not associated with age, gender, or race/ethnicity.

TABLE 3. PROBLEMS RELATED TO CAFFEINE USE

	N (%)
Time devoted	42 (35.0)
Use despite harm	38 (31.7)
Use more or longer than intended	23 (19.2)
Withdrawal	21 (17.5)
Tolerance	17 (14.2)
Unsuccessful quit attempt	3 (2.5)
Important activities given up or reduced	1 (0.8)

Discussion

Caffeine use by children and adolescents was commonly related to physical and emotional symptoms and problems in our sample. Caffeine use was *not* associated with gender, race/ethnicity, or age, suggesting that consumption is common across the adolescent population. This is consistent with previous research that found that children start consuming caffeine early and consume increasing amounts as they get older.^{8,20} For example, “energy drinks,” which are sold in large portions contain up to 500 mg of caffeine in a single serving,²¹ have been consumed by 62% of adolescents.²² These legal and easily accessible products are the fastest growing segment of the beverage industry and are specifically marketed to adolescents.²³ Based on our findings, we recommend that physicians include anticipatory guidance to limit caffeine and avoid highly caffeinated beverages beginning early in elementary school to minimize health-related symptoms.

Caffeine-related sleep problems were common in our sample. Caffeine is well known to have adverse effects on sleep, causing an increase in sleep latency, decrease in sleep efficiency, and overall sleep time.²⁴ Caffeine use may be an under-recognized contributor to sleep deficiency in adolescents, leading to problems, including drowsiness and difficulty with focus and attention at school.²⁵

Physical complaints that often present to physicians, such as stomach problems and headaches, were also commonly attributed to caffeine use or withdrawal by adolescents in our study. Healthcare providers may consider caffeine use as a possible causative factor when an adolescent presents with headaches, stomach problems, urinary frequency, sleep disturbance, or difficulty with concentration. Problems that adolescents relate to caffeine use and withdrawal could form the basis of clinician “brief advice” to reduce caffeine use—a strategy that is recommended for reducing use of other substances.²⁶

DSM-5 describes the high prevalence and physiological consequences of caffeine intoxication and caffeine withdrawal,²⁷ but does not presently recognize a “caffeine use disorder,” a subject of much debate. It is unclear whether caffeine use results in the same type of “disorder” as other psychoactive substances. While caffeine use is common and often benign, symptoms that impact functioning, such as headaches and fatigue, may be a rationale for developing criteria for a caffeine use disorder.

A number of potential limitations to our study should be noted. We recruited patients from a single academic hospital in an urban setting. Although our adolescent participants were diverse in age, gender, and race/ethnicity, the results may not be generalizable to other populations. We obtained data through self-reported surveys, which are susceptible to recall and other biases and may be

less sensitive for identifying caffeine use compared to 24-hour dietary recall used in other studies. We do not know if symptoms reported to be related to caffeine were, in fact, caused by caffeine use. We note, however, that we used a tool that has been well validated. Our approach, which involved summing of caffeine-related symptoms, does not “weigh” symptom burden or account for potential differences in the effects of different symptoms. Our assessment battery did not quantify the number of caffeinated beverages or record in what form caffeine was consumed (e.g., soda, tea, coffee, energy drink), so we cannot evaluate the relationship between the amount of caffeine consumed and caffeine-related symptoms. The questions pertained to caffeine in beverages only and did not include other modes of caffeine delivery (e.g., tablets). Future studies can be designed to address these issues, particularly in quantifying caffeine use to further our knowledge about the dose-dependent impact of caffeine on adolescent health.

Conclusions

We conclude that caffeine use may be a frequent cause of physical and emotional symptoms and problems in adolescents. Caffeine use should be included in the differential diagnosis for several common health complaints in this age group.

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Author Disclosure Statement

No competing financial interests exist.

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