



Caffeine Consumption Patterns and Beliefs of College Freshmen

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ABSTRACT

Background: Caffeine consumption by young people has increased dramatically over the last decade through increased coffee consumption and “energy drinks.” In higher amounts, caffeine causes many adverse effects that are cause for concern. **Purpose:** Purposes of this study were to determine: (1) the amount of caffeine consumed by a sample of college students, (2) beliefs regarding caffeine consumption, (3) reported perceived benefits and adverse effects of caffeine consumption, (4) reasons for consuming caffeine, and (5) predictors of caffeine consumption. **Methods:** An anonymous survey was administered 300 freshmen attending a southeastern university. **Results:** Eighty-three percent of the students reported having at least one sign/symptom of caffeine intoxication in the past; 51% reported having at least one sign/symptom of caffeine withdrawal. Students consumed three to five times the recommended amount of caffeine. Father’s social index, participation in organized activity in college and three alertness items (concentration, keep awake, wake up) were significant predictors of caffeine consumption. **Discussion:** Students ingested caffeine at levels that could cause negative health effects and seemed unaware of the total amount of caffeine consumed. **Translation to Health Education Practice:** More information about caffeine should be incorporated into health education at all levels, so students can identify and avoid negative effects along with caffeine withdrawal and addiction.

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BACKGROUND

Caffeine consumption by adolescents and young adults has increased dramatically over the last decade through both increased coffee consumption and so-called “energy drinks.”^{1,2} Energy drinks, such as Red Bull, Monster and Spike Shooter, for example, have become increasingly popular. In 2002, retail sales of energy drinks totaled \$1.2 bil-

lion but increased 440% to \$6.6 billion in 2007. By 2011, energy drinks are expected to exceed \$9 billion.³ A reported 31% of U.S. teens drink energy drinks, which have much more caffeine than a standard soft drink. For example, a 12-ounce serving of Amp contains 107 milligrams, Monster contains 120 milligrams and Spike Shooter contains 428 milligrams of caffeine compared to 34

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milligrams in a 12-ounce Coca-Cola.⁴ Consumption of coffee by young people is also growing. The National Coffee Association reported that in 2007, 37% of 18-24 year-olds drank coffee, an increase from 26% in 2005.⁵ Coffee drinks consumed by young people are often large, sweet drinks such as those sold at Starbucks. A 16-ounce Starbucks coffee contains 320 milligrams of caffeine, almost 10 times as much as that provided in a 12-ounce Coca-Cola.⁶ Whereas consumption of energy drinks and coffee is increasing, the consumption of soft drinks decreased from 2004 to 2009.⁷ However, American consumption of soft drinks was still 736 eight-ounce servings per capita in 2009, with the U.S. having the highest per capita consumption of carbonated soft drinks in the world.⁸ Caffeine content of soft drinks ranges from 0 mg to 71 mg per 12 oz. serving with most popular soft drinks ranging from 35 to 60 mg (Mountain Dew has 71 mg).⁹ While young people can get more caffeine per drink from energy drinks and coffee, the consumption of soft drinks certainly contributes to total overall caffeine consumption.

Caffeine is often used for some positive effects that can result when it is consumed in moderation. Some of these effects include alertness, cognitive vigilance and increased driver perception of driving performance among other effects.¹⁰ However, while caffeine is not usually associated with life-threatening health risks, there are many adverse effects that are cause for concern. Of all substances reported to and tracked by poison control centers, more than 23% were due to excessive caffeine consumption among ages 6-19.¹¹ There is increased evidence of adverse physical effects related to caffeine such as sleep deprivation,¹² increased heart rate and blood pressure,^{13,19} central nervous systems disorders, vasodilation, trembling, seizures,¹³ urticaria (severe allergic reaction),¹⁴ headaches,¹⁵ and increased body temperature.¹⁶ Caffeine has been shown to have effects on behavior as well. It has been shown to be related to poorer grades and decreased performance in the classroom,¹⁷ disruption of coordination

in complex tasks,¹³ sleep disorders such as sleep apnea,¹⁸ nervousness,¹⁹ hyperactivity, agitation, anxiety, withdrawal from play and interaction, attention disorders, and disruptive behaviors.^{20,21} The American Psychiatric Association (DSM_IV_TR) lists diagnostic criteria for caffeine intoxication.²² These criteria include recent consumption of caffeine, usually in excess of 250 mg (e.g. more than 2-3 cups of brewed coffee) and "... five (or more) of the following signs, developing during, or shortly after, caffeine use: restlessness, nervousness, excitement, insomnia, flushed face, diuresis, gastrointestinal disturbance, muscle twitching, rambling flow of thought and speech, tachycardia or cardiac arrhythmia, periods of inexhaustibility, and psychomotor agitation."²² Signs and symptoms of caffeine withdrawal can include fatigue, drowsiness, anxiety, depression, feeling sick at stomach, vomiting, difficulty concentrating, and irritability.²³

From a health promotion perspective, variables related to caffeine consumption are of interest. A relationship was found between energy drink consumption and risk-taking among college men.²⁴ Caffeine has been used as an ergogenic aid among athletes.²⁵ Although not shown specifically as being related to caffeine, Zuckerman's²⁶ sensation seeking scale has been positively correlated with varied sexual activities, drug and alcohol use, smoking, and food preferences such as spicy, sour and crunchy foods. Sensation seeking can be defined as "a trait defined by the seeking of varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal and financial risks for the sake of such an experience."²⁷ Researchers at Johns Hopkins University School of Medicine reported that moderate doses (200-300mg/day) of caffeine for adults are not harmful but doses of more than 500 - 600mg/day can cause side effects. Similar dosages are also supported by The Mayo Clinic.^{28,29} Health Canada recommends intake of no more than 45 mg/day for 4-6 year-olds, 62.5 mg a day for 7-9 year-olds and 85 mg/day for 10-12 year-olds.³⁰ There are a number of reasons that caffeine consumption needs more study: First, while we

know caffeine consumption has increased among young people, we know very little about their patterns of caffeine consumption. Second, there is ample evidence of adverse physical and behavioral effects of caffeine. Third, there has been a sharp increase in caffeine consumption among young people through coffee, soft drinks and energy drinks.^{1,2} Fourth, researchers have appealed to the Food and Drug Administration (FDA) for more research on caffeine regarding the possible physical consequences of caffeinated beverages as well as more understanding about the reasons why young people use energy drinks and the contexts in which they are used.³¹ Therefore, this study was undertaken.

PURPOSE

The purposes of this study were to determine: (1) the amount of caffeine consumed by a sample of freshmen students at a medium-sized university, (2) the beliefs of the students regarding caffeine consumption, (3) the reported perceived benefits and adverse effects of caffeine consumption, (4) reasons for consuming or refraining from consuming caffeine, and (5) predictors of high and low caffeine consumption. The possible predictors selected for this study were socioeconomic status, sex, sensation seeking and participation in sport, band, or academic or other extracurricular activities in high school.

METHODS

Participants

The participants for this study were 300 freshmen attending Marshall University which had a total student population of approximately 14,000 students. All participants were freshmen, had graduated from high school in the past year, and were 18-20 years of age. Of these 300, there were 118 men (39.3%) and 182 women (60.7%). Ethnic origin was predominantly Caucasian with 270 (90%) of participants being Caucasian, 12 (4%) African American, five (1.7%) Hispanic, three (1.0%) Asian, and 10 (3.3%) other. This sample was generally reflective of the student body as a whole, with the



university having 59% female, 41% male and 7.6% minority students. College students were selected for this study because of their availability and because of the increase in caffeine consumption by young people. Also, freshmen students were selected so that the time frame would allow for asking questions about both high school and college behaviors.

Procedures

Research approval was obtained at two institutions – the institution of the first author’s doctoral study and the institution where the study was conducted. Faculty who taught either a required university orientation class for all incoming freshmen or other classes that contained predominantly freshmen were contacted via email to obtain permission to administer the survey in their classes. The primary researcher used the university online registration system to locate classes that would be eligible for participation and sent out requests to 45 different instructors. Affirmative responses were received from 29 instructors and all those classes were included in the data collection. Surveys were given to all students, were anonymous and were strictly voluntary. The principal researcher for this study administered the instrument at the beginning of the regular class period. Students took approximately 15–20 minutes to complete the 29-item, paper and pencil survey. If students did not want to participate ($N=2$) or did not meet the inclusion criteria ($N=50$), they were instructed to return a blank survey. Three-hundred and-three participants returned surveys. Three surveys were excluded due to excessive missing data or participants electing not to finish the survey, leaving 300 usable surveys. Data were collected over a three-week period in January and February of 2008.

Instrument

An anonymous survey was used to address the purposes of the study. The possible predictors of caffeine use selected for this study were socioeconomic status, sex, sensation seeking and participation in sport, band, or academic or other extracurricular activities in high school and college.

Sensation seeking was selected as a possible predictor due to previous research linking sensation-seeking and drug use. The researchers wished to extend previous research by examining caffeine and sensation seeking. Since caffeine has been used as an ergogenic aid, participation in sport in high school or college was included as a predictor. Since the participants had been in college only one semester when the data were collected, questions regarding activities in both college and high school were asked. Other variables were simply included as exploratory variables. Questions included in the survey were general demographic and background information, self-reported body weight, questions adopted from Hollingshead’s Two Factor Index of Social Position³² and sensation seeking questions adopted from Hoyle, Stephenson, Palmgreen, et al.^{33,34}

A question was also asked to determine participation in sponsored activities or other organized activities while in high school. A number of interscholastic sports were listed for participants to choose from as well as intramural sports, band, choir, dance, gymnastics, journalism and other. A similar question was asked in regard to activities in college. Participants’ socioeconomic status was classified using Hollingshead’s Two Factor Index of Social Position.³² Hollingshead’s Two Factor Index of Social Position has produced valid and reliable results in previous research.^{35,36} An eight-item, Likert scale was used to assess sensation seeking. The range of scores was 8 to 40, with lower scores indicating stronger sensation seeking. A variable called “Risky” was tabulated by adding together the scores of each of the individual items of the eight-item sensation seeking scale. This variable was found reliable by calculating Cronbach’s Alpha, yielding a coefficient of .741. In addition, this variable has produced valid and reliable results in previously published research.³³ Some relevant caffeine questions were also adapted/adopted from Attitudes and Behaviors of New Brunswick Students Towards the Use of Performance-Enhancing Substances in Sport: Final report, 2002;³⁷ National Survey on Drugs and Sport: Final Report by Cana-

dian Centre for Drug-Free Sport, 1993;³⁸ and Young People’s Attitudes Towards Doping in Sport: Final Report by the Royal Canadian Mounted Police, 1998.³⁹ Nine questions in a yes or no format were asked in the survey instrument about beliefs about caffeine. Six questions in a yes or no format were asked regarding reasons to consume or not consume caffeine. An example of a question in this category was, “Have you ever used caffeine to stay awake?” Participants were asked their reactions from using caffeine and if they had any withdrawal symptoms from stopping caffeine use. A sample question was, “Have you ever felt/had any of the following reactions after taking/drinking caffeine?” A similar question was asked for stopping caffeine. A variety of symptoms were listed and participants were instructed to “check all that apply.” Some of the symptoms listed were adapted/adopted from the DSM-IV criteria for caffeine-induced sleep disorder, intoxication, anxiety disorder, and caffeine-related disorder.⁴⁰

To determine caffeine consumption, an exhaustive list of drinks containing caffeine was developed that included different sizes of that drink that are commonly sold. The questions asked how many of each size was consumed daily by those that completed the survey. The question was, “What is the average number of each drink you have consumed each day over the past week?” For example: If you drink any Colas (such as Coke, Pepsi, RC, Dr. Pepper, or Mr. Pibb) how many 8 oz drinks, 12 oz drinks, 20 oz drinks, 1 liter bottles and 2 liter bottles do you consume on average each day?” Then the total was calculated based on the amount consumed in ounces and the amount of caffeine in each drink.

Questions about caffeine pills, gum, and/or mints were asked by number of days consumed and number of pills, gum, and/or mints consumed each day. Having few respondents indicating they consumed caffeine pills, gum and/or mints, this category was only employed for tabulating total milligrams of caffeine used. Health promotion professionals reviewed the instrument for face validity. In addition, the instrument



was pilot tested with 30 university students who were not included in the final sample. Appropriate changes were made in the instrument according to comments made by the pilot test participants.

Data Analysis

Race categories were collapsed and coded as Caucasian or other. Father's and mother's occupations and highest level of education were given a numeric value listed in Hollingshead's occupation and education scale. A lower social index computation was associated with a higher socioeconomic status. Frequencies and percentages were calculated for any items requiring descriptive analysis. Means and standard deviations were calculated where appropriate.

Responses to items about beliefs about caffeine and reasons for using caffeine were tabulated by the total number of "yes" answers. The total number of signs/symptoms reported by each respondent was computed by totaling the number of circled responses for intoxication and withdrawal. Total milligrams of caffeine consumed per day were tabulated. The total amount of caffeine consumed/ingested was computed by asking participants to complete charts indicating how much caffeine each respondent consumed in soft drinks, energy drinks, coffee and tea, and caffeine pills, gum, and/or mints. Drink questions were asked by size of drink and number of drinks consumed.

Because the dependent variable (total caffeine) was positively skewed with a range from 0 to 12,566.72 mg, its variability was tightly constrained. To remedy this issue, all the values of the dependent variable were expressed in natural logarithms as recommended by a statistics expert. The dependent variable expressed in natural logarithms was then later used as the dependent variable in the regression analysis. Rather than submitting all 15 items on the caffeine belief scale to the regression analysis, a scale of caffeine beliefs was constructed using principal component analysis. As a cautionary comment, it should be noted that principal components is most reliable when used with interval or ratio level data that is approximately normally distributed. In

the present application, however, while the departure from normal criterion is met, the items used in constructing the components are dichotomies. Kolenikov and Angeles,⁴¹ however, have provided a rationale for using principal components with discrete data. Our use of dichotomies follows their account. The three items that resulted from this analysis were called concentration, keep awake and wake up (Table 1). This scale was found reliable in two ways. First, the loadings of Principal Component Analysis were all large and well above .3 suggesting the items were closely intercorrelated, indicating that they represent one construct/concept, and second by a Cronbach's α of .601 (a .601 Cronbach's α is an artifact of the small number of items that make up the scale). This collection of items was a powerful predictor of caffeine consumption (Table 2).

A multiple regression was performed to determine if there were significant predictors of high caffeine consumption. Caffeine consumption expressed in natural logarithms was used as the dependent variable and the following variables were entered as predictors: gender, sensation seeking, father's social index, mother's social index, ethnicity, participation in organized high school activity, participation in organized college activity and a composite of three caffeine beliefs (concentration, keep awake and wake up) (Table 2). This multiple linear regression analysis used ordinary least squares estimators with all independent variables estimated simultaneously. As such, each independent variable served as a control for all others, thereby addressing the issue of confounding.⁴² Correlation analysis was used to determine if there was a relationship between caffeine consumption and sensation seeking. A series of *t*-tests assessed hypotheses concerning differences in beliefs and consumption by gender. Cronbach's α and principal component loadings were used to determine intercorrelations between construct individual items.

RESULTS

Among the 300 participants, 255 (85%) reported participating in organized high

Table 1. Principal Component Analysis Using Caffeine Beliefs

Component Matrix ^a	
	Component
	1
Concentrate	.619
Keep awake	.799
Wake up	.813

school activities (this included activities organized by the high school such as competitive sports, academic competitions, etc., and those activities organized in the community such as boxing, gymnastics, etc.) whereas, 45 (15%) reported not participating in any organized activity. Eighty-five (28.3%) of the participants reported participating in organized activities during their freshman year in college and 215 (71.7%) reported that they did not participate in any organized activity while in college.

Table 3 indicates that the mean milligrams of caffeine consumed per day was 849.86 mg. and there was 12.1 mg. of caffeine consumed per kg. of body weight per day. Only 5.3% of participants reported that they did not consume caffeine in the previous two weeks.

Table 4 addresses beliefs regarding caffeine, perceived benefits and adverse effects of caffeine consumption, and reasons for consuming or refraining from consuming caffeine. Several items dealt with beliefs and behaviors about using caffeine to stay awake. Approximately 76% of students believed caffeine would keep them awake and the same percentage had actually used caffeine to stay awake. About 61% had used caffeine to wake up in the morning. An even higher percentage of students (80%) believed that "caffeine can be harmful to my health and can hurt me" and that caffeine is addictive (82%).

Table 5 also addressed adverse effects by displaying symptoms of caffeine intoxication and withdrawal. When asked if they



Table 2. Regression Analysis to Predict Caffeine Consumption

	Unstandardized Coefficients		Significance
	B	Std. Error	
Item 1 Sex	.27	.21	0.19
Item 2 Sensation Seeking	-.02	.01	0.16
Item 3 Father's Social Index	.08	.03	0.02*
Item 4 Mother's Social Index	-.01	.03	0.66
Item 5 Ethnicity	-.33	-.33	0.31
Item 6 Participation in Organized High School Activity	.10	.31	0.74
Item 7 Participation in Organized College Activity	.60	.23	0.01**
Item 8 Questions 1-3 of Caffeine Beliefs. Three items for concentration, keep awake and wake up.	.41	.10	0.00***

R² = .121
 Coefficient represent natural logs
 * P < 0.05 ** P = 0.01 *** P < 0.001

Table 3. Total Caffeine Means and Standard Deviations

	Mean	Std Deviation
Item 1 Milligrams of Caffeine/Day	849.86	1265.62
Item 2 Milligrams of Caffeine/Kilogram of Body Weight/Day	12.08	18.43
Number that reported they did not consume caffeine in the reporting time frame of the previous two weeks	16 (5.33%)	

had ever felt/had any of the following reactions after taking or drinking caffeine, 83% percent of the students reported having at least one sign/symptom of caffeine intoxication in the past. In addition, 51% reported having at least one sign/symptom of caffeine withdrawal. Of the 22 signs/symptoms of caffeine intoxication, the maximum number any one person reported was 14. The most common symptoms of caffeine intoxication that were reported were restlessness (40%), excitement (38%), can't sleep (49%), frequent urination (32%) and headache

(31%). Of nine signs/symptoms of caffeine withdrawal, the maximum number any one person reported was eight (Table 5). The most common symptoms of withdrawal were fatigue (20%), headache (36%) and cravings (25%).

To determine predictors of high and low caffeine consumption, a regression analysis (Table 2) was computed using the log of total caffeine consumption as the dependent variable. Father's social index, participation in organized activity in college, and three items for concentration, keep awake and wake up

(items of alertness) were statistically significant. On average, every time the respondent's father's social index increased by one point, caffeine consumption increased on average by eight percent. Respondents that indicated they participated in organized activity while in college consumed on average 60.7% more caffeine than those who indicated they did not participate in organized activity while in college. It was also found that every time the three items for concentration, keep awake, and wake up increased one point, caffeine consumption increased an average of 41.1%.

**Table 4. Caffeine Beliefs, Perceived Benefits and Adverse Effects, and Reasons For Consuming Caffeine**

	Yes	No
Q1. I believe caffeine will help me concentrate when studying	83 (27.7%)	217 (72.3%)
Q2. I believe that caffeine will help keep me awake	229 (76.0%)	71 (23.7%)
Q3. I believe that caffeine will wake me up in the morning	178 (59.3%)	122 (40.7%)
Q4. I believe that caffeine will help me lose weight	15 (5.0%)	285 (95.0%)
Q5. I believe caffeine enhances performance (athletic, academic, artistic, etc)	57 (19.0%)	243 (81.0%)
Q6. I believe that caffeine can be harmful to my health and can hurt me	239 (79.7%)	61 (20.3%)
Q7. I believe that caffeine is addictive	247 (82.3%)	53 (17.7%)
Q8. I believe that caffeine can disrupt coordination	129 (43.0%)	171 (57.0%)
Q9. I have religious objections to caffeine consumption	4 (1.3%)	296 (98.7%)
Q10. Have you ever used caffeine to wake up in the morning?	182 (60.7%)	118 (39.3%)
Q11. Have you ever used caffeine to stay awake?	229 (76.3%)	71 (23.7%)
Q12. Have you ever used caffeine to enhance physical performance?	41 (13.7%)	259 (86.3%)
Q13. Have you ever used caffeine to enhance mental performance?	80 (26.7%)	220 (73.3%)
Q14. Have you ever used drinks/pills with caffeine to lose Weight?	26 (8.7%)	274 (91.3%)
Q15. Do you drink beverages with caffeine in them on a daily basis?	195 (65.0%)	105 (35.0%)
	Mean	Standard Deviation
How many years have you been drinking beverages with caffeine. 0 1 2 3 4 5 6 7 8 9 10+	9.11	2.09

Sex, sensation seeking, mother's social index, ethnicity and participation in an organized activity in high school were not statistically significant. When analyzing belief questions one through eight for sex differences, only one question was found significant, "I believe caffeine is addictive." Females were more likely to believe that caffeine is addictive than their male counterparts. A correlation analysis showed no statistical relationship between the Brief Sensation Scale variable "Risky" and total caffeine consumption or the natural logarithm of total caffeine consumption.

DISCUSSION

The first research question was, "What is the amount of caffeine consumed daily?" The recommended maximum amount of caffeine consumption per kilogram per day was exceeded. The mean milligram of caffeine consumed per day in the present

study was 849.86, which computes to 12.08 mg/kg/day. This is nearly five times the recommended amount of Health Canada³⁰ and approximately three times the recommended amount the Mayo Clinic.²⁹ This level of caffeine consumption is generally associated with signs and symptoms of caffeine intoxication and withdrawal if one quits consuming caffeine. These college students were certainly ingesting caffeine at levels that could cause negative health effects. Respondents may not have been aware of the total amount of caffeine they were consuming because they did not pay close enough attention to product labels and may not have known other names caffeine can be listed under on the product labeling. Statements from participants after they finished the survey such as "I didn't realize a lot of the stuff I was drinking had caffeine in it," and "I was drinking that because caffeine was not listed on the label," lead the researchers to

believe that labeling on drinks is inconsistent and students may not be reading the labels regarding caffeine.

The second research question related to beliefs of college students regarding caffeine. These beliefs were somewhat inconsistent. Just more than 72% of respondents did not believe that caffeine would help them concentrate while 76% and approximately 59% believed that caffeine would keep them awake or wake them up in the morning respectively. This supports the findings of other researchers that caffeine was sought after to counteract tiredness.⁴³ More than 81% of the respondents did not believe that caffeine would enhance athletic, academic, artistic, or other performances. This is a different finding than that of Kristiansen, et al.⁴³ who reported that caffeine was sought by those wanting to enhance performance and have more energy. Respondents reported that they believe caffeine can be harmful



Table 5. Caffeine Intoxication and Withdrawal Frequencies, Percentages and Means

Caffeine Intoxication	Yes	No
Item 1 restlessness	120 (40.0%)	180 (60.0%)
Item 2 excitement	115 (38.3%)	185 (61.7%)
Item 3 hot flashes	13 (4.3%)	287 (95.7%)
Item 4 nervousness	35 (11.7%)	265 (88.3%)
Item 5 can't sleep	147 (49.0%)	153 (51.0%)
Item 6 red faced	7 (2.3%)	293 (97.7%)
Item 7 frequent urination	96 (32.0%)	204 (68.0%)
Item 8 stomach pain	49 (16.3%)	251 (83.7%)
Item 9 muscle twitching	39 (13.0%)	261 (87.0%)
Item 10 rambling speech	24 (8.0%)	276 (92.0%)
Item 11 can't concentrate	43 (14.3)	257 (85.7%)
Item 12 fast heart beat	52 (17.3%)	248 (82.7%)
Item 13 hives	0 (0.0%)	300 (100.0%)
Item 14 irritated	23 (7.7%)	277 (92.3%)
Item 15 rash	0 (0.0%)	300 (100.0%)
Item 16 panic attack	11 (3.7%)	289 (96.3%)
Item 17 anxiety	37(12.3%)	263 (87.7%)
Item 18 obsessive	8 (2.7%)	292 (97.3%)
Item 19 compulsive	12 (4.0%)	288 (96.0%)
Item 20 headache	94 (31.3%)	206 (68.7%)
Item 21 irregular heart beat	27 (9.0%)	273 (91.0%)
Item 22 hyperactivity	69 (23.0%)	231 (77.0%)
Caffeine Withdrawal	Yes	No
Item 1 fatigue	61 (20.3%)	239 (79.7%)
Item 2 drowsiness	45 (15.0%)	255 (85.0%)
Item 3 anxiety	7 (2.3%)	293 (97.7%)
Item 4 depressed	13 (4.3%)	287 (95.7%)
Item 5 sick at stomach	11 (3.7%)	289 (96.3%)
Item 6 vomiting	2 (0.7%)	298 (99.3%)
Item 7 headache	108 (36.0%)	192 (64.0%)
Item 8 cravings	74 (24.7%)	226 (75.3%)
Item 9 irritability	41 (13.7%)	259 (86.3%)
	Mean	Standard Deviation
Total Intoxication Signs/Symptoms	3.40	2.99
Total Withdrawal Signs/Symptoms	1.20	1.59

(80%), addictive (82%) and disrupt coordination (57%). Yet, respondents still exceeded by 3-5 times the recommended maximum amount of caffeine. This suggests that even though respondents felt that caffeine has negative health effects, the desire to use caffeine to stay awake or to wake up in the morning was more important than health concerns. It was not clear why, but females were more likely than males to believe caffeine was addictive.

The third research question was concerned with the perceived health benefits and adverse health effects of caffeine consumption. It was found that 83% of the respondents reported having at least one sign/symptom of caffeine intoxication and respondents had a mean of 3.4 signs/symptoms. This is slightly lower than the DSM IV-TR diagnostic criteria of five or more signs/symptoms to diagnose someone with caffeine intoxication. Even though the DSM IV-TR stops short of offering diagnostic criteria for caffeine withdrawal, the notion of withdrawal is supported by many authors.⁴⁴⁻⁴⁷ We found that 51% of respondents reported having at least one sign/symptom of caffeine withdrawal. This percentage could be due to the fact that 65% of respondents reported drinking caffeine on a daily basis for a mean of more than nine years, thus reinforcing caffeine dependence and averting withdrawal. Signs and symptoms of withdrawal would not occur if caffeine were constantly consumed, which is consistent with a very high percentage reporting that they have had signs/symptoms of caffeine intoxication (83%), with only 51% reporting withdrawal signs/symptoms.

Research question number four related to reasons participants gave for consuming or not consuming caffeine. Almost 61% had used caffeine to wake up in the morning while 76.3% had used caffeine to stay awake. This is consistent with the finding that students who participated in organized activities while in college consumed 60.7% more caffeine than those who did not participate in activities. It is logical that those who are participating are busier and may feel the need to get less sleep and still feel alert.



Only 13.7% of participants reported using caffeine to enhance physical performance and 26.7% reported using caffeine to enhance mental performance. A mere 8.7% of respondents reported using caffeine to lose weight. This suggests that participants in this study consumed caffeine for specific reasons, which were to help them wake up and to help them stay awake. As was mentioned earlier, moderate use of caffeine to produce alertness can be a benefit of caffeine and this may be an appropriate use of caffeine by college students. However, the quantity of caffeine consumed by these students far exceeded recommended amounts and thus may be a cause for concern.

Predictors of caffeine consumption were addressed in the fifth research question. Father's social index, participation in organized activities (athletics, intramurals and other organized activities on and/or off campus) while in college, and a scale containing three items for alertness (concentration, keep awake and wake up) were statistically significant in predicting caffeine consumption. As the father's social index increased (thus SES decreasing), it was found that caffeine consumption increased. Because there are many variables that could contribute to this relationship, we will not speculate on the reason for this result. Participation in organized college activity was found to be a significant predictor of caffeine consumption. Common drinks such as soft drinks, tea, and coffee containing caffeine were consumed more than energy drinks, but were consumed significantly higher by those that associated themselves with activity. We can speculate that those who were busier with activities were using caffeine to wake up or keep awake, since those beliefs were highly related to caffeine consumption. Sensation seeking was not found to be statistically significant in predicting caffeine consumption. This differs from two different studies reported by both Miller²⁴ and Gurpegui, et al.⁴⁷ Freshmen at this university were probably not motivated by sensation seeking ads and may have been deterred by the cost of the energy drinks. They also seemed to be using caffeine in

order to stay awake and to wake up in the mornings rather than for reasons related to sensation seeking. Participation in organized activity while in college was significantly related to caffeine consumption while participation in organized activities while in high school was not significant. This could be due to the respondents being busier in college than they were while in high school and using coffee or caffeine drinks to wake up or give them energy for the activities, or this result could be due to the fact that they were making buying decisions now that they were in college instead of a parent/guardian buying beverages for them.

Beliefs about alertness were found to be a strong predictor of high caffeine consumption. With 76% of respondents believing that caffeine would help keep them awake and slightly more than 59% of respondents believing that caffeine would wake them up in the morning, this again suggests that college freshmen sought out drinks with caffeine in them to either keep them up or to wake them up.

Although this study has reported several interesting findings, the study does have limitations. The major limitation is that the study is limited to one university in the southeast U.S. and it is not known if these results can be generalized to freshmen students at other universities. Participation of the students was limited to 29 different classes at the university, based on the instructor's willingness to cooperate. In addition, due to time constraints, all activities could not be assessed and students' participation in work was not included. However, the study does shed light on the beliefs and knowledge about caffeine use and motivations to use caffeine by college students and indicates that more education is needed on the possible harmful effects. The study also points out the large amount of caffeine being consumed by these students, with some of them reporting symptoms of caffeine withdrawal or caffeine intoxication. Another limitation is that this study did not specifically investigate the current trend of mixing caffeine drinks with alcohol. Future research is warranted on this topic, along with research on

caffeine consumption by middle and high school students, students in trade schools, and students enrolled at all levels in higher education.

TRANSLATION TO HEALTH EDUCATION PRACTICE

Whereas knowledge might not be sufficient for changing behavior, some knowledge is needed and these students appeared to be lacking some important information about caffeine. When teaching health classes in high school or college, teachers and college health professionals should include teaching health effects of caffeine as they do fat intake and alcohol consumption. Some of the topics that should be included are: how to read labels and calculate daily caffeine consumption, what foods or substances contain caffeine, health effects of caffeine (both positive and negative), how much caffeine is too much, and the amount of caffeine necessary to wake up and to keep one awake. This information would enable students to make better decisions on how much caffeine (if any) to consume. It would also enable students to identify if they might possibly have caffeine addiction or caffeine withdrawal symptoms.

Another implication of this study is to encourage the Centers for Disease Control and Prevention (CDC) to include questions regarding caffeine consumption on the Youth Risk Behavior Surveillance Survey. It was reported that the freshmen respondents, ranging from age 18-20, have consumed caffeine for a mean of 9.11 years. This shows that they were consuming caffeine by the age of 9-11 years of age and possibly before. Three Canadian reports^{37,38,39} asked questions regarding caffeine consumption along with asking use of tobacco, alcohol, marijuana, steroids, and other drugs. If caffeine questions were included in the YRBS, it could lead to longitudinal data resulting in a better understanding of caffeine consumption.

With more than 78% of the respondents consuming more than the recommended amount (200/mg of caffeine per day), the magnitude of caffeine consumption may not be fully understood. Further research with



different population groups to understand the level of caffeine consumption and the health effects is warranted.

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