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CAFFEINE "ADDICTION" IN HIGH SCHOOL YOUTH: EVIDENCE OF AN ADVERSE HEALTH RELATIONSHIP

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This exploratory study examined the association between self-reported caffeine "addiction" among high school students and their sociodemographic, health and welfare characteristics. Study subjects ($n = 6,867$) were drawn from the approximately 59,000 students in grades 9 through 12, who were surveyed about their drug use in 108 randomly selected Tennessee high schools in 1995. They indicated lifetime abstinence from all psychoactive drugs except caffeine. Multiple logistic regression analysis revealed excess risks for caffeine "addiction" among females who were white (OR = 2.0), in poor health and/or physically disabled (OR = 1.6), chronically depressed (OR = 1.5), had a parent with an alcohol or other drug problem (OR = 1.4), and perceived little or no harm from caffeine use (OR = 2.2). Excess risks for caffeine "addiction" were found among males who were white (OR = 1.8), severely stressed (OR = 1.8), had a friend with an alcohol or other drug problem (OR = 1.5), and perceived little or no harm from caffeine use (OR = 2.5).

Keywords: Caffeine; Adolescents; Youth; Drug use; Health

INTRODUCTION

Alcohol and other psychoactive drug use among children and youth has been closely monitored and investigated through surveys in

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recent years, including the University of Michigan's national high school drug survey *Monitoring the Future*. But caffeine use typically falls outside the purview of such surveys. Moreover, we found no epidemiologic studies that reported on the health effects of caffeine use and abuse upon youth. Limited caffeine items were included in the *Tennessee Alcohol, Tobacco and Other Drugs High School Survey*, which was sponsored by the Bureau of Alcohol and Drug Abuse Services at the Tennessee Department of Health. Inclusion of an accompanying battery of health items has enabled us to examine the association between self-reported caffeine "addiction" and ill-health. In this exploratory multivariate analysis, sociodemographic, health and welfare variables are examined as correlates of caffeine "addiction" among high school students. Separate analyses are conducted for the sexes because the adverse health effects of heavy caffeine use reported in the literature predominantly implicated females.

Caffeine is the most pervasively used psychoactive drug in the world (Gilbert, 1984). It appears in numerous prescription and over-the-counter medications, chocolate, coffee, tea, colas and other carbonated and non-carbonated beverages. The fact that caffeine is not regulated by the United States' Food and Drug Administration implies this drug belongs at the benign end of the continuum of harm. Yet caffeine receives explicit mention in the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV) in the form of caffeine-intoxication, caffeine-induced anxiety disorder, caffeine-induced sleep disorder and caffeine-related disorder not otherwise specified (American Psychiatric Association, 1994). Mention is also made in DSM-IV of the phenomena of caffeine dependence and withdrawal, and a case has been made for the existence of caffeine dependence syndrome (Strain *et al.*, 1994). The *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) lists caffeine poisoning (Anonymous, 1994).

While there is scant evidence that any of the above caffeine-related conditions are common, epidemiologic studies conducted on adults have attributed adverse health outcomes to heavy caffeine use. A meta-analysis revealed an elevated risk for myocardial infarction or coronary death for individuals consuming five cups of caffeinated coffee (approximately 500 mg of caffeine) daily (Greenland, 1993). Consumption of three or more cups of caffeinated coffee per day has

been linked to delay in conception (Stanton and Gray, 1995; Bolumar *et al.*, 1997) and spontaneous abortion (Fenster *et al.*, 1991). Daily consumption of 400 mg of caffeine during pregnancy may increase the risk for sudden infant death syndrome (SIDS) (Ford *et al.*, 1998). In addition, caffeine consumption may raise the likelihood of developing osteoporosis (Thomas, 1997). Although rare, fatalities from caffeine overdoses have also been documented (Mrvos *et al.*, 1989; Shum *et al.*, 1997).

Some epidemiologic studies of adults indicate that caffeine, or at least caffeinated coffee, may confer beneficial health effects. A meta-analysis suggests that "substantial" coffee consumption (1+ cups per day) protects against colorectal cancer (Giovannucci, 1998). But the author states that this finding is driven by twelve case-control studies, and that the protective effect is not affirmed by the five cohort studies also incorporated in the analysis. A prospective study of 46,008 male health professionals found that consumption of caffeinated coffee was inversely associated with the risk for symptomatic gallstone disease (Leitzman *et al.*, 1999). Data from the Nurses' Health Study, a prospective epidemiologic study of a cohort of over 86,000 registered female nurses in the United States, indicate that long-term caffeinated coffee drinking could be protective against suicide (Kawachi *et al.*, 1996). A dose–response relationship is evident, with the protective effect persisting even when coffee consumption could be considered very heavy, four or more cups per day. This research also reveals an inverse relationship between suicide and caffeine use for these adult females, independent of caffeine source. The authors speculated that their findings might be attributable to an improvement in mood and diminished irritability following caffeine ingestion. Their findings confirm a similar one from an 8-year prospective study of daily coffee drinking and suicide among nearly 129,000 enrollees in the Kaiser Permanente Medical Care Program (Klatsky *et al.*, 1993). The authors acknowledge that an alternative explanation to the mood elevation and anti-depressant properties of coffee in protecting against suicide might be that depressed patients avoid coffee. Such avoidance would consequently inflate the suicide rate in the non-coffee drinking comparison group.

While confined to adults, fetuses and newborns, the literature suggests that there are more adverse than beneficial health effects of

caffeine use. This provides the rationale for examining as potential correlates of caffeine "addiction" a number of welfare variables, each of which might be expected to shield students from this "addiction" or contribute to its development and maintenance.

METHOD

Data for this study derived from a cross-sectional survey of approximately 59,000 high school students in 108 randomly selected Tennessee high schools in 1995. These schools represented the four metropolitan and eight nonmetropolitan regions of Tennessee. One-third of students absent on survey day was surveyed during a two-week follow-up period, and incorporated into the general student sample. Subjects for this study were aged 14–19 years and in grades 9 through 12, and included both vocational and special education students. To rule out possible confounding health effects of psychoactive drug use, other than caffeine, selected students were confined to those who reported lifetime abstinence from remaining psychoactive drugs including alcohol. For each sex, the study or caffeine-"addicted" group comprised students who reported being "currently or previously hooked on or addicted to caffeine, coffee or cola" (female $n = 492$; male $n = 244$). The female and male comparison groups, comprising the selected students who denied caffeine-"addiction," numbered 3687 and 2444, respectively. Our decision to form the two study groups through combining self-reported ever and currently caffeine-"addicted" students was guided by lack of evidence that youth terminate or reduce their caffeine consumption. Any resulting bias would be conservative; that is, it would serve to minimize caffeine-related health differences between study and comparison groups.

The research instrument was a pretested mark-sensor questionnaire. Participation in the survey was voluntary and anonymous. Questionnaries were self-administered and individually sealed upon completion. Where possible, items were drawn from major surveys, including the United States' *Census*, *National Health Interview Survey*, and *Monitoring the Future*. This was for purposes of standardization and quality control.

Predictor variables examined in this study as potential correlates of caffeine "addiction" for each sex were broadly classified as *sociodemographic, welfare* or *health*. Sociodemographic variables were age, race, poor family, and two-parent household. Religiosity, truancy, close parental supervision, parent with an alcohol or other drug problem, friend with an alcohol or other drug problem, and perceived harm from caffeine use constituted the set of welfare variables. Health variables represented both the physical and mental dimensions. They were general poor health and/or physical disability, severe stress, chronic depression, and suicide attempt. Age was treated as a continuous variable, and the other variables were dichotomized. Respondents ranked high on religiosity if they indicated that religion was very important to them. For dichotomizing the perceived harm in caffeine use variable, one group comprised students who perceived use to be harmless or not very harmful and the other those who perceived it to be somewhat or very harmful. Respondents were classified as chronically depressed if they reported being often or almost always depressed. Prior to finalizing variable categorization, frequencies were run to examine dispersion among predictors. Owing to heterogeneity and small numbers, racial distinctions were limited to black and white.

As a first step, males and females in this study are compared with their counterparts from the general sample of high school students, according to sociodemographic, health and welfare characteristics. This is followed by a similar comparison, within the study sample, in which students are not only differentiated by sex but also by whether or not they reported caffeine "addiction". Lastly, the results of the multivariate analysis are presented. Prior to the multivariate analysis, associations for the continuous variables with the dependent variable, self-reported caffeine "addiction", were assessed by Student's *t*-test and for the categorical variables by the Pearson Chi-square statistic. Final models predicting self-reported caffeine "addiction" for each sex were generated using forward selection, stepwise, multiple logistic regression. Odds ratios pertinent to each individual association reflect adjustment for all independent variables entering the final model. Results were replicated using backward elimination stepwise logistic regression. A zero-order correlation matrix revealed at most very moderate linear relationships among the independent variables.

RESULTS

Table I provides the comparison of sociodemographic, health and welfare characteristics between the study sample and the general sample of Tennessee high school students. Notable differences between study females and males and their opposites in the general sample are that study subjects were more likely to report residing in a two-parent household and being very religious. They were less likely to report being poor, severely stressed, chronically depressed, truant, under close parental supervision, having attempted suicide, and having a friend or parent with an alcohol or other drug problem. They also were marginally younger than general sample counterparts.

A 0.05 cutoff was utilized in distinguishing, by sex, self-reported caffeine-"addicted" students from the non-"addicted" across sociodemographic, health and welfare characteristics (Table II). Both

TABLE I Sociodemographic, health and welfare characteristics of Tennessee high school students by sex: general sample (minus study sample) and study sample[a]

Characteristics	*Females*		*Males*	
	General Sample ($n=25,690$)	*Study Sample* ($n=4,179$)	*General Sample* ($n=25,524$)	*Study Sample* ($n=2,688$)
Sociodemographic				
Mean age (years)	16.1	15.9	16.3	15.9
White	82.0%	84.2%	84.5%	85.3%
Two-parent household	68.0	81.7	68.6	79.5
Poor family	14.3	8.7	9.7	6.8
Health				
Severely stressed	18.0	8.2	10.4	5.5
Chronically depressed	30.3	11.8	16.5	8.6
Suicide attempt	18.4	2.8	9.4	1.4
Poor health &/or physical disability	11.8	4.0	9.9	3.8
Welfare				
High religiosity	47.4	74.9	40.3	60.0
Truant	7.3	0.4	10.5	1.1
Close parental supervision	10.5	2.1	17.9	5.8
Parent with drug problem[b]	43.7	26.9	30.5	21.5
Friend with drug problem[b]	63.9	50.6	43.9	36.6
Little/no perceived harm from caffeine	54.4	51.8	50.2	49.0

[a]All differences are statistically significant ($p<0.05$) except with the male comparisons on race (% white) and perceived harm from caffeine use.
[b]Can include alcohol problem.

TABLE II Distinguishing sociodemographic, health and welfare characteristics of selected Tennessee high school students by sex and self-reported caffeine "addiction" status

Characteristics	*"Addicted"*	*Non-"addicted"*	*Chi-square*	*p*
Females				
Sociodemographic				
White	91.7%	83.2%	23.3	0.001
Two-parent household	85.0	81.3	4.0	0.046
Health				
Severely stressed	11.4	7.8	7.6	0.006
Chronically depressed	16.3	11.2	10.7	0.001
Suicide attempt	4.3	2.6	4.6	0.032
Welfare				
Parent with drug problem[a]	33.7	26.0	13.4	0.001
Friend with drug problem[a]	57.3	49.7	10.1	0.001
Little/no perceived harm from caffeine	69.3 ($n=492$)	49.5 ($n=3687$)	68.4	0.001
Males				
Sociodemographic				
White	92.6%	84.6%	11.5	0.001
Health				
Severely stressed	9.0	5.1	6.5	0.011
Chronically depressed	12.7	8.1	5.9	0.015
Welfare				
Friend with drug problem[a]	47.1	35.6	12.8	0.001
Little/no perceived harm from caffeine	70.5 ($n=244$)	46.9 ($n=2444$)	49.5	0.001

[a]Can include an alcohol problem.

sexes shared five variables differentiating the "addicted" and non-"addicted". Members of the "addicted" group were more likely than the non-"addicted" to report being white, having a friend with an alcohol or other drug problem, being severely stressed, chronically depressed and perceiving caffeine use to be of little or no harm. Unlike their male counterparts, self-reported caffeine-"addicted" females were more likely than the non-"addicted" to report coming from a two-parent household, having a parent with an alcohol or other drug problem, and attempting suicide.

Table III provides the results of the multivariate analyses. Five variables entered the final model for the female students compared with four for the males. With adjustment for the effects of the other covariates in the model, white female students were twice as likely to report caffeine "addiction" as their black counterparts. Those who perceived little or no harm in caffeine use were more than twice as likely to do so

TABLE III Characteristics associated with self-reported caffeine "addiction" among selected Tennessee high school students by sex: adjusted odds ratios with 95% confidence intervals

Characteristics	*Adjusted odds ratio*	95% *confidence interval*
Females		
Sociodemographic		
White	2.01	(1.49, 2.93)
Health		
Poor health &/or physical disability	1.60	(1.03, 2.49)
Chronically depressed	1.50	(1.15, 1.97)
Welfare		
Parent with drug problem[a]	1.44	(1.17, 1.78)
Little/no perceived harm from caffeine	2.20 ($n=4179$)	(1.79, 2.70)
Males		
Sociodemographic		
White	1.81	(1.10, 2.99)
Health		
Severely stressed	1.79	(1.10, 2.99)
Welfare		
Friend with drug problem[a]	1.50	(1.14, 1.96)
Little/no perceived harm from caffeine	2.51 ($n=2688$)	(1.88, 3.36)

[a]Can include an alcohol problem.

than those who perceived such use to be somewhat or very harmful. Female students categorized as being in poor health and/or possessing a physical disability, having a parent with an alcohol or other drug problem, and being chronically depressed manifested excess self-reported caffeine "addiction" of 60%, 44% and 50%, respectively. Male students who perceived caffeine use to be harmless or not very harmful were two-and-half times as likely to report caffeine "addiction" as those who perceived this use to be somewhat or very harmful. Excess "addiction" of 81%, 79% and 50% was manifest among males who respectively reported being white, severely stressed, and having a friend with an alcohol or other drug problem.

CONCLUSION/DISCUSSION

This exploratory research indicates that self-reported caffeine "addiction" is associated with health and welfare problems among

Tennessee high school students, although any adverse link to physical health is limited to females. Regarding health, female students who reported "addiction" to caffeine showed an excess risk for being chronically depressed and in poor health and/or physically disabled. Caffeine-"addicted" males showed an excess risk for being severely stressed. Regarding welfare, caffeine-"addicted" students of either sex were more likely than non-"addicted" counterparts to perceive caffeine use to be of little or no harm. Other adverse associations pertaining to welfare are indirect. Caffeine-"addicted" male students were more likely to report having a friend with an alcohol or other drug problem than non-"addicted" opposites. Caffeine-"addicted" female students were more likely to report having a parent with an alcohol or other drug problem than the non-"addicted". Irrespective of sex, white students were more likely than black students to report caffeine "addiction".

Completed suicides among adults, based on death certificates, and self-reported suicide attempts among youth constitute very different phenomena. Even if heavy use of caffeine or caffeinated coffee protects against suicide in adults, as found both in the Nurses' Health Study and the Kaiser Permanente Study (Klatsky, Armstrong and Friedman, 1993; Kawchi *et al.*, 1996), it may not automatically protect against suicide attempts by high school students. Indeed, we found no evidence of the latter in our study of Tennessee students. Also, our finding that chronic depression is positively associated with caffeine "addiction" among female high school students runs counter to the finding from a Japanese cross-sectional study that links heavy caffeine use to fewer symptoms of depression among female medical students (Mino *et al.*, 1990). Any such protective effect did not extend to Japanese male medical students. On the other hand, there was no adverse effect.

Among important differences between our study and the three previously mentioned studies (Mino *et al.*, 1990; Klatsky *et al.*, 1993; Kawachi *et al.*, 1996) are the relative youth of our subjects, and our efforts to rule out the possible confounding effects of illicit recreational drug use in impacting mental and physical health. But unlike the Nurses' Health and Kaiser Permanente studies, our study was constrained by the limitations of a cross-sectional design. This design alone precludes any assessment of causation, whether caffeine "addiction" is modeled as an antecedent or outcome variable. Additionally, our study used self-report data only and did not include medical

records as an objective data source on health status. Our data also lacked specificity on caffeine consumption with respect to source and dose.

Self-reported caffeine "addiction" on the part of student respondents obviously does not equate to a clinical diagnosis, and may overstate the magnitude of true addiction. But information bias is a likely compensatory factor, for some members of the comparison group themselves may be "addicted" to caffeine. This would dampen health and welfare differences between respective male and female study and comparison groups. While all self-report data are necessarily subjective, acquisition of frank and valid testimony about caffeine use and abuse from high school subjects should be facilitated by the fact that caffeine use is legal across the age spectrum. Except within a few religious groups, such as Seventh Day Adventists and Mormons, it also is non-stigmatized behavior.

As documented, researchers have linked caffeine use to health problems among adults, primarily females. The findings from this study concerning mental and physical health argue for the wisdom of implementing analytic epidemiologic research on the evolution of caffeine histories in children and youth, and their subsequent relationships to ill-health and addiction to caffeine and other psychoactive drugs.

Specific questions that prospective epidemiologic studies could address include the following:

1. How does caffeine addiction occur, and is there a dose–response relationship?
2. Does caffeine addiction typically precede addiction to other psychoactive drugs? Alternatively expressed, is caffeine a gateway drug?
3. Is caffeine used as a substitute for other psychoactive drugs?
4. Does caffeine act synergistically with other psychoactive drugs in adversely affecting health?
5. What is the shape of the caffeine use and addiction curves across age and other sociodemographic characteristics?
6. Do newborns experience withdrawal symptoms related to maternal caffeine addiction?
7. What sources of caffeine are most likely to be associated with addiction?

Stemming from the epidemiologic notion of population attributable risk, caffeine use and addiction among youth assume public health research importance because of their high prevalence. For although caffeine-related health and welfare risks are predictably smaller than those attributable to alcohol and other psychoactive drug use, the practical significance of these risks is magnified by their ubiquity. Moreover, the appearance of new caffeinated beverages and other caffeinated consumer products that target the young, together with the proliferation of coffee shops, and soda vending machines in schools, accentuate the importance of conducting rigorous longitudinal research on caffeine use and abuse from conception through the end of the human lifespan. Even current knowledge indicates that caffeine poses enough potential health risks to users and the unborn to justify being included by schools as a topic in drug education and awareness programs.

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