

# Energy Drink and Coffee Consumption and Psychopathology Symptoms Among Early Adolescents: Cross-Sectional and Longitudinal Associations

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**Background:** Little is known about possible links between energy drink use and psychopathology among youth. This study examined cross-sectional and longitudinal associations between energy drink consumption and psychopathology among early adolescents. In addition, associations between psychopathology and coffee consumption were examined to assess whether findings were specific to energy drinks or also applied to another commonly used caffeinated beverage.

**Methods:** One hundred forty-four youth who participated in the Camden Youth Development Study (72 males; mean age 11.9 at wave 1; 65% Hispanic, 30% African American) were assessed using self-report measures of frequency of energy drink and coffee consumption and depression, anxiety, conduct disorder (CD) symptoms, and teacher reports of attention-deficit hyperactivity disorder (ADHD). Youth (92%) were reassessed 16 months later.

**Results:** Concurrently, energy drink and coffee consumption were associated with similar psychopathology symptoms; when the other beverage was adjusted for, energy drinks remained associated with CD and coffee remained associated with panic anxiety. Initial energy drink consumption predicted increasing ADHD and CD over time, though the association with CD dropped to a trend level of significance when coffee was adjusted for. Initial levels of hyperactive ADHD predicted increasing coffee consumption over time; this association remained when energy drinks were controlled. Social anxiety was associated with less increase in energy drink consumption over time, controlling for coffee.

**Conclusion:** Energy drink and coffee consumption among early adolescents are concurrently associated with similar psychopathology symptoms. Longitudinally, the associations between these beverages and psychopathology differ, indicating that these substances have differing implications for development over time.

## Introduction

ENERGY DRINK CONSUMPTION in the United States has been growing rapidly,<sup>1,2</sup> and over 30% of adolescents use energy drinks regularly.<sup>3,4</sup> Despite their prevalent use and negative physical health consequences,<sup>5–8</sup> little is known about potential mental health correlates of energy drink consumption among young people. In addition, information regarding possible associations between coffee consumption and symptoms of psychopathology remains sparse. The purpose of this study was to examine how the frequencies of energy drink and coffee consumption relate to symptoms of psychopathology among early

adolescents (defined in this study as approximately ages 11–14), both concurrently and longitudinally.

There are both theoretical and empirical reasons to expect that caffeine consumption may relate to mental health problems among youth. Due to the minimal prior research on correlates of caffeine use among children and adolescents, we include key studies relating to caffeine use in adults in our review to inform our hypotheses. In the studies discussed below, adolescence tended to be defined as age 13–17, and young adulthood as age 18 and older, though there is some inconsistency in these definitions. We first consider caffeine in relation to externalizing behavior, then in relation to internalizing symptoms.

Previous research has indicated that energy drinks appear to be linked to externalizing behavior. Among male college students, energy drink consumption has been shown to be associated with risk-taking behavior<sup>9</sup> and energy drink use may be associated with other substance use among both adolescents<sup>10</sup> and young adults.<sup>11</sup> In addition, energy drinks are frequently combined with alcohol among young adults.<sup>12</sup> If energy drinks are particularly linked to externalizing behavior, it seems possible that consuming them may reflect an underlying predisposition to disinhibition and externalizing disorders.<sup>13</sup>

Other studies have examined caffeine use more generally in relation to externalizing symptoms; a limitation of these studies is that it is unclear whether the results are driven by a particular beverage or apply to all caffeinated beverages equally. A recent study demonstrated cross-sectional associations between caffeine use in adolescence and conduct disorder (CD) symptoms along with violence,<sup>14</sup> and caffeine use among adolescents is associated with sensation-seeking, impulsivity, and risk-taking more generally.<sup>15</sup> In addition, caffeine's likely positive effects on attention, concentration, and memory<sup>16–19</sup> may prompt youth with attention-deficit hyperactivity disorder (ADHD) symptoms to use caffeine; unfortunately research on these associations among children is minimal.<sup>20</sup> Conversely, caffeine withdrawal relates to problems with sustained attention among school-aged children,<sup>21</sup> so regular users may feel they need caffeine to counteract the effects of withdrawal on attention.

Turning to internalizing disorders, caffeine use has been shown to be associated with depression among youth,<sup>22–24</sup> perhaps due to the mood-enhancing effects of caffeine<sup>25–27</sup> (though it is unclear whether these mood-enhancing effects apply to children). Consistent with this, some research has shown that energy drinks specifically can improve mood.<sup>17</sup> In contrast, a person who experiences somatic symptoms of anxiety (e.g., racing heart) may find that large quantities of caffeine increase their experience of these symptoms and they may therefore avoid caffeinated beverages. Partially supporting this notion, caffeine intake may increase anxiety among youth,<sup>21,23</sup> though other research has found anxiety to be unrelated to caffeine use among children and adolescents.<sup>24</sup> Anxiety sensitivity (being attuned to bodily sensations and predisposed to interpret them as threatening) may be related to perceived stimulating and withdrawal effects of caffeine among youth; the increased attunement to withdrawal effects may contribute to greater caffeine intake.<sup>28</sup> In sum, it seems that caffeine use is positively associated with depression, while previous research on anxiety (and anxiety sensitivity, a related construct) is conflicting.

It is unclear whether similar or different associations between caffeine use and internalizing and externalizing psychopathology should be found for different types of caffeinated beverages. If caffeine ingestion itself is re-

sponsible for the associations, then all caffeinated substances should relate to psychopathology similarly, at least to the extent that youth are consuming similar amounts of caffeine. Energy drinks and coffee have broadly similar amounts of caffeine per ounce, while energy shots have more (energy drinks: 2.5–35.7 mg, coffee: 12.8–25 mg, energy shots: 90–171 mg<sup>5</sup>; serving sizes are variable<sup>2,29</sup>). It is not known whether early adolescents typically consume similar or different amounts of caffeine when drinking different caffeinated beverages. There are also reasons to expect different associations between energy drinks and psychopathology, compared to other caffeinated beverages. Energy drinks include other ingredients (e.g., sugar, taurine, ginseng, vitamins, and/or minerals<sup>15</sup>), which may also have physiological effects. In addition, youth may sometimes use alcohol together with energy drinks.<sup>12</sup> Finally, the advertising of energy drinks, whose names often refer to drugs or antisocial behavior (e.g., Cocaine, Blow, Pimp Juice<sup>30</sup>) and whose advertisements often feature extreme sports and risky activities<sup>9</sup> may encourage risk-taking youth to consume them.

Several broad questions remain unanswered: (1) is frequency of caffeine consumption (in any form or in the form of particular substance(s)), related to symptoms of psychopathology among youth, both concurrently and across time? (2) if so, are these associations general across all types of psychopathology, specific to externalizing or internalizing disorders, or specific to certain disorders? (3) Are any associations found specific to the type of drink (energy drinks and/or coffee), or are similar associations found across caffeinated drinks?

To address these questions, we examined cross-sectional and prospective longitudinal associations between frequency of energy drink and coffee consumption and symptoms of psychopathology (depression, panic, generalized anxiety disorder, social anxiety disorder, ADHD, and CD) among early adolescents. Strengths of this study included the examination of these associations prospectively (as called for in recent reviews<sup>3</sup>) and the focus on an under-studied population (primarily Hispanic and African American low-income youth). We followed youth across a key developmental period: the transition to adolescence (approximately ages 11–13), which frequently includes increasing independence from parents (and therefore more control over beverage choices). Although detailed developmental data on the consumption of coffee and energy drinks are lacking, soda consumption increases around ages 11–13<sup>31</sup> and one might expect a similar pattern for other caffeinated beverages.

We examined overall associations between (1) coffee and (2) energy drink consumption and psychopathology symptoms (by conducting separate models for each beverage), and unique associations for each beverage type (by adjusting for the other type of caffeinated beverage in analyses). We expected broad concurrent associations

between energy drink and coffee consumption and CD symptoms, attention problems (ADHD), mood problems (depressive symptoms), and anxiety (specifically somatic symptoms of anxiety, due to the acute physiological effects of caffeine). In addition, based on prior research indicating links between energy drinks and other types of externalizing behavior,<sup>9,10</sup> we expected to find that energy drink consumption predicted increases in CD symptoms over time. Conversely, we considered it possible that ADHD and depressive symptoms would lead to increases in caffeinated beverage consumption over time, as youth may attempt to self-medicate their ADHD symptoms (e.g., difficulty focusing) and/or depressive symptoms (e.g., low energy) with caffeine.

## Materials and Methods

### Participants

Data for this study were drawn from the Camden Youth Development Study, a study of middle-school students. Eighty-eight percent of parents contacted consented to their child's participation, and at each time point, 96% of youth whose parents gave consent provided assent for their own participation. Youth were in sixth or seventh grade at a charter school at the time of their initial participation in the study ( $n = 144$ ; 72 male, 72 female). At this initial assessment, the participants averaged nearly 12 years of age (range = 10–14, mean = 11.9,  $SD = 0.8$ ). According to self-reports, 65% were Hispanic, 30% were African American, 0.6% were Asian, 5% were Native American, 2% were white, and 6% endorsed being from another racial or ethnic category. Among students in these grades at this school, 81% qualified for free lunches (an indicator of low socioeconomic status) and 43% of families received public assistance (not including unemployment or social security benefits).

Youth were followed up for the next 16 months (until they were finishing seventh or eighth grade). The initial and final assessments were used in this study due to minimal change on the variables of interest, and lower participation rates, during the intervening assessments (conducted every 4 months for a total of five assessments). Ninety-two percent of the original participants, plus one youth who did not participate in the initial assessment, participated in this final assessment ( $n = 134$ ; the decrease in sample size was due to students moving and/or transferring out of the school). All teachers (of students whose parents gave consent for their child's participation) consented to fill out questionnaires about their students. This study was approved by the Institutional Review Board (IRB) of Rutgers University.

### Measures

**Self-report measures.** Questionnaires (listed below) were completed by youth in classrooms. One graduate research assistant read the questionnaire aloud and at least

one other research assistant was available to answer questions and assist students.

**Depressive symptoms.** The Mood and Feelings Questionnaire (MFQ<sup>32–34</sup>) was used to assess depressive symptoms that may have occurred in the past 2 weeks. This scale correlates highly with structured interview-based diagnoses of depression and other questionnaire measures of depression.<sup>32,33</sup> Each of the 33 items is scored on a 3-point scale (0 = not true, 1 = sometimes true, 2 = true;  $\alpha = 0.93$ ). At the initial assessment, the range of reported scores was 0–44, with a mean of 12.8 ( $SD = 11.3$ ). At the final assessment, the range was 0–61 and the mean was 10.0 ( $SD = 12.72$ ).

**Anxiety symptoms.** The Screen for Child Anxiety and Related Disorders (SCARED<sup>35–37</sup>) was used to assess anxiety-related symptoms. This questionnaire correlates highly with both structured interview-based assessments and questionnaire measures of anxiety.<sup>37</sup> It has 41 items, each scored on a 3-point scale (0 = not true, 2 = very true). Three subscales were used. Details of the scales were as follows: Panic Disorder or Significant Somatic Symptoms (13 items,  $\alpha = 0.81$ ; initial range = 0–24, mean = 5.5,  $SD = 4.4$ ; final range = 0–23, mean = 4.0,  $SD = 4.9$ ); Generalized Anxiety Disorder (9 items,  $\alpha = 0.71$ ; initial range = 0–16, mean = 6.3,  $SD = 3.6$ ; final range = 0–18, mean = 4.5,  $SD = 4.3$ ); Social Anxiety Disorder (7 items,  $\alpha = 0.74$ ; initial range = 0–14, mean = 6.3,  $SD = 3.1$ ; final range = 0–14, mean = 5.0,  $SD = 3.7$ ).

**CD symptoms.** Self-reports of CD symptoms were collected using a modified version of the Conduct Disorder Rating Scale.<sup>38</sup> This measure correlates highly with diagnostic interview-based assessments of DSM-IV CD and with observer ratings of antisocial behavior.<sup>28</sup> It had 14 items, each scored on a 4-point scale (0 = never, 3 = 5 or more times;  $\alpha = 0.79$ ). At the first assessment, questions were asked on a lifetime basis; at the final assessment, youth were asked about behaviors they had engaged in during the previous 4 months. The resulting scale had an initial mean of 4.6 ( $SD = 4.6$ , range = 0–23); at the final assessment, the mean was 2.5 ( $SD = 3.5$ , range = 0–21).

**Energy drink and coffee consumption.** Frequency of caffeinated drink consumption was assessed using a 5-point scale asking about use in the previous 4 months (“In the past 4 months, how often did you drink...?”): 0 = not in the past 4 months; 1 = at least once in the past 4 months, but less than once per month; 2 = one to three times per month; 3 = one to three times per week; 4 = most days. The question about energy drinks specified “Red Bull, Monster, Rock Star, or other drinks like that”) to ensure that youth interpreted the question as intended. At the initial assessment, mean were as follows: energy

drinks = 0.71 (SD = 1.04); coffee = 1.45 (SD = 1.41). At the final assessment, mean were as follows: energy drinks = 0.98 (SD = 1.20); coffee = 1.40 (SD = 1.40).

**Teacher-report measures.** Teacher questionnaires were completed within 2 weeks of the youth questionnaire administrations.

**ADHD symptoms.** The Child and Adolescent Symptom Inventory-4th edition, Revised (CASI-4R<sup>39</sup>) was used to assess teachers' impressions of youths' ADHD symptoms.<sup>40</sup> The reliability and validity of this scale have been demonstrated in both community and clinical samples.<sup>39</sup> Symptoms of hyperactivity and inattention were examined separately. Each scale had nine items, each scored from 0–3 (0 = never to 3 = very often; inattention alpha = 0.95, hyperactivity alpha = 0.95). The scales had the following initial mean: hyperactivity = 3.83 (SD = 5.90, range = 0–27); inattention = 6.85 (SD = 6.37; range = 0–27) and the following final mean: hyperactivity = 3.21 (SD = 5.34, range = 0–26); inattention = 6.21 (SD = 5.27, range = 0–22).

#### *Statistical analyses*

Three youth were eliminated from these analyses due to concerns about the validity of their answers (they endorsed being only “kind of honest” instead of “totally” or “mostly” honest, or endorsed used of a fake drug). All analyses were adjusted for age (in years; older youth used energy drinks more frequently than younger youth,  $t = 1.95$ ,  $p = 0.05$ ), gender (male/female; men used energy drinks more frequently than women,  $t = -2.37$ ,  $p < 0.05$ ), and race/ethnicity (African American yes/no; non-African American youth consumed coffee more frequently than African American youth,  $t = -2.70$ ,  $p < 0.01$ ). Due to skewness values greater than 1.0, frequencies of energy drink and coffee consumption, and scores on measures of CD symptoms and depressive symptoms, were log-transformed before analyses being conducted (resulting in skewness values less than 1.0).

Cross-sectional associations between energy drink and coffee consumption and symptoms of psychopathology were assessed at the initial assessment using regression analyses. First, each type of psychopathology was included as an independent variable (along with age, gender, and race/ethnicity as control variables) and frequency of use of energy drinks was included as the dependent variable. After a regression for each type of psychopathology was conducted, analogous regressions were conducted using frequency of coffee consumption as the dependent variable. Finally, regressions including the “opposite” type of caffeinated beverage as a covariate were conducted to assess the associations between psychopathology and energy drinks net the effect of coffee, and between psychopathology and coffee net the effect of energy drinks.

Multiple imputation was used to appropriately deal with missing data for the longitudinal analyses. Data were assumed to be missing at random. Complete and incomplete (missing the final assessment) cases did not significantly differ ( $p < 0.05$ ) on any of the demographic, caffeine use, or psychopathology variables examined in this study with one exception: those missing at the final assessment had higher ADHD inattentive scores at the initial assessment ( $t = 2.14$ ,  $p = 0.04$ ). The multiple imputation procedure (PROC MI) in SAS version 9.2 was used. This procedure uses the Markov Chain Monte Carlo (MCMC) method, with the initial estimates derived from the expectation–maximization (EM) algorithm. Forty imputations were conducted, and this SAS procedure takes 100 iterations between imputations (and 200 iterations before the first imputation). The MIANALYZE procedure was then used to combine the results of the analyses of imputations. This procedure computes valid inferences using the parameter estimates and associated standard errors from each imputation.

Longitudinal analyses were conducted in two stages, with the first examining whether initial levels of consumption of caffeinated drinks predicted change in psychopathology symptoms over time and the second examining whether initial levels of psychopathology symptoms predicted change in caffeinated drink consumption over time. First, the associations between initial frequencies of energy drink use and increases in symptoms of psychopathology over the subsequent 16 months were assessed using regression analyses with initial energy drink frequency as the independent variable and final levels of the psychopathology type as the dependent variable, with initial levels of the psychopathology type, age, sex, and race/ethnicity as control variables in the model. Separate regressions were conducted for each type of psychopathology. All regressions were then repeated, using the initial frequency of coffee consumption as the independent variable. Finally, all regressions were repeated using both frequency of energy drink and frequency of coffee consumption as independent variables, to provide estimates of these associations while adjusting for consumption of the other caffeinated beverage.

Second, the associations between initial levels of psychopathology and increases in the frequency of energy drink consumption were assessed using regression analyses with initial levels of the psychopathology type as the independent variable and frequency of energy drink consumption at the final assessment as the dependent variable, with initial frequency of energy drink consumption, age, sex, and race/ethnicity as control variables in the model. Separate regressions were then conducted using frequency of coffee consumption as the predictor variable and each type of psychopathology as the outcome variables. Finally, these regressions were repeated entering the “opposite” caffeinated beverage as a

covariate to provide estimates of each association while controlling for the other caffeinated beverage.

## Results

### Descriptive statistics

At the first assessment, 41% of youth reported having at least one energy drink in the past 4 months and 8% endorsed at least weekly use. Frequency of use increased somewhat over time such that by the last assessment, 50% endorsed having at least one energy drink in the past 4 months and 12% endorsed at least weekly use. Coffee consumption was stable across this time period: 63% and 61%, respectively, reported any use in the past 4 months at the initial and final assessments, while 12% and 11%, respectively, reported at least weekly use at the initial and final assessments. Frequencies of energy drink and coffee consumption were significantly correlated ( $r=0.43$ ,  $p<0.0001$ ).

### Cross-sectional associations between caffeine consumption and symptoms of psychopathology

Results of concurrent regression analyses are presented in Table 1. Overall, frequencies of energy drink and coffee consumption were both related to ADHD inattention, CD, depressive (coffee at a trend level), and panic symptoms. Once the other caffeinated beverage was adjusted for, energy drinks were uniquely associated

with CD and depressive symptoms and coffee was uniquely associated with panic anxiety symptoms.

### Prospective associations between caffeine consumption and change in psychopathology symptoms

As illustrated in Table 2, initial frequency of energy drink consumption predicted increases in CD and ADHD inattentive symptoms over a 16-month period. In contrast, coffee consumption was not associated with increases or decreases in any form of psychopathology. Once the effects of coffee were adjusted, energy drinks were associated with increases in ADHD (both inattentive and hyperactive symptoms), while the association with increases in CD symptoms dropped to a trend level ( $p<0.10$ ).

### Prospective associations between psychopathology symptoms and change in caffeine consumption

As illustrated in Table 3, symptoms of psychopathology did not predict change in the frequency of energy drink consumption over a 16-month period. ADHD hyperactivity symptoms were associated with increases in the frequency of coffee consumption over this 16-month period. Once the other caffeinated substance was adjusted, ADHD hyperactive symptoms continued to predict increases in coffee consumption, while social anxiety was associated with less increase in energy drink consumption.

## Discussion

The results of this study indicate that among early adolescents, the patterns of concurrent association between psychopathology and coffee and energy drink consumption were similar, with each being related to multiple internalizing and externalizing symptoms. Unique associations emerged once the effects of the other caffeinated beverage were adjusted: energy drink consumption was associated with CD and depressive symptoms, while coffee consumption was associated with panic anxiety symptoms. The longitudinal associations between these types of caffeinated beverages and psychopathology differed. Specifically, energy drink consumption at the initial assessment predicted increases in CD and ADHD symptoms over time. Conversely, initial levels of ADHD hyperactivity symptoms predicted later increases in coffee consumption, while social anxiety was protective against increases in energy drink consumption.

The similar cross-sectional associations between energy drink and coffee consumption and symptoms of psychopathology implies that there may be a common factor linking caffeine consumption in young adolescents and psychopathology. This factor could be a characteristic of the individual (such as inadequate sleep) or the family (such as low levels of parental involvement). At the same time, the unique associations that emerged argue for some specificity. It is possible that there are other biological reasons for

TABLE 1. CROSS-SECTIONAL ASSOCIATIONS BETWEEN SYMPTOMS OF PSYCHOPATHOLOGY AND FREQUENCY OF CAFFEINATED DRINK CONSUMPTION

	Overall associations		Unique associations	
	Energy drinks	Coffee	Energy drinks, controlling for coffee	Coffee, controlling for energy drinks
ADHD inattention	0.19*	0.18*	0.12	0.10
ADHD hyperactive	0.09	0.11	0.05	0.07
CD	0.35***	0.24**	0.28***	0.11
Depression	0.21**	0.15 <sup>§</sup>	0.15*	0.07
Panic	0.23**	0.29**	0.13	0.20*
Generalized anxiety	0.07	0.06	0.05	0.03
Social anxiety	-0.14 <sup>§</sup>	-0.05	-0.12	0.01

All models adjusted for age, gender, and race/ethnicity (African American yes/no); those in the right two columns also adjusted for frequency of consumption of the other caffeinated beverage. Standardized parameter estimates (stb) are presented. Data for analyses in this table are from the initial assessment of youth in this study (mean age=11.9).

<sup>§</sup> $p<0.10$ .

\* $p<0.05$ .

\*\* $p<0.01$ .

\*\*\* $p<0.001$ .

ADHD, attention-deficit hyperactivity disorder; CD, conduct disorder.

TABLE 2. INITIAL FREQUENCIES OF CAFFEINATED DRINK CONSUMPTION PREDICTING LATER PSYCHOPATHOLOGY SYMPTOMS

	<i>Follow-up ADHD inattention</i>	<i>Follow-up ADHD hyperactive</i>	<i>Follow-up CD</i>	<i>Follow-up depression</i>	<i>Follow-up panic</i>	<i>Follow-up generalized anxiety</i>	<i>Follow-up social anxiety</i>
Overall associations							
T1 energy drinks	0.17*	0.13 <sup>§</sup>	0.20*	0.08	0.16 <sup>§</sup>	0.08	-0.04
T1 coffee	-0.01	0.00	0.09	0.06	0.06	0.04	-0.04
Unique associations							
T1 energy drinks, controlling for coffee	0.20*	0.20*	0.18 <sup>§</sup>	0.08	0.17 <sup>§</sup>	0.09	-0.02
T1 coffee, controlling for energy drinks	-0.08	-0.07	0.03	0.04	0.00	0.00	-0.03

Models are adjusted for age, gender, race/ethnicity, and initial levels of the psychopathology type. The bottom two rows also adjusted for the frequency of use of the other type of caffeinated beverage. Standardized parameter estimates (stb) are presented.

<sup>§</sup>*p* < 0.10.

\**p* < 0.05.

T1, time 1 (i.e., the initial assessment); Follow-up, the follow-up assessment 16 months after the initial assessment.

these differences, such as differing amounts of caffeine that may be ingested when different drinks are consumed and/or the non-caffeine ingredients in energy drinks. There also may be environmental reasons that youth choose one beverage over the other. Specifically, the marketing of energy drinks presents them as “edgy” and associated with risk-taking and/or antisocial behavior. Therefore, youth with predispositions toward externalizing behavior<sup>13</sup> might be drawn to energy drinks more than coffee. There is limited information available about the reasons that youth use caffeine, and that which is available is not specific to certain beverages<sup>41</sup>; future research would be useful in helping us understand how youth make decisions regarding the consumption of different beverages.

The contrast between the broad concurrent associations found and the relatively fewer longitudinal associations found implies that most links between caffeine and psychopathology are occurring around the same time. For example, youth may consume energy drinks to cope with

depressive symptoms that they are experiencing, but depression may not put them at risk for future energy drink use, and energy drink use may not put them at risk for future depressive symptoms.

The longitudinal association between energy drink consumption and later increases in ADHD and CD symptoms could be explained by common factors (e.g., an underlying predisposition to sensation-seeking), or by energy drinks contributing to risk for ADHD and/or conduct-disordered behavior (either directly, perhaps by altering the brain’s reward system,<sup>42,43</sup> or indirectly, such as by increasing risk for association with antisocial peers). Either way, energy drink consumption should be considered a risk marker for the development of externalizing behavior among early adolescents.

The longitudinal association between ADHD hyperactive symptoms and later frequency of coffee consumption could be due to self-medication of ADHD symptoms. Caffeine increases sustained attention, at least

TABLE 3. INITIAL LEVELS OF PSYCHOPATHOLOGY SYMPTOMS PREDICTING LATER FREQUENCIES OF CAFFEINATED DRINK CONSUMPTION

	<i>Overall associations</i>		<i>Unique associations</i>	
	<i>Follow-up energy drinks</i>	<i>Follow-up coffee</i>	<i>Follow-up energy drinks, controlling for T1 coffee</i>	<i>Follow-up coffee, controlling for T1 energy drinks</i>
T1 ADHD inattention	0.13 <sup>§</sup>	0.13 <sup>§</sup>	0.12 <sup>§</sup>	0.13 <sup>§</sup>
T1 ADHD hyperactive	-0.01	0.16*	-0.01	0.16*
T1 CD	-0.07	-0.08	-0.08	-0.09
T1 depression	0.07	0.03	0.05	0.03
T1 panic	0.10	0.02	0.05	0.00
T1 generalized anxiety	0.01	-0.11	0.00	-0.12
T1 social anxiety	-0.13 <sup>§</sup>	-0.05	-0.14*	-0.04

Models are adjusted for age, gender, race/ethnicity, and initial levels of the psychopathology type. The right two columns also adjust for frequency of use of the other type of caffeinated beverage. Standardized parameter estimates (stb) are presented.

<sup>§</sup>*p* < 0.10.

\**p* < 0.05.

among young adults.<sup>44</sup> The finding that social anxiety symptoms were protective against increases in energy drink use over time (once coffee consumption was controlled for) may indicate that youth who avoid certain social settings (as many socially anxious youth do) may be somewhat protected against use of energy drinks; future research examining this hypothesis as well as other possible explanations for this finding would be useful.

This study is unique in its longitudinal examination of two forms of caffeine use and symptoms of psychopathology among early adolescents. However, it has limitations. We do not have information on the exact caffeine content of each drink. Energy drinks frequently contain active ingredients other than caffeine,<sup>15,42</sup> so correlates of these beverages could be due to these ingredients. We were not able to differentiate between energy drinks and energy shots (which have differing caffeine concentrations<sup>4</sup>), though some other studies that do differentiate between these beverage types end up combining them in analyses.<sup>43</sup> Our measure of energy drink and coffee use was retrospective and was not validated using other methods (e.g., daily diaries of consumption). This type of methodology is standard in studies of adolescent alcohol and other substance consumption (e.g., the Monitoring the Future study inquires about past-year and past-30-days use<sup>3,43</sup>) and generally valid.<sup>44</sup> The timeline for questions about caffeine consumption and CD symptoms (past 4 months) was used because it corresponded to the time since the prior (intermediate) assessment. We enhanced recall by providing anchors for this time frame at several points in the questionnaire (e.g., “Think about what has happened in the past 4 months, since fall, when this school year started”). We utilized a single informant for each construct; future research including additional informants would provide an interesting angle on the questions addressed in this study. Because of the multiple analyses conducted and possible resulting Type I error inflation, it is possible that some effects were found due to chance. Finally, we did not assess caffeine dependence in these participants. Caffeine’s effects may differ depending on whether an individual is dependent on it.<sup>21</sup>

## Conclusions

The results of this study indicate that energy drink consumption is a risk marker for a broad array of concurrent psychopathology symptoms and increasing ADHD and CD symptoms over time. Although similar concurrent associations were found for coffee consumption, it did not predict increasing psychopathology over time but instead, ADHD symptoms predicted increasing coffee consumption over time. Therefore, there are associations with psychopathology that are common to these caffeinated beverages as well as associations that are unique to each beverage. Future research examining the mecha-

nisms behind these associations and the unique and common characteristics and correlates of energy drink and coffee consumption among young adolescents would improve our understanding of the links between youths’ consumption of caffeinated beverages and their psychological and behavioral well-being. In particular, research investigating the mechanisms by which consuming energy drinks predicts increasing ADHD and CD symptoms over time would be warranted, as this may provide information that could lead to the development of interventions for high-risk youth.

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## Author Disclosure Statement

No competing financial interests exist.

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