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The Relationships between Addiction to Highly Caffeinated Drinks, Burnout, and Attention-Deficit/Hyperactivity Disorder

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Objectives: This study aimed to evaluate the addiction to highly caffeinated drinks among university students, and we investigated the relationships between smartphone addiction, depression, anxiety, attention-deficit/hyperactivity disorder (ADHD), burnout, self-esteem, impulsiveness in high caffeine drink addiction risk group (high caffeine group). We also compared these mental health factors differences between the high caffeine group and the control group; and, investigated the relative risk between the independent variables of the high caffeine group.
Methods: This study was conducted in Korea, from June 2015 to July 2016. A set of questionnaires was administered on 511 college students.
Results: The participants who belonged to the high caffeine group were more likely to demonstrate the symptoms of ADHD and higher levels of burnout and impulsiveness. Further, the results of logistic regression analysis confirmed the association between the high caffeine group and burnout.
Conclusion: These behaviors among university students addicted to highly caffeinated drinks suggests the need for timely and effective interventions for those at risk of addiction.

Key Words: Caffeine addiction; Depression; Attention-deficit/hyperactivity disorder; Burnout; Impulsiveness.

INTRODUCTION

In recent times, highly caffeinated drinks, which are marketed as beverages that can alleviate fatigue and provide stimulation, have become popular among and are abused by teenagers and young adults [1]. In addition, some young adults consume a mixture of highly caffeinated drinks and other sports drinks to hasten the effects of highly caffeinated drinks. They may also mix highly caffeinated drinks and alcohol to create cocktails. In a survey that was conducted among 300 college students in 2014, 68.7% of the students reported that they had consumed highly caffeinated energy drinks [2]. A highly caffeinated drink is a beverage that contains more than 0.15 mg of caffeine per mL [3]. Quintessential highly caffeinated drinks such as Burn Intense (250 mL), Red Bull (250 mL),

and Hot Six (250 mL) contain 30 mg, 63 mg, and 60 mg of caffeine, respectively [1].

In general, the intake of small amounts of caffeine can temporarily alleviate mild fatigue and boredom, and provide stimulation with almost no harmful effects. However, the excessive or continuous consumption of caffeine can cause psychological and physical side effects. In a study that was conducted in Seoul, college students reported that the most frequent side effect of consuming energy drinks is an abnormal heart rate/rhythm. Further, they reported that addiction was the most significant problem that was associated with the consumption of energy drinks [4]. Gunja and Brown [5] reported that an accelerated heart rate, agitation, and gastrointestinal disturbances are common side effects of consuming highly caffeinated drinks and that caffeine addiction is becoming more prevalent, especially among young adults.

Kendler et al. [6] reported that an addiction to highly caffeinated energy drinks is significantly correlated with depres-

sion. Park et al. [7] reported that students who did not consume highly caffeinated energy drinks had a 24.7% probability of experiencing depression. Further, 54.9% of the students who consumed these drinks more than 5 times a week experienced depression. This suggests that highly frequent consumption of highly caffeinated drinks is associated with a higher likelihood of experiencing depression. In one study that was conducted among college students, the consumption of energy drinks was significantly correlated with the symptoms of anxiety [8].

In a study that was conducted among elementary school students in Korea, those with attention-deficit/hyperactivity disorder (ADHD) consumed higher levels of caffeine than normal controls [9]. Similarly, Martin et al. [10] found that high levels of caffeine intake are correlated with the symptoms of ADHD and conduct disorder, and smoking and aggressive behaviors. Kendler et al. [6] found that excessive caffeine intake is associated with greater risk of developing an externalizing disorder [odds ratio (OR) 1.94−2.34] rather than an internalizing disorder (OR 1.50−1.79). Heinz et al. [11] found that the habitual intake of caffeinated alcoholic beverages is positively correlated with impulsivity and risk behaviors. Evren and Evren [12] also reported positive correlations between the consumption of energy drinks, self-injurious behaviors, and suicidal impulses. On the other hand, caffeine addiction is a substance addiction, and multiple addictions can simultaneously coexist as comorbidities. Indeed, it has been reported that addiction to substances such as caffeine and cigarettes are correlated with behavioral addictions (e.g., addiction to smartphones, internet, gambling, and eating). The number of studies of smartphone addiction is continuously increasing; however, only a few studies have examined the phenomenon of coexisting substance and behavioral addictions. In a study that was conducted among medical students, the consumption of energy drinks was significantly correlated with burnout [13]. Another experimental study found that the consumption of energy drinks can greatly increase burnout during marathons by increasing concentration, energy, and decreasing fatigue [14]. In another study, intake of highly caffeinated drinks was related to self-esteem [15]. Addiction to highly caffeinated drinks is also a risk factor for obesity, and addiction to energy drinks is positively correlated with marijuana use, sexual risk behaviors, fighting, failure to wear a seatbelt, reckless risk behaviors, smoking, drinking, and illegal drug use among Caucasians [16,17].

The present study had four objectives: 1) to examine addiction to highly caffeinated drinks among college students; 2) to investigate the relationship that addiction to highly caffeinated drinks shares with smartphone addiction, depression, anxiety, symptoms of ADHD, burnout, self-esteem, and

impulsiveness; 3) to compare the differences in mental health characteristics between individuals who are at high risk for addiction to highly caffeinated drinks and individuals in the control group; and 4) to investigate the relative risk of the various variables in the high caffeine drink addiction risk group.

METHODS

Subjects

This study was conducted from June 2015 to July 2016 among 511 college students who agreed to participate in the survey after they were briefed about the purpose of the study. Basic demographic information (e.g., age, sex, academic achievements) were collected from the participants. This random sample of participants was recruited from various departments of a university that is located in Cheonan. Participants who consumed one or more highly caffeinated drinks per week were assigned to the high caffeine drink addiction risk group or the high caffeine group (i.e., individuals who were at risk for addiction to highly caffeinated drinks) and the others were assigned to the control group. In a previous research study that used data that were collected by the Ministry of Gender Equality and Family to examine the frequency of consumption of highly caffeinated drinks among Korean high school students, 14.7% of the students reported that they had consumed highly caffeinated drinks once or twice a week. This is similar to the percentage (17.6%) of participants who were assigned to the high caffeine group [18]. Informed consent was obtained from all the participants, and the research method of the present study was reviewed and approved by Dankook University Ethics Committee (DK-2017-02-004).

Procedure

After the participants provided written informed consent, they responded to an ethically approved and individually administered questionnaire. We requested the participants complete the surveys within or near a university campus or around bus stops.

Measures

The epidemiology and consumption of highly caffeinated drinks

Each student responded to a questionnaire that consisted of items that required information about their sex, age, grade, recent academic achievements, types of highly caffeinated drinks that they consumed, and their frequency of consumption.

Korean Adult Attention-Deficit/Hyperactivity Disorder Scale

The Adult Attention-Deficit/Hyperactivity Disorder Scale (AADHDS) is a self-report assessment that has been developed by Murphy and Barkley [19] based on the Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) [20] diagnostic criteria for ADHD in adults. This 18-item scale is a valid measure that can differentiate between adults with and without ADHD. It is designed to effectively differentiate between three subtypes of ADHD: predominantly inattentive, predominantly hyperactive-impulsive, and combined (i.e., hyperactive-impulsive and inattentive). The Korean standardization of this assessment (K-AADHDS) was undertaken by Kim [21]. The internal consistency (Cronbach's α) of this scale was 0.80 in the present study. The internal consistency coefficients (Cronbach's α) were 0.84, 0.80, and 0.80 for the inattentiveness, hyperactivity, and impulsiveness subscales, respectively.

Korean Smartphone Addiction Scale

The Korean Smartphone Addiction Scale (KSAS) was developed in 2011 by the National Information Society Agency to measure smartphone addiction and use. It was developed based on the Internet Addiction Scale and Cellular Phone Addiction Scale [22]. The KSAS, which has been designed for use with adults, consists of a total of 15 questions. Five questions assess difficulties with daily activities, two questions assess the pursuit of a virtual world, four questions assess withdrawal, and four questions assess tolerance. Responses are recorded on a four-point scale, and the composite score can range from 15 to 60 points. In a study of 3230 adults, by the National Information Society Agency, the high caffeine group accounted for 1.0%, and the potential risk group for 6.7%, for a total of 7.7% in the addiction group. The internal consistency (Cronbach's α) of this scale was 0.81 in the original validation study and 0.89 in this study.

Beck Depression Inventory

This Beck Depression Inventory (BDI) was developed to measure depression in adults, and it is widely used around the world. It consists of 21 items that assess the cognitive, emotional, and physical symptoms of depression. Respondents are required to choose one of several sentences that differentially describe the severity of a symptom. Such a response method is more advantageous than Likert scales, which can confuse respondents by requiring them to quantify their psychological states. Scores that are assigned to the responses can range from 0 to 3 for each item. Higher scores are indicative of a greater severity of depression. Lee and Song [23] translated the BDI in Korea. The CRESCEND study es-

tablished that scores of 10−15 were indicative of a mild depressive state, 16−23 of a moderate depressive state, and 24−63 of a severe depressive state. The internal consistency (Cronbach's α) of this scale was 0.89 in their study [23] and 0.89 in the present study.

Beck Anxiety Inventory

The Beck Anxiety Inventory (BAI) is a useful measure of clinical anxiety. It can be used to measure anxiety among adults who have never been diagnosed with a psychiatric disorder. It has been translated into Korean by Yook and Kim [24]. The internal consistency of the Korean version of the BAI was found to be 0.91. Scores that lie between 22 and 26, and 27 and 31 are indicative of mildly and considerably high levels of anxiety; scores that are equal to or higher than 32 are indicative of extremely high levels of anxiety. The internal consistency (Cronbach's α) of this scale was 0.82 in this study.

Maslach Burnout Inventory

The Maslach Burnout Inventory (MBI) consists of items that assess emotional exhaustion, depersonalization, and a perceived lack of personal accomplishment. Kang and Kim [25] reported an internal consistency coefficient (Cronbach's α) of 0.85 for a Korean sample. Each of the 22 items are to be rated on a scale that ranges from 0 to 6. Higher scores are indicative of higher levels of burnout. According to the Official Manual of Manual Worker, scores that are equal to or higher than 27 points are indicative of emotional exhaustion. The internal consistency (Cronbach's α) of this scale was 0.84 in the present study.

Rosenberg's Self-Esteem Scale

The Rosenberg's Self-Esteem Scale (RSE) measures self-esteem. The inventory was adapted by Lee [26] for use with Korean samples. This self-report assessment consists of a total of 10 questions (five questions are positively worded, and five questions are negatively worded). Each item can receive a score that ranges from 0 to 3 points, and the total score can range from 0 to 30 points. The internal consistency (Cronbach's α) of this scale was 0.88 in this study.

Barratt Impulsiveness Scale

The Barratt Impulsiveness Scale (BIS) was developed to measure of impulsiveness. Lee [27] adapted it to the Korean context. It consists of 23 questions and three subordinate factors: six questions measure cognitive impulsiveness, eight questions measure motor impulsiveness, and nine questions measure non-planning impulsiveness. Responses are recorded on a four-point Likert-type scale that ranges from "It never does" (1 point) to "It always does" (4 points). Higher scores are in-

dicative of higher levels of impulsiveness. The internal consistency (Cronbach's α) of this scale was 0.82 in the Korean validation study and 0.81 in the present study.

Data analysis

We used the Statistical Package for the Social Sciences (SPSS) 24 software (IBM Corp., Armonk, NY, USA). We conducted t-tests and chi-squared tests to examine age and sex differences in epidemiologic variable. Finally, through correlation analysis, we investigated the relationship between addiction to highly caffeinated drinks and mental health indicators. Analysis of covariance (ANCOVA) was used to examine differences in the symptoms of ADHD, smartphone addiction, depression, anxiety, burnout, impulsiveness, and self-esteem between the high caffeine and control groups. Additionally, logistic regression analysis was used to examine the relative risk that each of these variables entailed. Results with a p-value that is less than 0.05 were considered statistically significant.

Table 1. Epidemiological characteristics between high caffeine group and comparison group

	High caffeine group (n=92)*	Control group (n=419)	t or χ^2	p value
Age (yr)	22.74±5.60	22.96±7.36	-0.26	0.792
Sex			6.56[†]	0.001
Women	38 (41.3)	239 (57.0)		
Men	52 (56.5)	180 (43.0)		
Economic status[‡]			0.36	0.840
Low	6 (6.5)	30 (7.4)		
Middle	40 (43.4)	169 (41.5)		
High	43 (46.7)	208 (51.1)		

Data represent mean±standard deviation, by independent t-test, or n (%), by chi-square test. *high caffeine group: high caffeine drinking addiction risk group, [†]p<0.01, [‡]low: below 2000000 KRW/month, middle: 2000000−4000000 KRW/month, high: above 4000000 KRW/month

RESULTS

Demographic characteristics of the participants

The sample consisted of 511 men (n=234, 45.7%) and women (n=278, 54.3%). A total of 92 (18.0%) participants belonged to the high caffeine group (men: n=52, 56.5%; women: n=38, 41.3%). The control group consisted of 180 (43.0%) men and 239 (57.0%) women. There was a significant difference in the sex ratios of the two groups (χ^2=6.56, p<0.01). The mean ages of the participants who belonged to the high caffeine and control groups were 22.74±5.60 years and 22.96±7.36 years, respectively. There was no significant age difference between the two groups (Table 1).

Correlations between the high caffeine group, smartphone addiction, depression, anxiety, ADHD, burnout, self-esteem, and impulsiveness

Depression (r=0.108, p<0.05) and burnout (r=0.128, p<0.01) were positively correlated with the high caffeine group. Although the p-value is significant, the magnitude of the correlation coefficient is small, meaning although the correlation is significant between the two factors, it is not a strong relationship. In addition, depression, anxiety, ADHD, burnout, and impulsiveness were positively inter-correlated. Self-esteem was negatively correlated with variables such as smartphone addiction (r=-0.262, p<0.01), depression (r=-0.267, p<0.01), anxiety (r=-0.583, p<0.01), ADHD (r=-0.270, p<0.01), burnout (r=-0.529, p<0.01), and impulsiveness (r=-0.412, p<0.01) (Table 2).

Comparison of the high caffeine and control groups

The high caffeine and control groups obtained total scores of 32.88±0.80 and 32.15±0.37 on the KSAS, respectively. The mean difference was nonsignificant. The high caffeine and control groups obtained total scores of 9.56±0.79 and 8.13±0.37 on the BDI, respectively; the mean difference was non-

Table 2. Correlation coefficient of high caffeine, smartphone addiction, depression, anxiety, ADHD, exhaustion, impulsivity and self-esteem of life of high caffeine group and control group

	1	2	3	4	5	6	7	8
1. High caffeine								
2. KSAS	-0.008							
3. BDI	0.108*	0.349[†]						
4. BAI	0.051	0.242[†]	0.377[†]					
5. K-AADHDS	0.038	0.204[†]	0.446[†]	0.522[†]				
6. MBI	0.128[†]	0.271[†]	0.366[†]	0.515[†]	0.386[†]			
7. RSE	-0.038	-0.262[†]	-0.267[†]	-0.583[†]	-0.270[†]	-0.529[†]		
8. BIS	0.075	0.312[†]	0.538[†]	0.316[†]	0.311[†]	0.380[†]	-0.412[†]	

Data present correlation coefficient by a correlation analysis. *p<0.05, [†]p<0.01. BAI: Beck Anxiety Inventory, BDI: Beck Depression Inventory, BIS: Barratt Impulsiveness Scale, High caffeine: high caffeine addiction risk group, K-AADHDS: Korean Adult Attention-Deficit/Hyperactivity Disorder Scale, KSAS: Korean Smartphone Addiction Scale, MBI: Maslach Burnout Inventory, RSE: Rosenberg's Self-Esteem Scale

significant. The high-risk and control groups obtained total scores of 8.20±0.88 and 6.96±0.41 on the BAI, respectively. The mean difference was nonsignificant.

The high caffeine and control groups obtained total scores of 30.24±0.84 and 27.79±0.39 on the K-AADHDS, respectively; the mean difference was significant (F=7.03, p<0.01). The high caffeine and control groups obtained total scores of 15.44±0.45 and 14.48±0.21 on the inattentiveness subscale of the K-AADHDS, respectively; the mean difference was non-significant. The high caffeine and control groups obtained total scores of 14.80±0.45 and 13.31±0.21 on the hyperactivity subscale of the K-AADHDS, respectively; the mean difference was significant (F=8.92, p<0.01).

The high caffeine and control groups obtained total scores of 66.06±2.05 and 59.08±0.95 on the MBI, respectively; the mean difference was significant (F=9.49, p<0.01). The high caffeine and control groups obtained total scores of 28.55±0.56 and 29.41±0.26 on the RSE, respectively; the mean difference was nonsignificant. The high caffeine and control groups obtained total scores of 53.74±0.98 and 51.30±0.45 on the BIS, respectively; the mean difference was significant (F=5.12, p<0.05) (Table 3).

Logistic regression analysis of mental health characteristics associated with the highly caffeinated drinks

In the logistic regression model that included the high caffeine and control group, the relative risk of burnout was 2.70 times higher (95% confidence interval=1.51−4.80), and this result was statistically significant (χ^2=11.335, p<0.01). The risk was 1.97 times higher among men than among women (95% confidence interval=1.21−3.21), and this result was also statistically significant (χ^2=7.336, p<0.01) (Table 4).

DISCUSSION

This study provides empirical evidence about the status of addiction to highly caffeinated drinks and associated indicators of mental health. In this study, which was conducted among college students, 48.8% of the participants reported that they had consumed a highly caffeinated drink at least once. Among them, 17.6% consumed more than one can per week, and 2.8% consumed more than one can per day. These results are similar to the statistics that were released by the Ministry of Gender Equality and Family in 2019. Specifically, they reported that 14.7% of high school students consume more than one can of a highly caffeinated drink per week and that 5.6% of high school students consume more than one can of a highly caffeinated drink per day. "There was a significant sex difference in the consumption of highly caffeinated drinks" This result is consistent with Park et al. [7] reported that men are significantly more likely to consume highly caffeinated energy drinks than women. This suggests that men prefer and consume highly caffeinated drinks to a greater extent than women. Advertisements for highly caffeinated drinks utilize terms such as "power" and "energy"; therefore, due to

Table 3. Score of smartphone addiction, depression, anxiety, ADHD, exhaustion, impulsivity, self-esteem of high caffeine group and control group

Rating scale	High caffeine group (n=92)	Control group (n=419)	F	p value
KSAS	32.88±0.80	32.15±0.37	0.68	0.410
Disability of daily living	11.33±0.31	11.34±0.14	0.001	0.980
Virtual world orientation	3.34±0.12	3.08±0.05	4.15*	0.040
Prohibition	8.40±0.26	8.04±0.12	1.52	0.220
Tolerance	9.82±0.26	9.70±0.12	0.19	0.660
BDI	9.56±0.79	8.13±0.37	2.70	0.100
BAI	8.20±0.88	6.96±0.41	1.64	0.200
K-AADHDS	30.24±0.84	27.79±0.39	7.03†	0.008
Inattention	15.44±0.45	14.48±0.21	3.70	0.055
Hyperactivity	14.80±0.45	13.31±0.21	8.92†	0.003
MBI	66.06±2.05	59.08±0.95	9.49†	0.002
RSE	28.55±0.56	29.41±0.26	1.97	0.160
BIS	53.74±0.98	51.30±0.45	5.12*	0.020
Recognition	14.98±0.28	14.33±0.13	4.52*	0.030
Exercise	18.15±0.48	17.02±0.22	4.52*	0.030
Unplanned	20.61±0.44	19.95±0.20	1.86	0.170

Data represent mean±standard deviation, ANCOVA adjusted for sex by general linear model. *p<0.05, †p<0.01. BAI: Beck Anxiety Inventory, BDI: Beck Depression Inventory, BIS: Barratt Impulsiveness Scale, F: female, K-AADHDS: Korean Adult Attention-Deficit/Hyperactivity Disorder Scale, KSAS: Korean Smartphone Addiction Scale, RSE: Rosenberg's Self-Esteem Scale

Table 4. Logistic regression analysis of mental health characteristics associated with the highly caffeinated drinks

Variables	Parameter stimate	Standard error	χ^2	p value	Odds ratio (95% confidence interval)
KSAS	-0.034	0.288	0.014	0.905	0.97 (0.55−1.70)
BDI	0.088	0.334	0.070	0.792	1.09 (0.57−2.10)
BAI	0.327	0.308	1.128	0.288	1.39 (0.76−2.54)
K-AADHDS	-0.093	0.299	0.097	0.755	0.91 (0.51−1.64)
MBI	0.992	0.295	11.335	0.001	2.70 (1.51−4.80)*
RSE	-0.356	0.315	1.277	0.258	0.70 (0.38−1.30)
BIS	0.080	0.295	0.074	0.785	1.08 (0.61−1.93)
Sex	0.676	0.250	7.336	0.007	1.97 (1.21−3.21)*

*$p < 0.01$. BAI: Beck Anxiety Inventory, BDI: Beck Depression Inventory, BIS: Barratt Impulsiveness Scale, K-AADHDS: Korean Adult Attention-Deficit/Hyperactivity Disorder Scale, KSAS: Korean Smartphone Addiction Scale, RSE: Rosenberg's Self-Esteem Scale

their implicit association with physical activity, these products may be more appealing to men than to women.

In this section, the important results of the study are summarized, and possible explanations for the findings are discussed. First, burnout is moderately related to addiction to highly caffeinated drinks. Accordingly, in the present study, there was a significant difference in the scores that the high caffeine and control groups obtained on the measure of burnout. Thus, these results indicate that the high caffeine group is associated with burnout. The factors that motivate college students to consume highly caffeinated drinks are primarily academic in nature [28]. Therefore, it can be suggested that academic factors are moderately related to the consumption of highly caffeinated drinks among college students. In particular, the results of the logistic regression analysis showed that there was a positive relationship between burnout and high caffeine group. This indicates that people with high levels of stress exhibit the symptoms of burnout. Consequently, they may frequently consume highly caffeinated drinks to alleviate their fatigue and sleepiness.

Second, addiction to highly caffeinated drinks is associated with externalizing disorders such as ADHD and variable such as impulsiveness. In this study, the high caffeine and control groups differed significantly in their symptoms of ADHD. This suggests that individuals with greater symptoms of ADHD are more likely to consume highly caffeinated drinks. This result is similar to past findings that the amount of caffeine that was consumed by upper elementary students with ADHD was 1.6 times higher than what was consumed by their normal counterparts. Similarly, teenagers with ADHD also consume twice as many caffeinated drinks as their normal counterparts [9,29]. In addition, the results of the present study are also consistent with past findings that excessive caffeine intake increases the risk of developing externalizing rather than internalizing disorders. This indicates that the effect of caffeine on the body may be more easily exhibited by externalizing rather than internalizing symptoms [6]. The con-

sumption of highly caffeinated drinks may temporarily enhance concentration, but prolonged consumption can lead to negative consequences such as memory impairment. In other words, the results of this study suggest that addiction to highly caffeinated drinks is related to ADHD and that it can consequently affect the concentration circuits in the brain.

In this study, the high caffeine and control groups differed significantly on impulsiveness. This suggests that higher levels of impulsiveness are associated with a greater likelihood of consuming highly caffeinated drinks. Since impulsiveness is characterized by a preference for immediate and stimulating rewards, it may be linked to a tendency to impulsively consume reactive stimulants such as highly caffeinated drinks.

Third, the present findings suggest that an addiction to highly caffeinated drinks is unrelated to emotional factors such as depression, anxiety, and low self-esteem. The high caffeine and control groups did not differ in their levels of depression. Although burnout was strongly related to depression in previous studies, group differences in this study were not significant [30]. When compared to depression, chronic fatigue or burnout has stronger implications for social functioning and weaker implications for emotional functioning [31]. Therefore, people who consume highly caffeinated drinks may be more likely to exhibit difficulties in social functioning (e.g., physical functions and vitality) rather than emotional functioning. The high caffeine and control groups did not differ in their levels of anxiety; this result contradicts past findings [32].

The present study has a few limitations. First, the study variables were measured using self-report questionnaires; therefore, the measurements may have entailed a false negative or positive bias. Although it was important to control the confounding influence of demographic factors (e.g., socioeconomic status, period of education) on the findings, the data that were collected were insufficient to conduct these analyses. Second, as this was a cross-sectional study, this study was not able to present a causal relationship between the comparison

group and the control group; hence, we only presented the relationship between the high caffeine drink addiction risk group, ADHD, burnout, and impulsiveness. Third, this study focused only on students who were living within the local community. Specifically, this study was conducted in a new town that has a population of more than 500000 people. Thus, the sample may not have been representative of diverse local communities. Fourth, high caffeine group was predicated upon consumption of more than one can of a highly caffeinated drink per week. However, a wide range of criteria have been used in different studies. We used the aforementioned criteria based on the data that have been released by the Ministry of Gender Equality and Family of Korea. The size of the high-risk group was small. Future studies should use larger samples to overcome this limitation. Despite these limitations, this study meaningfully examined the relationship between the consumption of highly caffeinated drinks and indicators of mental health among Korean college students. In the present study, the mental health of individuals who consume highly caffeinated drinks was assessed using universally validated measures of related constructs. Future studies should aim to address the many limitations of the present study and examine addiction to highly caffeinated drinks after controlling for potential confounds (e.g., sex, socioeconomic status, regional distribution).

CONCLUSION

In this study, the high caffeine group was at risk for burnout, ADHD, and impulsiveness; therefore, there is a need for effective evaluation and treatment for ADHD, burnout, and impulsiveness among adults who abuse highly caffeinated drinks.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: Eun Ju Bae, Eun Bi Kim, Bo Ram Choi, Myung Ho Lim. Data curation: Eun Ju Bae, Eun Bi Kim, Bo Ram Choi, Myung Ho Lim. Formal analysis: Eun Ju Bae, Myung Ho Lim. Investigation: Eun Ju Bae, Eun Bi Kim, Bo Ram Choi, Sun Ho Won, Ji Hwan Kim, Sun Min Kim, Hyun Jeong Yoo, Sung Man Bae, Myung Ho Lim. Methodology: Eun Ju Bae, Sung Man Bae, Myung Ho Lim. Project administration: Myung Ho Lim. Supervision: Sung Man Bae, Myung Ho Lim. Validation: Myung Ho Lim. Visualization: Eun Ju Bae. Writing—original draft: Eun Ju Bae. Writing—review & editing: Myung Ho Lim.

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