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Comparative Study of Middle and High School Students on the Relationship between High-Caffeine Drinks and Mental Health

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ABSTRACT

Background: This study aim to compare between middle and high school students on the relationship of high-caffeine drinks and mental health.

Methods: This national cross-sectional secondary study used data from the 20th Korea Youth Risk Behavior Survey (2024). The respondents of this study were 54,653 middle and high school students. Descriptive statistics, chi-square analysis, and complex sample logistic regression analysis were performed using IBM SPSS Statistics 25.0.

Results: Respondents of 'much' perceived stress consumed 1.493 times ($P<0.001$) more high-caffeine drinks in middle school and 1.699 times ($P<0.001$) in high school than those of 'little.' Respondents of 'yes' sadness & despair consumed 1.189 times ($P<0.001$) more high-caffeine drinks in middle school and consumed 1.142 times ($P<0.001$) in high school than those of 'no.' Suicidal ideation and loneliness variables were statistically significant in middle school, but not in high school.

Conclusions: It was concluded that middle and high school students who were more stressed and experienced sadness & despair consumed more high-caffeine drinks. However, only middle school students who experienced suicidal ideation and loneliness consumed more high-caffeine drinks. Recognizing each characteristic of middle and high school students, tailored intervention program should be developed based on the community and school.

Keywords: Mental health, Caffeine, Middle school, High school

INTRODUCTION

Caffeine is a central nervous system stimulant and has been consumed worldwide for a long time as food supplements [1]. High-caffeine drinks contain large amounts of caffeine, taurine, etc., and are widely consumed by adolescents for reasons such as increased energy and concentration, awakening effects, and athletic performance [2]. The Ministry of Food and Drug Safety [3] recommends that adolescents consume no more than 2.5 mg

of caffeine per kg of body weight per day. There are concerns that adolescents' recommended daily caffeine intake may easily be exceeded when combined with multiple caffeinated drinks or foods. As it is known that high-caffeine drinks are effective in temporarily relieving fatigue, increasing physical activity, and relieving stress, their consumption is increasing, especially among adolescents [2,4]. According to the results of the Korea Youth Risk Behavior Survey (KYRBS) targeting middle and high school students in Korea, the consumption of high-caffeine

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drinks increased from 28.4% in 2022 to 31.5% in 2024 [5]. Despite of side effects such as heart palpitations and sleep disturbances, the consumption of high-caffeine drinks by adolescents is increasing every year [6]. Students in middle adolescence, including middle and high school students, is a developmental transition period from childhood to adult and they experienced physical and mental changes in this period. The social environment contains various factors that threaten mental health, such as stress and anxiety, so adolescents face many difficulties in adapting to changes in the social environment [7,8]. According to the results of the KYRBS, the rate of youth's perceived stress, depression, and loneliness experiences is expected to increase in 2024 compared to 2023 [6]. Mental health in middle and high school affects adulthood, so it is very important to manage it not only on an individual but also at a policy level. Adolescents are likely to consume excessive amounts of high-caffeine drinks for curiosity without recognizing the health issue [9]. Consumption of high-caffeine drinks by middle and high school students can be addictive and have negative mental health, more research is needed to develop policy development.

In prior studies on the mental health of adolescents and high-caffeine drinks, most of them were surveys or studies on influencing factors targeting adolescents [10-14]. Despite the differences in physical and mental development characteristics of middle and high school students, there have been no cases of studying them separately. Considering the results of KYRBS that show that the stress rate in middle school is higher than that in high school, it is necessary to establish policy measures tailored to each middle and high school student. This study aim to compare between middle and high school students on the relationship of high-caffeine drinks and mental health. And we expect that the results of this study may contribute to the development of policies for improving mental health coping skills of middle and high school students and strengthening customized support programs.

METHODS

Research design

This study is a secondary data analysis study to compare the relationship between high-caffeine drinks and mental health by separating middle and high school students in Korea. Data on the study respondents were obtained from the 20th KYRBS [5], which was administered in 2024 by the Korean Ministry of Education, Science and Technology, the Ministry of Health and

Welfare, and the Korea Disease Control and Prevention Agency (KDCA).

Respondents

KYRBS is an ongoing national cross-sectional survey that assesses health-risk behaviors among middle and high school students monitor progress toward achieving national health objectives and health plan of South Korea. Respondents of this study were 54,653 respondents from 400 middle schools and 400 high schools. Written informed consent was obtained from each participant prior to the self-administered online survey. All the data used in this study were fully anonymized before access. The data collection period was from June 2024 to July 2024.

Measures

The data collected by the survey includes information on respondent's characteristics such as sex, school, academic performance, and household income. As health-related behaviors, high-intensity physical activity, high-caffeine drinks, walking days, cigarette smoke, and drinking experience, perceived health were included. The mental health variables were perceived stress, sadness & despair, suicidal ideation, and loneliness. As an outcome variable, we analyzed the relationship between high-caffeine drinks and mental health variables. Academic performance was asked, "How was your academic performance over the past 12 months?" and response were modified upper, middle, and lower. Household income was asked, "What is your family's financial situation?" and response were modified upper, middle, and lower. The variable of 'high-caffeine drinks' was asked, "During the past 7 days, how often did you get high-caffeine drinks?" and response were modified that 'yes' is if student drank high-caffeine drinks at least once and 'no' is if student did not drink it in last 7 days. In mental health variables, perceived stress was asked, "How much stress do you usually feel?" and responses were modified often, sometimes, or rarely. Sadness & despair was asked, "In the past 12 months, have you ever felt so sad or hopeless that you stopped doing your usual activities for a full 2 weeks?" and suicidal ideation was asked, "In the past 12 months, have you ever seriously considered suicide?" Loneliness was asked, "In the past 12 months, how often have you felt lonely?" and responses were modified often, sometimes, or rarely.

Data analysis

The KYRBS comprises complex data, which were analyzed based on complex sampling design and strata, cluster, weight, and finite population correction provided by the KDCA. The analysis was performed using IBM SPSS Statistics 25.0 at a significance level of 0.05. Descriptive statistics were used to characterize the study population. Differences high-caffeine drinks consumption by respondent's characteristics were analyzed using chi-square and the t-test. Lastly, logistic regression analysis using complex sample were performed to identify the relationship high-caffeine drinks and mental health. Logistic analysis was conducted in two steps. First, the analysis was conducted without adjusting the general characteristic variables, which is Model 1. Second, analysis was performed after adjusting general characteristic variables which is Model 2.

Ethical considerations

The KYRBS is a government-approved statistical survey conducted annually in Korea since 2005 (approval no. 117058). This study obtained data from the survey website (<https://www.kdca.go.kr/yhs>) according to the regulations of the KDCA.

RESULTS

General characteristics

The general characteristics of respondents are as follows Table 1. Male is 51.3% and female is 48.7% in middle school. Male is 51.6% and female is 48.4% in high school. In academic achievement, upper was the highest in middle school at 45.8% (13,009 persons), and lower was the highest in high school at 38.3% (8,246 persons). In household income, upper was the highest in middle school at 47.7% (13,451 persons), and middle was the highest in high school at 48.9% (12,598 persons). Looking at health-related behavior variables, the highest of middle school students engaged in high-intensity physical activity 3 or more times per week at 51.5% (15,170 persons), while the highest of high school students engaged in 1–2 times at 39.4% (10,099 persons). In case of walking days per week, the highest of middle school students engaged in high-intensity physical activity 3 or more times per week at 46.8% (13,741 persons), while the highest of high school students engaged in never at 34.9% (8,847 persons). In lifetime smoking experience, the most common answer was 'no' in middle (95.6%) and high school (88.8%). In lifetime drinking experience, the most common answer was 'no' in middle (78.8%) and high school (59.5%). In weekly con-

Table 1. General characteristics in respondents (N=54,653)

Variable	Category	Respondents, n (%)	
		Middle school (n=29,087)	High school (n=25,566)
Sex	Male	15,067 (51.3)	13,023 (51.6)
	Female	14,020 (48.7)	12,543 (48.4)
Academic performance	Upper	13,009 (45.8)	7,829 (30.4)
	Middle	7,831 (26.7)	8,013 (31.3)
	Lower	8,246 (27.5)	8,246 (38.3)
Household income	Upper	13,451 (47.7)	9,692 (38.6)
	Middle	12,833 (43.4)	12,598 (48.9)
	Lower	2,801 (8.9)	3,273 (12.5)
High-intensity physical activity (/wk)	Never	4,796 (16.9)	7,431 (29.2)
	1–2 times	9,121 (31.6)	10,099 (39.4)
	≥3 times	15,170 (51.5)	8,036 (31.4)
Walking days per week (≥ 60 min/day)	Never	7,520 (26.2)	8,847 (34.9)
	1–2 times	7,826 (27.0)	8,601 (33.5)
	≥3 times	13,741 (46.8)	8,118 (31.6)
Cigarettes smoking experience	No	27,766 (95.6)	22,676 (88.8)
	Yes	1,321 (4.4)	2,890 (11.2)
Drinking experience	No	22,751 (78.8)	15,247 (59.5)
	Yes	6,336 (21.2)	10,319 (40.0)
High-caffeine drink (last 7 days)	No	17,033 (58.6)	10,480 (40.2)
	Yes	12,054 (41.4)	15,086 (59.8)
Perceived health	Healthy	20,144 (69.4)	16,052 (62.8)
	Neutral	6,742 (23.2)	6,610 (25.9)
	Unhealthy	2,201 (7.5)	2,904 (11.3)
Perceived stress	Much	11,961 (41.3)	11,081 (43.4)
	Middle	12,235 (42.1)	10,728 (42.2)
	Little	4,891 (16.6)	8,648 (15.5)
Sadness & despair	No	20,950 (72.1)	18,538 (72.5)
	Yes	8,137 (27.9)	7,028 (27.5)
Suicidal ideation	No	25,098 (86.1)	22,604 (88.5)
	Yes	3,989 (13.9)	2,962 (11.5)
Loneliness	Much	5,324 (18.7)	4,837 (19.0)
	Middle	10,539 (36.1)	9,528 (37.5)
	Little	13,224 (45.2)	11,201 (43.5)

sumption of high-caffeine drinks, 'no' was the highest at 58.6% (17,033 persons) followed by 'yes' at 41.4% (12,054 persons) in middle school. On the other hand, 'yes' was the highest at 59.8% (15,086 persons) followed by 'no' at 40.2% (10,480 persons) in high school.

Regarding variables of mental health, perceived health was healthy accounted for the most in middle and high school. In terms of perceived stress, middle was the highest at 42.1% (12,235 persons) followed by much at 41.3%, little at 16.6% in middle school. On the other hand, much was the highest at 43.4% (11,081 persons) followed by middle at 42.2%, little at 15.5% in high school. In terms of sadness & despair, the most common answer was 'no' in middle (72.1%) and high school (72.5%). In terms of suicidal ideation, the most common answer

was 'no' in middle (86.1%) and high school (88.5%). In terms of loneliness, little was the highest at 45.2% (13,224 persons) in middle school and 43.5% (11,201 persons) in high school.

Differences of high-caffeine drinks by general characteristics

Table 2 shows the differences in consumption of high-caffeine drinks by general characteristics. There were statistically significant differences in high-caffeine drinks consumption by sex ($P=0.001$), academic performance ($P<0.001$), household income ($P<0.001$), walking days ($P<0.001$), smoking and drinking experience ($P<0.001$), perceived health ($P<0.001$), perceived stress ($P<0.001$), sadness & despair ($P<0.001$), suicidal ideation ($P<0.001$), and loneliness ($P<0.001$). However, high-intensity physical activity was not statistically significant.

The specific results about consuming high-caffeine drinks are as follows. In middle school, respondents with 'yes' were male (42.8%, 6,446 persons) and female (40.0%, 5,608 persons), but in high school, respondents with 'yes' were male (60.3%, 7,768 persons) and female (59.2%, 7,318 persons). In the academic performance variable, in middle school, students with 'lower' (47.5%, 3,906 persons) consumed more high-caffeine drinks than middle and upper, while in high school, students with upper (62.8%, 4,821 persons) consumed more it than middle and lower. In the household income variable, in middle school, students with lower (48.5%, 1,355 persons) consumed more high-caffeine drinks than middle and upper, while in high school, students with upper (62.4%, 5,944 persons) consumed more it than middle and lower. In the walking variable, students with ≥ 3 times per week in middle (43.8%, 6,053 persons) and

Table 2. Differences of high-caffeine drinks by respondents's characteristics (N=54,653)

Variable	Category	High-caffeine drinks (last 7 days), n (%)				F or χ^2 (P)
		Middle school		High school		
		No	Yes	No	Yes	
Sex	Male	8,621 (57.2)	6,446 (42.8)	5,255 (39.7)	7,768 (60.3)	21.966 (0.001)
	Female	8,412 (60.0)	5,608 (40.0)	8,412 (40.8)	7,318 (59.2)	
Academic performance	Upper	8,095 (62.2)	4,914 (37.8)	3,008 (37.2)	4,821 (62.8)	50.817 (<0.001)
	Middle	4,598 (58.6)	3,233 (41.4)	3,215 (39.5)	4,798 (60.5)	
	Lower	4,340 (52.5)	3,906 (47.5)	4,256 (43.2)	5,466 (56.8)	
Household income	Upper	7,975 (59.0)	5,479 (41.0)	3,748 (37.6)	5,944 (62.4)	23.498 (<0.001)
	Middle	7,611 (59.6)	5,222 (40.4)	5,367 (42.1)	7,231 (57.9)	
	Lower	1,446 (51.5)	1,355 (48.5)	1,363 (41.0)	1,910 (59.0)	
High-intensity physical activity (/wk)	Never	2,946 (61.4)	1,850 (38.6)	3,230 (42.6)	4,201 (57.4)	3.025 (0.050)
	1–2 times	5,490 (60.2)	3,631 (39.8)	4,069 (39.4)	6,030 (60.6)	
	≥3 times	8,597 (56.6)	6,573 (43.4)	3,181 (39.1)	4,855 (60.9)	
Walking days per week (≥60 min/day)	Never	4,712 (62.1)	2,808 (37.9)	3,938 (43.5)	4,909 (56.5)	19.826 (<0.001)
	1–2 times	4,633 (59.2)	3,193 (40.8)	3,408 (38.9)	5,193 (61.1)	
	≥3 times	7,688 (56.2)	6,053 (43.8)	3,134 (38.0)	4,984 (62.0)	
Cigarettes smoking experience	No	16,602 (59.8)	11,164 (40.2)	9,676 (41.9)	13,000 (58.1)	820.428 (<0.001)
	Yes	431 (32.5)	890 (67.5)	804 (27.2)	2,086 (72.8)	
Drinking experience	No	14,277 (62.7)	8,474 (37.3)	6,947 (44.7)	8,300 (55.3)	1,523.609 (<0.001)
	Yes	2,756 (43.3)	3,580 (56.7)	3,533 (33.7)	6,787 (66.3)	
Perceived health	Healthy	12,195 (60.6)	7,949 (39.4)	6,722 (41.0)	9,330 (59.0)	78.918 (<0.001)
	Neutral	3,721 (55.1)	3,021 (44.9)	2,657 (39.7)	3,953 (60.3)	
	Unhealthy	1,117 (51.0)	1,084 (49.0)	1,101 (37.1)	1,803 (62.9)	
Perceived stress	Much	6,237 (52.4)	5,724 (47.6)	4,082 (35.8)	6,999 (64.2)	325.469 (<0.001)
	Middle	7,489 (61.0)	4,746 (39.0)	4,512 (41.5)	6,216 (58.5)	
	Little	3,307 (67.9)	1,584 (32.1)	1,886 (49.7)	1,871 (50.3)	
Sadness & despair	No	13,003 (61.9)	7,947 (38.1)	7,967 (42.3)	10,571 (57.7)	413.423 (<0.001)
	Yes	4,030 (49.9)	4,107 (50.1)	2,513 (34.8)	4,515 (65.2)	
Suicidal ideation	No	15,154 (60.4)	9,944 (39.6)	9,439 (41.0)	13,165 (59.0)	192.766 (<0.001)
	Yes	1,879 (47.6)	2,110 (52.4)	1,041 (34.5)	1,921 (65.5)	
Loneliness	Much	2,644 (49.8)	2,680 (50.2)	1,794 (36.1)	3,043 (63.9)	207.112 (<0.001)
	Middle	5,928 (56.3)	4,611 (43.7)	3,735 (38.5)	5,793 (61.5)	
	Little	8,461 (64.0)	4,763 (36.0)	4,951 (43.5)	6,250 (56.5)	

high school (62.0%, 4,984 persons) consumed more high-caffeine drinks than 1–2 times per week and never. In smoking variable, 67.5% of smoking experience in middle school and 72.8% of smoking experience in high school consumed high-caffeine drinks. In drinking variable, 56.7% of drinking experience in middle school and 66.3% of drinking experience in high school consumed high-caffeine drinks. In perceived health variable, respondents with unhealthy consumed the most high-caffeine drinks in middle (49.0%, 1,084 persons) and high school (62.9%, 1,803 persons).

In the mental health-related variables, the more stressed, the more sadness & despair, the more suicidal ideation, and the more loneliness, the more high-caffeine drinks they consumed. The specific results are as follows. In perceived stress variable, respondents with much consumed the most high-caffeine drinks in middle (47.6%, 5,724 persons) and high school (64.2%, 6,999 persons). In sadness & despair variable, respondents with 'yes' consumed the most high-caffeine drinks in middle (50.1%, 4,107 persons) and high school (65.2%, 4,515 persons). In suicidal ideation variable, respondents with 'yes' consumed the most high-caffeine drinks in middle (52.4%, 2,110 persons) and high school (65.5%, 1,921 persons). Lastly, in loneliness variable, respondents with much consumed the most high-caffeine

drinks in middle (50.2%, 2,680 persons) and high school (63.9%, 3,043 persons).

Logistics regression analysis of mental health and high-caffeine drinks

Complex sample logistic regression analysis were performed after non-adjusting control variables (model 1) and adjusting control variables (model 2) in Table 3. In middle school, there were statistically significant differences in perceived stress ($P<0.001$), sadness & despair ($P<0.001$), suicidal ideation ($P=0.07$), and loneliness ($P<0.001$) with high-caffeine drinks. But in high school, only perceived stress ($P<0.001$) and sadness & despair ($P<0.001$) were statistically significant. The specific results are as follows after adjusting control variables (model 2). In middle school, respondents of much perceived stress consumed 1.493 times ($P<0.001$) more high-caffeine drinks than those of little. Respondents of 'yes' sadness & despair consumed 1.189 times ($P<0.001$) more high-caffeine drinks than those of 'no.' Respondents of 'yes' suicidal ideation consumed 1.125 times ($P<0.05$) more high-caffeine drinks than those of 'no.' And respondents of 'yes' loneliness consumed 1.243 times more high-caffeine drinks than those of little. In high school, respondents of much perceived stress consumed 1.699 times ($P<0.001$)

Table 3. Logistic regression analyses of high-caffeine drinks and mental health

Variable	Category	High-caffeine drinks (last 7 days) (Ref. none)			
		Model 1 ^a		Model 2 ^b	
		Middle school, yes	High school, yes	Middle school, yes	High school, yes
Perceived stress (Ref. little)	Much	1.482 (1.359–1.616)***	1.598 (1.478–1.727)***	1.493 (1.366–1.632)***	1.699 (1.571–1.836)***
	Middle	1.242 (1.148–1.343)***	1.341 (1.253–1.44)***	1.257 (1.160–1.362)***	1.404 (1.311–1.503)***
Sadness Et despair (Ref. no)	Yes	1.290 (1.218–1.367)***	1.197 (1.125–1.272)***	1.189 (1.121–1.262)***	1.142 (1.075–1.214)***
Suicidal ideation (Ref. no)	Yes	1.226 (1.132–1.328)***	1.066 (0.977–1.163)	1.125 (1.032–1.227)*	1.047 (0.956–1.147)
Loneliness (Ref. little)	Much	1.243 (1.145–1.350)***	1.028 (0.947–1.116)	1.243 (1.142–1.353)***	0.976 (0.897–1.062)
	Middle	1.179 (1.110–1.252)***	1.068 (0.896–1.056)	1.181 (1.111–1.256)***	1.041 (0.986–1.099)
Sex (Ref. female)				1.157 (1.094–1.223)***	0.981 (0.925–1.041)
Academic performance (Ref. lower)	Upeer			0.745 (0.701–0.790)***	1.326 (1.234–1.426)***
	Middle			0.882 (0.825–0.942)***	1.234 (1.156–1.317)***
Household income (Ref. lower)	Upeer			1.010 (0.920–0.1110)	1.191 (1.096–1.294)***
	Middle			0.901 (0.827–0.981)***	1.037 (0.956–1.124)
Walking days per week (≥60 min/day) (Ref. never)	1–2 times			1.142 (1.069–1.220)***	1.201 (1.131–1.276)***
	≥3 times			1.237 (1.159–1.320)***	1.241 (1.164–1.322)***
Cigarettes smoking experience (Ref. no)				1.919 (1.704–2.162)***	1.573 (1.443–1.716)***
Drinking experience (Ref. no)				1.798 (1.695–1.908)***	1.453 (1.369–1.542)***
Perceived health (Ref. unhealthy)	Healthy			0.900 (0.809–1.001)	0.950 (0.870–1.038)
	Neutral			1.013 (0.909–1128)	0.967 (0.981–1.062)

Values are presented as adjusted OR (95% CI). Logistic regression was done on the complex sample.

CI, confidence interval; OR, odds ratio; Ref., reference.

* $P<0.05$, *** $P<0.001$.

^aAnalyzed high-caffeine drinks and mental health with non-adjust variables. ^bAnalyzed high-caffeine drinks and mental health after adjusting sex, academic performance, household income, walking days, cigarettes smoking and drinking, and perceived health variables.

more high-caffeine drinks than those of little. Respondents of 'yes' sadness & despair consumed 1.142 times ($P<0.001$) more high-caffeine drinks than those of 'no'.

DISCUSSION

This study was conducted to compare the relationship between consumption of high-caffeine drinks and mental health in middle and high school students. Data were used from the 20th KYRBS (2024). Statistically significant variables associated with high-caffeine drinks were academic performance, household income, walking days, smoking and drinking experience, and mental health variables. Some findings are consistent with those of previous research. Students with lower academic performance had higher rated of consuming high-caffeine drinks [15] and my research results showed the same results in middle school, but different results in high school. People with relatively high household income tended to consume more high-caffeine drinks [15,16] and my research results showed the same results in middle school, but different results in high school. So, further studies are needed to segment respondents. According to this study, students with ≥ 3 times per week walking consumed more high-caffeine drinks than other, and the previous research showed similar results [17]. This appears to be due to the positive effect of caffeine intake on improving exercise performance. The more students smoked and drank, the more they consumed high-caffeine drinks. Also, previous researches showed significant differences between smoking, drinking, and experience consuming high-caffeine drinks [18]. High-caffeine drinks consumption was higher in the current smoking and current drinking groups [17].

In result of complex sample logistic regression analysis after adjusting the control variable, the more stressed, the more sad or hopeless students felt, and the more they consumed high-caffeine drinks in middle and high school. This findings are consistent with those of previous research, which found that students who answered 'yes' to high-caffeine drinks consumption experienced 2.46 times more sadness & despair than those who answered 'no' [19]. And the higher consumption of high-caffeine drinks, the more negative mental health problems such as stress, sadness, and depression [13,14]. According to the results of this study, in situations of high stress, middle school students consumed 1.493 times more high-caffeine drinks, and high school students consumed 1.699 times more. These results looks like that high school students consume more high-caf-

feine drinks in stressful situation to increase their academic concentration for preparing college entrance exams.

Interestingly, suicidal ideation and loneliness were significant variables associated with high-caffeine consumption in middle school students, but not in high school students in this study. But, in previous studies, adolescents with suicidal thoughts consumed 1.37 and 1.47 times more high-caffeine drinks than those without [13] and high school students who consumed high-caffeine drinks had a higher risk of suicidal thoughts than those who did not [20,21]. The fact that suicidal thoughts and loneliness variables were significant only for middle school students seems to be because middle school students are in early adolescence, when school adaptability is evaluated as lower than high school students. There is research that shows that suicidal thoughts occur when school adaptability is low [22]. In addition, middle school students are subject to greater psychological control from their parents than high school students, and previous research results have shown that those who receive greater psychological control from their parents are more likely to become addicted to social networking service, etc. [23]. High-caffeine drinks are also one of the addictive substances with caffeine, so it can be assumed in a similar context.

There is concern that students are unaware of the dangers of high-caffeine drinks and habitually consume them frequently when studying or when tired in order to achieve a short-term boost of energy during exam periods. Therefore, customized education on consumption habits is necessary for middle and high school students separately. Adolescents are emotionally less mature due to the nature of puberty. They can easily become mentally disturbed or engage in unhealthy behaviors to avoid problems, the consumption of caffeinated beverages as stimulants is one example. Adolescents are exposed to stress on academics, interpersonal relationships, and social expectations. The high-caffeine drinks market is expanding, and adolescents' consumption of high-caffeine drinks is expected to continue. In addition, stress, despair, depression, and suicidal thoughts are highly related to adolescents and it can be assumed that they inevitably consume high-caffeine drinks for relieving these problems. Therefore, management and emotional support from home, school, and society are very important and government-level intervention programs are needed to effectively carry out this. Recognizing each characteristic of middle and high school students, tailored intervention program should be developed based on the community and school.

The limitation of this study are as follows. First, it does not

reflect long-term changes due to a cross-sectional study. So it is unable to establish direct causal relationships between high-caffeine drinks and mental health. Second, there is a limit to the selection and adjustment of variables in secondary data analysis. Despite its limitations, this study may contribute as a basic data for policy development by presenting specific variables related to various mental health issues and showing the differences in research results for middle and high school students. Adolescents are a valuable asset that will lead the future of the country. So we have to pay attention for their mental health issue they are experiencing. This study suggests that tailored preventive policies for mental health in middle and high school each based on school and community levels, and further comparative studies considering the characteristics of each school are needed.

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AUTHOR CONTRIBUTIONS

Dr. Haesun YUN had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Author reviewed this manuscript and agreed to individual contributions.

Conceptualization, Data curation: JP. Formal analysis: HY. Writing—original draft, Writing—review & editing: all authors.

CONFLICTS OF INTEREST

No existing or potential conflict of interest relevant to this article was reported.

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DATA AVAILABILITY

The data presented in this study are available upon reasonable request from the corresponding author.

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