Use of Alcohol, Tobacco, and Caffeine and Suicide Attempts: Findings From a Nationally Representative Cross-sectional Study

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Abstract

In this study, the association between students' substance use and suicide attempts in the past 1 year was examined using secondary data from the 13th Korea Risk Behavior Web-based Survey. Participants were 7th- to 12th-grade students and 50.9% were male. A binominal logistic regression analysis was used to investigate the association between past experience of substance use (alcohol, tobacco, and caffeine) and suicide attempts after controlling for sociodemographic and psychological factors. Compared with no use, daily use of alcohol (odds ratio [OR] = 8.00), caffeine (OR = 2.13), and tobacco (OR = 1.41) was associated with increased odds of suicide attempts. These results indicate that school-based suicide prevention programs should cover awareness, surveillance, and treatment referral for these 3 substances. Moreover, mental health professionals should monitor intake of these substances when evaluating risk of suicide attempts in youth.

Keywords

adolescent, substance use, suicide attempt, alcohol, tobacco, caffeine, Korea

Introduction

In 2016, the suicide mortality rate among individuals aged 15 to 29 years in South Korea[1] was 7.8 per 100 000 population, making it the leading cause of death in this population, followed by traffic accidents (3.8) and cancer (3.1). Thus, youth suicide has become a major concern in Korean public health. According to the Korea National Health Insurance Corporation, the total estimated societal cost of suicide deaths was $1.4 billion in 2014.[2] Suicide is arguably the greatest cause of premature death, and represents a significant social and economic burden for public health because of its association with the utilization of health services to cope with its long-term harmful psychological and social consequences.

The term *suicidal behavior* is used to denote a range of behaviors that include ideation of suicide, planning for suicide, attempting suicide, and completed suicide.[3] A suicide attempt is defined as nonfatal self-harm behavior such as poisoning, injury, or self-harm, with or without a fatal intent or outcome.[3] In the United States in 2014, there were 9.4 million adults with serious thoughts of suicide, 2.7 million

reported they had made suicide plans, 1.1 million made a nonfatal suicide attempt, and over 33 000 adults died of suicide.[4] Among these behaviors, suicide attempts are the robust predictor of death by suicide, more so than suicidal ideation which is often a fleeting, fluctuating experience not observable to others.[3]

In 2011, the Korean government adopted a 5-year comprehensive suicide prevention and control action plan, based on an act that aimed to improve access to suicide prevention resources and create a culture of respect for life.[5] Identifying high-risk adolescents and providing them with follow-up care and support should be a key component of all comprehensive suicide prevention strategies. Accordingly, the Korean Ministry of Education recommends that primary and middle schools perform suicide risk screenings on all students as well

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as provide counselling and suicide prevention programs for high-risk groups. Unfortunately, research suggests that few schools actually adhere to these recommendations, and only 34.1% of surveyed schools reported that the impact of the school-based suicide prevention program was positive. Therefore, current suicide prevention policies and programs do not appear to be effective when applied to youth.[6]

There is substantial research on the risk factors of suicidality in adolescents. Identified factors include age, gender, ethnicity, socioeconomic status (SES), living apart from parents, lack of social support, psychological factors (eg, depression, stress) and substance use.[3,7-9]

The *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition (*DSM-5*) has specific diagnostic categories for alcohol-, nicotine-, and caffeine-related substance use disorders.[10] Alcohol, tobacco, and caffeine are commonly used by adolescents to alter their mood, both globally[11] and in South Korea.[12,13] For instance, statistics from 2016 showed that 38.8% of Korean adolescents have lifetime experience of alcohol use and 14.8% have experience of smoking, though only 0.5% had experience of illicit drug use.[14] Moreover, the proportion of adolescents who consumed energy drinks at a high frequency (more than 5 time per week) increased 2-fold in 2016 from 1.4% in 2015.[14] All these substances are highly addictive and may be related to suicide. Indeed, alcohol and tobacco users had moderately greater odds of a suicide attempt in the past year (odds ratio [OR] = 1.6-2.2) according to data from the 2001-2009 Youth Risk Behavior Survey, which included 73 183 high school students in the United States.[15] Similarly, in a large community sample, lifetime use of tobacco and alcohol were associated with suicidal attempt even after controlling for sociodemographic and psychological factors (OR = 2.3-2.9) in Korea.[16] Adolescents who consumed energy drinks frequently (5 or more times per week) had substantially higher odds of suicide attempts (OR = 6.8).[13] Previous studies have presented positive associations across substance use dimensions (ie, lifetime use, current use, substance related disorder), and all suicidal behavior (ie, suicidal ideation, plan, attempt, and suicide) but given little attention to frequency of substance use.[17] However, teen substance use disorder, drug abuse, or addiction is caused by the habitual taking of addictive substances, which is preventable.[18] Therefore, the present study examined how the frequency of use of 3 common substances—alcohol, tobacco, and caffeine—was associated with suicide attempts among adolescents.

Methods

Design and Subjects

This study was a secondary data analysis of the 13th Korea Youth Risk Behavior Survey (KYRBS). The KYRBS, conducted annually since 2005 by the Ministry of Education, Ministry of Health and Welfare, and Korea Centers for Disease Control and Prevention (KCDC), provides national data on 15 categories of health-risk behaviors associated with mortality, morbidity, and social problems among 7th-to 12th-grade students in Korea using a 123-item questionnaire. The 13th KYRBS was conducted in 2017 with a representative sample of 5632 middle and high schools, covering 3 027 488 adolescents aged 12 to 18 years (selected via proportional allocation from 39 clusters and 117 strata). The final sample comprised 62 276 students (31 624 boys and 30 652 girls, mean age 15.04 ± 1.75 years) who agreed to participate. The questionnaire was completed using computer-assisted self-reporting in school labs. The KYRBS was certified by the Statistics Korea (Certificate Number: 11758) and approved by the institutional review board of the KCDC. Data were made available by the KCDC after the current study's purpose and design were reviewed. Permission was received on June 15, 2018 (http://yhs.cdc.go.kr).[14]

Measurements

The frequency of current (past 30 days) use of substances was measured: "During the past 30 days, on how many days did you have at least one drink of alcohol?"; "During the past 30 days, on how many days did you smoke cigarettes?"; and "How often did you drink caffeine-containing energy drinks (Hot6, Redbull, Bacchus, etc) during the previous week?" The response criteria were regrouped: 0, 1 to 9 days/month, 10 to 19 days/month, 20 to 29 days/month, and every day.

Suicide attempts were investigated with one yes/no question: "Have you attempted suicide during the past 12 months?"

The sociodemographic factors included gender, school level, residential area (rural, small city, large city), household SES (low, middle, high), living together with parents (no, yes), and presence of emotional supporters (no, yes). Depressive mood was assessed using a yes/no question, "During the past 12 months, did you ever feel so sad or hopeless almost every day for 2 weeks or more in a row that you stopped doing some usual activities?" Perceived stress was assessed using a 5-point Likert-type question, "How would you rate your usual stress level?" and the responses recoded for analysis as "yes" and "no."

Statistical Analysis

All statistical data analyses were performed using SPSS Statistics 21.0 (IBM Corp, Armonk, NY). Complex sampling design, including multistage, stratified, and cluster sampling, was taken into account in the analysis; weights supplied by the KCDC were applied in the analysis to reduce bias from individual nonresponse within schools,

grades, and genders.[14] The Rao-Scott chi-square test was used to identify significant differences between observed and expected frequencies in suicide attempts. A logistic regression analysis was conducted to investigate the effect of substance use on suicide attempts after adjusting for potential confounders (gender, school level, residential area, household SES, living together with parents, emotional supporters, psychological factors). The significance level was set at $P < .05$ and adjusted P value with the Bonferroni correction for multiple testing. ORs and 95% confidence intervals (CIs) were calculated using frequency of alcohol, tobacco use, and caffeine intake as the independent variables and suicide attempt as the dependent variable.

Results

The mean age of the suicide attempters in this study was 15.10 ± 1.18 years, with a range of 12 to 18 years. The sociodemographic characteristics and frequency of substance use among Korean adolescents according to their suicide attempts are presented in Table 1. The 12-month prevalence of suicide attempts was 2.6% in the whole sample, 2.6% among females, 2.5% among males, 3% among middle school students, and 2.2% among high school students. Of all respondents, 14 841 (23.9%) reported current caffeine intake, 9597 (16.1%) reported current alcohol use, and 3769 (6.4%) reported current tobacco use. Suicide attempters reported significantly different results from non–suicide attempters regarding the following: school level, residential area, self-perceived SES, living with family, having emotional supporters, feeling stress, and being depressed. Of the overall respondents, 1724 (3.0%) reported daily use of tobacco use, 1075 reported (1.8%) daily use of alcohol and 220 (0.4%) reported daily use of caffeine, whereas 128 (7.2%), 109 (9.4%), and 67 (30.0%) made these reports respectively among suicide attempters (Table 1).

For the binomial logistic regression analysis, three models were constructed. Model 1 contained the main independent variables (frequency of current substance use for the different substances); model 2 added gender, school level, residential area, SES, living with family, and emotional supporters as confounders; and model 3 added psychological confounders such as stress and depression. Frequency of use of all substances was associated with significantly higher odds of suicide attempts in the past year in all models, excluding 20 to 29 days use of alcohol and 1 to 9 days of caffeine intake (Table 2). The odds of a suicide attempt were higher among daily alcohol users (OR $= 8.00$, 95% CI $= 5.43$-11.77, $P < .001$), daily caffeine users (OR $= 2.13$, 95% CI $= 1.67$-2.72, $P < .001$), and daily tobacco users (OR $= 1.41$, 95% CI $= 1.11$-1.79, $P = .005$) compared with nonusers.

Middle school students had greater odds of attempting suicide than did high school students. Likewise, low-SES households, living without family, lacking emotional support, experiencing stress (OR $= 2.13$), and experiencing depressive mood (OR=7.23) substantially increased the odds of suicide attempts.

Discussion

In this cross-sectional study, the association between substance use and suicide attempts was examined in a nationally representative sample of Korean middle and high school students from the 2017 KYRBS using a complex sample analysis method. Consistent with prior reports, alcohol, tobacco, and caffeine were significantly associated with suicide attempts even after controlling for sociodemographic and psychological factors.[16,19] Alcohol use was at least as strongly and as consistently predictive of suicide attempts as tobacco and caffeine use, even in the fully adjusted models. Specifically, daily use was significantly associated with suicide attempts. Notably, more frequent use of alcohol, caffeine, and tobacco was associated with increased odds of suicide attempts, consistent with findings among adolescents in Mexico.[19]

This study confirmed relationships between substance use (alcohol, tobacco, and caffeine) and suicide attempts among adolescents. However, because of the limitations of the cross-sectional design, the causal relations among these variables cannot be confirmed. The results align with the findings of a meta-analysis of 24 cross-sectional studies conducted in the United States, Canada, Australia, Mexico, Europe, and South Korea, which revealed that use of caffeine, alcohol, tobacco, and drugs is associated with increased odds of suicide attempts (OR 1.8-2.9).[20] The differences in odds might be attributed to the different sociodemographic characteristics of the populations; the methods of assessing the exposure and outcome variables; and/or the type, frequency, dose, and route of administration of substances used.

According to several cohort and longitudinal studies, alcohol, tobacco, and caffeine users have been shown to have poorer impulse control in general, so stressful life circumstances and substance use might interact to amplify the risk of suicidality in adolescence.[21] Substance use might also lead to a breakdown in personal relationships and exacerbate impulsive aggression in adolescence, thus enhancing the likelihood of suicidal behavior in adolescence.[22] However, one study found that use of alcohol and tobacco increased suicide risk, but suicide risk did not increase the risk of alcohol and tobacco use after adjusting for latent time-invariant effects.[23] The association between substance use and suicide risk may also vary in magnitude and significance according to the type of substance used (alcohol, tobacco, and caffeine), the onset time of substance use, the degree of dependence, and additional variables such as sociodemographic factors, family history of substance use, and psychological factors. Still, more research is needed to clarify the extent to which substance use is indirectly or directly related to suicide risk.

Table 1. Sociodemographic Characteristics of the Suicide Attempter and Non–Suicide Attempter Among Korean Adolescents.

Characteristics	Total, 62 276 (100%) n (weighted %)	Suicide Attempters, 1634 (2.6%) n (weighted %)	Non–Suicide Attempters, 60 642 (97.4%) n (weighted %)	F^a or t	P
Age (years)	15.04 ± 0.3	15.10 ± 1.18	15.04 ± 1.75	−9.21	.448
Gender				0.31	.599
Male	31 624 (50.9)	810 (2.5)	30 814 (97.5)		
Female	30 652 (49.1)	824 (2.6)	29 828 (97.4)		
School level[b]				38.41	<.001
Middle	30 885 (45.3)	933 (3.0)	29 952 (97.0)		
High	31 391 (54.7)	701 (2.2)	30 690 (97.8)		
Residential area				16.08	<.001
Rural	4839 (7.9)	103 (2.3)	4736 (97.7)		
Small city	29 808 (48.8)	689 (2.3)	29 119 (97.7)		
Large city	27 629 (43.3)	842 (3.0)	26 787 (97)		
Socioeconomic status				68.71	<.001
Low	8892 (14.1)	401 (4.5)	8491 (95.5)		
Middle	28582 (45.6)	614 (2.1)	27968 (97.9)		
High	24802 (40.4)	619 (2.5)	24183 (97.5)		
Living with family				69.1	<.001
No	3114 (4.6)	166 (5.5)	2948 (94.5)		
Yes	59 162 (95.4)	1468 (2.4)	57 694 (97.6)		
Emotional support				132.59	<.001
No	12 450 (19.6)	516 (4.1)	11 934 (95.9)		
Yes	49 826 (80.4)	1118 (2.2)	48 708 (97.8)		
Stress				886.50	<.001
No	39017 (62.8)	436 (1.1)	38581 (98.9)		
Yes	23259 (37.2)	1198 (5.0)	22061 (95.0)		
Depressive mood				2452.01	<.001
No	46 664 (74.9)	362 (0.8)	46 302 (99.2)		
Yes	15 612 (25.1)	1272 (8.0)	14 340 (92.0)		
Alcohol use				961.99	<.001
None	52 679 (83.9)	1121 (2.1)	51 558 (97.9)		
1-9 days	8525 (14.3)	384(4.5)	8141 (95.5)		
10-19 days	610 (1.0)	52 (8.3)	558 (91.7)		
20-29 days	242 (0.4)	10 (4.6)	232 (95.4)		
Every day	220 (0.4)	67 (30.0)	153 (70.0)		
Tobacco use				416.54	<.001
None	58 507 (93.6)	1341 (2.2)	57 166 (97.8)		
1-9 days	1253 (2.1)	92 (7.2)	1161 (92.8)		
10-19 days	390 (0.7)	33 (8.0)	357 (92.0)		
20-29 days	402 (0.7)	40 (9.5)	362 (90.5)		
Every day	1724 (3.0)	128 (7.2)	1596 (92.8)		
Caffeine intake				312.69	<.001
None	47 435 (76.1)	1032 (2.2)	46 403 (97.8)		
1-9 days	9969 (15.9)	308 (3.0)	9661 (97)		
10-19 days	2962 (4.8)	127 (3.9)	2835 (96.1)		
20-29 days	835 (1.4)	58 (6.4)	777 (93.6)		
Every day	1075 (1.8)	109 (9.4)	966 (90.6)		

[a]F: Rao-Scott chi-square test.
[b]Middle school students—7th, 8th, and 9th grades; high school students—10th, 11th, and 12th grades.

Identifying the specific contribution of the aforementioned intervening factors in future research may help in the development of effective evidence-based interventions and treatment programs. One study found that school-based suicide prevention intervention combining psychological health literacy, suicide risk awareness, and skills training

Table 2. Associations Between Substance Use (Alcohol, Tobacco, and Caffeine) and Suicide Attempts Among Korean Adolescents.[a]

Characteristics	Model 1			Model 2			Model 3		
	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P
Frequency of alcohol use (ref = No)									
1-9 days	1.80	(1.58-2.06)	<.001	1.43	(1.24-1.64)	<.001	1.82	(1.56-2.12)	<.001
10-19 days	2.79	(2.04-3.82)	<.001	2.04	(1.48-2.80)	<.001	2.42	(1.76-3.32)	<.001
20-29 days	1.58	(0.83-3.00)	.163	1.20	(0.63-2.31)	.579	1.48	(0.76-2.87)	.250
Every day	11.54	(8.31-16.03)	<.001	9.30	(6.48-13.35)	<.001	8.00	(5.43-11.77)	<.001
Frequency of tobacco use (ref = No)									
1-9 days	2.11	(1.62-2.73)	<.001	1.84	(1.4-2.41)	<.001	1.87	(1.43-2.46)	<.001
10-19 days	2.37	(1.63-3.45)	<.001	2.1	(1.44-3.07)	<.001	2.14	(1.47-3.12)	<.001
20-29 days	2.72	(1.91-3.87)	<.001	2.59	(1.79-3.74)	<.001	2.59	(1.8-3.73)	<.001
Every day	1.48	(1.19-1.84)	.001	1.28	(1.02-1.60)	.035	1.41	(1.11-1.79)	.005
Frequency of caffeine intake (ref = No)									
1-9 days	1.25	(1.1-1.42)	.001	1.13	(1.00-1.29)	.057	1.14	(1.00-1.30)	.056
10-19 days	1.63	(1.34-1.98)	<.001	1.24	(1.02-1.5)	.035	1.24	(1.02-1.51)	.030
20-29 days	2.45	(1.82-3.29)	<.001	1.68	(1.24-2.3)	.001	1.76	(1.28-2.41)	<.001
Every day	3.33	(2.63-4.22)	<.001	2.23	(1.75-2.85)	<.001	2.13	(1.67-2.72)	<.001
Stress (ref = No)									
Yes				2.23	(1.97-2.53)	<.001	2.13	(1.89-2.41)	<.001
Depressive mood (ref = No)									
Yes				7.57	(6.66-8.61)	<.001	7.23	(6.35-8.24)	<.001
School levels (ref = High school)									
Middle school							1.97	(1.75-2.20)	<.001
Gender (ref = Female)									
Male							1.04	(0.94-1.16)	.452
Residential area (ref = Rural)									
Large city							1.44	(1.18-1.77)	<.001
Small city							1.08	(0.88-1.32)	.469
Socioeconomic status (ref = High)									
Low							1.24	(1.07-1.44)	.005
Middle							0.88	(0.78-1.00)	.048
Living with family (ref = Yes)									
No							1.7	(1.41-2.03)	<.001
Emotional support (ref = Yes)									
No							1.67	(1.48-1.88)	<.001
χ^2 (P)	840.71 (P < .001)			2212.45 (P < .001)			2440.15 (P < .001)		
R^2	.050			.192			.212		

Abbreviations: OR, odds ratio; CI, confidence interval.
[a]P values are Bonferroni-adjusted P values.

led to a significant reduction in suicide attempts, whereas a program focusing only on awareness and information delivery improved knowledge and attitudes toward suicide but had no effect on actual suicidal behaviour.[24] Moreover, suicide screening in both school and primary care settings was effective and safe for enhancing treatment referrals and service provision for target groups of students, such as heavy smokers, binge drinkers, and frequent caffeine users.

For interventions to be truly effective, it is important to determine whether substance use has a dose-response relationship with suicidality. Our results to some extent confirm this, given that daily current use, compared to less use and non-use, was associated with greater odds of suicide attempts. Moreover, past studies have shown that the likelihood of suicide attempts was higher among frequent caffeine users than among non–caffeine users.[13] However, there is insufficient evidence of the effects of various types of substance on suicide and whether there is a dose-response relationship between substance use and suicide attempts. Thus, further investigations are needed to explore these issues.

Younger age, not residing with family, low household SES, no emotional supporter, stress, and depression were positively, significantly associated with suicide attempts in

this study.[16] Perceived low SES was associated with suicide attempt. Individuals who perceived their SES as moderate reported fewer suicide attempts compared with those who considered themselves to have high SES, but the differences in the rates were small, consistent with previous findings.[25] The subjective feeling of depression was the strongest factor predicting increased odds ratios for suicide attempts. It is well known that mental disorders such as depression are closely related to suicidal behaviors.[26]

Regarding the age effect, the findings of this study accord with those of another showing that 9.9%, 9.4%, 8.0%, and 6.2% of students in grades 9 to 12, respectively, had attempted suicide.[27] A plausible explanation is that as students become older they become less likely to report suicidal behaviors. Also, as teens grow up, they tend not to report suicide attempts to family or teachers, preventing them from receiving much-needed support and involvement.[28]

A significant gender difference was not found in the current study, with females showing a slightly higher prevalence of suicidal behaviors (2.6%) than males (2.5%). The current study also found that boys had nonsignificantly greater odds of engaging in suicidal attempts than girls, in contrast with the findings of a recent investigation showing that girls had about twice the odds of attempting suicide.[29] The gender differences in suicidal behaviors might be related to pubertal developmental differences between males and females, which make females more vulnerable to depression and stress. Thus, future investigation of these potential mediators and moderators is needed.

Despite this study's many strengths, including its large, nationally representative sample of middle and high school students in South Korea, it also has several limitations. First, this study examined suicide attempts with use of a single self-report question to assess the presence of suicidal behaviors; this could tend to lead to misclassification, increasing the likelihood of statistical decision errors.[30]

Second, the KYRBS was administered through computer-assisted self-reporting in participants' school labs, and the questions asked about sensitive topics, such as drug use and suicide behaviors. This type of self-report data is highly subject to external bias caused by social desirability or approval, especially when anonymity and confidentiality cannot be guaranteed at the time of data collection, as in this study. Therefore, the rates of alcohol, tobacco, and caffeine use among school students could have been underestimated.

Third, the findings might be confounded, positively or negatively, by other risk factors such as negative life events, family history of suicidal behavior, and other type of substance use. Finally, a cross-sectional study design was used, which precludes an understanding of whether suicide attempts increase substance use or vice versa or whether or the correlations were spurious. Therefore, further evidence based on long-term prospective cohort studies is needed to make robust conclusions about the association between substance use and the risk of suicide attempts. Age of substance use initiation and use of multiple substances (eg, consumption of more than one kind of substance simultaneously) among adolescents might also be important factors to consider. Thus, these issues should be examined in further research.

Conclusion

Alcohol, tobacco, and caffeine use were associated with suicide attempts after controlling for sociodemographic and psychological factors. Frequent current use of substance had a stronger association than did less use or nonuse. The findings from this study thus suggest strong linkages between substance use and suicide and the need for suicide prevention programs designed to include substance users.

The findings are also relevant for prevention planning. For instance, including information on the importance of changes in substance use patterns as a risk factor for suicide attempts might be beneficial for suicide reduction initiatives. Additionally, prevention work might involve the provision of more information to adolescents about the levels and patterns of alcohol, tobacco, and caffeine use.

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