The association between alcohol use and suicide attempt in employees

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ABSTRACT

Purpose: This study aimed to analyze the alcohol use patterns that may influence suicide attempt in employees who have suicidal ideation.
Methods: The 15,199 participants were classified into three groups according to suicide risk severity. Participant scores on the Alcohol Use Disorders Identification Test-Korea (AUDIT-K), subscale for drinking amount/frequency (AUDIT-C, items 1–3), subscale for dependence/related problems (AUDIT-D/P, items 4–10), and other sociodemographic and psychiatric scales were analyzed between the groups using one-way analysis of variance (ANOVA) and the chi-square test, followed by *post hoc* analysis using the Bonferroni correction.
Results: A statistically significant difference between all three groups was observed for AUDIT-D/P scores after *post hoc* analysis (P < 0.001), indicating an increasing trend for greater suicide risk. This trend was present in both sexes and across all age groups above 30 years old.
Conclusion: Alcohol dependence/related problems are significantly associated with suicide attempt among employees. Assessing and preventing suicide risk according to these issues may minimize socioeconomic losses due to suicide.

Keywords: Alcohols; Employee; Suicide

INTRODUCTION

According to Statistics Korea, Korea's suicide rate was 26.9 per 100,000 individuals in 2019 [1]. Korea has the highest suicide rate and average number of suicides among Organisation for Economic Co-operation and Development (OECD) countries [2]. Based on the data from the National Health Insurance Policy Research Institute of Korea National Health Insurance Service, the socioeconomic cost of suicide is approximately 6.5 trillion won and it is the third high-

est economic impact factor after cancer and cerebrovascular disease among major causes of death in Korea [3]. Moreover, the actual socioeconomic cost of suicide is assumed to be significantly greater considering the medical expenses for injuries, the consequences of attempted suicides, and the physical and psychological treatment for the bereaved. Therefore, assessing the risk of suicide in adults in the working population can prevent staggering losses for the country, corporations, and society. Thus, works that explore the influencing factors and preventative measures for suicide are needed.

Meanwhile, the annual drinking rate of Koreans aged 19 years and older in a standardized population was 79.7%, according to the 2018 Korea National Health and Nutrition Examination Survey (KNHANES), conducted by the Ministry of Health and Welfare [4]. According to 2017 data from the World Health Organization (WHO), this rate is approximately two times higher than the average annual drinking rate in the global population of people who are 15 years and older [5]. In a previous autopsy study conducted by the Korean National Forensic Service, the blood alcohol concentration (BAC) of 48.4% of people who committed suicide between 2007 and 2009 was over 0.05 at the time of committing suicide [6], which is commonly known as the global standard for driver's license suspension limit. Alcohol consumption affects perception, judgement, and memory function by weakening emotional control and inducing impulsive aggression and cognitive distortion [7]. Hence, alcohol consumption in people who are at imminent risk of suicide plays a crucial role in unplanned suicide attempts [8], while acute alcohol intoxication is known to provoke suicidal ideation and suicide attempts in at-risk people [9]. Also, consuming alcohol after a suicide attempt that had serious medical consequences increases the risk of re-attempting suicide or having a successful suicide [10]. Drinking is therefore considered a predisposing factor for suicide. Behavioral problems due to impulsiveness after drinking are presumed to be directly related to suicidal ideation and induce actual suicide attempts in addition to other problems related to drinking. Several studies have explored the correlation between drinking and suicide, but no study has yet investigated how an individual's drinking behavior is associated with suicide attempts.

This study aimed to examine the link between factors related to drinking and attempted suicide in the working population by examining the effects of alcohol consumption in people who have suicidal ideation, cross-sectionally. This work may help to prevent future suicides of workers by eval-

uating risks associated with suicide attempts and thus minimize socioeconomic losses of society. Correlations between drinking and suicide were analyzed according to sex and age, and other sociodemographic factors that might influence suicide attempts were also inspected.

METHODS

Participants
This was a cross-sectional study that targeted individuals between the ages of 20 and 65 who participated in a mental health examination program conducted by the Workplace Mental Health Institute of Kangbuk Samsung Hospital. The participants were employees of 52 different corporations, government institutions, and private institutions, who voluntarily participated in the study. This study was conducted from 2014 to 2019: a total of 15,226 individuals completed the survey on suicidal ideation and suicide attempt. After excluding 27 inappropriate responses in which answered that they attempted suicide without suicidal ideation, a total of 15,199 participants were included in the analysis. The 12,177 participants who had no suicidal ideation or suicide attempts were categorized into Group 1, while 2,843 participants who had suicidal ideation but no suicide attempts were categorized into Group 2, and 179 participants who had both suicidal ideation and suicide attempts were categorized into Group 3 (Fig. 1). The total missing data value was less than 1% for each variable. This study obtained the approval of the Institutional Review Board of Kangbuk Samsung Hospital (IRB no. KBSMC 2019-01-042). Informed consents were not obtained because the study was conducted using anonymized data only.

Research tool
Sociodemographic assessment of participants
Participants' age, sex, obesity index, marital status, education level, and work position were evaluated. The obesity index was assessed based on body mass index (BMI). Marital status was classified into single, married, or other. Education level was classified into high school/junior college or college degree or higher. Work position was classified into employee, manager, deputy section chief, section chief, deputy department head, department head, executive, or other.

Major questionnaires
To assess suicidal ideation, participants were asked to answer "never," "occasionally," or "almost always" to the ques-
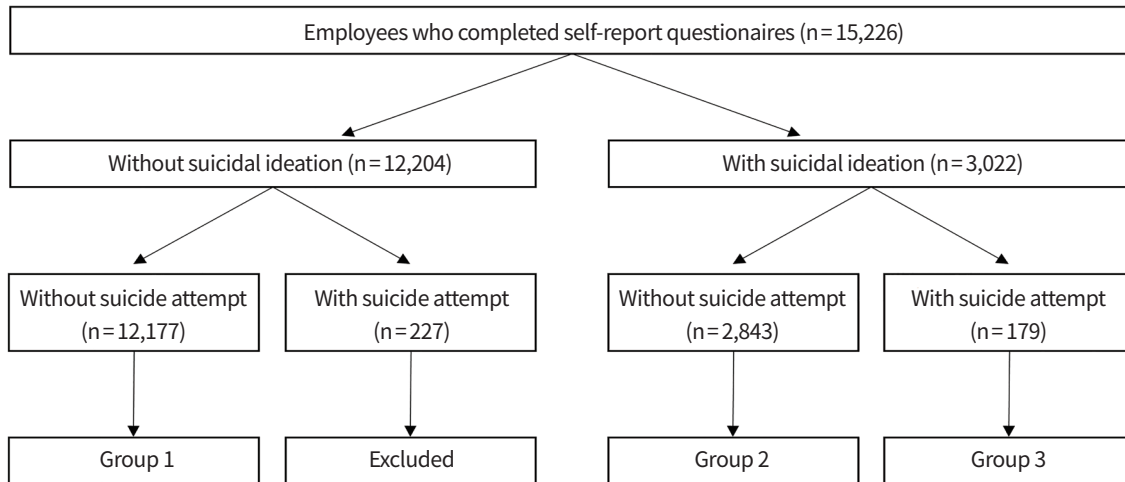
Fig. 1. Study population.

tion, "Have you thought about suicide in the past year?" from KNHANES [4]. Participants who answered, "never" were categorized into the "without suicidal ideation" group, while those who answered "occasionally" or "almost always" were categorized into the "with suicidal ideation" group.

To assess prior suicide attempt, participants were asked to answer "never," "self-injury but no suicide attempt," or "attempted suicide," to the question, "Have you attempted suicide in the past year?" from KNHANES [4]. Participants who answered "never" were categorized into the "without suicide attempt" group, while those who answered "self-injury but no suicide attempt" (133 participants) or "attempted suicide" (46 participants) were categorized into the "with suicide attempt" group in a broad sense, considering the strong linkage between nonsuicidal self-injury and suicide attempt [11, 12].

Drinking level was measured using the Alcohol Use Disorders Identification Test-Korea (AUDIT-K). Each item of the AUDIT-K evaluates consumption quantity, behavior, and presence of psychological-social problems [13]. The AUDIT-K consists of 10 items scored from 0 to 4 in which a high score indicates greater severity. The total score ranges from 0 to 40. Items 1–3 were defined in previous studies as AUDIT-Alcohol Consumption Questions (AUDIT-C) [14], and their validity and reliability have been proven as a screening tool [15]. In this study, items 4–10, which relate to dependence and problematic behavior, have been defined as Alcohol Dependence/related Problem Questions (AUDIT-D/P).

Other questionnaires
The Korean version of the Center for Epidemiological Studies

Depression Scale (CES-D), developed for an epidemiological survey on depression in the general population, was used to assess depression symptoms [16]. The CES-D is a self-reporting scale consisting of 20 items in which a high score indicates greater severity. The total score ranges from 0 to 60.

Anxiety symptoms were assessed using the Korean version of the Beck Anxiety Inventory (BAI) [17]. The BAI is a self-reporting scale consisting of 21 items scored from 0 to 3 in which a high score indicates greater severity. The total score ranges from 0 to 63.

Occupational stress was measured using the Korean Occupational Stress Scale (KOSS) [18]. This scale consists of 27 items in seven subcategories: job demands, insufficient job control, interpersonal conflict, job insecurity, organizational system, lack of reward, and organizational culture. Each item is scored from 1 to 4. The total score ranges from 27 to 108.

Several additional tools, including the Perceived Stress Scale (PSS) [19], Daily Life Stressors Scale (DLSS) [20], Connor-Davidson Resilience Scale (CD-RISC) [21], and World Health Organization-Quality of Life (WHO-QOL) scale [22], were used to assess different types of stress and quality of life.

Each scale was completed in a self-reporting format.

Statistical analyses
Data were analyzed using SPSS Statistics for Windows version 18.0 (SPSS Inc., Chicago, IL, USA). Participants were divided into three groups: participants without suicidal ideation and suicide attempt (Group 1), participants with suicidal ideation but without suicide attempt (Group 2), and participants with suicidal ideation and suicide attempt (Group 3). Multiple logistic regression model was used to evaluate the

multicollinearity of variants such as depression, anxiety, occupational stress, alcohol, perceived stress, daily-life stressors, resilience, quality of life. The model was statistically significant (P<0.01). For further analysis, chi-square tests and one-way analysis of variance (ANOVA) tests were performed to analyze the sociodemographic and clinical characteristics of each group. Bonferroni corrections were performed to compare the three groups. The significance level for all statistics was established at P<0.05.

RESULTS

Sociodemographic characteristics

The average age of the 15,199 participants was 39 years; 58.2% (n=8,843) were male and 41.8% (n=6,356) were female.

Among the 15,199 participants, 3,022 participants had suicidal ideation and 179 participants had attempted suicide.

The severity of suicide risk increased from Group 1 to Group 3 by order. Increased suicide risk was significantly associated with decreased age (P<0.001), female (P<0.001), unmarried status (P<0.001), lower education level (P<0.001), and lower position such as employee or in a managerial position (P<0.001). BMI was statistically different among the groups (P=0.029), but no apparent tendency was observed from Group 1 through Group 3 (Table 1).

Psychiatric characteristics

Several associations with self-reporting scales for increased suicide severity were observed. Scores for depression (CES-D), anxiety (BAI), occupational stress (KOSS), drinking (AUDIT-K), perceived stress (PSS), and daily-life stressors (DLSS) were significantly higher in Group 2 than Group 1, and higher in Group 3 than Group 2 (P<0.001), while resilience (CD-RISC) and quality of life (WHO-QOL) were lower in Group 2 than Group 1 and

Table 1. Sociodemographic characteristics of employees

Characteristic	Group 1 (n=12,177)	Group 2 (n=2,843)	Group 3 (n=179)	P-value
Age (yr)	39.43±9.46	37.96±8.65	37.09±8.79	<0.001
BMI (kg/m^2)	23.37±3.83	23.25±4.48	24.04±8.35	0.029
Sex				<0.001
Male	7,421 (60.9)	1,356 (47.7)	65 (36.3)	
Female	4,755 (39.8)	1,487 (52.3)	114 (63.7)	
Marital status				<0.001
Single	3,792 (39.8)	1,062 (37.4)	73 (40.8)	
Married	7,624 (62.6)	1,529 (53.8)	94 (52.5)	
Other	229 (1.8)	97 (3.5)	7 (4.0)	
Education				<0.001
High school/Jr. College	3,568 (29.3)	839 (29.5)	77 (43.0)	
College degree/higher	7,971 (65.5)	1,829 (64.3)	97 (54.2)	
Position				<0.001
Employee	2,706 (22.2)	704 (24.8)	60 (33.5)	
Manager	2,909 (23.9)	763 (26.8)	55 (30.7)	
Deputy section chief	2,013 (16.5)	513 (18.0)	20 (11.2)	
Section chief	1,670 (13.7)	366 (12.9)	12 (6.7)	
Deputy department head	1,126 (9.2)	213 (7.5)	14 (7.8)	
Department head	732 (6.0)	80 (2.8)	2 (1.1)	
Executive	392 (3.2)	41 (1.4)	4 (2.2)	
Other	627 (5.1)	160 (5.6)	12 (6.7)	

Values are presented as mean ± standard deviation or number (%). Group 1: participants who had no suicidal ideation and had not attempted suicide; Group 2: participants who had suicidal ideation and had not attempted suicide; Group 3: participants who had suicidal ideation and had attempted suicide.
BMI, body mass index.

lower in Group 3 than Group 2 (P<0.001). These tendencies were mostly significant in *post hoc* analyses as well, yet no statistically significant difference for daily-life stressors was observed between Group 2 and Group 3 (Table 2).

Table 2. Psychiatric characteristics of employees

Characteristic	Group 1 (n=12,177)	Group 2 (n=2,843)	Group 3 (n=179)	P-value	Group 1&2 P-value[a]	Group 2&3 P-value[a]	Group 1&3 P-value[a]
Depression (CES-D)	8.15±7.865	17.57±11.587	24.55±13.991	<0.001	<0.001	<0.001	<0.001
Anxiety (BAI)	5.48±6.574	12.89±10.115	20.72±13.021	<0.001	<0.001	<0.001	<0.001
Occupational stress (KOSS)	60.23±9.216	66.07±9.370	68.77±9.967	<0.001	<0.001	<0.001	<0.001
Alcohol (AUDIT-K)	7.77±6.290	9.08±7.348	11.22±8.227	<0.001	<0.001	<0.001	<0.001
Perceived stress (PSS)	15.66±5.262	20.39±5.328	22.63±5.722	<0.001	<0.001	<0.001	<0.001
Daily-life stressors (DLSS)	87.00±33.632	99.17±13.402	100±0	<0.001	<0.001	1.000	<0.001
Resilience (CD-RISC)	65.53±15.222	54.84±15.558	50.64±17.664	<0.001	<0.001	0.001	<0.001
QOL (WHO-QOL)	55.88±8.300	48.06±7.963	44.64±7.778	<0.001	<0.001	<0.001	<0.001

Values are presented as mean±standard deviation. Group 1: participants who had no suicidal ideation and had not attempted suicide; Group 2: participants who had suicidal ideation and had not attempted suicide; Group 3: participants who had suicidal ideation and had attempted suicide.
CES-D, The Center for Epidemiologic Studies Depression Scale; BAI, Beck Anxiety Inventory; KOSS, Korean Occupational Stress Scale; AUDIT-K, Alcohol Use Disorders Identification Test-Korea; PSS, Perceived Stress Scale; DLSS, Daily Life Stressors Scale; CD-RISC, The Connor-Davidson Resilience Scale; WHO-QOL, World Health Organization-Quality of Life.
[a]Bonferroni correction.

Table 3. AUDIT-K specific factor analysis by sex

Variable	Overall	Group 1	Group 2	Group 3	P-value	Group 1&2 P-value[a]	Group 2&3 P-value[a]	Group 1&3 P-value[a]
Total								
Number	15,199	12,177	2,843	179				
AUDIT-K		7.77±6.290	9.08±7.348	11.22±8.227	<0.001	<0.001	<0.001	<0.001
AUDIT-C		5.21±3.336	5.38±3.415	5.72±3.540	0.008	0.040	0.595	0.136
AUDIT-D/P		2.56±3.702	3.70±4.622	5.51±5.533	<0.001	<0.001	<0.001	<0.001
Male								
Number	8,843	7,422	1,356	65				
AUDIT-K		9.17±6.330	11.20±7.258	14.43±8.421	<0.001	<0.001	<0.001	<0.001
AUDIT-C		6.14±3.241	6.63±3.242	6.55±3.729	<0.001	<0.001	1.000	0.921
AUDIT-D/P		3.03±3.908	4.57±4.796	7.88±5.846	<0.001	<0.001	<0.001	<0.001
Female								
Number	6,356	4,755	1,487	114				
AUDIT-K		5.59±5.563	7.15±6.886	9.39±7.562	<0.001	<0.001	<0.001	<0.001
AUDIT-C		3.76±2.939	4.25±3.166	5.24±3.351	<0.001	<0.001	0.002	<0.001
AUDIT-D/P		1.83±3.221	2.90±4.306	4.16±4.878	<0.001	<0.001	0.001	<0.001

Values are presented as mean±standard deviation. Group 1: participants who had no suicidal ideation and had not attempted suicide; Group 2: participants who had suicidal ideation and had not attempted suicide; Group 3: participants who had suicidal ideation and had attempted suicide.
AUDIT-K, Alcohol Use Disorders Identification Test-Korea; AUDIT-C, alcohol consumption score; AUDIT-D/P, alcohol dependent/related problem score.
[a]Bonferroni correction.

Characteristics related to drinking

The overall score (AUDIT-K) and item scores (AUDIT-C, AUDIT-D/P) for drinking scales were compared between the groups, and all scores were significantly different, indicating that as alcohol use problem increased, suicide severity also increased. With regard to the AUDIT-C, no statistically significant difference between Group 2 and Group 3 was observed in the *post hoc* analysis (P=0.595), while a statistically significant difference for all three groups was observed for the AUDIT-D/P in the *post hoc* analysis (Table 3).

Meanwhile, alcohol consumption quantity and behavior are different according to sex [23]. When the overall scores and item scores were compared for all groups according to sex, all scores increased from Group 1 to Group 3. For male participants (n=8,843), the difference in the AUDIT-C items between Group 2 and Group 3 was statistically non-significant (P=1.000), while those for the AUDIT-D/P were all statistically significant (P<0.001) in *post hoc* analyses. For female participants (n=6,356), the differences in the overall scores and item scores were statistically significant for all groups in the *post hoc* analyses (Table 3).

Also, the overall scores and item scores were compared by dividing the participants in each group by age to examine whether there was a difference according to age. Scores for all ages were significantly different between the groups, except for AUDIT-C scores for participants in their 20s (P=0.553), among whom (n=2,718), there was no significant difference in any scores between Group 2 and Group 3 according to *post hoc* analyses. Additionally, the difference in the AUDIT-C scores for participants in their 30s (n=5,566) was not statistically significant between Group 2 and Group 3 in *post hoc* analyses (P=0.066), whereas the difference in AUDIT-D/P was statistically significant (P=0.007). Similarly, the difference in the AUDIT-C scores for participants in their 40s or over (n=6,915) was not statistically significant between Group 2 and Group 3 in *post hoc* analyses either (P=1.000), whereas the difference in the AUDIT-D/P across groups was statistically significant (P<0.001) (Table 4).

DISCUSSION

This study analyzed various factors that may influence sui-

Table 4. AUDIT-K specific factor analysis by age group

	Overall	Group 1	Group 2	Group 3	P-value	Group 1&2 P-value[a]	Group 2&3 P-value[a]	Group 1&3 P-value[a]
20s								
Number	2,718	2,145	534	39				
AUDIT-K		8.04±6.049	9.30±7.425	9.16±8.803	<0.001	<0.001	1.000	0.860
AUDIT-C		5.36±3.053	5.43±3.288	4.87±3.618	0.553	1.000	0.859	1.000
AUDIT-D/P		2.69±3.773	3.88±4.874	4.29±5.756	<0.001	<0.001	1.000	0.047
30s								
Number	5,566	4,300	1,190	76				
AUDIT-K		7.75±6.400	8.73±7.158	11.08±7.377	<0.001	<0.001	0.008	<0.001
AUDIT-C		5.11±3.299	5.19±3.349	6.09±3.082	0.031	1.000	0.066	0.031
AUDIT-D/P		2.63±3.838	3.54±4.489	4.99±5.056	<0.001	<0.001	0.007	<0.001
Over 40s								
Number	6,915	5,731	1,119	65				
AUDIT-K		7.69±6.293	9.34±7.499	12.60±8.673	<0.001	<0.001	<0.001	<0.001
AUDIT-C		5.23±3.461	5.56±3.534	5.77±3.944	0.007	0.010	1.000	0.637
AUDIT-D/P		2.46±3.566	3.78±4.636	6.83±5.749	<0.001	<0.001	<0.001	<0.001

Values are presented as mean±standard deviation. Group 1: participants who had no suicidal ideation and had not attempted suicide; Group 2: participants who had suicidal ideation and had not attempted suicide; Group 3: participants who had suicidal ideation and had attempted suicide.

AUDIT-K, Alcohol Use Disorders Identification Test-Korea; AUDIT-C, alcohol consumption score; AUDIT-D/P, alcohol dependent/related problem score.

[a] Bonferroni correction.

cidal ideation and suicide attempt in the working population of Korea and confirmed that alcohol dependence and problematic behavior after alcohol consumption play key roles in suicide attempts. Many studies have focused on the relationship between alcohol use and suicide, but no study has separated the drinking problem by alcohol consumption quantity from related problematic behavior and individually assessed their risk for suicide attempt. This is also the first large-scale study that examines the relationship between alcohol use and suicide attempt in the working population which includes relatively a large number of participants who attempted suicide, thus highlighting the importance of identifying high-risk groups for suicide among employees.

It was found that alcohol dependence and related problematic behavior has a strong connection from suicidal thoughts to actual suicide attempts. This correlation was common in both sexes and across all age groups above 30 years old. Subcategories of the AUDIT-D/P related to alcohol dependence and problematic behavior include impaired control over drinking, malfunction, morning drinking, feelings of guilt, blackouts, alcohol-related injuries, and the concern of others [13], which are indices for alcohol-related dependence and functioning in daily living. The items of the AUDIT-D/P represent different effects of frequent drinking in daily life, which may be caused by reduced executive function and can further deteriorate executive function. Thus, a prediction can be made that the AUDIT-D/P items would be significantly correlated with attempted suicide risk. Drinking has consistently been demonstrated in previous studies to induce deteriorated executive function such as cognitive function, psychomotor retardation, and response inhibition, not only in patients with alcohol use disorder (AUD) but also in the general population [24]. Suicide is associated with impairment of executive functions such as decision-making and impulse control [25], which are known to increase suicide risk in patients with depression [26,27]. Additionally, suicidal behavior in patients with AUD is strongly correlated with psychopathological symptoms of alcohol dependence, like poor impulse control [28]. Suicide attempts in these patients are less fatal and tend to be repetitive and are thus often collectively referred to as "deliberate self-harm syndrome" [29]. Accordingly, it can be predicted that individuals with suicidal ideation may have a high risk of future suicide attempts due to deteriorated judgment and difficulty with impulse control caused by executive function impairment after drinking. More accurate assessments and interventions are needed for drinkers with a high risk for suicide, considering the high possibility of recurrence of future suicide attempts [28].

Additional analyses to examine differences by sex showed that female participants exhibited an apparent correlation between past suicide attempt and drinking quantity, unlike male participants. This result may be attributed to alcohol tolerance differences between men and women. Men have higher total body water volume and higher levels of alcohol dehydrogenase than women and are less affected by drinking quantity [30]. These vulnerabilities must be taken into consideration when establishing preventive measures for suicide because consumption quantity has a greater effect on suicide attempt risk in women. This finding is consistent with a previous study that reported that females have a higher rate of intoxication and twice the BAC or higher than males at the time of committing suicide [6].

This study also included an analysis stratified by age, because age differences in alcohol consumption have been reported [31]. The result showed an increasing correlation between alcohol dependence and problematic behavior and suicide attempt with increasing age, which was in contrast to drinking quantity and frequency. The elderly are generally known to have lower rates of excessive drinking and higher rates of non-drinking compared with younger groups [31]. However, most of the participants in this study were assumed to be of relatively young age compared with other elderly studies because this study specifically targeted the working population. Therefore, the results are likely to be due to decreased metabolism by increased age, as change in drinking amount is not so significant within the working population.

The first limitation of this study is that a causal relationship between alcohol use and suicide could not be demonstrated because of the cross-sectional design. Second, the assessment of each risk factor was subjectively assessed and greatly simplified due to the self-reported survey. Third, the results may not be representative of the general working population or the general population because the study targeted subjects recruited from a few institutions. Moreover, the groups also differ in other psychopathologies such as depression and anxiety, and these interactions may have influenced suicidality.

Despite these limitations, this study offers several contributions and advantages. First, it is the first study to identify a correlation between alcohol use and suicide attempt based on analyses that distinguish between drinking amount/frequency and dependence/problematic behavior. Second, the validity and reliability of the self-reporting scales used in this

study have been established in numerous previous studies and are currently used in various institutions. Third, compared with previous studies conducted on a relatively small number of subjects, this study recruited nearly 15,000 participants to obtain more objective and reliable results, thus enabling a more meaningful contribution to establishment of preventive measures for suicide. Fourth, excluding autopsy studies, this is the first study to focus on drinking in a large number of individuals who had actually attempted suicide. This study can be supplemented in the future by targeting a greater number of participants in the working population or the general population or by conducting analyses on detailed items related to alcohol consumption.

In conclusion, alcohol-related dependence and problematic behavior in the working population are strongly correlated with risk of attempting suicide. Therefore, an assessment of drinking-related factors is particularly crucial among various factors that can evaluate suicide risk. It is important to identify which people have a higher risk of attempting suicide during mental health examinations, and to emphasize the correlation between alcohol-related dependence and problematic behavior and suicide attempts during education on drinking and suicide prevention at the workplace. Consequently, the socioeconomic loss to corporations and society can be minimized if suicide attempts can be prevented. Moreover, social mechanisms should be provided to enable people to seek professional help more easily when they consider themselves at risk.

CONFLICTS OF INTEREST

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

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