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**The effect of alcohol use  
on the characteristics of suicidal behaviors  
and risk of repetition of suicide attempt**

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**The effect of alcohol use  
on the characteristics of suicidal behaviors  
and risk of repetition of suicide attempt**

**Directed by Professor Seongho Min**

**A Doctoral Dissertation**

**Submitted to the Department of Medicine  
and the Graduate School of Yonsei University**

**in partial fulfillment of the  
requirements for the degree of**

**Doctor of Medicine**

**Jinhee Lee**

**July 2019**

**This certifies that the Doctoral Dissertation  
of Jinhee Lee is approved**

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**July 2019**

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## **ABSTRACT**

# **The effect of alcohol use on the characteristics of suicidal behaviors and risk of repetition of suicide attempt**

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Suicide is one of the most serious public health problems, according to the World Health Organization report, about one million people die from suicide each year. Suicide is known to occur because of the combined effects of various factors, but numerous studies have reported particular relation with alcohol drinking. Alcohol is used widely worldwide and is known to cause not only various physical diseases

but also problems related to impulse control such as violence, self-harm, and suicide. Therefore, this study aimed to outline the transient and prolonged effects of alcohol use patterns on suicide attempters.

The participants in this study were suicide attempters who visited Gangwon Western Region Emergency Medical Center during the 6-year period from March 1, 2010, to December 31, 2015. This study obtained the sociodemographic and clinical information of these participants. Through the interview by psychiatrist, the Participants were categorized into following three groups according to alcohol use pattern at the time of the suicide attempt: 1) suicide attempters with neither alcohol use disorder nor acute alcohol consumption (NAU), 2) suicide attempters who had used alcohol during the suicide attempt but did not have alcohol use disorder (AAU), and 3) suicide attempters with alcohol use disorder (AUD). Group comparisons and multivariate Cox proportional models for suicidal behavior were used for statistical analysis.

The results showed that patients with AUD attempted suicide with more help seeking behaviors and had higher proportion of low medical lethality compared to not only NAU but also AAU group and AUD was related to higher risk of suicide reattempt compare to other groups and the increased risk was prolonged longer period.

The findings of study suggest the impulsive suicide attempts are more strongly

associated with AUD than with AAU and AUD was found to increase the risk of repeated suicide attempts. The results highlight the importance of evaluation of alcohol use for suicide attempters regardless of whether they had consumed alcohol at the time of the recent suicide attempt, and need of specific and individualized aftercare programs with suicide attempters with alcohol use disorder for the sufficient duration.

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Key Words: Suicide, Suicide attempt, Alcohol use disorder

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**I. INTRODUCTION**

**1. Background**

According to the World Health Organization (WHO) report, about one million

people die from suicide each year. Suicide attempts are a major public health problem, with an estimated 25 million suicide attempts occurring each year worldwide (Walsh, Ribeiro, & Franklin, 2017).

Suicide is known to occur because of the combined effects of various factors, but numerous studies have reported particular relation with alcohol drinking (Wilcox, Conner, & Caine, 2004). Alcohol is used widely worldwide and is known to cause not only various physical diseases but also problems related to impulse control such as violence, self-harm, and suicide. Suicide attempters are commonly in an acute alcohol consumption state; in previous studies, about 33%–66% of suicide victims were reported to have a positive response to serum alcohol (Giancola et al., 2002). In addition, patients with alcohol dependence are more likely to commit impulsive and fatal attempts (Jakubczyk et al., 2012), and alcohol itself is known as an important risk factor of suicide reattempt (Haukka, Suominen, Partonen, & Lönnqvist, 2008).

Alcohol is one of the leading causes of the global burden of disease, and alcohol use disorders (AUDs) are known to be a major risk factor for suicide (Ezzati et al., 2002). AUDs are the second most common psychiatric disorder among those exhibiting suicidal behaviors worldwide, following major depression (Cavanagh, Carson, Sharpe, & Lawrie, 2003). Further, about 40% of patients with AUD have had at least one suicide attempt at some point (Koller, Preuss, Bottlender, Wenzel,

& Soyka, 2002). A large cohort study conducted in Denmark indicated that suicide mortality was higher in patients with AUD than it was in any other psychiatric illness (unadjusted hazard ratio: 7.98) (Flensburg-Madsen et al., 2009). On the other hand, acute alcohol use (AAU) increases the risk of suicidal behavior, which indicates that alcohol consumption at the time of suicide is not merely a reflection of ongoing drinking problems (Borges & Rosovsky, 1996). Further, about 37% (10–69%) of suicide decedents and 40% (10–73%) of suicide attempters were found to have used alcohol at the time of the suicide attempt (Cavanagh et al., 2003). Several studies have examined the overlapping effect of AUD and AAU on suicide attempts (Boenisch et al., 2010). One previous study suggested that individuals attempting suicide under the influence of alcohol were more likely to have AUD (30–49%) (Lejoyeux et al., 2008) and other studies found that the rate of AAU was higher in individuals with AUD in completed suicides (69% vs. 23%) (Pirkola, Isometsa, Heikkinen, & Lonnqvist, 2000) and in suicide attempts (83% vs. 31%) (Hawton, Fagg, & McKeown, 1989). However, since the alcohol use patterns are often duplicated and it is difficult to distinguish clearly, there are few studies that separately examine the effects of the AUD and AAU on suicidal behavior.

The suicide rate in Korea is the second highest among the Organization for Economic Co-Operation and Development (OECD) member countries, with 25.8 deaths per 100,000 people, which is approximately 2.2 times higher than the OECD

average of 11.6 deaths per 100,000 people (OECD, 2018). Suicide is the fourth leading cause of death following cancer, stroke, and cardiovascular disease (Korea National Statistical Office, 2012). Therefore, suicide is considered one of the most serious and urgent public health and social issues in Korea. There are a number of hypothesis that try to explain the high suicide rate in Korea such as, extremely competitive and increasingly polarized Korean society, the lack of welfare programs to assist struggling individuals and families, cultural belief that suicide is an individual problem, and stigma for psychiatric treatment (Kim & Yoon, 2013).

The high rate of alcohol consumption is one of the potent hypothesis to explain the high rate of suicide attempt in Korea. In Korea, the per capita consumption of alcohol is 7.95 L, and the annual drinking rate of adults is close to 77%, which is far above the world average according to the WHO statistics published in 2014. According to previous study, Lifetime prevalence of alcohol use disorder was 15.6 % (abuse 6.8 %, dependence 8.8 %) and 1-year prevalence 7.5 % (abuse 2.5 %, dependence 5 %) in Korea and the male-to-female ratio of lifetime prevalence was 5.8, which markedly decreased with decreasing age (Cho et al., 2004).

## **2. Research purpose**

Although controversy still exists with the alcohol use pattern in relation to the risk

factors for suicide reattempts, alcohol use has been known to be associated with repeated suicide attempts (Wojnar et al., 2008).

However, studies on the association between alcohol use pattern and suicide reattempts are lacking in Korea, and very little is known about the effect of alcohol use in prolonged risk of suicide reattempt. In these contexts, we aimed to outline the transient and prolonged effects of alcohol use patterns on suicide attempters. The main objectives of the present study were: 1) to assess the characteristics of suicidal behaviors according to alcohol use patterns; 2) to compare the lethality and intent of suicide attempters by alcohol use patterns; 3) to investigate the prolonged risks of repeated suicide attempts by alcohol use patterns. To our knowledge, this is the first study to compare the characteristics of suicidal behaviors within groups according to non-overlapping patterns of alcohol use, using a Korean sample who have both high rates of suicide and alcohol consumption at the same time.

## II. MATERIALS AND METHODS

### 1. Study subjects

Study subjects were 1659 suicide attempters who visited Gangwon Western Region Emergency Medical Center during the 6-year period from March 1, 2010, to December 31, 2015. A suicide attempt was defined as self-destructive behavior with the intention of ending one's life, leading to a patient's admission to the emergency room (Hillbrand, Krystal, Sharpe, & Foster, 1994). Data on 691 suicide attempters were finally analyzed, excluding those who were aged less than 18 years (N=139), were not available to evaluate alcohol use history (N=139), and had refused the case management program intervention (N=636) (Fig. 1). All subjects were fully informed about the aims and methods of the study and the case management program, and informed consent was obtained prior to participation.

### 2. Baseline Procedures

Suicide attempters who visit emergency rooms was requested first by having

emergency medical center interns, who are in charge of the first medical examination, conduct an interview and fill out the record form. Then, after physical assessment by an emergency department physician, a psychiatric interview was conducted with all patients, with modifying and improving the interview record form.

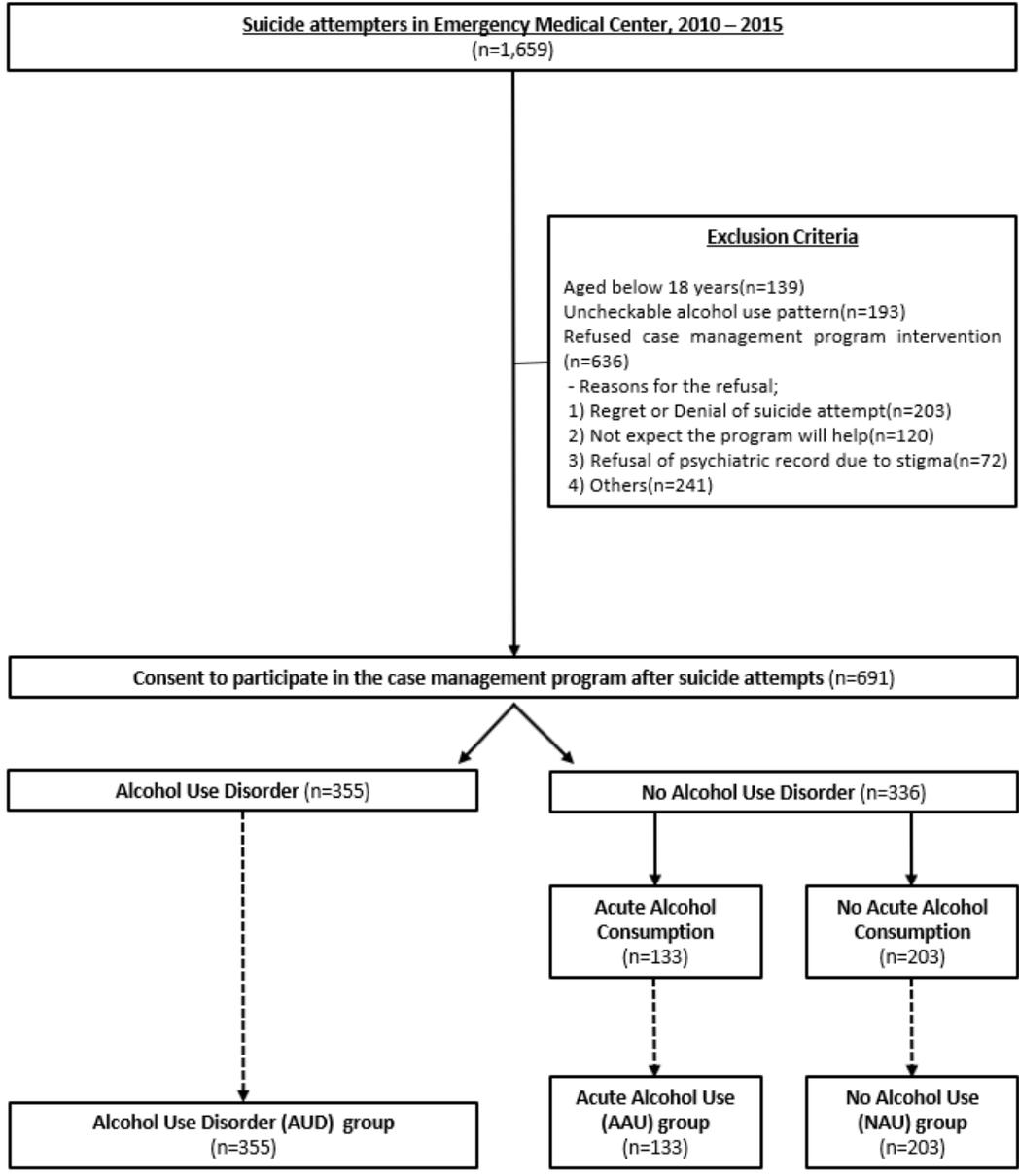


Figure 1. Selection process of the study subjects

### **3. Measures**

#### **1) Sociodemographic characteristics and Psychiatric characteristics**

Basic sociodemographic data were collected from the participants who could be interviewed among the suicide attempters that visited the emergency rooms. Age, gender, education level, marital status, religion, employment, monthly income, and medical problems were also investigated.

For psychiatric characteristics, history of suicide attempts, history of psychiatric treatment, current psychiatric treatment, family history of suicide, family psychiatric illness history, and psychiatric follow up after suicide attempt were investigated.

#### **2) Suicide-related factors**

The characteristics of suicide behaviors presented were assessed for all patients, including current suicide ideation, suicide plan, last will, method of suicide attempt, help seeking, and medical lethality were investigated. Moreover, motivation of suicide attempt was also identified to determine the direct cause of the suicide

attempt such as psychiatric problems, interpersonal problems, work/school problems, economic problems, physical problems, and family problems.

### **3) Risk-Rescue Rating**

The Risk-Rescue Rating (RRR) was used to measure the current lethality of suicide attempt after checking with the patients and their families regarding the situation at the point of suicide attempt (Weisman & Worden, 1972). If it was difficult to interview the patients, the information was reconfirmed through cooperative treatment with other departments such as emergency medicine and internal medicine after they were hospitalized and could be interviewed. The risk score consists of five factors: lesion/toxicity, agent used, impaired consciousness, reversibility, and treatment required. Each factor is rated on a scale of 1 to 3, and the total is then converted to an overall risk score coefficient ranging from 1 (low risk) to 5 (high risk). The rescue score consists of five factors, the location of the event, person initiating the rescue, accessibility to rescue, delay until discovery, and probability of discovery by a rescuer, each of which is also rated on a scale of 1 to 3. The total is then converted to the rescue score coefficient, ranging from 1 (least rescuable) to 5 (most rescuable). Then, the RRR score is calculated by adding the

risk score to the rescue score and then dividing it by the risk score. Lower RRR score indicates lower lethality and vice versa.

#### **4) Suicidal Intent Scale**

The Suicidal Intent Scale (SIS) was developed to assess the risk of suicide and severity of suicidal intent. It is used widely because it quantifies suicidal intentions and has been validated, exhibiting a high correlation with suicide risk (Misson et al., 2010). The SIS score was calculated by summing the circumstances score (eight items) and self-report score (seven items), with higher scores indicating higher suicide intention.

#### **5) Categorization of alcohol use patterns**

To evaluate the alcohol drinking pattern of suicide attempters, we assessed the consumption of alcohol at the time of the suicide attempt and used a three-items subscale of the Alcohol Use Disorders Identification Test (AUDIT-C) (Babor, Kranzler, & Lauerma, 1989). Acute alcohol use was considered present if the suicide attempters consumed alcohol before and/or at the time of the suicide attempt. Male suicide attempters who had AUDIT-C scores of 7 or higher, and

females with scores of 6 or higher were considered to have alcohol use disorder. The higher cut-off scores of the AUDIT-C in the Korean population as compared to that in other countries (4 or higher in men and 3 or higher in women) (Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998) represent the high frequency and quantity of alcohol drinking observed in Korea, and the validity of the cut-off scores has been confirmed in a previous study (Seong et al., 2009). Thus, based on the AUDIT-C scores, we divided the suicide attempters into the following three groups: (1) suicide attempters with neither alcohol use disorder nor acute alcohol consumption (NAU; n=203 (29.4%)), (2) suicide attempters who had used alcohol during the suicide attempt but did not have alcohol use disorder (AAU; n=133 (19.2%)), and (3) suicide attempters with alcohol use disorder (AUD; n=355 (51.4%)).

#### **4. Follow-up procedures**

Participants who consented to participation in the study have been followed up by trained investigators. The investigators were mainly psychiatric nurses and social workers, but the procedures and assessments of the study were guided and supervised by two psychiatrists, and weekly consensus meetings were held with the entire investigators, two psychiatry residents, and two psychiatrists. Each

participant is assessed for repeat suicide attempts every 3 months, via face-to-face or over the phone interviews, and/or he/she is contacted at the time of suicide reattempt (Figure 2).

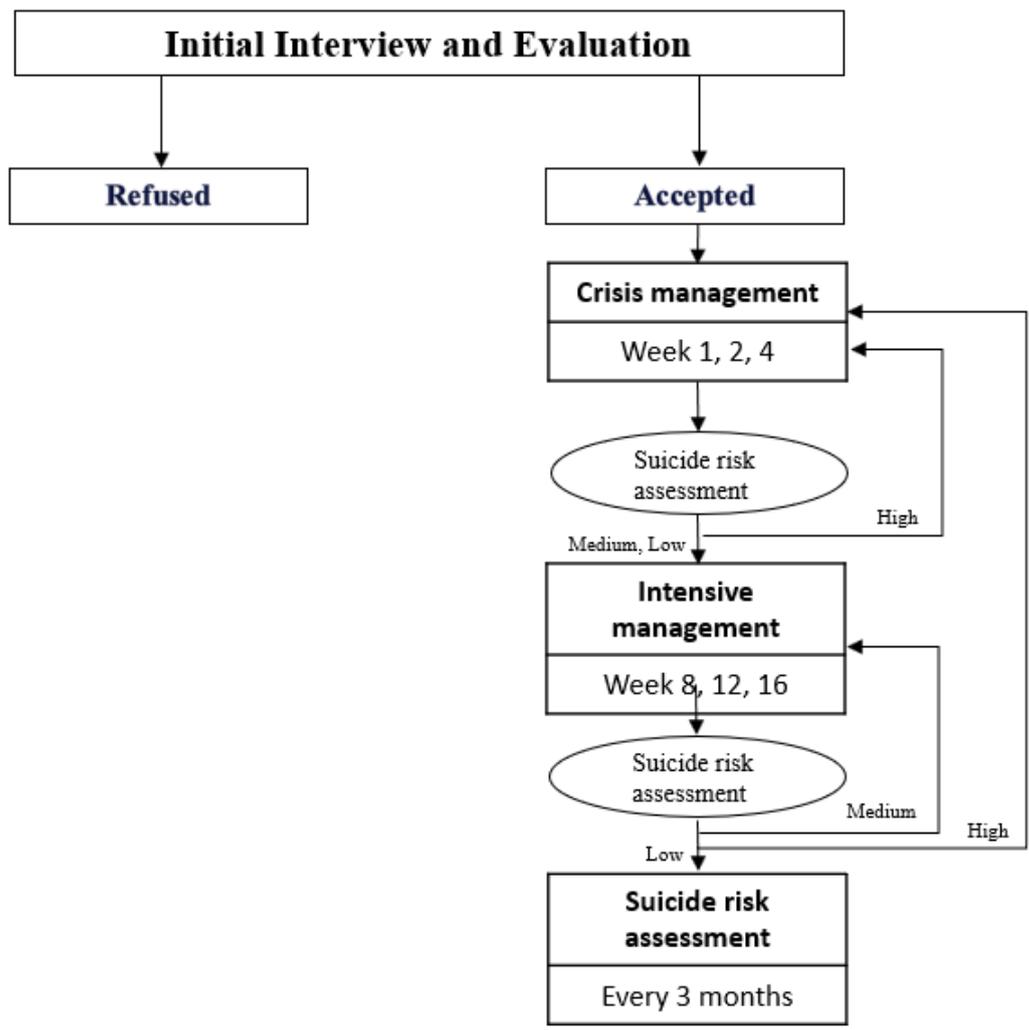


Figure 2. Algorithm of the follow-up procedure for suicide attempters

## 5. Statistical Analysis

At baseline, we compared the sociodemographic and suicidal behavior characteristics of the three groups using a Pearson's chi square test and a one-way ANOVA. The RRRS and SIS scores were compared using the Scheffe's method. The primary endpoint was based on a survival analysis and was determined using the Cox proportional model. The length of follow-up for each subject was determined by the number of months between the baseline evaluation and the date of either a repeat suicide attempt or the end of the follow-up period. The results are reported as hazard ratios (HRs) with 95% confidence intervals (CI) and p values from the Cox proportional hazard regression model. Furthermore, multivariate Cox proportional models were applied to examine group differences after controlling for demographic factors (age, sex, education level, marriage status, religion, employment, monthly income, smoking, and medical problems) and characteristics of suicide behaviors (suicide ideation, suicide plan, last will, past suicide attempt history, method of suicide attempt, medical lethality, and help seeking). Further, the Kaplan-Meier method was used to compare the point of suicide reattempt for the participants. All statistical analyses were performed using SPSS (version 23.0, IBM Corp., Armonk, NY, USA), and statistical significance was declared at  $p < 0.05$ . This

study was approved by the institutional review board of the Yonsei University Wonju College of Medicine (YWMR-15-9-097). All the participants provided informed consent.

## □. RESULTS

### 1. Comparison of characteristics of suicide attempters depending on alcohol use patterns

The final sample included 691 suicide attempters, who were divided into the three groups according to the pattern of alcohol use in relation to the suicide attempt. The descriptive statistics and proportions of each alcohol use pattern among suicide attempters who visited the emergency room have been presented in Table 1. Among the suicide attempters, 19.2% had AAU, and 51.4% had AUD. And also 78.9% of AUD group had drunk alcohol at the time of suicide attempt. There were significant differences between the three groups in terms of age, gender, education level, religion, monthly income, medical problems, and smoking status but no differences were found for marital status and employment. The participants belonging to the NAU group were significantly older ( $52.87 \pm 20.15$  vs. AAU:  $47.11 \pm 16.54$  and AUD:  $41.96 \pm 14.25$ ;  $p < 0.001$ ) and a larger proportion among them had medical problems (50.5% vs. AAU: 30.8% and AUD: 28.6%;  $p < 0.001$ ) as compared to the others. Further, the AUD group had the lowest proportion of those with a religion (30.9% vs. NAU: 49.5% and AAU: 43.5%;  $p < 0.001$ ) and medical

problems (27.5% vs. NAU: 50.5% and AAU: 30.8%;  $p < 0.001$ ). Rate of current smoking was significantly higher in those with AUD as compared to the others (62.5% vs. NAU: 23.4% and AAU: 29.5%;  $p < 0.001$ ) (Table 1).

Table1. Sociodemographic characteristics of subjects depending on alcohol use patterns

	NAU N(%)	AAU N(%)	AUD N(%)	t/x or F	p- value
<b>Total Number (%)</b>	203(29.4)	133(19.2)	355(51.4)		
<b>Age, years (Mean±SD)</b>	52.87±20.15	47.11±16.54	41.96±14.25	28.00	<0.001
<b>Gender</b>				36.00	<0.001
Male	62(30.5)	42(31.6)	190(53.5)		
Female	141(69.5)	91(68.4)	165(46.5)		
<b>Education level</b>				32.67	<0.001
<Elementary school	83(41.3)	30(23.1)	68(19.8)		
Middle/High school	90(44.8)	79(60.8)	226(65.9)		
≥College	28(13.9)	21(16.2)	49(14.3)		
<b>Marital status</b>				6.77	0.148
Single or never married	45(22.3)	24(18.0)	98(28.2)		
Married/Cohabitation	109(54.0)	80(60.2)	182(52.3)		
Separated/Divorced/widowed	48(23.8)	29(21.8)	68(19.5)		
<b>Religion</b>				17.41	<0.001
Absent	101(50.5)	74(56.5)	234(68.0)		
Present	99(49.5)	57(43.5)	110(32.0)		
<b>Employment</b>				4.12	0.127
Unemployed	75(36.9)	35(26.3)	117(33.0)		
Employed	128(63.1)	98(73.7)	238(67.0)		
<b>Monthly income(\$)</b>				15.61	0.016
≤1000	91(51.4)	46(40.4)	114(37.3)		
1000-2000	41(23.2)	29(25.4)	103(33.7)		
2000-3000	31(17.5)	21(18.4)	46(15.0)		
≥3000	14(7.9)	18(15.8)	43(14.1)		
<b>Medical problems (</b>				27.92	<0.001
No	98(49.5)	90(69.2)	247(71.4)		
Yes	100(50.5)	40(30.8)	99(28.6)		
<b>Smoking</b>				95.70	<0.001
Never smoker	135(67.2)	73(56.6)	109(32.4)		
Ex-smoker	19(9.5)	18(14.0)	17(4.1)		
Current smoker	47(23.4)	38(29.5)	210(62.5)		

NAU; No Alcohol Use Group, AAU; Acute Alcohol Consumption Group, AUD; Alcohol Use Disorder Group

Regarding psychiatric characteristics related to suicide attempt, the portions of history of psychiatric treatment (37.4% vs. NAU: 25.8% and AAU: 28.2%;  $p < 0.001$ ) was higher in those with AUD, but current psychiatric treatment (39.4% vs. AAU: 28.5% and AUD: 25.6%;  $p < 0.001$ ) was higher in NAU group. There were no difference in history of psychiatric treatment, family history of suicide, familiar psychiatric illness history, and psychiatric follow up after suicide attempt among the groups (Table 2).

Table 2. Psychiatric characteristics of subjects depending on alcohol use patterns

	<b>NAU N(%)</b>	<b>AAU N(%)</b>	<b>AUD N(%)</b>	<b>t/x or F</b>	<b>p-value</b>
<b>History of suicide attempts</b>				8.963	0.011
No	147(74.2)	94(71.8)	216(62.6)		
Yes	51(25.8)	37(28.2)	129(37.4)		
<b>History of psychiatric treatment</b>				3.793	0.150
No	96(51.3)	76(62.3)	183(57.4)		
Yes	91(48.7)	46(37.7)	136(42.6)		
<b>Current psychiatric treatment</b>				11.834	0.003
No	123(60.6)	95(71.4)	264(74.4)		
Yes	80(39.4)	38(28.5)	91(25.6)		
<b>Family history of suicide</b>				5.820	0.054
No	182(89.7)	115(86.5)	292(82.3)		
Yes	21(10.3)	18(13.5)	63(17.7)		
<b>Familiar psychiatric illness history</b>				1.176	0.555
No	168(85.3)	113(89.0)	283(85.2)		
Yes	29(14.7)	14(11.0)	49(14.8)		
<b>Psychiatric follow up</b>				3.229	0.199
No	112(55.2)	76(57.1)	222(62.5)		
Yes	91(44.8)	57(42.9)	133(37.5)		

NAU; No Alcohol Use Group, AAU; Acute Alcohol Consumption Group, AUD; Alcohol Use Disorder Group

## **2. Comparisons the risk of repetition of suicide attempt according to alcohol use pattern**

The groups did not differ in terms of current suicide ideation, suicide plan, and last will. However, those with AUD tended to choose swords as a suicide method (14.6% vs. NAU: 4.9% and AAU: 6.0%;  $p=0.008$ ) than the others did. Help seeking, including providing a clue, and seeking help before and after an attempt were most common in the AUD group (47.9% vs. NAU: 30.6% and AAU: 41.1%;  $p=0.005$ ). The proportion of low medical lethality of suicide attempts is also higher in the AUD group than other groups. (8.0% vs. NAU: 15.8% and AAU: 10.5%;  $p=0.017$ ) (Table 3).

Table3. Suicidal characteristics of subjects depending on alcohol use patterns

	NAU N(%)	AAU N(%)	AUD N(%)	t/x or F	p-value
<b>Current suicide ideation</b>				7.898	0.095
Absent	49(25.4)	36(28.3)	110(33.3)		
Present	71(36.8)	56(44.1)	126(38.2)		
Uncheckable	73(37.8)	35(27.6)	94(28.5)		
<b>Suicide plan</b>				0.713	0.700
Absent	158(83.6)	109(85.8)	295(86.3)		
Present	31(16.4)	18(14.2)	47(13.7)		
<b>Last will</b>				0.845	0.656
Absent	178(90.8)	116(88.5)	314(91.3)		
Present	18(9.2)	15(11.5)	30(8.7)		
<b>Method of suicide attempt</b>				23.914	0.008
Poisoning	161(79.3)	97(72.9)	250(70.4)		
Gas inspiration	14(6.9)	18(13.5)	24(6.8)		
Hanging	13(6.4)	8(6.0)	19(5.4)		
Swords	10(4.9)	8(6.0)	52(14.6)		
Fall down	2(1.0)	0(0)	3(0.8)		
Etc.	3(1.5)	2(1.8)	7(2.0)		
<b>Help seeking</b>				18.545	0.005
No	136(69.4)	76(58.9)	175(52.1)		
Provide a Clue	18(9.2)	24(18.6)	62(18.5)		
Seek before attempt	3(1.5)	4(3.1)	12(3.6)		
Seek after attempt	39(19.9)	25(19.4)	87(25.9)		
<b>Medical lethality</b>				8.121	0.017
Low	170(84.2)	119(89.5)	321(92.0)		
High	32(15.8)	14(10.5)	28(8.0)		

NAU; No Alcohol Use Group, AAU; Acute Alcohol Consumption Group, AUD; Alcohol Use Disorder Group

Regarding motivations for suicide attempts, there was a higher portion of suicide due to interpersonal problems (65.2% vs. NAU: 51.0% and AAU: 64.6%;  $p=0.003$ ) and economic problems (29.0% vs. NAU: 17.7% and AAU: 25.6%;  $p=0.015$ ), but a lower proportion of suicide due to physical problems (7.3% vs. NAU: 27.2% and AAU: 11.2%;  $p<0.001$ ) in the AUD group. There was no significant difference in distribution of psychiatric problems, work/school problems, and family problems (Table 4).

Table4. Suicidal motivation of subjects depending on alcohol use patterns

	NAU N(%)	AAU N(%)	AUD N(%)	t/x or F	p-value
<b>Psychiatric problems</b>				5.073	0.079
No	134(69.8)	98(80.3)	231(70.4)		
Yes	58(30.2)	24(19.7)	97(29.6)		
<b>Interpersonal problems</b>				11.371	0.003
No	96(49.0)	45(35.4)	118(34.8)		
Yes	100(51.0)	82(64.6)	221(65.2)		
<b>Work/School problems</b>				2.750	0.253
No	166(87.4)	103(83.7)	265(81.8)		
Yes	24(12.6)	20(16.3)	59(18.2)		
<b>Economic problems</b>				8.370	0.015
No	158(82.3)	90(74.4)	237(71.0)		
Yes	34(17.7)	31(25.6)	97(29.0)		
<b>Physical problems</b>				41.006	<0.001
No	142(72.8)	111(88.8)	304(92.7)		
Yes	53(27.2)	14(11.2)	24(7.3)		
<b>Family problems</b>				3.542	0.170
No	166(86.9)	98(79.7)	267(81.4)		
Yes	25(13.1)	25(20.3)	61(18.6)		

NAU; No Alcohol Use Group, AAU; Acute Alcohol Consumption Group, AUD; Alcohol Use Disorder Group

Further, those with AUD showed a lower RRRS score as compared to those in the NAU group ( $37.52 \pm 7.99$  and  $40.46 \pm 8.99$ , respectively;  $p < 0.001$ ), and a higher rescue score than those in both NAU and AAU groups ( $12.46 \pm 2.05$ ,  $11.64 \pm 2.17$ , and  $11.90 \pm 2.23$ , respectively;  $p < 0.001$ ), which means that those with AUD tended to attempt low-risk suicide with a high rescue opportunity. However, there was no significant difference between the AAU and the other groups in terms of the RRRS and SIS scores (Table 5).

Table5. Comparison of Risk-rescue rating score and Suicidal intent scale of subjects depending on alcohol use patterns

	NAU	AAU	AUD	p-value	Group comparison
<b>RRR</b> (mean±SD)	40.46±8.99	39.48±8.08	37.52±7.99	<0.001	NAU>AUD
Risk(mean±SD)	7.97±2.31	7.75±2.00	7.51±1.99	0.058	-
Rescue(mean±SD)	11.64±2.17	11.90±2.23	12.46±2.05	<0.001	NAU<AUD, AAU<AUD
<b>SIS</b> (mean±SD)	5.83±5.14	6.18±5.55	5.84±5.12	0.807	-
P1(mean±SD)	3.21±2.64	3.26±2.92	3.14±2.63	0.904	-
P2(mean±SD)	2.61±3.42	2.93±3.49	2.74±3.17	0.720	-

NAU; No Alcohol Use Group, AAU; Acute Alcohol Consumption Group, AUD; Alcohol Use Disorder Group

RRR(Risk-Rescue Rating) = Risk score/(Risk score + Rescue score)×100, SIS(Suicidal Intent Scale)=P1(objective circumstances of the act)+P2(subject's own perception of their feelings and thoughts at the time of the act)

Conducted by ANCOVA, adjusted for age.

The difference between groups based on Scheffe multiple comparison test.

### **3. Analysis of repetition of suicide attempt period According to the alcohol use pattern**

The mean follow-up period of participants was 13 months (SD 15.87) and ranged from 1 to 60 months. Table 6 shows that AUD was associated with increased HR of suicide reattempts before and after adjusting for covariates such as demographic and suicide-related variables; however, AAU was not associated with future suicide reattempts. Further, as compared to the NAU group, the AUD group was 2.55 times (95% CI: 1.36–4.78) was more likely to repeat suicide attempts, before adjusting for other factors. Model 1 shows the HR after adjusting for sociodemographic factors (age, sex, education level, marriage status, religion, employment, monthly income, smoking, and medical problems), Model 2 shows the HR after adjusting for the characteristics of suicidal behavior (suicide ideation, suicide plan, last will, past suicide attempt history, method of suicide attempt, medical lethality, and help seeking), and Model 3 shows the HR after adjusting for both sociodemographic and suicide behavior characteristics. The HRs for the AUD group were higher for each model (HR: 2.96, 95% CI: 1.23–7.10 in Model 1; HR: 2.27, 95% CI: 1.12–4.58 in Model 2; HR: 2.96, 95% CI: 1.23–7.10 in Model 3) as compared to that for the NAU group. Further, as compared to the AAU group, the AUD group was not more

likely to attempt suicide before adjusting covariates, but it was 2.43 times (95% CI: 1.03–5.69) more likely to repeat suicide attempts after adjusting for demographic factors in Model 1 (Table 6).

Table6. Logistic models of evaluate the main effect of alcohol use disorder and acute alcohol consumption on suicide reattempt

	NAU	AAU		AUD		AIC	AAU	AUD		AIC
		HR	P(CI)	HR	P(CI)			HR	P(CI)	
Crude HR	Reference	1.325	0.524(0.558-3.146)	2.559	0.003(1.369-4.783)	839.305	Reference	1.923	0.070(0.949-3.897)	665.335
Model 1	Reference	1.449	0.470(0.530-3.965)	3.175	0.004(1.458-6.915)	550.514	Reference	2.432	0.041(1.038-5.697)	426.611
Model 2	Reference	1.519	0.387(0.588-3.922)	2.271	0.022(1.126-4.580)	633.874	Reference	1.531	0.276(0.712-3.293)	506.716
Model 3	Reference	2.190	0.160(0.733-6.543)	2.962	0.015(1.234-7.107)	447.576	Reference	1.784	0.211(0.720-4.424)	352.851

Model 1: Adjusted for Demographic characteristics (age, sex, education level, marriage status, religion, employment, monthly income, smoking, and medical problems)

Model 2: Adjusted for Characteristics of suicide behaviors (suicide ideation, suicide plan, last will, past suicide attempt history, method of suicide attempt, medical lethality, help seeking)

Model 3: Adjusted for Demographic characteristics and Characteristics of suicide behaviors

Following an analysis of the reattempt period using the Kaplan-Meier method, it was found that 76 out of the 691 patients reattempted suicide; 12 (5.9%) of the NAU group, 10 (7.5%) of the AAU group, and 54 (15.2%) of the AUD group ( $\chi^2=13.44$ ,  $p=0.001$ ). The survival analysis revealed that the risk of suicide reattempt was significantly higher in the AUD group than it was in the others, throughout the 60-month follow-up period. Further, as a result of drawing a hazard curve for each variable, it was confirmed that the proportional hazard exhibited valid intersections (Fig 2.). Analysis of the difference in the reattempt period according to alcohol use patterns found that the increase in the cumulative proportion of suicide reattempts in patients with AUD lasted for a longer period than it did for the others (60 months vs. NAU: 36 months and AAU: 25 months; Log Rank  $\chi^2=11.34$ ,  $p=0.003$ ).

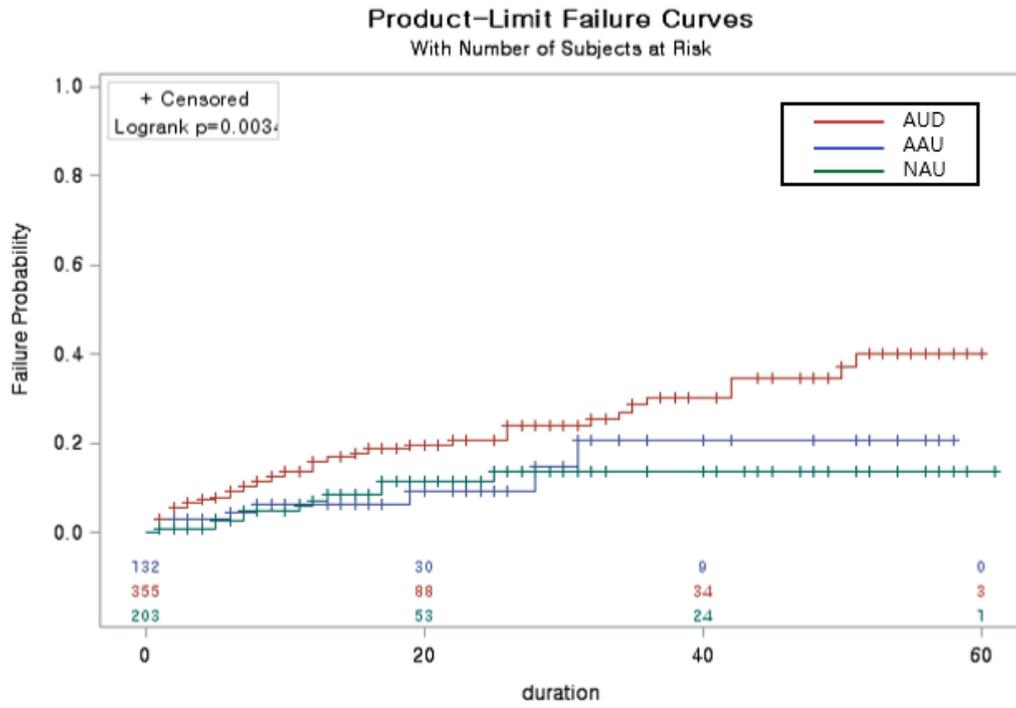


Figure3. Kaplan-Meier estimates of cumulative incidence of suicide reattempt among study participants, stratified by type of alcohol use pattern

## □. DISCUSSION

In the present study, we highlighted several important associations among characteristics of suicidal behaviors, risk of suicide reattempt, and alcohol use patterns among suicide attempters who visited emergency room. The present analysis revealed a high rate of incidence of AUD (n=355, 51.4%) in suicide attempters who visited the emergency room. This prominent association of alcohol with suicide behavior may be due to the cultural differences in alcohol drinking observed in Korea. The main findings of this study are as follows. First, we found that patients with AUD attempted suicide with more help seeking behaviors and had higher proportion of low medical lethality compared to not only NAU but also AAU group. Second, suicide attempters with AUD showed lower risk-rescue rating score with a high rescue opportunity but suicide attempters with only AAU did not. Third, while AAU was not associated with the risk of future suicide reattempt before and after adjusting for other risk factors, AUD was related to higher risk of suicide reattempt compare to NAU and the increased risk was prolonged longer period.

This finding is consistent with those of previous studies that revealed that impulsive suicide attempts are more strongly associated with AUD than with AAU (Cherpitel, Borges, & Wilcox, 2004). The present study also replicated previous

studies that AUD was found to increase the risk of repeated suicide attempts (Haukka et al., 2008), and previous suicide attempts in alcohol dependent patients increased the risk of subsequent suicide attempts (Buri, von Bonin, Strik, & Moggi, 2009). While in line with prior work, the unique findings of this study are that the risk of suicide reattempts in patients with AUD was consistently high regardless of AAU, both before and after adjusting for other risk factors for repeated suicide attempt such as lethality and suicidal intent of the previous suicide attempt.

The results of this study reflect the fact that, among those with AUD, suicidal behavior is more related to the psychopathology of alcohol dependence, such as difficulty in impulse control. In the study, suicide attempts in patients with AUD tended to have low lethality and risk-rescue rating scores at baseline. Several previous studies have focused on this issue, and have reported that alcohol-related suicide attempts have low mortality and high risk of repeated suicide attempts. This tendency is called as “deliberate self-harm syndrome” (Pennel, Quesada, Begue, & Dematteis, 2015). Therefore, suicide attempts in those with AUD may be overlooked due to their low lethality, as revealed in the present study (e.g., there is a lower risk of completed suicide in patients with AUD). However, based on the present findings, it is suggested that suicide attempts in patients with AUD require more careful evaluation and intervention owing to the high risks of repetition.

Furthermore, we also found that the high risk of suicide reattempt for patients with

AUD lasted for more than 60 months after the previous suicide attempt, while the same persisted for up to 36 months in patients with AAU. This suggests that AUD may have more extensive and long-lasting impacts on subsequent suicidal behavior. It is important to note that some mood disorders, one of the important risk factor of suicide attempts, may be caused by alcohol consumption and alcohol withdrawal, and it is often associated with chronic affective dysregulation. (Bagge & Sher, 2008). Both aggression and depression are well-known risk factors for subsequent suicidal behavior in alcohol dependent individuals (Conner et al., 2001). As has been noted by numerous studies, AUD may play a key role in recurrent suicidal behavior, through a number of mechanisms that exacerbate negative mood states and risky behaviors that promote suicidal behaviors (Zhang et al., 2010). On the other hand, some previous studies have explained the adverse consequences on brain development and executive function in patients with AUD due to a number of neurotransmitter hypofunctions (Harper, 1998). Thus, neurobiological factors, including serotonergic mechanisms, may play a role in repeated suicide attempts in patients with AUD. The serotonin neurotransmission deficiency may be associated with impulsiveness and suicide attempts that accompany alcohol dependence (Li & He, 2007). It is well known that behaviors associated with prefrontal brain dysfunction in patients with AUD significantly predict not only the executive function system but also affective abnormalities (Gorwood, 2001). These

permanent and complex effects of AUD in suicide attempters may increase and sustain the risk of repeated suicide attempts.

The strengths of this register-based study include the large numbers of cases of suicide attempters included in the analysis and the use of a detailed questionnaire to collect information on alcohol use pattern and characteristics of suicidal behaviors. Additionally, we performed follow-up and analysis of suicide reattempts after adjusting the detailed variables over a sufficient period of time, which has never been done before in Korea. The present study has a number of limitations that should be considered when interpreting the findings. First, the sample of the present study was limited to one university hospital in a specific area in Korea, which may limit the generalizability of the current findings. Second, there was a selection bias because we excluded several patients who refused to consent to psychiatric evaluation or were missing drinking information. Third, there is insufficient information on comorbid diseases (e.g., mood disorder, personality disorder) that may affect the progress of suicide attempters. Despite these limitations, this study made it possible to understand the relationships among the factors related to alcohol use patterns that affect suicidal behavior over time.

## □. CONCLUSION

In conclusion, suicide attempters with AUD have been shown to have lower lethality of suicide attempt but higher risk of suicide reattempts in the future, regardless of alcohol use at the time of suicide attempt. The results of present study suggest that suicide attempters with AUD should be considered a high-risk group for future suicide reattempts, and careful attention should be paid to the development of a longer-term intervention program. Additionally, each suicide attempter needs to be evaluated carefully for AUD, regardless of whether they had consumed alcohol at the time of the recent suicide attempt. Our results highlight the importance of specific and individualized aftercare programs of sufficient duration for suicide attempters with AUD. In this context, besides suicide prevention and aftercare programs that usually focus on depression (Szanto, Kalmar, Hendin, Rihmer, & Mann, 2007), the careful assessment and appropriate treatment for underlying AUD among suicide attempters should be considered.

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## APPENDIX 1. AUDIT-C Questionnaire

**1. How often do you have a drink containing alcohol?**

- A. Never
- B. Monthly or less
- C. 2-4 times a month
- D. 2-3 times a week
- E. 4 or more times a week

**2. How many standard drinks containing alcohol do you have on a typical day?**

- A. 1 or 2
- B. 3 or 4
- C. 5 or 6
- D. 7 or 9
- E. 10 or more

**3. How often do you have six or more drinks on one occasion?**

- A. Never**
- B. Less than monthly**
- C. Monthly**
- D. Weekly**
- E. Daily or almost daily**

## APPENDIX 2. Risk-Rescue Rating

<b>RISK FACTORS</b>	<b>RESCUE FACTORS</b>
<p><b>1. Agent used:</b></p> <ul style="list-style-type: none"> <li>_1. Ingestion, cutting, stabbing</li> <li>_2. Drowning, asphyxiation, strangulation</li> <li>_3. Jumping, shooting</li> </ul> <p><b>2. Impaired consciousness:</b></p> <ul style="list-style-type: none"> <li>_1. None in evidence</li> <li>_2. Confusion, semicoma</li> <li>_3. Coma, deep coma</li> </ul> <p><b>3. Lesion/Toxicity :</b></p> <ul style="list-style-type: none"> <li>_1. Mild</li> <li>_2. Moderate</li> <li>_3. Severe</li> </ul> <p><b>4. Reversibility :</b></p> <ul style="list-style-type: none"> <li>_1. Good, complete recovery expected</li> <li>_2. Fair, recovery expected with time</li> <li>_3. Poor, residual expected, if recovery</li> </ul>	<p><b>1. Location :</b></p> <ul style="list-style-type: none"> <li>_3. Familiar</li> <li>_2. Non-familiar, non-remote</li> <li>_1. Remote</li> </ul> <p><b>2. Person initiating rescue :</b></p> <ul style="list-style-type: none"> <li>_3. Key person</li> <li>_2. Professional</li> <li>_1. Passerby</li> </ul> <p><b>3. Probability of discovery by any rescuer :</b></p> <ul style="list-style-type: none"> <li>_3. High, almost certain</li> <li>_2. Uncertain discovery</li> <li>_1. Accidental discovery</li> </ul> <p><b>4. Accessibility to rescue :</b></p> <ul style="list-style-type: none"> <li>_3. Asks for help</li> <li>_2. Drops clues</li> <li>_1. Does not ask for help</li> </ul>

<p><b>5. Treatment required :</b></p> <p>_1. First aid, ER care _2. Admission, routine treatment _3. Intensive care, special treatment</p> <p><b>Total Risk Point</b> _____</p> <p>RISK SCORE</p> <p>5. High risk (13-15 risk points) 4. High moderate (11-12 risk points) 3. Moderate (9-10 risk points) 2. Low moderate (7-8 risk points) 1. Low risk (5-6 risk points)</p> <p>RISK-RESCUE SCORE = RISK SCORE / (RISK S. + RESCUE S.)</p> <p>RISK SCORE : _____ RESCUE SCORE : _____ RISK-RESCUE SCORE: _____</p>	<p><b>5. Delay until discovery :</b></p> <p>_3. Immediate 1 hour _2. Less than 4 hours _1. Greater than 4 hours</p> <p><b>Total Rescue Point</b> _____</p> <p>RESCUE SCORE</p> <p>1. Least rescuable (5-7 rescue points) 2. Low moderate (8-9 rescue points) 3. Moderate (10-11 rescue points) 4. High moderate (12-13 rescue points) 5. Most rescuable (14-15 rescue points)</p> <p>* Self-rescue 의 경우:Rescue score 5 점으로 평가 * 발견후 부당하게 치료가 늦어진 경우에 최종 Rescue Score 에서 1 점을 뺀다.</p>
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## APPENDIX 3. Suicidal Intent Scale

<b>Part 1. Objective Indicators</b>	<b>Part 2. Subjective Indicators</b>
1. Isolation during attempt <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2	9. purpose of attempt <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2
2. Likelihood of intervention <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2	10. Expectations of death <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2
3. precautions taken against discovery <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2	11. Perception of method's lethality <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2
4. Actions taken to get help <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2	12. View of attempt's seriousness <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2
5. Preparations for death <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2	13. Desire to live or die <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2
6. Preparations for attempt <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2	14. Perceptions of rescuability <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2
7. Suicide note <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2	15. Premeditation <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2

8. Communication of intent  <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2  <b>Part 1 subtotal</b> _____	    <b>Part 2 subtotal</b> _____
<b>SIS total</b> _____	

## **ABSTRACT (IN KOREAN)**

# **자살시도자의 알코올 사용이 자살행동과 자살 재시도 위험에 미치는 영향**

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세계보건기구(WHO) 보고서에 따르면 자살은 가장 심각한 공중 보건 문제 중 하나이며 매년 약 100 만 명이 자살로 사망하는 것으로

알려졌다. 자살은 여러 가지 요인의 복합 효과로 인해 발생하는 것으로 알려져 있지만, 많은 연구에서 특히 알코올 사용과 밀접한 관계가 있음이 보고되었다. 알코올은 전 세계적으로 널리 사용되고 있으며 다양한 신체적 질병 뿐만 아니라 폭력, 자해, 자살과 같은 충동 조절과 관련된 문제를 일으키는 것으로 알려져 있다. 본 연구에서는 자살 시도자의 알코올 사용 패턴의 일시적인 효과와 지속적인 효과에 대하여 개괄적으로 설명하고자 목표하였다.

본 연구는 2010년 3월 1일부터 2015년 12월 31일까지 강원 영서 권역응급센터를 방문한 자살시도자를 대상으로 하였다. 연구자들은 대상자의 사회인구학적 및 임상적 정보를 수집하였고, 정신과 의사의 인터뷰를 통하여 대상자의 자살시도 당시 알코올 사용 유형에 따라서 1) 비알코올사용 자살시도자(NAU), 2) 급성알코올사용 자살시도자(AAU), 3) 알코올사용장애가 있는 자살시도자 (AUD) 군으로 나누어서 자살 행동의 특성 및 자살 재시도 위험을 비교하였다.

분석 결과, 알코올사용장애가 있는 자살시도자는 비알코올사용 자살시도자 및 급성알코올사용 자살시도자와 비교하였을 때, 자살 행동의 결과로 낮은 의학적 치명도 비율이 높았고 (각각, NAU 84.2%,

AAU 89.5%, AUD 92.0%,  $p=0.017$ ), 높은 구조 가능도 점수(각각, NAU  $11.64\pm 2.17$ ; AAU  $11.90\pm 2.23$ ; AUD  $12.46\pm 2.05$ ,  $p<0.001$ )를 보였다. 그럼에도 불구하고 알코올사용장애가 있는 자살시도자의 향후 자살 재시도의 위험은 비알코올사용 자살시도자군과 비교하였을 때, 60 개월까지 지속적으로 유의하게 증가되어 있는 것으로 관찰되었다 (HR 2.96, 95% CI 1.23-7.10).

본 연구 결과, 자살 시도 당시 알코올 사용 여부와 상관없이 알코올사용장애가 있는 자살시도자는 보다 충동적이고 반복적인 자살 시도를 반복한다는 것을 고려할 때, 응급실에 내원한 자살시도자의 알코올사용장애에 대한 면밀한 평가와 충분한 기간의 주의 깊은 관찰 및 관리의 필요성이 강조된다.

핵심 되는 말: 자살, 자살시도, 알코올사용장애