■ Original Article

Usefulness of Heavy Drinking and Binge Drinking for the Diagnosis of Alcohol Use Disorder

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Background: This research investigated the sensitivity and specificity of heavy and binge drinking for screening of alcohol use disorder.

Methods: This retrospective study was conducted with 976 adults who visited the Sun Health Screening Center for health screenings in 2015. Daily drinking amount, drinking frequency per week, and weekly drinking amount were investigated. Using criteria from the National Institute on Alcohol Abuse and Alcoholism, participants were classified as normal drinkers, heavy drinkers, or binge drinkers, and grouped by age and sex. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of heavy and binge drinking were compared for the diagnosis of alcohol abuse and alcohol dependence using the Diagnostic and Statistical Manual of Mental Disorders (DSM) 4th edition-text revision and alcohol use disorder using the DSM 5th edition.

Results: The sensitivity of heavy and binge drinking for the diagnosis of alcohol abuse, alcohol dependence, and alcohol use disorder were 51.7%, 43.8%, and 35.3%, and 69.0%, 62.5%, and 48.2%, respectively. The specificity of these were 90.1%, 91.7%, and 95.5%, and 84.3%, 86.8%, and 91.2%, respectively. The PPV of these were 24.8%, 40.5%, and 72.7%, and 21.7%, 38.0%, and 65.2%, respectively. The NPV of these were 96.7%, 92.6%, and 81.2%, and 97.8%, 94.7%, and 83.7%, respectively.

Conclusion: Heavy and binge drinking did not show enough diagnostic power to screen DSM alcohol use disorder although they did show high specificity and NPV.

Keywords: Alcohol; Alcoholism; Binge Drinking; Sensitivity and Specificity

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INTRODUCTION

Excessive alcohol drinking causes many problems both socially and economically.^{1,2)} Therefore, it is important to address alcohol-related problems using appropriate diagnostic standards. In clinical practice, the guidelines proposed by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) are widely used.³⁾ According to the NIAAA, healthy males aged less than 65 years should not drink more than four standard drinks per day or 14 standard drinks per week (a standard drink is any drink that contains approximately 14 g of pure alcohol). Healthy males aged 65 years and older and healthy females should not drink more than three standard drinks per day or seven standard drinks per week. The NIAAA defines an alcohol intake per drinking time that exceeds these amounts as binge drinking. A weekly alcohol intake that exceeds these amounts is defined by the NIAAA as heavy drinking. An alcohol-drinking pattern classified as either binge drinking or heavy drinking is also termed at-risk drinking.

Other academic and scientific criteria are also used to diagnose alcohol-drinking disorders. The Diagnostic and Statistical Manual of Mental Disorders (DSM), published by the American Psychiatric Association, sets out the standard diagnostic criteria for the classification of mental disorders, including alcohol-drinking disorders. In May 2013, the DSM was revised from the DSM 4th edition-text revision (DSM-IV-TR) to the DSM 5th edition (DSM-5). Considerable changes were made in the DSM-5,^{4,5)} including to the terminology and the diagnostic threshold. Additionally, several additions and deletions were made to the diagnostic criteria.

Alcohol-screening tools enable the detection of alcohol use disorder (AUD) according to the DSM criteria. However, these alcohol-screening tools can be difficult to use due to the limited time available in clinical practice. In contrast, the heavy- and binge-drinking standards of the NIAAA have been widely used in clinical practice due to their simplicity. Therefore, this study was conducted to investigate the diagnostic power of heavy- and binge-drinking standards for alcohol abuse and dependence as defined by the DSM-IV-TR, and for AUD as defined by the DSM-5.

METHODS

1. Participants

The participants comprised 976 adults (515 males, 461 females) who visited the Sun Health Screening Center for health screenings in 2015. As drinking is forbidden for youths in Korea, the participants were limited to those aged 19 years and older in accordance with the Republic of Korea Youth Protection Act, which defines a youth as a person less than 19 years old. During an interview before health screening, anyone who had recently experienced illness of sufficient severity to interfere with usual drinking habits was excluded from the study. The institutional review board of Korea's National Institute for Bioethics Policy approved this study (IRB number: P01-201512-21-004).

2. Data Collection

Gender, age, weekly alcohol intake, and daily average alcohol intake were obtained from the health-screening center's basic questionnaire. The weekly alcohol-drinking amount was determined using the question "How many days do you drink in a week?" Multiple responses to this question were possible, as follows: do not drink, 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, or 7 days.

The daily average alcohol-drinking amount was determined using the question "When drinking, how much do you drink on average per day?" The possible responses to this question were as follows: "I drink beer/soju/whisky/rice wine/wine," together with a short answer "I drink () glasses a day."

To convert daily average alcohol intake into standard drinks (one standard drink=14 g of alcohol), a glass of soju was multiplied by 4/7 and a glass of beer by 1/2. Glasses of wine, rice wine, and whisky were not converted. The data of drinks per week were obtained by multiplying the average standard drinks per drinking day by the number of drinking frequency per week.

Heavy drinking was defined as drinking 15 standard drinks or more because the recommended amount is 14 drinks or fewer for males up to 65 years of age. For males over 65 years of age and females, heavy drinking was defined as drinking eight standard drinks or more because the recommended amount is seven drinks or fewer.

Binge drinking was defined as drinking five standard drinks or more because the recommended amount is four drinks or fewer for males up to 65 years of age. For males over 65 years of age and females, binge drinking was defined as drinking four standard drinks or more because the recommended amount is three drinks or fewer.

In addition, to investigate whether the participants were diagnosed with DSM-IV-TR alcohol abuse, alcohol dependence, and/or DSM-5 AUD, the following diagnostic interview regarding alcohol-drinking habits was administered to health-screening examinees: (1) "Alcohol is often taken in larger amounts or over a longer period than was intended." (2) "There is a persistent desire or unsuccessful efforts to cut down or control alcohol use." (3) "A great deal of time is spent in activities necessary to obtain alcohol (e.g., driving long distances), use alcohol, or recover from its effects." (4) "Craving, or a strong desire or urge to use alcohol." (5) "Recurrent alcohol use resulting in a failure to fulfill major role obligations at work, school, or home." (6) "Continued alcohol use despite having persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of the alcohol." (7) "Important social, occupational, or recreational activities are given up or reduced because of alcohol use." (8) "Recurrent alcohol use in situations in which it is physically hazardous (e.g., driving an automobile or operating a machine when impaired by alcohol)." (9) "Alcohol use is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by the substance." (10) "A need for markedly increased amounts of alcohol to achieve intoxication or the desired effect." (11) "Alcohol is taken to relieve or avoid withdrawal symptoms (e.g., paroxysmal sweats, tremor, or anxiety)." (12) "Recurrent alcohol-related le-

gal problems (e.g., arrests for alcohol-related disorderly conduct)."

Participants who responded "yes" to more than one of four questions (questions 5, 6, 8, and 12) were diagnosed with alcohol abuse using the DSM-IV-TR. Participants who responded "yes" to more than three of seven questions (questions 1, 2, 3, 7, 9, 10, and 11) were diagnosed with alcohol dependence using the DSM-IV-TR. Participants who responded "yes" to two or more questions (of the first 11) were diagnosed with DSM-5 AUD.

3. Statistical Analyses

Age, drinking frequency per week, drinks per drinking day, and drinks per week among the heavy-drinking group, non-heavy-drinking groups, binge-drinking group, and non-binge-drinking groups were compared using an independent t-test. The presence or absence of alcohol abuse, alcohol dependence, and AUD in the four groups was compared using a chi-square test. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of heavy drinking and binge drinking for predicting alcohol abuse, alcohol dependence, and AUD were investigated. The areas under the receiver operating characteristic curves (AUROC) for alcohol abuse, alcohol dependence, and AUD were assessed. Windows SPSS ver. 13.0 (SPSS Inc., Chicago, IL, USA) and Windows Medcalc ver. 12.1.0.0 (MedCalc, Mariakerke, Belgium) were used for statistical analysis; a P-value <0.05 was regarded as statistically significant.

RESULTS

1. General Characteristics of Research Participants according to Heavy Drinking and Non-Heavy Drinking

The mean±standard deviation (SD) age of males in the heavy- and non-heavy-drinking groups were 47.20±9.37 and 46.33±9.36 years, respectively. There was no significant difference in age. Those of females in the heavy- and non-heavy-drinking groups were 41.44±8.20 and 45.25±9.28 years, respectively. The age of females was significantly ($P<0.01$) higher in the heavy-drinking group than in the non-heavy-drinking group.

In males, drinking frequency per week, drinks per drinking day, and

drinks per week in the heavy- and non-heavy-drinking group were 3.38±1.30, 7.08±2.59, and 22.27±9.42, and 1.24±1.00, 2.84±20.5, and 4.39±4.07, respectively. In females, those of the heavy- and non-heavy-drinking group were 3.25±1.61, 4.96±1.95, and 15.21±9.03, and 0.60±0.81, 0.79±1.07, and 0.93±1.46, respectively. Drinking frequency per week, drinks per drinking day, and drinks per week were significantly ($P<0.01$) higher in the heavy-drinking group than in the non-heavy-drinking group.

Regarding the diagnostic interview results, the heavy-drinking group included 30 individuals with DSM-IV alcohol abuse (24.8%), 49 with DSM-IV alcohol dependence (40.5%), and 88 with DSM-5 AUD (72.7%). In males, the heavy-drinking group included 22 participants with DSM-IV alcohol abuse (24.7%), 40 with DSM-IV alcohol dependence (44.9%), and 67 with DSM-5 AUD (75.3%). In females, the heavy-drinking group included 8 participants with DSM-IV alcohol abuse (25.0%), 9 with DSM-IV alcohol dependence (28.1%), and 21 with DSM-5 AUD (65.6%). The non-heavy-drinking group included 28 participants with DSM-IV alcohol abuse (3.3%), 63 with DSM-IV alcohol dependence (7.4%), and 161 with DSM-5 AUD (18.8%). In males, the non-heavy-drinking group included 25 participants with DSM-IV alcohol abuse (5.9%), 58 with DSM-IV alcohol dependence (13.6%), and 138 with DSM-5 AUD (32.4%). In females, the non-heavy-drinking group included 3 participants with DSM-IV alcohol abuse (0.7%), 5 with DSM-IV alcohol dependence (1.2%), and 23 with DSM-5 AUD (5.4%). The values were significantly ($P=0.000$) higher in the heavy-drinking group than in the non-heavy-drinking group (Table 1).

2. General Characteristics of Research Participants according to Binge Drinking and Non-Binge Drinking

The mean±SD age of males in the binge- and non-binge-drinking groups were 44.05±8.52 and 47.48±9.52 years, respectively. The age of males was significantly ($P=0.000$) higher in the non-binge-drinking group than in the binge-drinking group. The age of females in the binge- and non-binge-drinking groups were 40.59±7.30 and 45.33±9.31 years, respectively. The age of females was significantly ($P=0.000$) higher in the non-binge-drinking group than in the binge-drinking group.

Table 1. General characteristics of participants according to heavy drinking and non-heavy drinking

Variable	Heavy-drinking group (n=121)		Non-heavy-drinking group (n=855)		P-value*	
	Male (n=89)	Female (n=32)	Male (n=426)	Female (n=429)	Male	Female
Age (y)	47.20±9.37	41.44±8.20	46.33±9.36	45.25±9.28	0.424	0.024
Drinking frequency per week	3.38±1.30	3.25±1.61	1.24±1.00	0.60±0.81	0.000	0.000
Drinks [†] per drinking day	7.08±2.59	4.96±1.95	2.84±2.05	0.79±1.07	0.000	0.000
Drinks [†] per week	22.27±9.42	15.21±9.03	4.39±4.07	0.93±1.46	0.000	0.000
DSM criteria						
DSM-IV alcohol abuse	22 (24.7)	8 (25.0)	25 (5.9)	3 (0.7)	0.000	0.000
DSM-IV alcohol dependence	40 (44.9)	9 (28.1)	58 (13.6)	5 (1.2)	0.000	0.000
DSM-5 alcohol use disorder	67 (75.3)	21 (65.6)	138 (32.4)	23 (5.4)	0.000	0.000

Values are presented as mean±standard deviation or number (%).

DSM-IV, Diagnostic and Statistical Manual of Mental Disorders 4th edition; DSM-5, Diagnostic and Statistical Manual of Mental Disorders 5th edition.

*By independent sample t-test or χ^2 test. [†]One standard drink: 14 g ethanol.

In males, drinking frequency per week, drinks per drinking day, and drinks per week in the binge- and non-binge-drinking groups were 2.25 ± 1.16 , 6.86 ± 1.95 , and 15.73 ± 10.27 , and 1.35 ± 1.30 , 2.22 ± 1.52 , and 4.09 ± 4.77 , respectively. In females, these values in the binge- and non-binge-drinking groups were 2.32 ± 1.58 , 5.47 ± 1.61 , and 12.91 ± 10.17 , and 0.66 ± 0.97 , 0.73 ± 0.88 , and 1.05 ± 1.98 , respectively. Drinking frequency per week, drinks per drinking day, and drinks per week were significantly ($P=0.000$) higher in the binge-drinking group than in the non-binge-drinking group.

Regarding the diagnostic interview results, the binge-drinking group included 40 participants with DSM-IV alcohol abuse (21.7%), 70 with DSM-IV alcohol dependence (38.0%), and 120 with DSM-5 AUD (65.2%). The number of male and female binge drinkers diagnosed with DSM-IV alcohol abuse, DSM-IV alcohol dependence, and DSM-5 AUD was 31 (20.7%), 59 (39.3%), and 99 (66.0%), and 9 (26.5%), 11 (32.4%), and 21 (61.8%), respectively. The non-binge-drinking group included 18 participants with DSM-IV alcohol abuse (2.3%), 42 with DSM-IV alcohol dependence (5.3%), and 129 with DSM-5 AUD (16.3%); these values were higher in the binge-drinking group than in the non-binge-drinking group. The number of male and female non-binge drinkers diagnosed with DSM-IV alcohol abuse, DSM-IV alcohol dependence, and DSM-5 AUD was 16 (4.4%), 39 (10.7%), and 106 (29.0%), and 2 (0.5%), 3 (0.7%), and 23 (5.4%) respectively; these values were significantly ($P=0.000$) higher in the binge-drinking group than in the non-binge-drinking group (Table 2).

3. Sensitivity, Specificity, PPV, NPV, and the AUROC of Heavy Drinking for the DSM-IV Alcohol Abuse and Alcohol Dependence, and the DSM-5 Alcohol Use Disorder

The sensitivity, specificity, PPV, NPV, and the AUROC of males up to 65 years of age who drink over 14 drinks per week for diagnosis of DSM-IV alcohol abuse were 46.7%, 86.0%, 25.0%, 94.1%, and 0.663, respectively. The corresponding values for diagnosis of DSM-IV alcohol dependence were 40.0%, 88.5%, 45.2%, 86.1%, and 0.642, respectively. The values for diagnosis of DSM-5 AUD were 31.8%, 92.6%, 73.8%, 67.6%, and 0.622, respectively. There were no significant differences in the AUROC among DSM-IV alcohol abuse, DSM-IV alcohol depen-

dence, and DSM-5 AUD.

The sensitivity, specificity, PPV, NPV, and the AUROC of males over 65 years of age and females who drink over 7 drinks per week for diagnosis of DSM-IV alcohol abuse were 69.2%, 94.0%, 24.3%, 99.1%, and 0.816, respectively. The corresponding values for diagnosis of DSM-IV alcohol dependence were 64.7%, 94.4%, 29.7%, 98.7%, and 0.796, respectively. The values for diagnosis of DSM-5 AUD were 48.1%, 97.4%, 70.2%, 93.7%, and 0.728, respectively. There were no significant differences in the AUROC among DSM-IV alcohol abuse, DSM-IV alcohol dependence, and DSM-5 AUD.

The sensitivity, specificity, PPV, NPV, and the AUROC of the heavy-drinking group for diagnosis of DSM-IV alcohol abuse were 51.7%, 90.1%, 24.8%, 96.7%, and 0.709, respectively. The corresponding values for diagnosis of DSM-IV alcohol dependence were 43.8%, 91.7%, 40.5%, 92.6%, and 0.677, respectively. The values for diagnosis of DSM-5 AUD were 35.3%, 95.5%, 72.7%, 81.2%, and 0.654, respectively. There were no significant differences in the AUROC among DSM-IV alcohol abuse, DSM-IV alcohol dependence, and DSM-5 AUD (Table 3).

4. Sensitivity, Specificity, PPV, NPV, and the AUROC of the Binge-Drinking Group for the DSM-IV Alcohol Abuse and Alcohol Dependence, and the DSM-5 Alcohol Use Disorder

The sensitivity, specificity, PPV, NPV, and the AUROC of males up to 65 years of age who drink over four drinks per drinking day for diagnosis of DSM-IV alcohol abuse were 66.7%, 73.9%, 20.4%, 95.7%, and 0.703, respectively. The corresponding values for diagnosis of DSM-IV alcohol dependence were 60.0%, 77.4%, 38.8%, 89.0%, and 0.687, respectively. The associated values for diagnosis of DSM-5 AUD were 49.2%, 82.9%, 65.3%, 71.5%, and 0.661, respectively. There were no significant differences in the AUROC among DSM-IV alcohol abuse, DSM-IV alcohol dependence, and DSM-5 AUD.

The sensitivity, specificity, PPV, NPV, and the AUROC of males over 65 years of age and females who drink over three drinks per day for diagnosis of DSM-IV alcohol abuse were 76.9%, 94.2%, 27.0%, 99.3%, and 0.856, respectively. The corresponding values for diagnosis of DSM-IV alcohol dependence were 76.5%, 94.8%, 35.1%, 99.1%, and 0.857, respectively. Those values for diagnosis of DSM-5 AUD were

Table 2. General characteristics of participants according to binge drinking and non-binge drinking

Variable	Binge-drinking group (n=184)		Non-binge-drinking group (n=792)		P-value*	
	Male (n=150)	Female (n=34)	Male (n=365)	Female (n=427)	Male	Female
Age (y)	44.05±8.52	40.59±7.30	47.48±9.52	45.33±9.31	0.000	0.004
Drinking frequency per week	2.25±1.16	2.32±1.58	1.35±1.30	0.66±0.97	0.000	0.000
Drinks [†] per drinking day	6.86±1.95	5.47±1.61	2.22±1.52	0.73±0.88	0.000	0.000
Drinks [†] per week	15.73±10.27	12.91±10.17	4.09±4.77	1.05±1.98	0.000	0.000
DSM criteria						
DSM-IV alcohol abuse	31 (20.7)	9 (26.5)	16 (4.4)	2 (0.5)	0.000	0.000
DSM-IV alcohol dependence	59 (39.3)	11 (32.4)	39 (10.7)	3 (0.7)	0.000	0.000
DSM-5 alcohol use disorder	99 (66.0)	21 (61.8)	106 (29.0)	23 (5.4)	0.000	0.000

Values are presented as mean±standard deviation or number (%).

DSM-IV, Diagnostic and Statistical Manual of Mental Disorders 4th edition; DSM-5, Diagnostic and Statistical Manual of Mental Disorders 5th edition.

*By independent sample t-test or χ^2 test. [†]One standard drink: 14 g ethanol.

Table 3. Sensitivity, specificity, PPV, NPV, and the AUROC of heavy drinking for the DSM-IV alcohol abuse and alcohol dependence, and the DSM-5 alcohol use disorder

	Sensitivity	Specificity	PPV	NPV	AUROC
DSM-IV alcohol abuse					
Total heavy-drinking group*	30/58 (51.7)	827/918 (90.1)	30/121 (24.8)	827/855 (96.7)	0.709
Males up to age 65	21/45 (46.7)	386/449 (86.0)	21/84 (25.0)	386/410 (94.1)	0.663
Males over age 65/females	9/13 (69.2)	441/469 (94.0)	9/37 (24.3)	441/445 (99.1)	0.816
DSM-IV alcohol dependence					
Total heavy-drinking group*	49/112 (43.8)	792/864 (91.7)	49/121 (40.5)	792/855 (92.6)	0.677
Males up to age 65	38/95 (40.0)	353/399 (88.5)	38/84 (45.2)	353/410 (86.1)	0.642
Males over age 65/females	11/17 (64.7)	439/465 (94.4)	11/37 (29.7)	439/445 (98.7)	0.796
DSM-5 alcohol use disorder					
Total heavy-drinking group*	88/249 (35.3)	694/727 (95.5)	88/121 (72.7)	694/855 (81.2)	0.654
Males up to age 65	62/195 (31.8)	277/299 (92.6)	62/84 (73.8)	277/410 (67.6)	0.622
Males over age 65/females	26/54 (48.1)	417/428 (97.4)	26/37 (70.2)	417/445 (93.7)	0.728

Values are presented as number (%), unless otherwise stated.

PPV, positive predictive value; NPV, negative predictive value; AUROC, areas under the receiver operating characteristic curves; DSM-IV, Diagnostic and Statistical Manual of Mental Disorders 4th edition; DSM-5, Diagnostic and Statistical Manual of Mental Disorders 5th edition.

*Heavy-drinking group: over 14 drinks in a week for males up to age 65 years; over seven drinks in a week for males over age 65 years and females.

Table 4. Sensitivity, specificity, PPV, NPV, and the AUROC of binge drinking for the DSM-IV alcohol abuse and alcohol dependence, and the DSM-5 alcohol use disorder

	Sensitivity	Specificity	PPV	NPV	AUROC
DSM-IV alcohol abuse					
Total binge-drinking group*	40/58 (69.0)	774/918 (84.3)	40/184 (21.7)	774/792 (97.8)	0.766
Males up to age 65	30/45 (66.7)	332/449 (73.9)	30/147 (20.4)	332/347 (95.7)	0.703
Males over age 65/females	10/13 (76.9)	442/469 (94.2)	10/37 (27.0)	442/445 (99.3)	0.856
DSM-IV alcohol dependence					
Total binge-drinking group*	70/112 (62.5)	750/864 (86.8)	70/184 (38.0)	750/792 (94.7)	0.747
Males up to age 65	57/95 (60.0)	309/399 (77.4)	57/147 (38.8)	309/347 (89.0)	0.687
Males over age 65/females	13/17 (76.5)	441/465 (94.8)	13/37 (35.1)	441/445 (99.1)	0.857
DSM-5 alcohol use disorder					
Total binge-drinking group*	120/249 (48.2)	663/727 (91.2)	120/184 (65.2)	663/792 (83.7)	0.697
Males up to age 65	96/195 (49.2)	248/299 (82.9)	96/147 (65.30)	248/347 (71.5)	0.661
Males over age 65/females	24/54 (44.4)	415/428 (97.0)	24/37 (64.9)	415/445 (93.3)	0.707

Values are presented as number (%), unless otherwise stated.

PPV, positive predictive value; NPV, negative predictive value; AUROC, areas under the receiver operating characteristic curves; DSM-IV, Diagnostic and Statistical Manual of Mental Disorders 4th edition; DSM-5, Diagnostic and Statistical Manual of Mental Disorders 5th edition.

*Binge-drinking group: over four drinks in a day for males up to age 65 years; over three drinks in a week for males over age 65 years and females.

44.4%, 97.0%, 64.9%, 93.3%, and 0.707, respectively. There were no significant differences in the AUROC among DSM-IV alcohol abuse, DSM-IV alcohol dependence, and DSM-5 AUD.

The sensitivity, specificity, PPV, NPV, and the AUROC of the binge-drinking group for diagnosis of DSM-IV alcohol abuse were 69.0%, 84.3%, 21.7%, 97.8%, and 0.766, respectively. The corresponding values for diagnosis of DSM-IV alcohol dependence were 62.5%, 86.8%, 38.0%, 94.7%, and 0.747, respectively. The associated values for diagnosis of DSM-5 AUD were 48.2%, 91.2%, 65.2%, 83.7%, and 0.697, respectively. There were no significant differences in the AUROC among DSM-IV alcohol abuse, DSM-IV alcohol dependence, and DSM-5 AUD (Table 4).

DISCUSSION

Many studies have developed and evaluated screening tools for the diagnosis of alcohol disorders using the DSM criteria. In addition, one

study revealed that using the cut-down, annoyed, guilty, and eye-opener (CAGE) with the drinking standard suggested by the NIAAA was more effective than the use of CAGE alone.⁶⁾ Many problem drinkers tend to obtain alcohol-related counseling by chance during health checkups at a health-screening center rather than visiting an alcohol clinic for counseling. Recently in Korea, a large number of health-screening centers that provide health checkups to large numbers of people in a short time have been established.⁷⁾ In many cases, health-screening centers administer questionnaires about past medical history, obesity, smoking, alcohol drinking, and exercise, consisting of only one or two questions each. In most health-screening centers, questions about alcohol drinking ask only about the type of alcohol beverage, drinking frequency per week, and number of drinks per drinking day. However, it is possible to apply the heavy-drinking and binge-drinking standards suggested by the NIAAA to the patient's age and sex using this limited questionnaire. Accordingly, it is meaningful to evaluate the heavy- and binge-drinking standards of the DSM diag-

nostic criteria without using an alcohol-screening tool in clinical situations.

In the current study, the sensitivity of the heavy- and binge-drinking group for DSM-IV alcohol abuse, DSM-IV alcohol dependence, and DSM-5 AUD was 51.7%, 43.8%, and 35.3%, and 69.0%, 62.5%, and 48.2%, respectively. Park et al.⁸⁾ reported the sensitivity of the alcohol use disorders identification test (AUDIT) and CAGE for DSM-IV alcohol dependence and AUD to be 77.8%–100.0% and 87.1%–89.1%, and 44.4%–88.9% and 76.1%–97.8%, respectively. Kim et al.⁹⁾ reported the sensitivity of the AUDIT for DSM-IV alcohol dependence and AUD to be 71.4%–85.7% and 84.2%–91.2%, respectively. Lee et al.¹⁰⁾ reported the sensitivity of the AUDIT and CAGE for problem drinking to be 77.1%–100.0% and 12.5%–70.4%, respectively. Furthermore, Nam et al.¹¹⁾ reported the sensitivity of binge drinking for problem drinking in males to be 61.7%–93.8% and in females to be 46.7%–86.6%. In conclusion, this study showed a lower sensitivity compared with previous reports that used questionnaires. In other words, alcohol drinkers can fulfill the criteria for DSM-IV alcohol abuse, DSM-IV alcohol dependence, or DSM-5 AUD while not satisfying heavy- or binge-drinking standards. Therefore, using only the heavy-drinking or binge-drinking standard for a DSM AUD diagnosis has limitations. Although heavy and binge drinking are also important factors, they should be used in combination with other alcohol-screening tools for DSM AUD. Use of the guidelines for moderate alcohol drinking for Koreans, which suggest a lower weekly drinking amount and maximum drinking amount per drinking days than the NIAAA standard,¹²⁾ would result in higher sensitivity.

Between the group of males up to age 65 years and the group of males over age 65 and females, the comparison of the AUROC of heavy drinking for DSM-IV alcohol abuse, DSM-IV alcohol dependence, and DSM-5 AUD were 0.663 vs. 0.816, 0.642 vs. 0.796, and 0.622 vs. 0.728, respectively. The AUROC comparisons of binge drinking for these groups were 0.703 vs. 0.856, 0.687 vs. 0.857, and 0.661 vs. 0.707, respectively. As a result, the diagnostic accuracy was better for the group of males up to age 65 years than for the group of males over age 65 and females in the AUROC comparison of both heavy and binge drinking for DSM AUD.

In this study, the specificity of the heavy-drinking group for DSM-IV alcohol abuse, DSM-IV alcohol dependence, and DSM-5 AUD was 90.1%, 91.7%, and 95.5%, respectively. The specificity of the binge-drinking group for DSM-IV alcohol abuse, DSM-IV alcohol dependence, and DSM-5 AUD was 84.3%, 86.8%, and 91.2%, respectively. Park et al.⁸⁾ reported the specificity of the AUDIT and CAGE for DSM-IV alcohol dependence and AUD to be 92.5%–95.4% and 80.0%–84.0%, and 85.1%–99.7% and 58.0%–90.0%, respectively. Kim et al.⁹⁾ reported the specificity of the AUDIT for DSM-IV alcohol dependence and AUD to be 90.7%–94.7% and 74.4%–84.6%, respectively. Lee et al.¹⁰⁾ reported the specificity of the AUDIT and CAGE for problem drinking to be 72.0%–95.3% and 64.0%–98.9%, respectively. Moreover, Nam et al.¹¹⁾ reported the specificity of binge drinking for problem drinking in males to be 75.0%–92.3% and in females to be 86.7%–91.2%. In con-

trast, the present study showed similar or higher specificity compared with previous reports. In other words, the majority of those without DSM AUD are not likely to undertake heavy or binge drinking. Considering the high specificity of heavy drinking and binge drinking for DSM AUD diagnosis, the presence of heavy drinking and binge drinking on the screening questionnaire may facilitate doctors to evaluate DSM-IV alcohol abuse, alcohol dependence, and DSM5 AUD more effectively in a clinical sense.

In our study, the PPV of the heavy-drinking group for DSM-IV alcohol abuse, DSM-IV alcohol dependence, and DSM-5 AUD was 24.8%, 40.5%, and 72.7%, respectively. The PPV of the binge-drinking group for DSM-IV alcohol abuse, DSM-IV alcohol dependence, and DSM-5 AUD was 21.7%, 38.0%, and 65.2%, respectively. Lee et al.¹⁰⁾ reported the PPV of the AUDIT and CAGE for problem drinking to be 67.5%–88.1% and 43.2%–85.7%, respectively. In addition, Nam et al.¹¹⁾ reported the PPV of binge drinking for problem drinking in males to be 85.4%–92.6% and in females to be 41.2%–50.0%. The PPV in our study for the DSM-IV criteria is lower compared with previous reports. However, the PPV of heavy drinking for the diagnosis of DSM-5 AUD in this study was 72.7%. The PPV of binge drinking for the diagnosis of DSM-IV alcohol abuse and DSM-IV alcohol dependence was lower compared with previous reports. However, the PPV of binge drinking for the diagnosis of DSM-5 AUD in this study was 65.2%.

In the present study, the NPV of the heavy-drinking group for DSM-IV alcohol abuse, DSM-IV alcohol dependence, and DSM-5 AUD was 96.7%, 92.6%, and 81.2%, respectively. The NPV of the binge-drinking group for DSM-IV alcohol abuse, DSM-IV alcohol dependence, and DSM-5 AUD was 97.8%, 94.7%, and 83.7%, respectively. Lee et al.¹⁰⁾ reported the NPV of the AUDIT and CAGE for problem drinking to be 86.4%–100.0% and 66.0%–88.2%, respectively. Furthermore, Nam et al.¹¹⁾ reported the NPV of binge drinking for problem drinking in males to be 60.7%–88.6% and in females to be 92.8%–98.0%. In this study, the NPV of heavy drinking for the diagnosis of DSM-IV alcohol abuse and alcohol dependence was 96.7% and 92.6%, respectively, which is higher than previous reports. The NPV of binge drinking for the diagnosis of DSM-IV alcohol abuse and alcohol dependence was 97.8% and 94.7%, respectively, which is also higher than previous reports. The NPV of binge drinking for the diagnosis of DSM-5 AUD was 83.7%. In clinical practice, various diagnostic standards are used. The PPV and NPV are the most important parameters for diagnosis. In this study, the PPV for DSM-IV alcohol abuse and alcohol dependence was relatively low. However, the PPV for the revised DSM-5 AUD was higher, which is meaningful. The NPV of this study was relatively high compared to previous studies. Therefore, persons who do not undertake heavy or binge drinking tend to have a low probability of DSM AUD.

In conclusion, it may be inappropriate to use only heavy and binge drinking for screening of DSM AUD due to the low sensitivity. However, we report here higher specificity and NPV than several complex alcohol-screening tools. This study also showed an increased PPV for the revised DSM-5 AUD.

This study has the following limitations. First, it was a retrospective

study. Second, the number of participants with a severe AUD diagnosis was insufficient (approximately 2% of the entire sample). This may be due to the extremely extended diagnostic range of the DSM-5. Only four females or males aged 65 years and older were diagnosed with severe AUD. In the future, more detailed research at a larger scale is required to obtain results that are more accurate. Third, the average drinking amount per day was used as a barometer of binge drinking. Drinking amount per day was obtained by asking, "How much do you drink on average per day?" Instead, we could have asked, "What is the maximum you drink per day?" In the binge-drinking group, diagnostic power could be reduced because the maximum drinking amount was omitted. Future research should include this question. Fourth, almost all of the participants of this study were health-screening examinees who visited a health-screening center voluntarily. As such, they have a lot of interest in their health, and enough time and money to obtain the health screening. Therefore, they could have different alcohol drinking patterns in comparison with people who do not voluntarily access screening. Fifth, there is a possibility that there was under-reporting of alcohol intake on the questionnaires. Problem drinkers tend to under-report their alcohol drinking pattern. When interpreting the results of this study, this point needs to be considered. Sixth, the prevalence of binge drinking in this study was lower in comparison to that of the Korea National and Nutrition Examination Survey (KNHANES) 2014.¹³⁾ The binge-drinking rate in this study was 29.13% in males and 7.38% in females; the monthly binge-drinking rate in the KNHANES 2014 was 53.0% in males and 22.5% in females. Considering sensitivity and specificity are usually influenced by the prevalence itself, the sensitivity might be much lower than expected in this study that has a lower binge-drinking rate in comparison with the KNHANES 2014. Taken as a whole, heavy and binge drinking did not have enough diagnostic power for DSM-IV alcohol abuse, DSM-IV alcohol dependence, and DSM-5 AUD despite its high specificity and NPV.

CONFLICT OF INTEREST

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

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