



Relationships of both Heavy and Binge Alcohol Drinking with Unhealthy Habits in Korean Adults Based on the KNHANES IV Data

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Abstract

Background: We conducted this cross-sectional study to examine the relationships between problematic alcohol drinking, unhealthy habits and socio-demographic factors based on the Fourth Korean National Health and Nutrition Examination Survey (KNHANES IV).

Methods: We analyzed a total of 13,488 participants based on the data collected from the KNHANES IV performed between 2007 and 2009.

Results: The frequency of binge and heavy drinking was significantly higher in men and the married participants with intermediate income. The frequency of binge drinking was higher in younger adults and individuals with at least high school graduates. After the adjustment of socio-demographic factors, the odds of current smoking (adjusted Odds Ratio [aOR] 4.11, 95% CI 3.35-5.03), abdominal obesity (aOR 1.26, 95% CI 1.08-1.48), stress (aOR 1.45, 95% CI 1.26-1.68), and depressed mood (aOR 1.31, 95% CI 1.08-1.58) were greater in heavy drinkers than in nondrinkers. The odds of current smoking (aOR 1.73, 95% CI 1.42-2.09 for infrequent binge drinking and aOR 4.95, 95% CI 4.25-5.77 for frequent binge drinking), obesity (aOR 1.22, 95% CI 1.06-1.41 for infrequent binge drinking and aOR 1.64, 95% CI 1.46-1.85 for frequent binge drinking), and abdominal obesity (aOR 1.22, 95% CI 1.04-1.43 for infrequent binge drinking and aOR 1.55, 95% CI 1.36-1.77 for frequent binge drinking) were increased with the increased frequency of the binge drinking.

Conclusions: Our results would be of help for screening a specific subgroup of individuals who are vulnerable to alcohol drinking by establishing effective population-based strategies to reduce the problematic drinking.

Keywords: Alcohol drinking, Unhealthy habits, Socio-demographic factors, Korean adult

Introduction

Moderate alcohol consumption has been associated with a decreased incidence of cardiovascular disease (1) and a reduction of total mortality (2). However, problematic use of alcohol, like heavy drinking or binge drinking, has been linked to adverse health and social consequences (3, 4). Therefore, the socioeconomic cost of problematic drinking has become an important global issue (5), where Korea is not an exception in that it is a region with an alcohol-related economic loss being much greater than other countries (6).

Numerous nations have implemented public health policies to improve problems related to alcohol and many studies on public policy are currently underway (7). Likewise, Korea has implemented national policies to decrease it. Nevertheless, the prevalence of problematic drinking has been increased from 14.9% in 2005 to 17.1% in 2009 among current drinkers (8, 9). The underlying mechanisms remain unclear. But this might be because the Korean policies have merely focused on the education and public information cam-

paigns for the entire population (10). It can therefore be inferred that it would be more effective in reducing the problematic drinking to screen a specific subgroup of vulnerable individuals.

Health behaviors like abstinence from smoking, limited alcohol consumption, sleeping 7-8 hours a night, regular exercise and maintenance of a healthy weight are positively related to good physical health status (11) and lower mortality (12, 13). Several studies have shown, however, that unhealthy habits, the opposed concept of health behaviors are linked to elevated risk of cardiovascular diseases, cancer and mortality (14, 15). In addition, according to a review of literatures, psychiatric problems like depressed mood or stress tend to increase the negative health outcomes and mortality (16). The co-occurrence of unhealthy habits is more influential on people's health than the sum of effects that is expected from the individual unhealthy habits (14, 17). Because of the potential synergistic effects, multiple-behavior interventions may be more effective than single-behavior ones (18). It would therefore be mandatory to clarify the relationship between problematic alcohol drinking and other unhealthy habits, which is essential for promoting the public health. A comprehensive understanding of socio-demographic determinants of alcohol drinking would make it possible to make individualized, differentiated approaches to problematic drinking. To date, several studies have shown that there is a relationship between problematic drinking and various socio-demographic factors. Still, however, such relationship remains uncertain (19-22). Thus, it is necessary to determine specific socio-demographic factors associated with alcohol drinking from Korean adults.

With the implementation of healthcare policy, as well as anti-drinking program, considering unhealthy habits and socio-demographic factors in problematic drinkers, the problematic drinking would be more effectively corrected. To date, however, few studies have attempted to examine the impacts of problematic drinking, including both heavy and binge drinking, on various unhealthy habits and psychiatric problems (22). Therefore, we conducted this study to examine

the relationship between problematic alcohol drinking, unhealthy habits and socio-demographic factors based on a representative nationwide survey.

Materials & Methods

The Fourth Korean National Health and Nutrition Examination Survey (KNHANES IV)

The KNHANES IV was performed by the Korea Centers for Disease Control and Prevention (KCDC) for the purposes of clarifying the status of public health and presenting the baseline data for the development, establishment and evaluation of public health policy in a Korean population during a period ranging from 2007 to 2009. In the KNHANES IV, participants include non-institutionalized individuals aged ≥ 1 year by a stratified, multi-stage cluster probability sampling design to ensure an independent and homogeneous sampling for each year in addition to nationally representative sampling. Data were collected by a variety of means including household interview, self-reporting questionnaire, physical examination and the assessment of the nutritional status (8). The protocols for the KNHANES IV were approved by the Institutional Review Board of the KCDC and the participants submitted a written informed consent at baseline.

Study population

A total of 31,705 participants were recruited and 24,871 of them completed the KNHANES IV. Inclusion criteria for the current study is adults, we therefore excluded 11,383 participants aged 20 years or younger. In this cross-sectional study, we finally examined the data of 13,488 participants collected from the KNHANES IV. The current study was approved by the Institutional Review Board of the Catholic University of Korea (Seoul, Korea, IRB approval number: VC11QDSE0184).

Variables and evaluation criteria

(a) Problematic drinking

A series of alcohol-related questionnaire using in the KNHANES IV included the frequency of drinking days, the number of a standard drink consumed per drinking day, and the frequency of

binge drinking during one month that preceded the interview for KNHANES IV. A standard drink is any drink that contains 12 g of pure alcohol and the Korean version of a standard drink based on 4.5 vol% in beer, 12 vol% in wine, 6 vol% in Korean traditional makgeolli, 20 vol% in Korean soju, and 40 vol% in whisky was used in the KNHANES IV.

In the current study, we defined the problematic drinking as heavy drinking and binge one, and sub-categorized it as follows:

Heavy drinking: To define the heavy drinking, we converted the amount of alcohol consumed per drinking day and the frequency of drinking in the past month into the mean daily alcohol consumption (gram pure alcohol/day). Using the WHO classification (23), we classified the mean daily alcohol consumption into three categories: non-drinking, moderate drinking (women, 0.1-19.99 g pure alcohol/day; men, 0.1-39.99 g pure alcohol/day) and heavy drinking (women, ≥ 20 g pure alcohol/day; men, ≥ 40 g pure alcohol/day).

Binge drinking: Binge drinking is defined as consuming ≥ 5 standard drinks (≥ 4 drinks for women) consecutively on one occasion (24), and these data were subcategorized into three groups based on frequency: none (non-binge drinking), infrequent binge drinking (< 1 time/month) and frequent binge drinking (≥ 1 time/month).

(b) Variables associated with the unhealthy habits
Variables associated with the unhealthy habits include sleep ≤ 6 hours per night (11), a current history of smoking, less physical activity (less than 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity physical activity per week) (25), obesity (BMI ≥ 25 kg/m²), abdominal obesity (waist circumference ≥ 90 cm in men and ≥ 85 cm in women) (26), stress (answered "I feel a lot of stress" to a question about the stress the participants experienced during daily life) and depressed mood (answered an affirmative response to "Have you ever felt so sad or hopeless that you experienced difficulties in daily life on a continuous basis for more than 2 weeks during the past year?").

(c) Socio-demographic variables

In the current study, socio-demographic variables include the age (20-29 years, 30-39 years, 40-49

years, 50-59 years, and 60 years or older), marital status (never married, currently married, and formerly married [separated, divorced or widowed]), level of monthly income (low, moderate and high income), years of education (≤ 6 years: elementary school or less, 7-9 years: middle school, 10-12 years: high school and > 13 years: college or above) and occupation (white-collar worker: a salaried professional or an educated worker working in offices, blue-collar worker: worker who performs manual labor in the types of physical work, and unemployed: not having a job).

Data analysis

To analyze the data through a complex sample design, we used the SAS PROC SURVEY module, considering strata, clusters and weights. All analyses were carried out with the sample weights of KNHANES.

We analyzed the frequency of heavy drinking and that of binge drinking depending on the demographic variables using chi-square tests. Moreover, we also examined the relationship between problematic drinking as the independent variables and other unhealthy habits as the dependent variables using a multiple logistic regression analysis after the adjustment of demographic variables (gender, age, marital status, monthly income, education, occupation), served as covariates. All statistical analyses were performed using the SAS software (ver. 9.2; SAS Institute, Cary, NC). *P*-values of < 0.05 were considered statistically significant.

Results

Demographic characteristics

As shown in Table 1, 50.9% of study participants were men ($n = 5,796$). More than 70% had a spouse ($n = 10,130$). Approximately 11% of participants were from low-income families ($n = 1,658$) and 66.9% possessed high school diplomas or lower ($n = 9,262$). At least 44% of participants were blue-collar workers ($n = 5,609$).

Frequency of problematic drinking

The overall percentage of heavy drinking in participants was 23.3% (33.4% in men and 12.9% in

women). In addition, the frequency of heavy drinking was the highest in married middle school graduates in their 40s with intermediate income and a blue-collar job. The overall percentage of binge drinking in current drinkers was 73.4% (86.1% in male drinkers and 60.2% in female drinkers). The frequency of total binge drinking including infrequent and frequent binge drinking was highest in the married high-school graduates with an intermediate income and a white collar job. Frequent binge drinking was more common in the participants with a low income or a blue collar job (Table 2).

Relationships between the amount of alcohol consumption, unhealthy behaviors and psychiatric problems

There was a significant relationship between heavy drinking, current smoking and stress, which also reached a statistical significance even after the adjustment of covariates. It is noteworthy that there was a dose-dependent relationship between the variables. That is, as the amount of daily alcohol consumption was increased, the odds of smoking (adjusted Odds Ratio [aOR] 1.74, 95% CI 1.43-

2.10 for moderate drinking, aOR 4.11, 95% CI 3.35-5.03 for heavy drinking) and stress (aOR 1.16, 95% CI 1.03-1.31 for moderate drinking, aOR 1.45, 95% CI 1.26-1.68 for heavy drinking) were increased. Abdominal obesity and depressed mood had a positive relationship with heavy drinking (aOR 1.26, 95% CI 1.08-1.48, aOR 1.31, 95% CI 1.08-1.58, respectively). But they had no relationship with moderate drinking (aOR 1.00, 95% CI 0.87-1.14, aOR 1.00, 95% CI 0.86-1.16, respectively). There were no significant relationships between the obesity, physical activity and the degree of daily alcohol consumption after the adjustment of covariates. There was a negative relationship between moderate drinking and sleeping ≤ 6 hours, which also reached a statistical significance even after the adjustment of covariates (aOR 0.85, 95% CI 0.76-0.95) (Table 3).

Relationships between the frequency of binge drinking, unhealthy behaviors and psychiatric problems

The relationships between the frequency of binge drinking and unhealthy habits are shown in Table 4.

Table 1: Socio-demographic characteristics (n=13,488)

		n	%	SE
Gender	Men	5,796	50.9	0.4
	Women	7,692	49.1	0.4
Age (yr)	20-29	2,100	22.2	0.6
	30-39	3,481	25.6	0.6
	40-49	3,394	25.9	0.5
	50-59	2,892	18.9	0.4
	≥ 60	1,621	7.4	0.2
Marital status	Never married	2,148	21.9	0.6
	Currently married	10,130	70.8	0.7
	Other ^a	1,162	7.3	0.2
Monthly income	Low	1,658	11.1	0.4
	Intermediate	7,378	56.4	0.9
	High	4,184	32.5	0.9
Education	\leq Elementary school	2,270	12.7	0.4
	Middle school	1,581	10.5	0.3
	High school	5,411	43.7	0.6
	\geq College	4,193	33.1	0.7
Occupation	White collar	3,048	27.0	0.6
	Blue collar	5,609	44.2	0.7
	Unemployed	3,801	28.8	0.7

%, percent; SE, standard error. ^aseparated/divorced/widowed

Table 2: The frequency of problematic drinking depending on socio-demographic factors

	Amount of alcohol consumption ^a			<i>P</i>	Frequency of binge drinking ^b			<i>P</i>
	None	Moderate	Heavy		None	Infrequent	Frequent	
Gender				<0.001				<0.001
Men	11.6(0.5)	55.0(0.8)	33.4(0.7)		13.9(0.6)	17.7(0.6)	68.4(0.8)	
Women	29.1(0.6)	58.0(0.6)	12.9(0.4)		39.8(0.8)	27.6(0.7)	32.6(0.8)	
Age (years)				<0.001				<0.001
20-29	12.3(0.8)	65.6(1.2)	22.1(1.0)		16.9(1.0)	25.8(1.1)	57.3(1.3)	
30-39	16.5(0.7)	60.5(0.9)	23.0(0.9)		24.1(1.0)	23.6(0.9)	52.3(1.2)	
40-49	18.9(0.7)	54.5(0.9)	26.6(0.8)		25.9(0.9)	20.9(0.9)	53.2(1.1)	
50-59	29.0(1.0)	47.7(1.1)	23.3(0.9)		31.8(1.2)	18.1(0.9)	50.1(1.2)	
≥60	38.2(1.4)	45.5(1.4)	16.3(1.0)		43.2(1.9)	16.0(1.3)	40.8(1.9)	
Marital status				<0.001				<0.001
Never married	22.0(0.5)	54.7(0.6)	23.3(0.5)		27.8(0.6)	21.6(0.5)	50.6(0.7)	
Currently married	11.2(0.7)	65.2(1.2)	23.6(1.1)		16.6(1.0)	24.3(1.1)	59.1(1.3)	
Other ^c	29.4(1.4)	47.8(1.7)	22.8(1.5)		30.4(1.9)	17.8(1.5)	51.8(2.2)	
Monthly income				<0.001				0.006
Low	27.1(1.3)	49.9(1.5)	23.0(1.4)		26.1(1.5)	17.3(1.4)	56.6(1.8)	
Intermediate	20.8(0.5)	55.2(0.6)	24.0(0.6)		24.2(0.7)	22.6(0.6)	53.2(0.8)	
High	16.2(0.6)	61.2(0.8)	22.6(0.8)		25.9(0.9)	22.9(0.9)	51.2(1.1)	
Education				<0.001				<0.001
≤Elementary school	34.6(1.2)	43.7(1.2)	21.7(1.0)		36.8(1.6)	17.0(1.2)	46.2(1.7)	
Middle school	21.2(1.2)	51.4(1.5)	27.4(1.3)		29.2(1.6)	17.9(1.2)	52.9(1.7)	
High school	17.7(0.6)	57.2(0.8)	25.1(0.7)		22.3(0.7)	21.6(0.7)	56.1(0.9)	
≥College	17.5(0.7)	62.2(0.8)	20.3(0.7)		24.2(0.9)	25.5(0.9)	50.3(1.1)	
Occupation				<0.001				<0.001
White collar	14.3(0.7)	61.8(0.9)	23.9(0.9)		20.9(0.9)	24.1(1.0)	55.0(1.2)	
Blue collar	16.2(0.5)	53.3(0.8)	30.5(0.7)		22.5(0.7)	18.1(0.7)	59.4(0.9)	
Unemployed	29.1(0.8)	56.3(1.0)	14.6(0.7)		32.7(1.2)	26.5(1.0)	40.8(1.2)	

Data are presented as percent (standard error). ^aNone: nondrinkers, Moderate: for women <20g alcohol/day, for men <40g alcohol/day, Heavy: for women ≥20 g alcohol/day, for men ≥40 g alcohol/day; ^bNone: no binge drinking, Infrequent: binge drinking <1 time/month, Frequent: binge drinking ≥1 times/month; ^cseparated/divorced/widowed.

There was a strong relationship between the current smoking and binge drinking irrespective of the adjustment of covariates, where the odds ratios were increased as the frequency of binge drinking was increased (aOR 1.73, 95% CI 1.42-2.09 for infrequent binge drinking, aOR 4.95, 95% CI 4.25-5.77 for frequent binge drinking). Frequent binge drinking had a positive relationship with both obesity (aOR 1.22, 95% CI 1.06-1.41 for infrequent binge drinking, aOR 1.64, 95% CI 1.46-1.85 for frequent binge drinking) and abdominal obesity (aOR 1.22, 95% CI 1.04-1.43 for infrequent binge drinking, aOR 1.55, 95% CI 1.36-1.77 for frequent binge drinking), which is

notable after the adjustment of covariates. In addition, the aOR for obesity and abdominal obesity were increased as the frequency of binge drinking was increased. After the adjustment of covariates, there was a positive relationship between stress and frequent binge drinking (aOR 1.18, 95% CI 1.02-1.36). But there was a relationship between the depressed mood and binge drinking irrespective of the frequency of binge drinking (aOR 1.38, 95% CI 1.13-1.68 for infrequent binge drinking, aOR 1.37, 95% CI 1.16-1.62 for frequent binge drinking). There were no significant relationships between binge drinking, the amount of sleep and physical activity.

Table 3: Odds ratios and 95% confidence intervals of unhealthy habits depending on the amount of alcohol consumption^a

	None	Moderate	Heavy	P for trend
Sleeps 6 hours or less				
Crude OR (95% CI)	1	0.87 (0.78, 0.96)	1.01 (0.89, 1.14)	0.719
Adjusted OR (95% CI)	1	0.85 (0.76, 0.95)	0.93 (0.81, 1.07)	0.497
Current smoker				
Crude OR (95% CI)	1	2.64 (2.26, 3.09)	8.39 (7.12, 9.89)	<0.001
Adjusted OR (95% CI)	1	1.74 (1.43, 2.10)	4.11 (3.35, 5.03)	<0.001
Less physical activity				
Crude OR (95% CI)	1	1.12 (0.97, 1.30)	0.95 (0.82, 1.12)	0.497
Adjusted OR (95% CI)	1	1.11 (0.95, 1.29)	1.02 (0.85, 1.22)	0.907
Obesity				
Crude OR (95% CI)	1	0.92 (0.82, 1.02)	1.30 (1.14, 1.48)	<0.001
Adjusted OR (95% CI)	1	0.96 (0.85, 1.07)	1.11 (0.96, 1.28)	0.077
Abdominal obesity				
Crude OR (95% CI)	1	0.78 (0.69, 0.87)	1.09 (0.96, 1.12)	0.081
Adjusted OR (95% CI)	1	1.00 (0.87, 1.14)	1.26 (1.08, 1.48)	0.001
Stress				
Crude OR (95% CI)	1	1.15 (1.03, 1.29)	1.37 (1.21, 1.55)	<0.001
Adjusted OR (95% CI)	1	1.16 (1.03, 1.31)	1.45 (1.26, 1.68)	<0.001
Depressed mood				
Crude OR (95% CI)	1	0.74 (0.65, 0.85)	0.90 (0.76, 1.07)	0.335
Adjusted OR (95% CI)	1	1.00 (0.86, 1.16)	1.31 (1.08, 1.58)	0.004

Adjustment of such variables as gender, age, marital status, monthly income, education and occupation. ^aNone: nondrinkers; Moderate: for women <20 g alcohol/day, for men <40g alcohol/day; Heavy: for women ≥20 g alcohol/day, for men ≥40 g alcohol/day

Table 4: Odds ratios and 95% confidence intervals of unhealthy habits depending on the frequency of binge drinking^a

	None	Infrequent	Frequent	P for trend
Sleeps 6 hours or less				
Crude OR (95% CI)	1	0.86 (0.76, 0.98)	1.05 (0.94, 1.17)	0.158
Adjusted OR (95% CI)	1	0.93 (0.81, 1.06)	1.06 (0.94, 1.19)	0.381
Current smoker				
Crude OR (95% CI)	1	1.71 (1.44, 2.04)	5.35 (4.64, 6.16)	<0.001
Adjusted OR (95% CI)	1	1.73 (1.42, 2.09)	4.95 (4.25, 5.77)	<0.001
Less physical activity				
Crude OR (95% CI)	1	1.12 (0.97, 1.30)	1.03 (0.89, 1.19)	0.857
Adjusted OR (95% CI)	1	1.04 (0.85, 1.28)	1.08 (0.92, 1.27)	0.502
Obesity				
Crude OR (95% CI)	1	1.04 (0.91, 1.19)	1.42 (1.28, 1.58)	<0.001
Adjusted OR (95% CI)	1	1.22 (1.06, 1.41)	1.64 (1.46, 1.85)	<0.001
Abdominal obesity				
Crude OR (95% CI)	1	0.93 (0.80, 1.08)	1.19 (1.06, 1.33)	<0.001
Adjusted OR (95% CI)	1	1.22 (1.04, 1.43)	1.55 (1.36, 1.77)	<0.001
Stress				
Crude OR (95% CI)	1	1.14 (0.99, 1.31)	1.10 (0.98, 1.24)	0.117
Adjusted OR (95% CI)	1	1.14 (0.98, 1.33)	1.18 (1.02, 1.36)	0.026
Depressed mood				
Crude OR (95% CI)	1	1.05 (0.88, 1.26)	0.96 (0.83, 1.11)	0.498
Adjusted OR (95% CI)	1	1.38 (1.13, 1.68)	1.37 (1.16, 1.62)	<0.001

Adjustment of such variables as gender, age, marital status, monthly income, education and occupation. ^aNone: no binge drinking; Infrequent: binge drinking <1 times/month; Frequent: binge drinking ≥1 times/month.

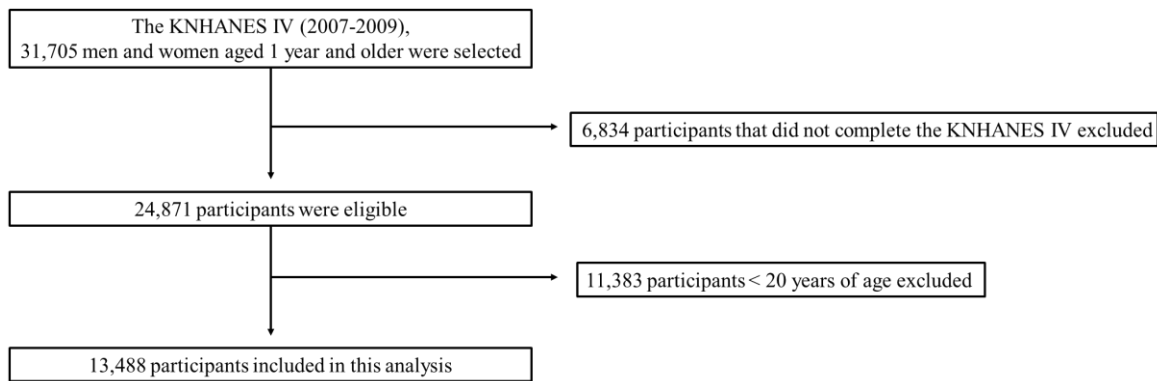


Fig. 1: Recruitment of participants for the KNHANES IV, and derivation of the population used in this analysis

Discussion

In the current study, there were significant positive relationships between heavy drinking, binge drinking, current smoking, abdominal obesity, stress and depressed mood. In addition, the prevalence of heavy and binge drinking were different depending on socio-demographic factors. These results suggest that the problematic drinking is associated with other unhealthy behaviors, psychiatric problems, and socio-demographic factors.

These results showed that there was a strong relationship between the problematic drinking and current smoking. In addition, there were dose-response relationships between the amount of daily alcohol consumption, the frequency of binge drinking and current smoking. There was also a strong relationship between alcohol drinking and cigarette smoking, which has been supported by numerous cross-sectional studies (21, 22, 27, 28) as well as those examining specific causal relationship (29, 30). Such relationship may be attributable to multiple factors including biological, genetic and social factors although little is known about the exact mechanisms underlying the co-use of alcohol and nicotine. Further studies are therefore warranted to clarify the mechanisms of the concurrent use of alcohol and nicotine, which is essential for providing guidance for the development of more effective prevention and treatment strategies.

We found that the proportion of obesity and abdominal obesity was significantly higher in binge drinkers where there was a dose-response relationship. In heavy drinkers, however, only the proportion of abdominal obesity was significantly higher. Previous studies also have shown inconsistent results about the relationship between alcohol drinking and obesity. Arif and Rohrer (31) reported a positive relationship between the obesity and binge drinking, which is consistent with our results. According to Wannamethee et al. (32), however, the prevalence of obesity and abdominal obesity was the highest in heavy drinkers. Breslow and Smothers (33) also demonstrated a linear dose-response relationship between BMI and the amount of drinking, which is inconsistent with our results. The mechanism underlying the relations of alcohol drinking and obesity is likely explained by alcohol being high in calories. An alternative explanation is that drinkers tend to consume additional calories by drinking while they dine, consequently aggravating weight control issues. In addition, ingested alcohol is used to produce energy, replacing the lipid oxidation process. Thus, obesity may occur through an increase in the body fat ratio.

More recently, there is a consensus that the degree of physical activity is higher in drinkers as compared with non-drinkers. Some reports in this series have shown that there is a possible dose-response correlation between the amount of alcohol consumption and the degree of physical activity

(34, 35). On the other hand, some studies have shown a curvilinear relationship between the two factors, thus suggesting that the degree of physical activity is relatively higher in moderate drinkers and relatively lower in problematic drinkers (36, 37). These reports indicate that various beneficial effects of moderate alcohol drinking might be based on the increased physical activity. This leads us to speculate that the degree of physical activity (e.g., recreational, occupational and sports activities) might be relatively higher in drinkers than in nondrinker in Korea. In the current study, however, we failed to identify any significant relationships between alcohol drinking and physical activity. There might be a discrepancy in the results between the current study and previous reports due to the differences in the socio-cultural background, study population and design. Further studies are therefore warranted to identify the specific factors associated with the physical activity in drinkers and its causal relationship with alcohol consumption.

It has commonly been recognized that alcohol is helpful for sleeping (38). Our results also showed that there was a negative relationship between moderate drinking and sleeping ≤ 6 hours. Previous studies have shown, however, that there is a variability in the relationship between alcohol and sleep problem. Bruck and Astbury (39) conducted a study to examine sleep difficulties in Australian women, thus reporting that binge drinking had a significant impact on sleep difficulty. In a population-based study, Popovici and French (40) also showed a strong relationship between sleep problems and the frequency of binge drinking in young adults. In addition, Vinson et al. (41) showed that there were no relationships between drinking and sleep problems and there were negative relationships between moderate drinking and sleep apnea. There are complicated relationships between alcohol consumption and sleep problems, which might be attributable to the pharmacological effects of alcohol (42), comorbid psychiatric conditions (39) or other factors. Further prospective clinical and laboratory studies are therefore warranted to clarify the above relationships.

The prevalence of problematic drinking showed to differ depending on the socio-demographic factors. Consistent with previous reports (19, 20-22), our results showed the following:

1. Heavy and binge drinking were more prevalent in men.

2. Binge drinking was more common in younger adults and individuals with at least high school graduates.

The differences of gender on the frequency of problematic drinking might be explained by the fact that the Korean work force includes more men than women, who are accustomed to offering each other drinks after work (43). Specialized strategic approaches depending on the differing gender would be needed for dealing with problematic drinking. However, inconsistent with previous reports (19, 21, 22), the frequency of heavy and binge drinking was the highest in the married participants with intermediate incomes. Furthermore, the prevalence of binge drinking was higher among the white collar- or the blue collar workers than the unemployed. This could be explained by Korea's drinking culture: in Korean society, drinking is an important medium of non-verbal communication and a drinking gathering is an opportunity to form and strengthen social bonds. Thus, alcohol consumption in Korea is primarily a social behavior generally done in groups to socialize, and binge drinking might be the result of mutual encouragement of alcohol consumption.

In the current study, we found that binge drinking was more common than non-binge drinking in all socio-demographic factors. Recent surveys have shown continued trends of binge drinking in drinkers (43, 44), and the rates of binge drinking in Korea are considerably higher than other countries (45). Binge drinking, one of the main drinking behaviors in Korean adults, is related to higher socio-economic costs as it increases acute outcomes such as accidents, intentional injuries or deaths, domestic conflict and violence (4). Thus, there is a strong need to establish policies and strategies to decrease binge drinking, which could consequently reduce alcohol-related problems.

There are several limitations of the study as shown below:

1) The current study was conducted under the cross-sectional design.

2) A recall bias might be involved considering that the KNHANES data was obtained from an interview and a self-reporting questionnaire.

3) In the KNHANES, the questions for screening psychiatric conditions were difficult to make an objective diagnosis of stress or depression.

Despite these limitations, our results are of significance. Given the findings about heavy and binge drinking as well as health-related variables, it would become possible to make a differential approach by screening a high-risk group of individuals who are vulnerable to heavy and binge drinking. Thus, with the recognition of alcohol-related health risks, public health strategies will be planned and then implemented. This will eventually lead to the promotion of public health. Further studies are warranted to identify a causal relationship between problematic drinking and unhealthy habits, which is essential for understanding and implementing more effective strategies to regulate the problematic drinking.

Conclusions

The problematic drinking is associated with current smoking, abdominal obesity, and psychiatric problems such as feeling under stress or depressed mood in daily life, as well as the prevalence of the problematic drinking differ depending on gender, age, marital status, level of monthly income, years of education, and occupation. Our results indicate that it would be useful in planning and developing effective population-based strategies to reduce the problematic drinking for the purposes of screening a specific subgroup of individuals who are vulnerable to alcohol drinking.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submis-

sion, redundancy, etc) have been completely observed by the authors.

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References

1. Ronksley PE, Brien SE, Turner BJ, Mukamal KJ, Ghali WA (2011). Association of alcohol consumption with selected cardiovascular disease outcomes: a systematic review and meta-analysis. *BMJ*, 342:d671.
2. Di Castelnuovo A, Costanzo S, Bagnardi V, Donati MB, Iacoviello L, de Gaetano G (2006). Alcohol dosing and total mortality in men and women: an updated meta-analysis of 34 prospective studies. *Arch Intern Med*, 166 (22):2437-45.
3. Parry CD, Patra J, Rehm J (2011). Alcohol consumption and non-communicable diseases: epidemiology and policy implications. *Addiction*, 106 (10):1718-24.
4. Stickley A, Pridemore WA (2010). The effects of binge drinking and social capital on violent victimisation: findings from Moscow. *J Epidemiol Community Health*, 64(10):902-7.
5. Baumberg B (2006). The global economic burden of alcohol: a review and some suggestions. *Drug Alcohol Rev*, 25 (6):537-51.
6. Chung WJ, Chun HJ, Lee SM (2006). Socioeconomic costs of alcohol drinking in Korea. *J Prev Med Public Health*, 39(1):21-9.
7. Babor T, Caetano R, Casswell S, Edwards G, Giesbrecht N, Graham K, et al. (2010). *Alcohol: No Ordinary Commodity: Research and Public Policy*. 2nd ed. Oxford University Press. Oxford.
8. Korean Centers for Disease Control and Prevention: Korea National Health and Nutrition Examination Survey [http://knhanes.cdc.go.kr].
9. Road Traffic Authority, Traffic Accident Analysis Center: Road Traffic Accidents in Korea 2010

- [https://www.koroad.or.kr/kp_web/accStatReport.do].
10. Anderson P, Chisholm D, Fuhr DC (2009). Effectiveness and cost-effectiveness of policies and programmes to reduce the harm caused by alcohol. *Lancet*, 373(9682):2234-46.
 11. Belloc NB, Breslow L (1972). Relationship of physical health status and health practices. *Prev Med*, 1(3):409-21.
 12. Belloc NB (1973). Relationship of health practices and mortality. *Prev Med*, 2(1):67-81.
 13. Wiley JA, Camacho TC (1980). Life-style and future health: Evidence from the Alameda County Study. *Prev Med*, 9(1):1-21.
 14. McGinnis JM, Foege WH (1993). Actual causes of death in the United States. *JAMA*, 270(18):2207-12.
 15. Murray C, Lopez A (2002). *World Health Report 2002: Reducing Risks, Promoting Healthy Life*. World Health Organization. Geneva.
 16. Wulsin LR, Vaillant GE, Wells VE (1999). A systematic review of the mortality of depression. *Psychosom Med*; 61(1):6-17.
 17. Breslow L, Enstrom JE (1980). Persistence of health habits and their relationship to mortality. *Prev Med*, 9(4):469-83.
 18. Prochaska JO (2008). Multiple health behavior research represents the future of preventive medicine. *Prev Med*, 46(3):281-5.
 19. Dias P, Oliveira A, Lopes C (2011). Social and behavioural determinants of alcohol consumption. *Ann Hum Biol*, 38(3):337-44.
 20. Tsai J, Floyd RL, Green PP, Boyle CA (2007). Patterns of average volume of alcohol use among women of childbearing age. *Matern Child Health J*, 11(5):437-45.
 21. Dawson DA, Li TK, Grant BF (2008). A prospective study of risk drinking: at risk for what? *Drug Alcohol Depend*, 95(1-2):62-72.
 22. Paul LA, Grubaugh AL, Frueh BC, Ellis C, Egede LE (2011). Associations between binge and heavy drinking and health behaviors in a nationally representative sample. *Addict Behav*, 36(12):1240-5.
 23. Rehm J, Room R, Monteiro M, Gmel G, Graham K, Rehn N, et al. (2004). Alcohol use. In: *Comparative quantification of health risks: global and regional burden of disease attributable to selected major risk factors*. Ed, Ezzati M, Lopez AD, Rodgers A, Murray CJ. World Health Organization, Geneva, pp. 959-1108.
 24. Johnston LD, O'Malley PM, Bachman JG (1991). *Drug use among American high school seniors, college students and young adults, 1975-1990. Volume II: College students and young adults*. National Institute on Drug Abuse. Rockville, MD.
 25. World Health Organization (2010). *Global recommendations on physical activity for health*. World Health Organization. Geneva.
 26. Park HS, Yun YS, Park JY, Kim YS, Choi JM (2003). Obesity, abdominal obesity, and clustering of cardiovascular risk factors in South Korea. *Asia Pac J Clin Nutr*, 12(4):411-8.
 27. Paavola M, Vartiainen E, Haukka A (2004). Smoking, alcohol use, and physical activity: a 13-year longitudinal study ranging from adolescence into adulthood. *J Adolesc Health*, 35(3):238-44.
 28. Reed MB, Wang R, Shillington AM, Clapp JD, Lange JE (2007). The relationship between alcohol use and cigarette smoking in a sample of undergraduate college students. *Addict Behav*, 32(3):449-64.
 29. Funk D, Marinelli PW, Lê AD (2006). Biological processes underlying co-use of alcohol and nicotine: neuronal mechanisms, cross-tolerance, and genetic factors. *Alcohol Res Health*, 29(3):186-92.
 30. Little HJ (2000). Behavioral mechanisms underlying the link between smoking and drinking. *Alcohol Res Health*, 24(4):215-24.
 31. Arif AA, Rohrer JE (2005). Patterns of alcohol drinking and its association with obesity: data from the Third National Health and Nutrition Examination Survey, 1988-1994. *BMC Public Health*, 5:126.
 32. Wannamethee SG, Shaper AG, Whincup PH (2005). Alcohol and adiposity: effects of quantity and type of drink and time relation with meals. *Int J Obes (Lond)*, 29(12):1436-44.
 33. Breslow RA, Smothers BA (2005). Drinking patterns and body mass index in never smokers: National Health Interview Survey, 1997-2001. *Am J Epidemiol*, 161(4):368-76.
 34. Dunn MS, Wang MQ (2003) Effects of physical activity on substance use among college students. *Am J Health Stud*, 18(2-3):126-32.
 35. French MT, Popovici I, Maclean JC (2009). Do alcohol consumers exercise more? Findings from a national survey. *Am J Health Promot*, 24(1):2-10.

36. Kunz JL(1997). Drink and be active? The associations between drinking and participation in sports. *Addict Res Theory*, 5(6):439-50.
37. Smothers B, Bertolucci D (2001). Alcohol consumption and health-promoting behavior in a U.S. household sample leisure-time physical activity. *J Stud Alcohol*, 62(4):467-76.
38. Dufour MC, Archer L, Gordis E (1992). Alcohol and the elderly. *Clin Geriatr Med*, 8(1):127-41.
39. Bruck D, Astbury J (2012). Population study on the predictors of sleeping difficulties in young Australian women. *Behav Sleep Med*, 10(2):84-95.
40. Popovici I, French MT (2013). Binge drinking and sleep problems among young adults. *Drug Alcohol Depend*, 132(1-2):207-15.
41. Vinson DC, Manning BK, Galliher JM, Dickinson LM, Pace WD, Turner BJ (2010). Alcohol and sleep problems in primary care patients: a report from the AAFP National Research Network. *Ann Fam Med*, 8(6):484-92.
42. Stein MD, Friedmann PD (2005). Disturbed sleep and its relationship to alcohol use. *Subst Abus*, 26(1): 1-13.
43. Helzer JE, Canino GJ, Yeh EK, Bland RC, Lee CK, Hwu HG, Newman S (1990). Alcoholism-North America and Asia. A comparison of population surveys with the Diagnostic Interview Schedule. *Arch Gen Psychiatry*, 47(4):313-9.
44. Habgood R, Casswell S, Pledger M, Bhatta K (2001). *Drinking in New Zealand: National Surveys Comparison 1995 and 2000*. Alcohol and Public Health Research Unit. Auckland.
45. Naimi TS, Brewer RD, Mokdad A, Denny C, Serdula MK, Marks JS (2003). Binge drinking among US adults. *JAMA*, 289(1):70-5.