



■ Original Article

# Associations of Alcohol Consumption and Smoking Behaviors with Depressed Mood According to Gender in Korean Young Adults

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**Background:** Recent studies have reported that chronic mental health problems often emerge in young adulthood. This study elucidated the independent effects of smoking and drinking on depressed mood in young adults by sex.

**Methods:** We used Data from the Korea National Health and Nutrition Examination Surveys conducted in 2014, 2016, and 2018. A total of 3,391 participants aged 19–35 years, without serious chronic diseases, were recruited for this study. Depression was evaluated using the Patient Health Questionnaire (PHQ-9).

**Results:** Smoking behavior, current smoking, and number of days smoked were significantly associated with higher PHQ-9 scores in both men and women (all  $P < 0.05$ ). However, past and ever smoking were positively associated with PHQ-9 scores only in women (all  $P < 0.001$ ). Regarding alcohol consumption, the age at which drinking first began was negatively associated with PHQ-9 scores in both men and women (all  $P < 0.001$ ), but the amount of alcohol consumed at 1 time was positively associated with PHQ-9 scores only in women ( $P = 0.013$ ). Men who drank 2–4 times a month and women who had not drunk during the past year had the lowest PHQ-9 scores.

**Conclusion:** Smoking and alcohol consumption were independently associated with depressed mood in young Korean adults, which was more pronounced in women, and exhibited sex-specific characteristics.

**Keywords:** Depression; Young Adults; Smoking; Alcohol Drinking; Patient Health Questionnaire

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## INTRODUCTION

Mental health is defined by the World Health Organization as “a state of well-being in which every individual realizes his or her own potential, can cope with stress, and work productively.”<sup>1)</sup> Mental health is known to be affected by individual, sociological, and environmental factors and can also affect physical and social conditions. According to previous reports, poor mental health is associated with cancer, asthma, heart disease, and diabetes.<sup>2)</sup> Furthermore, life expectancy may be shortened by up to 20 years after mental health illnesses occur.<sup>3)</sup> Therefore, the prevention and management of mental health diseases are important for developing a healthy society.<sup>4)</sup>

Young adults have fewer serious chronic diseases and physical illnesses than elderly individuals. However, their mental health during this period could have a significant impact on the occurrence and progression of chronic diseases after middle age.<sup>5)</sup> Poor mental health in young people is associated with other types of health and forms a significant proportion of the total burden of illnesses.<sup>6)</sup> Therefore, it is necessary to identify the factors related to mental illness to reduce the damage caused by these mental diseases and manage mental health in a productive way.

Smoking and alcohol consumption are important social problems associated with several health issues. According to a recent report in Korea, although prevalence rates vary by sex, >20% of adolescents reported that they smoked or drank alcohol.<sup>7)</sup> Moreover, smoking and alcohol consumption in adolescents have been reported to be highly associated with depressive symptoms, and these activities were more strongly associated with depressed mood in women than in men.<sup>7)</sup> However, there are few studies on their effects in young adults according to sex. Therefore, this study focused on elucidating the effects of smoking and drinking behaviors on depressed mood as measured using the Patient Health Questionnaire (PHQ-9), especially in young adults according to sex.

## METHODS

### 1. Subjects

Data from the 2014, 2016, and 2018 versions of the Korea National Health and Nutrition Examination Survey, a cross-sectional, nationwide, population-based survey, were analyzed because the PHQ-9 was administered every other year. Of the 3,966 participants aged 19–35 years, 108 with chronic diseases that could affect physical and mental health, such as cancer, diabetes, cerebrovascular disease, thyroid disease, chronic nephropathy, cirrhosis, tuberculosis, and rheumatoid arthritis, were excluded. After excluding 467 participants who did not respond to the PHQ-9, 3,391 participants were selected for the study.

### 2. General Characteristics of the Participants

Trained interviewers from the Korea Centers for Disease Control and Prevention's National Health and Nutrition Survey team arranged the questionnaires on the participants' sociodemographic factors and

health. Body mass index (BMI) was calculated by dividing the weight in kilograms by the height in meters squared ( $\text{kg}/\text{m}^2$ ).

Details on the participants' socioeconomic status, including education, employment, and household income, were obtained. Average smoking days for The average number of cigarettes smoked per day, whether a respondent had smoked in the previous month, lifetime smoking experience, and age at first smoking were recorded. Lifetime smoking experience was used to classify respondents as smokers (a person who, at the time of the survey, smoked any tobacco product daily or occasionally) or nonsmokers (a lifetime nonsmoker) according to the World Health Organization's 1998 standards. To evaluate alcohol use, the frequency of alcohol consumption per month, the amount of alcohol consumed in a single sitting, whether the respondent had any experience with alcohol consumption, and the age at which alcohol consumption began were surveyed.

### 3. Depression Measurements

Trained interviewers conducted the PHQ-9. The PHQ-9 is a reliable measurement tool for diagnosing and evaluating the severity of depression that contains nine items that measure the frequency of depressive symptoms during the previous 2 weeks by scoring them 0–27 points, with 27 points being the worst result.<sup>8)</sup> The PHQ-9 score can be categorized into five groups with cutoff points of 5, 10, 15, and 20 points, which represent minimal (0–4 points), mild (5–9 points), moderate (10–14 points), moderately severe (15–19 points), and severe depression (20–27 points).<sup>8)</sup>

### 4. Statistical Analyses

Data were analyzed using IBM SPSS Statistics ver. 21.0 (IBM Corp., Armonk, NY, USA). Sample weights from the Korea National Health and Nutrition Examination Survey were used in all the analyses. A general linear model for continuous variables and crosstabs for categorical variables of a complex sample were used to compare general characteristics by sex. Data are presented as mean±standard error values for continuous variables of a complex sample and unweighted percentages for categorical variables. We used unadjusted ordinal regression analysis to examine the potential covariates of depressed mood. Finally, to determine the independent association between alcohol consumption, smoking behaviors, and depressed mood, multivariate ordinal regression analyses were performed, including age and covariates ( $P$ -values <0.2) in the previous unadjusted ordinal regression analysis. Alcohol consumption and smoking status were included as covariates in the analysis to exclude the interaction between smoking and alcohol consumption. In women, aerobic and muscle-strengthening exercises had  $P$ -values <0.1, but the association with increased depression was assumed to be specific in this study; therefore, they were not included as covariates in the analyses involving women.  $P$ <0.05 was considered to be statistically significant.

## RESULTS

### 1. General Characteristics of Study Participants by Gender

The general characteristics of the participants are listed in Table 1. The mean age, total household income, and prevalence of atopic dermatitis showed no significant differences according to sex. Conversely, mean BMI, frequency of alcohol consumption, frequency of muscle-strengthening and regular aerobic exercise, percentage of past or current smokers, prevalence of hypertension, and percentage of employed individuals were significantly higher in men ( $P<0.001$ ). The

PHQ-9 score, marriage rate, percentage of individuals who completed at least a college degree, and prevalence of allergic rhinitis were significantly higher in women than in men ( $P<0.001$ ).

### 2. Covariates Associated with Depressive Mood

Covariates associated with the PHQ-9 scores were examined using unadjusted ordinal regression analysis (Table 2). In women, regular aerobic exercise showed a positive association, while economic factors, such as employment status and higher monthly household income, showed a negative relationship with the PHQ-9 score. The prev-

**Table 1.** General characteristics of study participants according to gender

Characteristics	Men (n=1,481)	Women (n=1,910)	P-value
Population size	16,916,737	15,505,551	
Age (y)	27.1±0.2	27.2±0.2	0.633
BMI (kg/m <sup>2</sup> )	24.3±0.1	22.1±0.1	<0.001
Obesity (BMI ≥25 kg/m <sup>2</sup> )	39.0	18.3	<0.001
Smoking status			<0.001
Never	40.9	81.0	
Past	18.4	10.1	
Current	40.6	9.0	
Alcohol consumption (frequency/mo)	4.1±0.1	3.0±0.1	<0.001
Married	24.3	40.7	<0.001
Total amount household income (10 <sup>4</sup> won)	459±11.9	462±10.1	0.751
College degree or higher	47.1	57.2	<0.001
The employed	66.2	57.6	<0.001
Regular aerobic exercise*	66.9	56.1	<0.001
Days of muscle-strengthening exercise per week	1.4±0.06	0.6±0.04	<0.001
Present prevalence <sup>†</sup>			
Atopic dermatitis	4.1	5.8	0.042
Allergic rhinitis	15.8	21.4	<0.001
PHQ-9 score <sup>‡</sup>	2.39±0.09	3.80±0.12	<0.001

Values are presented as number, mean±standard error for continuous variables, or % of a complex sample for categorical variables: general linear model for continuous variables and crosstabs for categorical variables.

BMI, body mass index; PHQ-9, Patient Health Questionnaire-9.

\*High-intensity exercise ≥20 min 3 times/wk, moderate-intensity exercise ≥30 min 5 times/wk, or walking ≥30 min 5 times/wk. <sup>†</sup>Diseases with a prevalence of ≥1% are included. <sup>‡</sup>PHQ-9 scores ranged from 0–27 points, with 27 points representing the worst results.

**Table 2.** Association of covariates with the PHQ-9\* according to gender

Variable	Men		Women	
	β±SE	P-value	β±SE	P-value
Age (y)	0.03±0.02	0.059	-0.01±0.01	0.418
BMI (kg/m <sup>2</sup> )	0.00±0.01	0.887	0.01±0.01	0.324
Obesity (BMI ≥25 kg/m <sup>2</sup> )	0.20±0.15	0.179	0.14±0.14	0.307
Married (no=0)	-0.21±0.16	0.206	-0.02±0.11	0.840
Monthly household income	-0.00±0.00	0.162	-0.01±0.00	<0.001
College degree or higher (no=0)	-0.10±0.16	0.542	-0.14±0.12	0.233
The employed (no=0)	0.05±0.17	0.748	-0.27±0.11	0.016
Regular aerobic exercise (no=0) <sup>†</sup>	-0.06±0.16	0.697	0.30±0.11	0.007
Days of muscle strengthening exercise per week	-0.06±0.04	0.155	0.08±0.04	0.054
Atopic dermatitis (no=0)	0.84±0.32	0.009	0.16±0.23	0.487
Allergic rhinitis (no=0)	0.30±0.21	0.153	0.57±0.13	<0.001

Unadjusted ordinal regression analysis of a complex sample (reference group=0 for dummy variables).

PHQ-9, Patient Health Questionnaire-9; SE, standard error; BMI, body mass index.

\*PHQ-9 score ranges from 0 to 27 points, with 27 points representing the worst result. Five groups with PHQ-9 scores of 5, 10, 15, and 20 were included in the analysis.

<sup>†</sup>High-intensity exercise for ≥20 min and ≥3×/wk, moderate-intensity exercise for ≥30 min and ≥5×/wk, or walking for ≥30 min and ≥5×/wk.

allergy rates of atopic dermatitis and allergic rhinitis were significantly associated with higher PHQ-9 scores in both men and women ( $P=0.009$  and  $P<0.001$ , respectively).

### 3. Association of Smoking Behavior with Depressed Mood

Table 3 shows covariate-adjusted associations of smoking behavior and PHQ-9 scores. In men, current smoking, the number of days of smoking during the prior month, and the average number of cigarettes smoked per day were positively associated with PHQ-9 score (all  $P<0.05$ ). In women, current as well as past smoking, more days of smoking in the prior month, a greater number of cigarettes smoked per day, and any smoking experience were significantly associated with depressed mood (all  $P<0.01$ ). These associations were independent

of alcohol consumption.

### 4. Association of Alcohol Consumption with Depressed Mood

Table 4 shows covariate-adjusted associations of alcohol consumption and PHQ-9 scores. In men, the age at which drinking first began was the only significant factor negatively associated with depressed mood ( $\beta=-0.13$ ,  $P<0.001$ ). In women, the younger the age at which the drinking first began and the larger the amount of alcohol consumption at a single time were associated with higher PHQ-9 scores ( $P<0.001$  and  $P=0.013$ , respectively). These associations were independent of smoking status.

Although the frequency of alcohol consumption was not associated

**Table 3.** Covariates-adjusted associations between smoking behavior and PHQ-9\* according to gender

Variable	$\beta \pm SE$	Odds ratio (95% CI)	P-value
<b>Men</b>			
Smoking status (never=0)			
Past smoker	-0.15 $\pm$ 0.27	0.86 (0.51–1.45)	0.567
Current smoker	0.45 $\pm$ 0.18	1.57 (1.10–2.24)	0.012
Average smoking days for the prior month	0.02 $\pm$ 0.01	1.02 (1.01–1.03)	0.002
Average numbers of cigarettes smoked per day	0.02 $\pm$ 0.01	1.02 (1.01–1.04)	0.012
Any experiences of smoking (no=0) <sup>†</sup>	0.29 $\pm$ 0.18	1.33 (0.94–1.88)	0.108
Age of starting regular smoking	-0.03 $\pm$ 0.06	0.97 (0.87–1.08)	0.544
<b>Women</b>			
Smoking status (never=0)			
Past smoker	0.59 $\pm$ 0.18	1.81 (1.27–2.58)	0.001
Current smoker	1.26 $\pm$ 0.19	3.51 (2.42–5.10)	<0.001
Average smoking days for the prior month	0.04 $\pm$ 0.01	1.04 (1.03–1.06)	<0.001
Average numbers of cigarettes smoked per day	0.11 $\pm$ 0.02	1.11 (1.06–1.17)	<0.001
Any experiences of smoking (no=0) <sup>†</sup>	0.90 $\pm$ 0.14	2.46 (1.86–3.26)	<0.001
Age of starting regular smoking	-0.05 $\pm$ 0.06	0.95 (0.85–1.07)	0.408

Ordinal regression analyses of a complex sample, adjusting for age, monthly household income, prevalence of allergic disease in men, frequency of alcohol consumption, obesity, muscle-strengthening exercise, and prevalence of atopic dermatitis; in women, adjusting for the amount of alcohol consumption at a single time and employment status.

PHQ-9, Patient Health Questionnaire-9; SE, standard error; CI, confidence interval.

\*PHQ-9 score ranges from 0 to 27 points, with 27 points representing the worst result. Five groups with PHQ-9 scores of 5, 10, 15, and 20 were included in the analysis.

<sup>†</sup>Dummy variable (reference group=0).

**Table 4.** Covariates-adjusted association between alcohol consumption and PHQ-9\* according to gender

Variable	$\beta \pm SE$	Odds ratio (95% CI)	P-value
<b>Men</b>			
Alcohol consumption (frequency/mo)	0.01 $\pm$ 0.02	1.01 (0.97–1.05)	0.621
Amount of alcohol consumption once	-0.00 $\pm$ 0.03	0.99 (0.95–1.05)	0.863
Any experience of alcohol consumption (no=0) <sup>†</sup>	-0.40 $\pm$ 0.46	0.67 (0.28–1.65)	0.385
Age of starting alcohol consumption	-0.13 $\pm$ 0.04	0.88 (0.82–0.94)	<0.001
<b>Women</b>			
Alcohol consumption (frequency/mo)	0.02 $\pm$ 0.01	1.02 (0.99–1.05)	0.075
Amount of alcohol consumption once	0.059 $\pm$ 0.02	1.05 (1.01–1.09)	0.013
Any experience of alcohol consumption (no=0) <sup>†</sup>	0.41 $\pm$ 0.33	0.66 (0.35–1.25)	0.204
Age of starting alcohol consumption	-0.11 $\pm$ 0.03	0.89 (0.85–0.94)	<0.001

Ordinal regression analyses of a complex sample were performed, adjusting for age, smoking status, exercise, monthly household income, and prevalence of allergic diseases; for men, adjusting for obesity, muscle strengthening, and prevalence of atopic dermatitis; and for women, adjusting for employment status.

PHQ-9, Patient Health Questionnaire-9; SE, standard error; CI, confidence interval.

\*PHQ-9 score ranges from 0 to 27 points, with 27 points representing the worst result. Five groups with PHQ-9 scores of 5, 10, 15, and 20 were included in the analysis.

<sup>†</sup>Dummy variable (reference group=0).

**Table 5.** PHQ-9 scores<sup>†</sup> according to frequency of alcohol consumption by gender

Variable	Frequency of alcohol consumption					P-value
	Never	≤1/mo	2–4/mo	2–3/wk	≥4/wk <sup>†</sup>	
<b>Men</b>						P for difference
No. of participants	117	434	542	285	102	
Unadjusted	2.4±0.3**	2.6±0.2*	2.0±0.1**	2.3±0.2**	3.6±0.4	0.002
Adjusted <sup>§</sup>	3.3±0.4	3.4±0.3	2.7±0.3**	2.9±0.3*	3.9±0.5	0.006
<b>Women</b>						P for trend
No. of participants	344	671	558	281	57	
Unadjusted	3.5±0.2**	3.6±0.2**	3.7±0.2**	4.0±0.3**	6.8±0.8	<0.001
Adjusted <sup>§</sup>	5.2±0.3*	5.3±0.3*	5.3±0.3*	5.4±0.3*	7.2±0.7	0.145

Values are presented as number or mean±standard error.

PHQ-9, Patient Health Questionnaire-9.

\*P<0.05, \*\*P<0.01: differences between the reference group and each other group by multiple comparisons. <sup>†</sup>PHQ-9 scores range from 0 to 27 points, with 27 points representing the worst result. <sup>‡</sup>Reference groups for multiple comparisons. <sup>§</sup>By ordinal regression analyses of a complex sample, adjusting for age, smoking status, muscle-strengthening exercise, monthly household income, and prevalence of allergic disease; in men, adjusting for obesity and prevalence of atopic dermatitis; and in women, adjusting for aerobic exercise and employment state.

with depressed mood in either men (P=0.621) or women (P=0.075), further analysis showed that men who drank 2–4 times a month had the lowest PHQ-9 scores compared to those who drank either more or less frequently (P=0.002 and P=0.006 in the unadjusted and adjusted analyses, respectively) (Table 5). Additional multiple comparisons showed that men who drank ≥4 times a week had significantly higher PHQ-9 scores than those who drank 2–4 times a month (P<0.001 in the unadjusted analysis and P=0.006 in adjusted analysis) or 2–3 times a week (P=0.004 in the unadjusted analysis and P=0.025 in the adjusted analysis) In contrast, among women, the PHQ-9 score was observed to be lowest in women who never drank, and there was a dose-dependent association between frequency of alcohol consumption and PHQ-9 score in the unadjusted analysis (P for trend <0.001). This significance disappeared after adjusting for covariates, including smoking status (P=0.145), but multiple comparison analysis showed that women who drank ≥4 times a week had significantly higher PHQ-9 scores than all other women (all P<0.05) (Table 5).

## DISCUSSION

Our cross-sectional study from a nationally representative survey showed that smoking and alcohol consumption were associated with depressed mood, as measured by the PHQ-9, in Korean adults aged 19–35 years. This was more pronounced in women, and there were some sex-specific differences.

In this study, current smoking status was associated with depression in both men and women. However, among women, both current smokers and past and ever smokers had higher PHQ-9 scores than those who had never smoked. We observed sex-specific differences in the association between the frequency of alcohol consumption and depressed mood. Our study showed a similar U-shaped relationship between frequency of alcohol consumption and depressed mood in men. However, in women, although the significance disappeared after adjusting for covariates, a dose-dependent trend was observed be-

tween these attributes in the unadjusted analysis. Men who drank 2 to 4 times a month had the lowest PHQ-9 scores among all men, whereas women who did not drink at all in the past year had the lowest PHQ-9 scores among all women.

Other studies have also suggested an association between smoking and mental health. Previous studies have reported that adolescent smoking is associated with depression,<sup>9)</sup> and the risk of smoking among depressed patients is ≥2 times that of the general population.<sup>10)</sup> Although the association between smoking and depression is not known, the predominant opinion is that smoking is a response to stress or psychological distress.<sup>11)</sup> Stress increases nicotine cravings by increasing responsiveness, negative emotion, and physiological reactivity involving the hypothalamic-pituitary-adrenal axis.<sup>12)</sup> However, while smoking has a temporary stress-reducing effect, continuous smoking intensifies negative emotional states and exacerbates stress.<sup>13)</sup> Furthermore, a study found that smoking reduction improved both alcohol consumption and depressive symptoms.<sup>14)</sup> Therefore, smoking cessation should be considered for long-term mental health management.

In our study, smoking was also associated with depressed mood, and this association was much stronger in women than in men. A previous study reported that smoking was more significantly associated with depressive disorders in women than in men,<sup>15)</sup> and another study showed a higher risk of drug abuse and anxiety in women who smoked.<sup>11)</sup> Other studies have also suggested that smoking, alcohol abuse, and drug use are more associated with depression in women. The mechanism of this sex-specific difference is not clear, but it seems that men overcome stress through acting-out behaviors, while women are thought to use alcohol as a more diverting coping strategy than men do.<sup>16)</sup>

Alcohol-seeking behavior in young adults has been reported to be associated with depression, and the negative reinforcement theory is expected to play an important role in this process.<sup>17)</sup> In a study conducted in Australia, it was reported that moderate to heavy drinking

that began in adolescence was associated with a high risk of alcohol abuse and dependence in adults.<sup>18)</sup> Moreover, although depressive disorders often accompany alcohol dependence disorder, caution is always required because the disease is more serious and often has a poor prognosis.<sup>17)</sup>

However, a previous study on the association between alcohol consumption and depressive symptoms in young adults in 20 countries reported that alcohol consumption and depressed mood exhibited a U-shaped association,<sup>19)</sup> which is somewhat consistent with our results showing that men who consumed alcohol 2 to 4 times a month had the lowest depression scores. However, a different result was obtained for women with the lowest depressed mood scores recorded among those who never drank. These discrepancies may be due to differences in drinking culture and the physiological capacity to detoxify alcohol metabolites between men and women. Sex differences in the pharmacokinetics of alcohols have been previously established. For equal alcohol intake, women acquire higher blood alcohol levels than men because women have a lower first-pass metabolism than men, which can lead to a greater physical vulnerability to alcohol in women.<sup>20)</sup> In addition, in Korea, although drinking is considered an acceptable social activity for men, it is still negatively perceived in the case of women. Therefore, alcohol consumption can place more physical and mental strain on women than men, whereas socially tolerable drinking habits can positively affect social relationships, stress, and depressed mood in men. Our study also showed that starting drinking at an older age was associated with reduced depressive mood scores in both men and women.

Atopic dermatitis in men and allergic rhinitis in women were also associated with depressed mood (all  $P < 0.01$ ). Similar to our findings, several other studies have reported an association between allergic diseases and mental health. Atopic dermatitis has been reported to be associated with anxiety, depression, suicide, and Alzheimer's disease.<sup>21)</sup> In a study of adults aged  $>19$  years, patients with allergic rhinitis had significantly higher rates of depression, stress, and mental consultation.<sup>22)</sup>

Interestingly, in this study, aerobic exercise, which is known to be effective for overcoming depression,<sup>23)</sup> was observed to have a positive relationship with depressed mood ( $\beta = 0.30$ ,  $P = 0.007$ ). Although insignificant, muscle strengthening was also positively associated with PHQ-9 score in women ( $\beta = 0.08$ ,  $P = 0.054$ ). These results might have been influenced by efforts to overcome depression through other methods, such as exercise, because of the negative perception of antidepressant use in Korean society. This effort might be possible because 91.3% of the women in our study had minimal or mild depression, with PHQ-9 scores  $<10$  points. If the participants had more severe depression, they might have had greater difficulty exercising and coping with it.

This study had some limitations. First, no causal relationships could be evaluated because this was a cross-sectional study. Second, in general, Koreans, especially Korean men, resist revealing their depressed mood; therefore, the incidence of depression was probably underesti-

ated. Finally, 497 participants did not report their PHQ-9 scores and were excluded from the study. Although the analysis found no significant differences in general characteristics between the recruited and excluded participants, it cannot be ruled out that participants who did not respond to the PHQ-9 questionnaire had more severe depression than those recruited for the study. Despite these limitations, to the best of our knowledge, this is the first population-based study to elucidate the independent association of mental health with smoking and alcohol consumption in young Korean adults showing sex-specific characteristics.

In conclusion, smoking and alcohol consumption were associated with depressed mood, and this association was much greater in women. Therefore, our results suggest that physicians should consider that patients' alcohol consumption and smoking histories may be important in predicting depression.

## CONFLICT OF INTEREST

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

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