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# Prevalence and Related Factors of Depression Before and During the COVID-19 Pandemic: Findings From the Korea National Health and Nutrition Examination Survey

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## ABSTRACT

**Background:** The coronavirus disease 2019 (COVID-19) pandemic has greatly altered the daily lives of people in unprecedented ways, causing a variety of mental health problems. In this study, we aimed to evaluate the prevalence of depression among Korean adults during the COVID-19 pandemic and explore the factors associated with depressive mood using data from the Korea National Health and Nutrition Survey (KNHANES).

**Methods:** We analyzed participants aged  $\geq 19$  years from KNHANES 2018 ( $n = 5,837$ ) and 2020 ( $n = 5,265$ ) to measure and compare the prevalence of depression before and during the COVID-19 pandemic. Depression was defined as a score  $\geq 10$  on the Patient Health Questionnaire-9. Furthermore, we performed a multivariate logistic regression analysis to investigate the independent predictors of depressive mood during the COVID-19 pandemic.

**Results:** The prevalence of depression was notably higher during the COVID-19 pandemic than in the pre-pandemic period (5.2% vs. 4.3%,  $P = 0.043$ ). In a multivariate model, female sex (adjusted odds ratio [aOR], 1.63; 95% confidence interval [CI], 1.10-2.41), age  $< 50$  years (19-29 years: aOR, 7.31; 95% CI, 2.40-22.21; 30-39 years: aOR, 7.38; 95% CI, 2.66-20.47; 40-49 years: aOR, 4.94; 95% CI, 1.84-13.31 compared to  $\geq 80$  years), unemployment (aOR, 2.00; 95% CI, 1.41-2.85), upper-middle class household income (aOR, 1.83; 95% CI, 1.18-2.85 compared to upper-class income), being a beneficiary of Medicaid (aOR, 2.35; 95% CI, 1.33-4.14), poor self-rated health (aOR, 4.99; 95% CI, 1.51-3.47 compared to good self-rated health), and current smoking (aOR, 2.29; 95% CI, 1.51-3.47) were found to be significant risk factors for depression during the pandemic.

**Conclusion:** Depression was significantly more prevalent among Korean adults during the COVID-19 pandemic than in the pre-pandemic era. Therefore, more attention should be paid to individuals vulnerable to depression during pandemics. Implementing psychological support public policies and developing interventions to prevent the adverse outcomes of COVID-19-related depression should be considered.

**Keywords:** COVID-19; Pandemic; Depression; Prevalence; Associated Factors

**Author Contributions**

Conceptualization: Lee EJ, Kim SJ. Data curation: Lee EJ. Formal analysis: Lee EJ, Kim SJ. Investigation: Lee EJ, Kim SJ. Methodology: Lee EJ, Kim SJ. Resources: Kim SJ. Software: Lee EJ. Supervision: Kim SJ. Validation: Kim SJ. Visualization: Lee EJ. Writing - original draft: Lee EJ, Kim SJ. Writing - review & editing: Lee EJ, Kim SJ.

**INTRODUCTION**

The global coronavirus disease 2019 (COVID-19) pandemic has affected the daily lives of people worldwide in unprecedented ways.<sup>1</sup> As of July 2022, more than 559 million people have been infected with COVID-19, resulting in at least 6.3 million deaths globally.<sup>1</sup> In addition to the fear of being infected or transmitting the disease, the COVID-19 pandemic resulted in new social situations as most of countries have implemented various infection control policies, such as “social distancing,” “staying at home,” “temporary school suspensions,” “international travel ban,” and “limit on private gatherings.”<sup>2-5</sup> Furthermore, there was a significant rise in the number of unemployed workers during the pandemic.<sup>6</sup> The COVID-19 pandemic itself has been a traumatic stressor for many people, evoking post-traumatic stress disorder-like responses and other associated mental health problems such as depression, anxiety and stress symptoms in some people.<sup>7</sup> In fact, a number of previous studies from various countries have reported that the prevalence of depression noticeably increased during the pandemic.<sup>8-12</sup> However, studies that measured and compared the prevalence of depression before and during the COVID-19 pandemic using nationally representative data are lacking. Furthermore, knowledge of the factors affecting depression during the COVID-19 crisis is important to understanding the psychological effects of pandemics of highly contagious, life-threatening infectious diseases, such as COVID-19 and to prepare for future pandemics.<sup>10,13</sup> Therefore, we aimed to estimate and compare the prevalence of depression before and during the COVID-19 pandemic using data from the Korea National Health and Nutrition Survey (KNHANES), a nationally representative population-based survey. In addition, we investigated factors associated with depression during the COVID-19 pandemic to provide meaningful insights into the prevention and management of depression during the ongoing pandemic.

**METHODS****Data source and study population**

The KNHANES is a cross-sectional nationwide surveillance program conducted annually by the Korea Disease Control and Prevention Agency (KDCA) since 1998. This program collects detailed information on the non-institutionalized civilian population of Korea, including socio-demographic status, past medical history, anthropometric measures, biochemical profiles, and health behaviors. Data is collected through personal interviews, physical examinations, and laboratory tests. The KNHANES sampling plan follows a complex, stratified, multistage, probability-cluster to select a nationally representative sample of Korean civilians.<sup>14,15</sup> Since the 9-item Patient Health Questionnaire (PHQ-9) was included in the survey in even numbered years, we analyzed the KNHANES 2018 and 2020 to measure and compare the prevalence of depression among Korean adults before and during the COVID-19 pandemic. After excluding those with missing data for any of the study variables, 5,837 participants aged  $\geq 19$  years were selected from the KNHANES 2018 and 5,265 were selected from the KHNANES 2020.

**Study variables**

The prevalence of depression, the outcome variable of this study, was defined as the proportion of participants with a PHQ score of 10 or greater, a standard cut-off score for identifying depression.<sup>16</sup> The accuracy and validity of the PHQ-9 for the detection of major depressive disorder has been well-established as a PHQ-9 score  $\geq 10$ , with a sensitivity of

88% and a specificity of 88%.<sup>16,17</sup> The depression status of participants was classified into 3 categories according to the severity of depression based on the PHQ-9 scores (PHQ-9 < 10, no depression; 10–19, moderate depression; and 20–27, severe depression).<sup>17</sup>

Factors associated with depression were classified into 3 domains: sociodemographic, health status, and health behavior. The sociodemographic domain comprised age, sex, marital status, number of persons living in a house, employment status, household income, residential area, and type of health insurance. Obesity status, comorbidities, and self-rated health were included in the health status domain, and the health behavior domain comprised smoking, drinking, physical activity, and regular health screening. Each variable was assembled using a self-administered questionnaire from the Health Interview Survey of KNHANES. Obesity status was assessed by computing the body mass index (BMI; m<sup>2</sup>/kg) and was categorized into 4 types based on the Korean obesity standards (BMI < 18.5 kg/m<sup>2</sup>: underweight, 18.5–22.9 kg/m<sup>2</sup>: ideal weight, 23–24.9 kg/m<sup>2</sup>: overweight, and ≥ 25.0 kg/m<sup>2</sup>: obese).<sup>18</sup> Comorbidities were defined as a prior diagnosis of any of the following diseases by a physician: hypertension, diabetes mellitus, ischemic heart disease (myocardial infarction and angina), stroke, cancers (stomach, liver, breast, lung, cervix, and thyroid cancer), chronic pulmonary diseases (chronic obstructive pulmonary disease and asthma), liver cirrhosis, and chronic renal disease. Smoking status was classified as current smoker or non-smoker (never smoker or former smoker). Regarding drinking, participants were categorized as risky drinkers (those who consume alcohol ≥ 2 times/week with an average of ≥ 5 drinks/occasion for men and ≥ 7 drinks/occasion for women) and non-risky drinking (non-alcoholic or those who consume alcohol less than risky drinkers).<sup>19</sup> Physical activity status of participants was assessed using the Physical Activity Guidelines for Americans (PAG) 2nd edition. According to PAG, adults should do at least 150 minutes of moderate-intensity aerobic physical activity, 75 minutes of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate and vigorous-intensity activity.<sup>20</sup> Individuals whose physical activity self-report met these criteria were labeled as having “sufficient activity.” Finally, the regular health screening status of participants was assessed based on the self-report of questions asking whether they had undergone health check-ups within the last 2 years.

### Statistical analysis

Sampling weights based on the sample design of each KNHANES were applied to all statistical analyses to present unbiased estimates representing the entire Korean population.<sup>14</sup> The baseline characteristics of participants from KNHANES 2018 and 2020 were presented through descriptive analyses. We conducted  $\chi^2$  analysis for proportions and Student's *t*-test for means to determine the statistical differences in the characteristics of participants from KNHANES 2018 and KNHANES 2020. Both the overall prevalence of depression and the prevalence according to the baseline characteristics before (KNHANES 2018) and during the COVID-19 pandemic (KNHANES 2020) were compared using the  $\chi^2$  test. Finally, considering the above-mentioned factors as covariates, univariate and multivariate logistic regression analyses were performed to identify factors associated with the prevalence of depression during COVID-19. Covariates with  $P < 0.1$  in the univariate analyses were included in the multivariate analyses. All statistical analyses were performed using IBM SPSS Statistics for Windows (version 22.0; IBM Corp., Armonk, NY, USA), and statistical significance was set at  $P < 0.05$ .

### Ethics statement

The present study protocol was reviewed and approved by the Institutional Review Board of Seoul St. Mary's Hospital, Catholic University of Korea (approval number: KC22ZASI0270). The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki. The requirement for written informed consent was waived since all data were fully anonymized and de-identified.

## RESULTS

### Baseline characteristics

The baseline characteristics of the participants in KNHANES 2018 (before the COVID-19 pandemic) and 2020 (during the COVID-19 pandemic) are presented in **Table 1**. In terms of the sociodemographic characteristics, the unemployment rate was significantly higher in 2020 than in 2018 (36.0% vs 33.5%,  $P = 0.044$ ), meaning that economic activity participation rate became

**Table 1.** Baseline characteristics of participants by survey years

Characteristics	2018 (n = 5,837)	2020 (n = 5,265)	P value
Sociodemographic factors			
Sex			0.417
Male	49.7 (0.7)	50.4 (0.5)	
Female	50.3 (0.7)	49.6 (0.5)	
Age, yr	47.10 ± 0.41	47.09 ± 0.443	0.987
19–29	18.3 (1.0)	18.3 (0.9)	
30–39	17.7 (0.9)	17.1 (1.0)	
40–49	20.0 (0.9)	19.6 (0.9)	
50–59	19.8 (0.7)	20.4 (0.8)	
60–69	13.3 (0.6)	14.8 (0.7)	
70–79	8.0 (0.5)	7.5 (0.5)	
≥ 80	2.9 (0.3)	2.3 (0.2)	
Marital status			0.345
Married	65.0 (1.2)	63.4 (1.2)	
Single/divorced/separated/widowed	35.0 (1.2)	36.6 (1.2)	
Total family members at home			0.972
1	11.1 (0.9)	10.7 (0.8)	
2	25.0 (1.0)	24.9 (1.0)	
3	27.2 (1.1)	27.7 (1.1)	
≥ 4	36.7 (1.4)	36.8 (1.5)	
Employment condition			0.044
Employed	66.5 (0.8)	64.0 (1.0)	
Unemployed	33.5 (0.8)	36.0 (1.0)	
Education status			0.079
Middle school or lower	21.8 (1.1)	18.4 (1.1)	
High school	36.6 (1.0)	38.9 (1.1)	
College or higher	41.6 (1.3)	42.7 (1.5)	
Household Income			0.068
Lower	15.2 (0.9)	13.3 (0.9)	
Lower middle	24.4 (1.1)	21.8 (1.1)	
Upper middle	29.4 (1.0)	29.9 (1.1)	
Upper	31.0 (1.4)	35.0 (1.6)	
Residential area			0.658
Urban	86.7 (2.4)	85.1 (2.6)	
Rural	13.3 (2.4)	14.9 (2.6)	
Health insurance			0.420
National health insurance	97.1 (0.4)	96.6 (0.5)	
Medicaid	2.9 (0.4)	3.4 (0.5)	

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**Table 1.** (Continued) Baseline characteristics of participants by survey years

Characteristics	2018 (n = 5,837)	2020 (n = 5,265)	P value
<b>Health-status factors</b>			
PHQ-9			0.043
< 10	95.8 (0.3)	94.8 (0.4)	
10–19	3.9 (0.3)	4.4 (0.4)	
20–27	0.4 (0.1)	0.8 (0.2)	
BMI, kg/m <sup>2</sup>			< 0.001
< 18.5	3.8 (0.3)	4.1 (0.4)	
18.5–22.9	39.0 (0.7)	34.1 (0.8)	
23–24.9	21.9 (0.6)	23.0 (0.6)	
≥ 25	35.3 (0.8)	38.7 (0.8)	
Comorbidities			0.156
No	71.7 (0.9)	69.9 (1.0)	
Yes	28.3 (0.9)	30.1 (1.0)	
Hypertension	19.5 (0.7)	19.8 (0.8)	0.752
Diabetes mellitus	7.3 (0.4)	8.5 (0.5)	0.063
Ischemic heart disease	2.1 (0.2)	2.2 (0.2)	0.674
Cancer <sup>a</sup>	4.3 (0.4)	4.7 (0.3)	0.409
Chronic pulmonary diseases <sup>b</sup>	3.2 (0.3)	3.1 (0.3)	0.831
Liver cirrhosis	0.4 (0.1)	0.3 (0.1)	0.360
Chronic renal disease	0.2 (0.1)	1.6 (0.2)	< 0.001
Self-rated health			0.890
Poor	30.8 (0.7)	30.5 (0.8)	
Fair	51.7 (0.8)	52.2 (0.9)	
Good	17.5 (0.6)	17.3 (0.7)	
<b>Health behavior factors</b>			
Smoking status			0.061
Never/past smoker	78.5 (0.8)	80.5 (0.8)	
Current smoker	21.5 (0.8)	19.5 (0.8)	
Drinking status			0.506
Non-risky drinking	86.1 (0.6)	86.7 (0.6)	
Risky drinking	13.9 (0.6)	13.3 (0.6)	
Physical activity			0.453
Sufficient	45.2 (1.0)	44.2 (0.9)	
Insufficient	54.8 (1.0)	55.8 (0.9)	
Health screening within the last 2 years			0.931
Yes	68.7 (0.9)	68.8 (0.8)	
No	31.3 (0.9)	31.2 (0.8)	

All data were weighted to the Korean standard population. Values are presented as % (standard error) or mean ± standard deviations. *P* values were obtained by  $\chi^2$  test or Student's *t*-test.

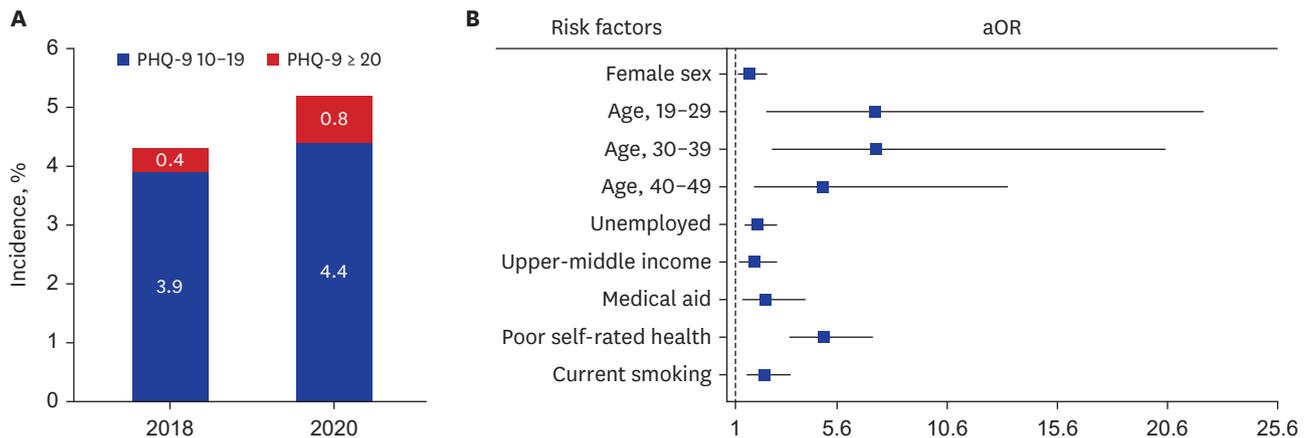
PHQ-9 = Patient Health Questionnaire-9, BMI = body mass index.

<sup>a</sup>Stomach, liver, colon, breast, cervix, lung, and thyroid cancer; <sup>b</sup>Asthma and chronic obstructive pulmonary disease.

relatively lower during the COVID-19 pandemic. Regarding health status, depression was significantly more prevalent during the COVID-19 pandemic than during pre-pandemic (5.2% vs. 4.3%, *P* = 0.043). More specifically, the prevalence of both moderate depression (PHQ-9: 10–19, 4.4% vs. 3.9%, *P* = 0.043) and severe depression (PHQ-9: ≥ 20, 0.8% vs. 0.4%, *P* = 0.043) were significantly higher during the pandemic than before (**Fig. 1**). The prevalence of obesity (38.7% vs. 35.3%, *P* < 0.001) and overweight (23.0% vs. 21.9%, *P* < 0.001) was also considerably higher during the pandemic than before. Chronic renal disease was the only comorbidity that was significantly more prevalent during the pandemic (1.6% vs. 0.2%; *P* < 0.001).

### Prevalence of depression according to the baseline characteristics

The prevalence of depression before and during the pandemic according to baseline characteristics is presented in **Table 2**. In the pre-pandemic period, the prevalence of depression was significantly higher in women, single/divorced/separated/widowed individuals, medicaid beneficiaries, risky drinkers, those with comorbidities, and those who



**Fig. 1.** Prevalence and the associated factors of depression in COVID-19 pandemic. **(A)** Comparison of prevalence rate of depression defined as PHQ-9  $\geq$  10 between 2018 and 2020. **(B)** Forest plot showing aOR and 95% confidence interval of significant associated factors for depression in 2020. COVID-19 = coronavirus disease 2019, PHQ-9 = Patient Health Questionnaire-9, aOR = adjusted odds ratio.

did not undergo health screening within the 2 prior years. Depression also tended to be more prevalent in individuals with lower education and income levels. Meanwhile, the prevalence of depression tended to decrease with age until the 40s, tending to increase thereafter, peaking at  $\geq$  80 years (8.5%). Lastly, the prevalence of depression was highest among the underweight population, and decreased as BMI increased until the point of being overweight, subsequently rising again as individuals became obese. The overall trend in depression during the pandemic was generally similar to that during the pre-pandemic period. However, during the pandemic, the prevalence of depression in men nearly doubled while women's prevalence was mostly stationary. In terms of age, the prevalence of depression notably increased in those aged  $<$  50 years during the pandemic and this trend was more prominent in men than women (**Supplementary Table 1**). The age group 20–29 years had the highest prevalence of depression, while those aged  $\geq$  80 years had the highest prevalence in the pre-pandemic period. Depression was also somewhat more prevalent in the upper-middle income class during the pandemic; in contrast, lower income class was associated with a higher prevalence of depression in the pre-pandemic period. Although the overall trend of depression according to BMI during the pandemic was stationary, the prevalence among the underweight population was relatively lower. Finally, unlike the pre-pandemic period, the difference in depression according to drinking status was not significant during the pandemic, although it was significantly more prevalent among smokers.

### Factors associated with depression before and during the pandemic

The results of the univariate and multivariate analyses of factors influencing depression during the COVID-19 pandemic are presented in **Table 3**. All variables except for residential area, drinking status, and physical activity were included in the multivariate analysis. This analysis revealed that female sex (adjusted odds ratio [aOR], 1.63; 95% confidence interval [CI], 1.10–2.41), age  $<$  50 years (19–29 years: aOR, 7.31; 95% CI, 2.40–22.21; 30–39 years: aOR, 7.38; 95% CI, 2.66–20.47; 40–49 years: aOR, 4.94; 95% CI, 1.84–13.31 compared to  $\geq$  80 years), unemployment (aOR, 2.00; 95% CI, 1.41–2.85), upper-middle class income (aOR, 1.83; 95% CI, 1.18–2.85 compared to upper-class income), being a beneficiary of Medicaid (aOR, 2.35; 95% CI, 1.33–4.14), poor self-rated health (aOR, 4.99; 95% CI, 1.51–3.47 compared to fair self-rated health), and current smoking (aOR, 2.29; 95% CI, 1.51–3.47) were independent risk factors for developing depression (**Fig. 1**).

**Table 2.** Comparison of prevalence of depression by general characteristics

Characteristics	2018 (n = 5,837)		2020 (n = 5,265)	
	% (SE)	P value	% (SE)	P value
<b>Sociodemographic factors</b>				
Sex				
Male	2.4 (0.3)	< 0.001	4.3 (0.5)	0.008
Female	6.0 (0.6)		6.1 (0.5)	
Age, yr				
19–29	5.8 (1.0)	0.022	8.4 (1.1)	< 0.001
30–39	3.9 (0.8)		6.7 (1.1)	
40–49	3.3 (0.6)		4.9 (0.9)	
50–59	3.5 (0.6)		2.3 (0.5)	
60–69	4.1 (0.7)		3.9 (0.7)	
70–79	4.0 (0.7)		5.0 (1.0)	
≥ 80	8.5 (2.2)		4.8 (1.9)	
Marital status				
Married	3.1 (0.3)	< 0.001	3.4 (0.4)	< 0.001
Single/divorced/separated/widowed	6.3 (0.6)		8.3 (0.9)	
Total family members at home				
1	7.9 (1.1)	< 0.001	9.9 (1.6)	< 0.001
2	4.2 (0.6)		5.0 (0.6)	
3	4.1 (0.7)		4.0 (0.6)	
≥ 4	3.2 (0.5)		4.8 (0.7)	
Employment status				
Employed	2.9 (0.3)	< 0.001	3.4 (0.4)	< 0.001
Unemployed	6.8 (0.7)		8.2 (0.8)	
Education status				
Middle school or lower	5.8 (0.7)	0.015	6.6 (0.8)	0.019
High school	4.0 (0.5)		5.7 (0.6)	
College or higher	3.6 (0.5)		4.0 (0.5)	
Household Income				
Lower	8.4 (1.1)	< 0.001	9.9 (1.4)	< 0.001
Lower middle	4.5 (0.6)		4.7 (0.8)	
Upper middle	4.1 (0.6)		6.0 (0.6)	
Upper	2.0 (0.4)		3.0 (0.5)	
Residential area				
Urban	4.0 (0.4)	0.089	5.2 (0.4)	0.996
Rural	5.5 (0.9)		5.2 (0.7)	
Health insurance				
National health insurance	3.9 (0.3)	< 0.001	4.7 (0.4)	< 0.001
Medicaid	16.7 (4.0)		18.9 (3.4)	
<b>Health-status factors</b>				
BMI, kg/m <sup>2</sup>				
< 18.5	8.7 (2.4)	0.040	6.6 (2.0)	0.238
18.5–22.9	4.3 (0.6)		5.1 (0.6)	
23–24.9	3.3 (0.5)		4.0 (0.7)	
≥ 25	4.2 (0.6)		5.8 (0.6)	
Comorbidities <sup>a</sup>				
No	3.7 (0.3)	0.002	4.6 (0.4)	0.011
Yes	5.5 (0.6)		6.5 (0.7)	
Self-rated health				
Good	0.8 (0.2)	< 0.001	1.6 (0.4)	< 0.001
Fair	2.9 (0.3)		3.6 (0.4)	
Poor	14.3 (1.4)		16.4 (1.5)	

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**Table 2.** (Continued) Comparison of prevalence of depression by general characteristics

Characteristics	2018 (n = 5,837)		2020 (n = 5,265)	
	% (SE)	P value	% (SE)	P value
Health behavior factors				
Smoking status		0.065		< 0.001
Current smoker	5.2 (0.7)		8.8 (1.2)	
Never/Past smoker	3.9 (0.4)		4.3 (0.4)	
Drinking status		< 0.001		0.537
Risky drinking	6.9 (1.0)		5.8 (1.2)	
Non-Risky drinking	3.8 (0.4)		5.1 (0.4)	
Physical activity		0.601		0.833
Sufficient	4.0 (0.5)		5.1 (0.6)	
Insufficient	4.4 (0.5)		5.2 (0.5)	
Health screening within the last 2 years		< 0.001		< 0.001
Yes	3.4 (0.3)		4.3 (0.4)	
No	6.1 (0.7)		7.1 (0.9)	

All data were weighted to the Korean standard population. P values were obtained by  $\chi^2$  test. SE = standard error, PHQ-9 = Patient Health Questionnaire-9, BMI = body mass index.

<sup>a</sup>Comorbidities: hypertension, diabetes mellitus, dyslipidemia, ischemic heart disease, stroke, cancer, chronic pulmonary disease, liver cirrhosis, and chronic renal disease.

## DISCUSSION

In this nationally representative cross-sectional study, survey respondents in the pandemic era were found to be significantly more depressed than those in the pre-pandemic era. This trend was consistent with the results of previous studies in other countries, which also showed increase in depression.<sup>8,9</sup> The detrimental impact of the COVID-19 pandemic on the mental health of the general population has been frequently demonstrated in earlier research.<sup>21</sup> Thus, it is important to recognize individuals' mental problems during the pandemic and to implement public policies for emotional support, especially for those who are particularly vulnerable to psychological stress.<sup>22,23</sup> Regarding the independent risk factors of depression during the pandemic, our multivariate logistic regression analysis revealed that women, those younger than 50 years, unemployed, upper middle class, current smokers, and those with subjective poor health were at significantly higher risk of developing depression.

Specifically, compared with men, women are generally known to have higher incidence of depression and present a more chronic disease course.<sup>24,25</sup> Greater vulnerability to depression in females has been extensively observed worldwide during the COVID-19 pandemic.<sup>26</sup> The entire pandemic situation would have been more burdensome to women, both socially and economically.<sup>26</sup> Extra parenting and household duties due to school closures or family members' COVID-19 infection are most commonly assigned to women.<sup>26,27</sup> Moreover, compared with men, women have lower salaries and poorer job security, and thus, are more likely to face tougher financial struggles during the pandemic.<sup>28,29</sup> These circumstances presumably caused women to be more depressed during the COVID-19 pandemic.

In terms of age, our findings demonstrated that participants younger than 50 years were more likely to experience depression during the COVID-19 pandemic. Recent studies have shown similar results, indicating that younger individuals were more vulnerable to depression globally during the COVID-19 pandemic.<sup>30,31</sup> Conversely, pre-pandemic studies have reported increasing age as a risk factor for depression.<sup>32,33</sup> This discrepancy is likely due to differences in social engagement between young and older adults before the pandemic. In normal times, younger people are less likely to be lonely due to their active social life, whereas older

**Table 3.** Factors associated with prevalence of depression during the COVID-19 pandemic

Variables	Prevalence of depression in 2020			P value
	Crude OR (95% CI)	P value	aOR <sup>a</sup> (95% CI)	
<b>Sociodemographic factors</b>				
Female sex	1.45 (1.10–1.89)	0.008	1.63 (1.10–2.41)	0.015
Age, yr				
19–29	1.83 (0.77–4.31)	0.168	7.31 (2.40–22.21)	0.001
30–39	1.44 (0.61–3.40)	0.404	7.38 (2.66–20.47)	< 0.001
40–49	1.02 (0.43–2.45)	0.959	4.94 (1.84–13.31)	0.002
50–59	0.46 (0.19–1.13)	0.089	1.50 (0.59–3.78)	0.389
60–69	0.81 (0.33–2.00)	0.651	1.71 (0.70–4.21)	0.239
70–79	1.04 (0.41–2.66)	0.928	1.36 (0.52–3.52)	0.526
≥ 80			ref	
Married	0.38 (0.28–0.54)	0.000	0.68 (0.44–1.05)	0.078
Number of family member				
1	2.17 (1.37–3.43)	0.001	1.16 (0.62–2.19)	0.636
2	1.04 (0.70–1.54)	0.853	0.96 (0.59–1.56)	0.864
3	0.82 (0.51–1.34)	0.431	0.91 (0.56–1.49)	0.720
Above 4			ref	
Unemployed	2.51 (1.92–3.29)	< 0.001	2.00 (1.41–2.85)	< 0.001
Education				
Middle school	1.68 (1.18–2.39)	0.004	1.91 (1.00–3.67)	0.050
High school	1.44 (0.99–2.08)	0.055	1.20 (0.80–1.79)	0.374
College			ref	
Household income				
Lower	3.51 (2.24–5.51)	< 0.001	1.41 (0.79–2.50)	0.245
Lower-middle	1.56 (0.96–2.53)	0.072	1.08 (0.64–1.83)	0.768
Upper-middle	2.02 (1.34–3.04)	0.001	1.83 (1.18–2.85)	0.008
Upper			ref	
Urban residency	1.00 (0.71–1.41)	0.996		
Medicaid	4.73 (3.02–7.41)	< 0.001	2.35 (1.33–4.14)	0.003
<b>Health-status factors</b>				
BMI, kg/m <sup>2</sup>				
< 18.5	1.16 (0.59–2.27)	0.665	1.02 (0.51–2.06)	0.947
18.5–22.9	0.88 (0.64–1.20)	0.410	0.97 (0.66–1.43)	0.872
23.0–24.9	0.69 (0.46–1.03)	0.066	0.92 (0.59–1.45)	0.720
≥ 25.0			ref	
Comorbidities <sup>b</sup>	1.43 (1.09–1.89)	0.011	1.36 (0.95–1.96)	0.092
Self-related health				
Fair			ref	
Good	0.43 (0.25–0.75)	0.003	0.43 (0.24–0.77)	0.005
Poor	5.35 (3.92–7.29)	< 0.001	4.99 (3.46–7.20)	< 0.001
Current smoking	2.14 (1.57–2.91)	< 0.001	2.29 (1.51–3.47)	< 0.001
Risky drinking	1.15 (0.74–1.79)	0.537		
Insufficient physical activity	0.97 (0.72–1.30)	0.833		
Regular health screening	0.59 (0.44–0.79)	< 0.001	1.04 (0.72–1.50)	0.827

All data were weighted to the Korean standard population. Analyses were performed by univariate and multivariate logistic regression models.

COVID-19 = coronavirus disease 2019, OR = odds ratio, aOR = adjusted odds ratio, CI = confidence interval, BMI = body mass index.

<sup>a</sup>Adjusted for age, sex, marital status, education status, employment status, household income, residential area, type of health insurance, BMI, hypertension, diabetes mellitus, dyslipidemia, ischemic heart disease, stroke, cancer, chronic pulmonary diseases, liver cirrhosis, chronic renal disease, level of self-related health, smoking status, drinking status, physical activity status and receiving regular health check-ups.

<sup>b</sup>Comorbidities: hypertension, diabetes mellitus, dyslipidemia, ischemic heart disease, stroke, cancer, chronic pulmonary disease, liver cirrhosis, and chronic renal disease.

people may have already felt emotionally isolated through retirement or widowhood.<sup>31</sup> Thus, a sudden reduction in social activity due to lockdown and social distancing likely gave younger individuals more emotional blows compared to older adults.<sup>31</sup>

Regarding socioeconomic factors, unemployment and Medicaid paid status, which are conventional risk factors for depression,<sup>34,35</sup> were persistently associated with an increased risk of depression during the COVID-19 pandemic. Interestingly, in terms of household income, upper middle-class families were more likely to develop depression during the pandemic. The Korean government's primary goal during the beginning of the pandemic was to prevent the spread of the disease through strict social distancing.<sup>36</sup> Consequently, the overall household economy collapsed, which led to a financial crisis in many middle-class families who had previously been relatively stable.<sup>37</sup> The lower income class families also financially collapsed during the pandemic. However, compared to lower middle- and lower-income class families who were already financially struggling, the psycho-emotional impact on the upper middle-class families was likely stronger owing to the sudden economic fallout during the pandemic. We believe that this situation increased the vulnerability of the upper middle class to depression.

Our study also revealed that smoking was notably associated with an increased risk of depression during the pandemic. A recent UK study based on a nationwide survey confirmed a significant association between deteriorated mental health and increased smoking during the COVID-19 pandemic.<sup>38</sup> Perceived stress is a well-known factor that triggers initiation and relapse of smoking,<sup>39,40</sup> and the causal relationship between stressful events and depression has been well-documented.<sup>41</sup> Therefore, various stresses induced by the COVID-19 pandemic, such as fear of infection, loneliness, and economic struggles, likely led to depression and increased tobacco consumption.

Lastly, poor self-rated health is not only a well-known risk factor for developing depressive symptoms, but is associated with poor long-term prognosis in those with depression.<sup>42,43</sup> This trend was consistently observed in our study participants during the pandemic.

This study has several limitations. First, since the KHNANES is conducted annually with different participants, we were not able to compare the depression status of identical individuals before and during the pandemic. However, the fact that each year of the KHNANES provides nationally representative data that objectively reflects the status of participants during that particular year makes it suitable for evaluating trends in the prevalence of depression before and during the pandemic and for analyzing associated factors. Second, owing to the nature of the cross-sectional study design, we were unable to track the long-term mental health status of participants throughout the ongoing pandemic. Thus, further longitudinal follow-up studies will be necessary to evaluate how the introduction of COVID-19 vaccines and prolonged social distancing policies has affected and changed the psychological status of individuals as the pandemic progressed. Last, since the KHNANES data were mostly obtained via self-reported surveys, response bias and recall errors may have occurred.

In this nationally representative study, we found that depression was significantly more prevalent among Korean adults during the COVID-19 pandemic than in the pre-pandemic era. In terms of factors predicting depression during the pandemic, female sex, age < 50 years, upper-middle-class household income, poor self-rated health, and smoking were all independent risk factors for depression. This indicates that more attention should be paid to individuals' mental health during the pandemic. Implementing public policies for psychological support and developing interventions to prevent the adverse outcomes of COVID-19 related depression should also be considered.

## SUPPLEMENTARY MATERIAL

### Supplementary Table 1

Comparison of depression by sex and age

[Click here to view](#)

## REFERENCES

1. World Health Organization. *COVID-19 Weekly Epidemiological Update, Edition 101, 20 July 2022*. Geneva, Switzerland: World Health Organization; 2022.
2. Zhang Y, Janda KM, Ranjit N, Salvo D, Nielsen A, van den Berg A. Change in depression and its determinants during the covid-19 pandemic: a longitudinal examination among racially/ethnically diverse us adults. *Int J Environ Res Public Health* 2022;19(3):1194.  
[PUBMED](#) | [CROSSREF](#)
3. Chung PC, Chan TC. Impact of physical distancing policy on reducing transmission of SARS-CoV-2 globally: perspective from government's response and residents' compliance. *PLoS One* 2021;16(8):e0255873.  
[PUBMED](#) | [CROSSREF](#)
4. Hellewell J, Abbott S, Gimma A, Bosse NI, Jarvis CI, Russell TW, et al. Feasibility of controlling COVID-19 outbreaks by isolation of cases and contacts. *Lancet Glob Health* 2020;8(4):e488-96.  
[PUBMED](#) | [CROSSREF](#)
5. Flaxman S, Mishra S, Gandy A, Unwin HJT, Mellan TA, Coupland H, et al. Estimating the effects of non-pharmaceutical interventions on COVID-19 in Europe. *Nature* 2020;584(7820):257-61.  
[PUBMED](#) | [CROSSREF](#)
6. Berkowitz SA, Basu S. Unemployment insurance, health-related social needs, health care access, and mental health during the covid-19 pandemic. *JAMA Intern Med* 2021;181(5):699-702.  
[PUBMED](#) | [CROSSREF](#)
7. Bridgland VM, Moeck EK, Green DM, Swain TL, Nayda DM, Matson LA, et al. Why the COVID-19 pandemic is a traumatic stressor. *PLoS One* 2021;16(1):e0240146.  
[PUBMED](#) | [CROSSREF](#)
8. Ettman CK, Abdalla SM, Cohen GH, Sampson L, Vivier PM, Galea S. Prevalence of depression symptoms in us adults before and during the covid-19 pandemic. *JAMA Netw Open* 2020;3(9):e2019686.  
[PUBMED](#) | [CROSSREF](#)
9. Bueno-Notivol J, Gracia-García P, Olaya B, Lasheras I, López-Antón R, Santabárbara J. Prevalence of depression during the COVID-19 outbreak: a meta-analysis of community-based studies. *Int J Clin Health Psychol* 2021;21(1):100196.  
[PUBMED](#) | [CROSSREF](#)
10. Khademian F, Delavari S, Koohjani Z, Khademian Z. An investigation of depression, anxiety, and stress and its relating factors during COVID-19 pandemic in Iran. *BMC Public Health* 2021;21(1):275.  
[PUBMED](#) | [CROSSREF](#)
11. Balakrishnan V, Ng KS, Kaur W, Govaichelvan K, Lee ZL. COVID-19 depression and its risk factors in Asia Pacific - a systematic review and meta-analysis. *J Affect Disord* 2022;298(Pt B):47-56.  
[PUBMED](#) | [CROSSREF](#)
12. Kim DM, Bang YR, Kim JH, Park JH. The prevalence of depression, anxiety and associated factors among the general public during COVID-19 pandemic: a cross-sectional study in Korea. *J Korean Med Sci* 2021;36(29):e214.  
[PUBMED](#) | [CROSSREF](#)
13. Ettman CK, Cohen GH, Abdalla SM, Sampson L, Trinquart L, Castrucci BC, et al. Persistent depressive symptoms during COVID-19: a national, population-representative, longitudinal study of U.S. adults. *Lancet Reg Health Am* 2022;5:100091.  
[PUBMED](#) | [CROSSREF](#)
14. Kweon S, Kim Y, Jang MJ, Kim Y, Kim K, Choi S, et al. Data resource profile: the Korea National Health and Nutrition Examination Survey (KNHANES). *Int J Epidemiol* 2014;43(1):69-77.  
[PUBMED](#) | [CROSSREF](#)

15. Kim Y. The Korea National Health and Nutrition Examination Survey (KNHANES): current status and challenges. *Epidemiol Health* 2014;36:e2014002.  
[PUBMED](#) | [CROSSREF](#)
16. Levis B, Benedetti A, Thombs BD. Accuracy of Patient Health Questionnaire-9 (PHQ-9) for screening to detect major depression: individual participant data meta-analysis. *BMJ* 2019;365:l1781.  
[PUBMED](#) | [CROSSREF](#)
17. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med* 2001;16(9):606-13.  
[PUBMED](#) | [CROSSREF](#)
18. Oh SW. Obesity and metabolic syndrome in Korea. *Diabetes Metab J* 2011;35(6):561-6.  
[PUBMED](#) | [CROSSREF](#)
19. Kim ES, Nam HS. Factors related to regional variation in the high-risk drinking rate in Korea: using quantile regression. *J Prev Med Public Health* 2021;54(2):145-52.  
[PUBMED](#) | [CROSSREF](#)
20. Piercy KL, Troiano RP, Ballard RM, Carlson SA, Fulton JE, Galuska DA, et al. The Physical Activity Guidelines for Americans. *JAMA* 2018;320(19):2020-8.  
[PUBMED](#) | [CROSSREF](#)
21. Serafini G, Parmigiani B, Amerio A, Aguglia A, Sher L, Amore M. The psychological impact of COVID-19 on the mental health in the general population. *QJM* 2020;113(8):531-7.  
[PUBMED](#) | [CROSSREF](#)
22. Choi KW, Jung JH, Kim HH. Political trust, mental health, and the coronavirus pandemic: a cross-national study. *Res Aging* 2023;45(2):133-48.  
[PUBMED](#) | [CROSSREF](#)
23. Kong X, Kong F, Zheng K, Tang M, Chen Y, Zhou J, et al. Effect of psychological-behavioral intervention on the depression and anxiety of covid-19 patients. *Front Psychiatry* 2020;11:586355.  
[PUBMED](#) | [CROSSREF](#)
24. Essau CA, Lewinsohn PM, Seeley JR, Sasagawa S. Gender differences in the developmental course of depression. *J Affect Disord* 2010;127(1-3):185-90.  
[PUBMED](#) | [CROSSREF](#)
25. Rosenfield S, Smith D. Gender and mental health: do men and women have different amounts or types of problems. In: Scheid TL, Brown TN, editors. *A Handbook for the Study of Mental Health: SOCIAL Contexts, Theories, and Systems*. 2nd ed. Cambridge, UK: Cambridge University Press; 2010, 256-67.
26. COVID-19 Mental Disorders Collaborators. Global prevalence and burden of depressive and anxiety disorders in 204 countries and territories in 2020 due to the COVID-19 pandemic. *Lancet* 2021;398(10312):1700-12.  
[PUBMED](#) | [CROSSREF](#)
27. Power K. The COVID-19 pandemic has increased the care burden of women and families. *Sustain Sci Pract Policy* 2020;16(1):67-73.  
[CROSSREF](#)
28. Wenham C, Smith J, Davies SE, Feng H, Grépin KA, Harman S, et al. Women are most affected by pandemics - lessons from past outbreaks. *Nature* 2020;583(7815):194-8.  
[PUBMED](#) | [CROSSREF](#)
29. Burki T. The indirect impact of COVID-19 on women. *Lancet Infect Dis* 2020;20(8):904-5.  
[PUBMED](#) | [CROSSREF](#)
30. Varma P, Junge M, Meaklim H, Jackson ML. Younger people are more vulnerable to stress, anxiety and depression during COVID-19 pandemic: a global cross-sectional survey. *Prog Neuropsychopharmacol Biol Psychiatry* 2021;109:110236.  
[PUBMED](#) | [CROSSREF](#)
31. Birditt KS, Turkelson A, Fingerman KL, Polenick CA, Oya A. Age differences in stress, life changes, and social ties during the covid-19 pandemic: implications for psychological well-being. *Gerontologist* 2021;61(2):205-16.  
[PUBMED](#) | [CROSSREF](#)
32. Anthony JC, Petronis KR. Suspected risk factors for depression among adults 18-44 years old. *Epidemiology* 1991;2(2):123-32.  
[PUBMED](#) | [CROSSREF](#)
33. Shin C, Kim Y, Park S, Yoon S, Ko YH, Kim YK, et al. Prevalence and associated factors of depression in general population of Korea: results from the Korea National Health and Nutrition Examination Survey, 2014. *J Korean Med Sci* 2017;32(11):1861-9.  
[PUBMED](#) | [CROSSREF](#)

34. Jefferis BJ, Nazareth I, Marston L, Moreno-Kustner B, Bellón JÁ, Svab I, et al. Associations between unemployment and major depressive disorder: evidence from an international, prospective study (the predict cohort). *Soc Sci Med* 2011;73(11):1627-34.  
[PUBMED](#) | [CROSSREF](#)
35. Zhdanova M, Pilon D, Ghelerter I, Chow W, Joshi K, Lefebvre P, et al. The prevalence and national burden of treatment-resistant depression and major depressive disorder in the united states. *J Clin Psychiatry* 2021;82(2):29169.  
[PUBMED](#) | [CROSSREF](#)
36. Kim S, Ko Y, Kim YJ, Jung E. The impact of social distancing and public behavior changes on COVID-19 transmission dynamics in the Republic of Korea. *PLoS One* 2020;15(9):e0238684.  
[PUBMED](#) | [CROSSREF](#)
37. Johnson AF, Roberto KJ. The COVID-19 pandemic: time for a universal basic income? *Public Adm Dev* 2020;40(4):232-5.  
[PUBMED](#) | [CROSSREF](#)
38. Tzu-Hsuan Chen D. The psychosocial impact of the covid-19 pandemic on changes in smoking behavior: evidence from a nationwide survey in the UK. *Tob Prev Cessat* 2020;6:59.  
[PUBMED](#)
39. Torres OV, O'Dell LE. Stress is a principal factor that promotes tobacco use in females. *Prog Neuropsychopharmacol Biol Psychiatry* 2016;65:260-8.  
[PUBMED](#) | [CROSSREF](#)
40. Stubbs B, Veronese N, Vancampfort D, Prina AM, Lin PY, Tseng PT, et al. Perceived stress and smoking across 41 countries: a global perspective across Europe, Africa, Asia and the Americas. *Sci Rep* 2017;7(1):7597.  
[PUBMED](#) | [CROSSREF](#)
41. Kendler KS, Karkowski LM, Prescott CA. Causal relationship between stressful life events and the onset of major depression. *Am J Psychiatry* 1999;156(6):837-41.  
[PUBMED](#) | [CROSSREF](#)
42. Mulsant BH, Ganguli M, Seaberg EC. The relationship between self-rated health and depressive symptoms in an epidemiological sample of community-dwelling older adults. *J Am Geriatr Soc* 1997;45(8):954-8.  
[PUBMED](#) | [CROSSREF](#)
43. Ambresin G, Chondros P, Dowrick C, Herrman H, Gunn JM. Self-rated health and long-term prognosis of depression. *Ann Fam Med* 2014;12(1):57-65.  
[PUBMED](#) | [CROSSREF](#)