

Original Paper

Association of Depression With Precautionary Behavior Compliance, COVID-19 Fear, and Health Behaviors in South Korea: National Cross-sectional Study

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Abstract

Background: As of January 2022, the number of people infected with COVID-19 worldwide has exceeded 350 million. As the COVID-19 pandemic continues, people are affected in a wide range of areas of life, which in turn causes numerous psychological problems. Depression is a serious problem for people who have suffered from COVID-19. Depression can worsen COVID-19 precautionary behavior compliance or the health behavior itself. In addition, these depressive symptoms may have different characteristics depending on the individual's gender.

Objective: The aim of this study was to determine whether depression is a factor that may affect COVID-19 fear, precautionary behavior compliance, and health behavior, and how these characteristic trends differ by gender.

Methods: This was a secondary analysis of data from the 2020 Korea Community Health Survey (KCHS), a national cross-sectional survey conducted with complex sampling analysis. In 2020, the KCHS included COVID-19-related questions. For this study, we used the KCHS data from both the COVID-19-related questions and the Patient Health Questionnaire-9 scale. After weighting the data according to the KCHS guidelines, we calculated the distribution of men and women according to depression level. The data were collected using multiple-choice questions related to precautionary behavior compliance, COVID-19-related fears, and health behavior changes.

Results: Of the 204,787 participants, those who were clinically depressed had a greater tendency to not comply with precautionary behaviors. Regarding COVID-19, "fear" showed a decreasing trend in both men (adjusted odds ratio [AOR] 0.72, 95% CI 0.61-0.83) and women (AOR 0.74, 95% CI 0.63-0.86) with clinically relevant depression. Moreover, for both men and women, health behaviors deteriorated as depression intensified; the AOR for sleep duration changes was 2.28 (95% CI 2.00-2.59) in men and was 2.15 (95% CI 1.96-2.36) in women. Notably, the responses of clinically depressed women revealed a doubled increase in both their drinking (AOR 2.25, 95% CI 1.88-2.70) and smoking (AOR 2.71, 95% CI 1.95-3.77) habits compared with those of nondepressed women.

Conclusions: Both men and women with more severe depression were more likely to violate precautionary health behaviors as their depression worsened. Health behaviors also deteriorated for both genders, but women tended to show a greater change. Therefore, additional studies and interventions for vulnerable groups such as severely depressed people are needed. More research is also necessary to develop interventions based on statistical comparisons of men and women.

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KEYWORDS

COVID-19; precautionary behaviors; COVID-19 fear; health behavior deterioration; gender differences

Introduction

As of January 25, 2022, 349,641,119 people worldwide had been infected with COVID-19 and the death toll had reached 5,592,266 [1]. Since the World Health Organization's March 11, 2020, declaration that the world was facing a pandemic, various restrictions have been implemented to prevent the global spread of the virus. These restrictions have included lockdowns for all or some educational facilities and nonessential businesses, travel limitations, quarantine measures, social isolation, and mandatory mask-wearing [2-4]. However, COVID-19 has had a profound impact on all countries, racial groups, and socioeconomic classes [5]. Secondary problems arise from these restrictions.

Among all the problems that have occurred, mental health issues related to COVID-19 are among the most important health concerns and have received considerable attention. Direct stress caused by illness and concerns about medical service interruption, employment, financial stability, and social contact restrictions may cause psychological problems [6-9]. Additionally, COVID-19 fear is associated with several mental health problems such as anxiety, depression, psychological distress, and sleep issues [10-12]. In particular, depression is one of the most representative mental health problems during COVID-19, which is associated with deterioration in health behaviors, including decreased physical activity and sleep and increased smoking [13-15].

Moreover, various empirical studies have reported gender differences in depression associated with the COVID-19 pandemic [16-18]. Depression is known to have some gender-specific characteristics, and depression rates are generally higher in women regardless of COVID-19 [19,20]. For example, among Australian adults, women were found to be more likely to have clinically significant depression and anxiety [17]. In the case of COVID-19, these differences still apply, as indicated by a study of adults aged 25-69 years showing that women reported more depression, anxiety, stress, loneliness, and a higher rate of increased cannabis use compared to pre-COVID-19 levels [16].

Mental health is not only a concern in and of itself, but may also impede health behaviors or COVID-19 precautionary actions [15,21,22]. Olapegba et al [23] reported that psychological distress caused by COVID-19 fear hinders precautionary behavior compliance. Moreover, depression can lead to even more significant health problems by reducing COVID-19 precautionary behavior compliance and general healthy behavior. In addition, given that severe degrees of fear can negatively impact an individual's ability to respond appropriately during the COVID-19 pandemic [24], the impact of depression may vary in severity, and, at the same time, gender differences may also exist. To date, studies have been conducted on the gender gap in depression related to COVID-19 or the following problems: medical service interruption, employment, financial stability, social contact restrictions [25-27], and the impact of depression on COVID-19 precautionary behavior compliance [22,28]. However, studies that have analyzed the severity of depression according to gender are scarce. Therefore,

the purpose of this study was to determine whether depression is a factor that worsens COVID-19 fears, precautionary behavior compliance, and health behavior, and whether these characteristic trends differ by gender.

Methods

Study Design

This was a secondary analysis of data from a national cross-sectional survey: the 2020 Korea Community Health Survey (KCHS) conducted by the Korea Centers for Disease Control and Prevention [29]. The Community Health Survey, initiated in 2008, is an annual, anonymous, computer-assisted personal interview survey that evaluates the health status and behaviors of South Korean adults. A trained surveyor visits the households selected as samples and conducts a one-on-one interview using a laptop computer equipped with a survey program. The 2020 Community Health Survey covered 18 geographical areas and comprised 142 survey questions, including those pertaining to health behaviors such as exercise, smoking, and drinking. Given the global health context in 2020, the survey for that year was revised to include questions related to the COVID-19 pandemic.

The data were collected from August 16, 2020, to October 31, 2020 [29]. The target population of 2020 KCHS was adults aged 19 years or older, and a sample group was extracted through a composite sample design to minimize sample bias [30]. Next, in the first official extraction, probability proportional to size sampling was performed to ensure that the extraction probability was proportional to the number and size of households by housing type in Tong, Ban, and Ri (the smallest administrative district units). The second extraction was a systematic extraction based on the number of households in Tong, Ban, and Ri. In total, 229,269 people were surveyed; after excluding incomplete responses, the data from 204,787 respondents were available for analysis. To request the KCHS data for use in the present study, we signed a written pledge to confirm our intentions and submitted a usage plan describing the purpose for which we intended to use the data if, after the Korea Centers for Disease Control and Prevention reviewed the plan, the data request was approved. Only those who have received approval can download and use the raw data of KCHS.

Ethical Approval

This study was conducted after review from the Institutional Review Board (IRB) of Chung-ang University. Because this was a secondary analysis of data from a national cross-sectional survey, the study received an exemption by the IRB (approval number 1041078-202201-HR-002).

Measures

General Participant Characteristics

To determine the participants' general characteristics, we included data about their sociodemographic characteristics and individual health. Sociodemographic characteristics were assessed according to age, gender, educational level, monthly household income, profession, and region. Age was divided into four generational groups based on the criteria used in the

Korean Longitudinal Study of Aging and previous studies [31-33]: 20 to 44 years (youth), 45 to 64 years (middle age), and 65 years or older (older adults). According to a previous study, education levels were categorized as follows: (1) elementary or less, (2) middle school, (3) high school, and (4) college or higher. Monthly household income was classified into quartiles as Q1 (<25%), Q2 (25%-49%), Q3 (50%-74%), and Q4 ($\geq 75\%$), and professions were organized according to the Korean version of the Standard Classification of Occupations and previous studies [34,35]. After referring to previous research, we reclassified occupations into four categories: white (white collar), pink (sales and service), blue (agricultural, forestry, fishing, and military), and unemployed. Region was divided into urban and rural areas.

Questions related to individual health conditions included drinking at least once a month, current smoking status, stress awareness, and subjective health status. Possible answers for drinking at least once per month, current smoking status, and stress awareness were either “yes” or “no.” Subjective health status was defined by the self-evaluation of one’s health as “very good” or “good,” and possible answers were “poor” and “fair.”

Depression Assessment

The Patient Health Questionnaire-9 (PHQ-9) was used to measure self-reported depression, with possible scores ranging from 0 to 27 [35]. PHQ-9 consists of nine items used to evaluate the diagnostic criteria for major depressive disorder in accordance with the Diagnostic and Statistical Manual of Mental Disorders, fifth edition. A high PHQ-9 score indicates a higher level of depressive symptoms, with 0-4 representing no depression, 5-9 indicating mild depression, 10-14 representing moderate depression, 15-19 indicating moderately severe depression, and 20-27 representing severe depression. In general, a PHQ-9 score ≥ 10 indicates major or clinically relevant depression [36]. To ensure greater clarity in the explanation of the results, we divided the PHQ-9 scores into three categories: 0-4 (none), 5-9 (mild), and ≥ 10 (clinically relevant).

Precautionary Behavior Compliance

Precautionary behavior compliance was defined as whether personal quarantine rules (eg, wearing a mask indoors, wearing a mask outdoors) and social distancing rules (eg, maintaining a healthy distance) were observed for the past week with the intention of helping to prevent the spread of COVID-19. According to a previous study [37], eight factors were used to evaluate precautionary behavior compliance as follows: in the last 7 days, had the individual (1) covered his or her mouth and nose while sneezing or coughing, (2) experienced daily ventilation at least twice a day, (3) had everyday spaces disinfected once per day, (4) wore a mask in facilities used by unspecified people, (5) worn a mask when it was impossible to keep an adequate distance, (6) maintained a 2-meter distance between themselves and others, (7) limited visiting sick people, and (8) limited going out or attending gatherings and events? Based on the KCHS’s indicator definition, for each of the eight items, only those who answered “very much” or “yes” were considered to have complied with each precautionary behavior. For example, only the respondents who answered “very much” or “yes” to the question “covered his or her mouth and nose

while sneezing or coughing” were considered to have performed precautionary behavior.

COVID-19 Fear

COVID-19 fear is defined as a psychological concern due to the spread of COVID-19 and is assessed by five factors: fear of infection, dying from infection, public criticism, a family member getting infected, and economic loss due to infection. Based on the KCHS’s indicator definition, only those who answered “strongly agree” or “agree” for any of the above five factors were evaluated as having COVID-19 fear of each factor.

Health Behavior Deterioration

Criteria pertaining to physical activity, sleep duration, fast food or energy drink consumption, food consumption, alcohol consumption, and smoking were included to investigate health behavior deterioration during the COVID-19 pandemic. Possible responses were “increased,” “same,” “decreased,” or “not applicable.” With reference to a previous study [37], health behavior deterioration was measured as follows: decreased physical activity, changes in sleep duration (either increased or decreased), increased consumption of instant meals/soda, increased consumption of delivery food, increased alcohol consumption, and an increase in the number of cigarettes smoked per day.

Data Analysis

The distribution of men and women according to depression level was calculated after weighting based on the KCHS guidelines. The weighted values of the distribution of men and women according to depression level are shown as descriptive statistics such as frequency, percentage, and standard error. The participants’ general characteristics according to depression level and gender were also analyzed using descriptive statistics such as frequency, percentage, and standard error. We performed a χ^2 test to confirm the general distribution of the characteristics according to the depression level of the participants.

Depression levels, gender-specific precautionary behavior noncompliance, COVID-19 fear, and health behavior deterioration were analyzed using logistic regression. After controlling for general characteristics (age, educational level, monthly household income, profession, region, heavy drinking, current smoking status, stress awareness, and subjective health status), logistic regression analysis was used to identify differences in depression level and gender-specific precautionary behavior noncompliance, COVID-19 fear, and health behavior deterioration. The adjusted odds ratios (AORs) and 95% CIs for failure to comply with precautionary behaviors, COVID-19-related fear, and health behavior deterioration were calculated. All results are presented as weighted values. The results were statistically analyzed using SPSS version 26.0 (IBM Corp, Armonk, NY, USA).

Results

Table 1 shows the weighted and unweighted distributions of depression in the population according to gender. This study included 204,787 participants (92,739 men and 112,048 women).

Approximately 2% and 3.5% of men and women were classified as having clinically relevant depression, respectively.

Table 2 shows the participants' general characteristics, and Table 3 and Table 4 further summarize these data by depression levels for men and women, respectively. To better represent the general population of South Korea, the percentages and standard errors are presented as weighted values. The largest group of men with clinically relevant depression (48.8%) were aged 20-44 years, and 44.6% of men with clinically relevant depression had a college degree or higher. Approximately 41.6% belonged to the income level Q1, and the rate of unemployment

reached 45.5%. Although there was no significant difference in the level of mental health by region, 45.6% of the men with clinically relevant depression reported heavy drinking and 44.5% were current smokers. Among the men with clinically relevant depression, only 21.3% answered that they had stress, but 79.3% evaluated their subjective health condition as poor. Among the women with clinically relevant depression, 60.3% were unemployed. Notably, self-reported heavy drinking increased to 19.4% and current smoking increased to 11.7%, which was five times higher than that of women without depression symptoms

Table 1. Overall and weighted distribution of depression in the sample population (N=204,787).

Depression level ^a	Unweighted, n (%)	Weighted ^b	
		Participants, n (%)	SE
Men (n=92,739)			
None (0-4)	83,026 (89.5)	16,832,027 (88.4)	0.1
Mild (5-9)	7889 (8.5)	1,799,468 (9.5)	0.1
Clinically relevant (≥10)	1824 (2.0)	399,490 (2.1)	0.1
Women (n=112,048)			
None (0-4)	93,305 (83.3)	15,943,821 (82.3)	0.2
Mild (5-9)	14,771 (13.2)	2,683,383 (13.9)	0.1
Clinically relevant (≥10)	3972 (3.5)	736,847 (3.8)	0.1

^aClassified according to Patient Health Questionnaire-9 scores.

^bData were weighted to yield nationally representative estimates (total N=38,395,036).

Table 2. Participants' general characteristics (N=204,787).

Characteristics	Unweighted, n	Weighted ^a Participants, n	% (SE)
Age (years)			
20-44	60,924	16,207,118	42.2 (0.1)
45-64	77,873	14,448,396	37.6 (0.1)
65 and over	65,990	7,739,521	20.2 (0.1)
Educational level			
Elementary or less	45,804	4,453,550	11.6 (0.1)
Middle school	23,051	3,089,900	8.1 (0.1)
High school	58,976	11,267,036	29.3 (0.1)
College or higher	76,956	19,584,549	51.0 (0.2)
Monthly household income quartile (Q)			
Q1 (lowest)	72,643	9,499,542	24.7 (0.1)
Q2	51,997	9,871,080	25.7 (0.1)
Q3	41,606	9,416,797	24.5 (0.1)
Q4 (highest)	38,541	9,607,616	25.0 (0.2)
Profession^b			
White	38,617	9,999,414	26.0 (0.1)
Pink	25,798	5,195,447	13.5 (0.1)
Blue	59,749	8,538,958	22.2 (0.1)
None	80,623	14,661,216	38.2 (0.1)
Region			
Urban	58,299	16,465,931	42.9 (0.1)
Rural	146,488	21,929,104	57.1 (0.1)
Heavy drinking			
Never	86,787	13,072,593	34.0 (0.1)
No	67,789	13,778,747	35.9 (0.1)
Yes	50,211	11,543,695	30.1 (0.1)
Current smoking status			
Never	134,123	24,290,719	63.3 (0.1)
Former	37,613	7,183,170	18.7 (0.1)
Current	33,051	6,921,146	18.0 (0.1)
Stress awareness			
No	45,478	9,869,519	25.7 (0.1)
Yes	159,309	28,525,516	74.3 (0.1)
Subjective health status			
Poor	107,046	18,202,506	47.4 (0.1)
Fair	97,741	20,192,529	52.6 (0.1)

^aData were weighted to yield nationally representative estimates (total N=38,395,036).

^bClassified into white (white collar), pink (sales and service), blue (agricultural, forestry, fishing, and military), and none (unemployed).

Table 3. Comparison of men's general characteristics by depression level (N=92,739).

Characteristics	No depression (PHQ-9 ^a 0-4)		Mild depression (PHQ-9 5-9)		Clinically relevant depression (PHQ-9≥10)		<i>F</i> ^b	<i>df</i>	<i>P</i> value
	Unweighted ^c , n	Weighted ^d , n (%), SE	Unweighted, n	Weighted, n (%), SE	Unweighted, n	Weighted, n (%), SE			
Age (years)							26.63	3.88, 61,102.47	<.001
20-44	25,820	7,320,210 (43.5, 0.2)	2762	875,763 (48.7, 0.7)	614	194,869 (48.8, 1.5)			
45-64	32,700	6,460,358 (38.4, 0.2)	2639	595,349 (33.1, 0.7)	561	116,955 (29.3, 1.3)			
65 and over	24,506	3,051,459 (18.1, 0.2)	2488	328,356 (18.2, 0.5)	649	87,666 (21.9, 1.1)			
Educational level							27.64	5.73, 90,089.21	<.001
Elementary or less	10,998	1,075,442 (6.4, 0.1)	1340	144,948 (8.1, 0.3)	418	51,493 (12.9, 0.8)			
Middle school	9269	1,194,121 (7.1, 0.1)	930	138,617 (7.7, 0.3)	250	40,617 (10.2, 0.8)			
High school	26,371	5,020,817 (29.8, 0.2)	2347	549,575 (30.5, 0.6)	555	129,132 (32.3, 1.4)			
College or higher	36,388	9,541,647 (56.7, 0.2)	3272	966,328 (53.7, 0.7)	601	178,248 (44.6, 1.5)			
Monthly household income quartile (Q)							62.22	5.93, 93,308.82	<.001
Q1 (lowest)	25,438	3,589,381 (21.3, 0.2)	3115	505,037 (28.1, 0.6)	949	166,331 (41.6, 1.4)			
Q2	21,809	4,321,547 (25.7, 0.2)	1864	459,319 (25.5, 0.6)	391	94,942 (23.8, 1.4)			
Q3	18,316	4,347,118 (25.8, 0.2)	1534	422,973 (23.5, 0.6)	257	72,562 (18.2, 1.2)			
Q4 (highest)	17,463	4,573,982 (27.2, 0.2)	1376	412,139 (22.9, 0.6)	227	65,655 (16.4, 1.1)			
Profession^e							42.96	5.94, 93,506.52	<.001
White	17,865	4,938,141 (29.3, 0.2)	1533	470,702 (26.2, 0.7)	251	84,165 (21.1, 1.3)			
Pink	8371	2,013,564 (12.0, 0.2)	819	229,551 (12.8, 0.5)	165	45,913 (11.5, 1.0)			
Blue	34,082	5,513,592 (32.8, 0.2)	2737	558,664 (31.0, 0.7)	464	87,410 (21.9, 1.2)			
None	22,708	4,366,730 (25.9, 0.2)	2800	540,551 (30.0, 0.6)	944	182,002 (45.5, 1.5)			
Region							1.05	1.99, 31,436.14	.35
Urban	23,214	7,100,130 (42.2, 0.2)	2438	778,683 (43.3, 0.7)	559	169,067 (42.3, 1.5)			
Rural	59,812	9,731,897 (57.8, 0.2)	5451	1,020,785 (56.7, 0.7)	1265	230,423 (57.7, 1.5)			
Heavy drinking							16.41	3.98, 62,618.59	<.001
Never	24,042	3,914,812 (23.3, 0.2)	2416	418,786 (23.3, 0.6)	725	127,952 (32.0, 1.3)			

Characteristics	No depression (PHQ-9 ^a 0-4)		Mild depression (PHQ-9 5-9)		Clinically relevant depression (PHQ-9 \geq 10)		<i>F</i> ^b	<i>df</i>	<i>P</i> value
	Unweighted ^c , n	Weighted ^d , n (%), SE	Unweighted, n	Weighted, n (%), SE	Unweighted, n	Weighted, n (%), SE			
No	24,751	5,072,726 (30.1, 0.2)	2202	514,892 (28.6, 0.7)	405	89,483 (22.4, 1.2)			
Yes	34,233	7,844,489 (46.6, 0.2)	3271	865,790 (48.1, 0.7)	694	182,055 (45.6, 1.5)			
Smoking status							53.93	3.98,	<.001
Never	25,752	5,621,708 (33.4, 0.2)	1914	474,901 (26.4, 0.6)	423	93,702 (23.4, 1.5)			
Former	30,840	5,750,630 (34.2, 0.2)	3004	613,040 (34.1, 0.7)	654	128,119 (32.1, 1.3)			
Current	26,434	5,459,689 (32.4, 0.2)	2971	711,527 (39.5, 0.7)	747	177,669 (44.5, 1.4)			
Stress awareness							2598.88	1.99,	<.001
No	14,374	3,431,190 (20.4, 0.2)	3997	1,021,365 (56.8, 0.7)	1342	314,591 (78.7, 1.2)		31,378.61	
Yes	68,652	13,400,837 (79.6, 0.2)	3892	778,103 (43.2, 0.7)	482	84,899 (21.3, 1.2)			
Subjective health status							867.4	2.00,	<.001
Poor	36,364	6,707,215 (39.8, 0.2)	5450	1,150,997 (64.0, 0.7)	1510	316,919 (79.3, 1.2)		31,446.08	
Fair	46,662	10,124,812 (60.2, 0.2)	2439	648,471 (36.0, 0.7)	314	82,571 (20.7, 1.2)			

^aPHQ-9: Patient Health Questionnaire-9.

^bRao-Scott composite sample χ^2 test.

^cData were not weighted (total N= 204,787).

^dData were weighted to yield nationally representative estimates (total N=38,395,036).

^eClassified into white (white collar), pink (sales and service), blue (agricultural, forestry, fishing, and military), and none (unemployed).

Table 4. Comparison of women's general characteristics by depression level (N=112,048).

Characteristics	No depression (PHQ-9 ^a 0-4)		Mild depression (PHQ-9 5-9)		Clinically relevant depression (PHQ-9 \geq 10)		<i>F</i> ^b	<i>df</i>	<i>P</i> value
	Unweighted ^c , n	Weighted ^d , n (%), SE)	Unweighted, n	Weighted, n (%), SE)	Unweighted, n	Weighted, n (%), SE)			
Age (years)							64.38	3.91, 62,134.61	<.001
20-44	26,185	6,354,538 (39.8, 0.2)	4323	1,137,258 (42.4, 0.5)	1220	324,480 (44.0, 1.0)			
45-64	36,214	6,187,323 (38.8, 0.2)	4674	880,246 (32.8, 0.5)	1085	208,165 (28.3, 0.9)			
65 and over	30,906	3,401,959 (21.3, 0.2)	5774	665,878 (24.8, 0.4)	1667	204,202 (27.7, 0.8)			
Educational level							41.03	5.81, 92,331.79	<.001
Elementary or less	26,408	2,480,195 (15.6, 0.1)	5111	528,808 (19.7, 0.4)	1529	172,665 (23.4, 0.7)			
Middle school	10,646	1,411,759 (8.9, 0.1)	1563	234,528 (8.7, 0.3)	393	70,257 (9.6, 0.6)			
High school	25,060	4,590,105 (28.8, 0.2)	3635	759,285 (28.3, 0.5)	1008	218,122 (29.6, 0.9)			
College or higher	31,191	7,461,761 (46.8, 0.2)	4462	1,160,761 (43.3, 0.5)	1042	275,803 (37.4, 1.0)			
Monthly household income quartile (Q)							95.29	5.94, 94,443.28	<.001
Q1 (lowest)	34,270	4,045,405 (25.4, 0.2)	6709	876,383 (32.7, 0.5)	2162	317,006 (43.0, 1.0)			
Q2	23,614	4,117,698 (25.8, 0.2)	3483	697,517 (26.0, 0.5)	836	180,058 (24.4, 0.9)			
Q3	18,471	3,866,590 (24.3, 0.2)	2481	579,397 (21.6, 0.5)	547	128,155 (17.4, 0.8)			
Q4 (highest)	16,950	3,914,127 (24.5, 0.2)	2098	530,085 (19.8, 0.5)	427	111,628 (15.1, 0.8)			
Profession^e							36.44	5.90, 93,721.40	<.001
White	16,222	3,802,298 (23.8, 0.2)	2277	577,758 (21.5, 0.5)	469	126,349 (17.1, 0.8)			
Pink	14,037	2,420,483 (15.2, 0.2)	1926	380,193 (14.2, 0.4)	480	105,743 (14.3, 0.7)			
Blue	19,458	2,021,899 (12.7, 0.1)	2520	296,602 (11.1, 0.3)	488	60,792 (8.3, 0.5)			
None	43,588	7,699,140 (48.3, 0.2)	8048	1,428,829 (53.2, 0.5)	2535	443,963 (60.3, 1.0)			
Region							0.049	1.99, 31,747.28	.95
Urban	26,358	6,928,218 (43.5, 0.2)	4522	1,167,254 (43.5, 0.5)	1208	322,577 (43.8, 1.0)			
Rural	66,947	9,015,602 (56.5, 0.2)	10,249	1,516,128 (56.5, 0.5)	2764	414,270 (56.2, 1.0)			
Heavy drinking							56.69	3.98, 63,305.92	<.001
Never	49,462	7,109,633 (44.6, 0.2)	7909	117,411 (43.8, 0.5)	2233	326,999 (44.4, 1.0)			

Characteristics	No depression (PHQ-9 ^a 0-4)		Mild depression (PHQ-9 5-9)		Clinically relevant depression (PHQ-9≥10)		<i>F</i> ^b	<i>df</i>	<i>P</i> value
	Unweighted ^c , n	Weighted ^d , n (% , SE)	Unweighted, n	Weighted, n (% , SE)	Unweighted, n	Weighted, n (% , SE)			
No	34,385	6,794,290 (42.6, 0.2)	4900	1,040,293 (38.8, 0.5)	1146	267,063 (36.2, 1.0)			
Yes	9458	2,039,897 (12.8, 0.2)	1962	468,678 (17.4, 0.4)	593	142,785 (19.4, 0.8)			
Smoking status							350.97	3.97, 63,128.55	<.001
Never	89,302	1,513,9982 (95.0, 0.1)	13,416	2,371,959 (88.4, 0.3)	3316	588,466 (79.9, 0.8)			
Former	2120	455,587 (2.8, 0.1)	714	173,855 (6.5, 0.3)	281	61,940 (8.4, 0.6)			
Current	1883	348,251 (2.2, 0.1)	641	137,568 (5.1, 0.2)	375	86,441 (11.7, 0.6)			
Stress awareness							3865.37	1.99, 31,722.31	<.001
No	15,760	3,131,642 (19.6, 0.2)	7157	1,413,307 (52.7, 0.5)	2848	557,423 (75.6, 0.8)			
Yes	77,545	1,281,2178 (80.4, 0.2)	7614	1,270,075 (47.3, 0.5)	1124	179,424 (24.4, 0.8)			
Subjective health status							1144.07	1.99, 31,746.02	<.001
Poor	49,326	7,556,843 (47.4, 0.2)	11,041	1,874,240 (69.8, 0.5)	3355	596,292 (80.9, 0.8)			
Fair	43,979	8,386,977 (52.6, 0.2)	3730	809,142 (30.2, 0.5)	617	140,555 (19.1, 0.8)			

^aPHQ-9: Patient Health Questionnaire-9.

^bRao-Scott composite sample χ^2 test.

^cData were not weighted (total N= 204,787).

^dData were weighted to yield nationally representative estimates (total N=38,395,036).

^eClassified into white (white collar), pink (sales and service), blue (agricultural, forestry, fishing, and military), and none (unemployed).

Table 5 illustrates how compliance with precautionary behaviors, COVID-19 fear, and health behavior deterioration differed according to gender and mental health determined using logistic regression analysis after adjusting for general characteristics. The crude odds ratios from the unadjusted model are shown in [Multimedia Appendix 1](#). The precautionary behavior noncompliance rate was found to increase as the depression worsened; this was the case for most items compared to the group without depressive symptoms. The AOR of the noncompliance rate regarding wearing a mask indoors was lower in participants with mild depressive symptoms compared to that for participants with clinically relevant depression, which was the case for both men and women ([Table 5](#)). However, in the case of noncompliance with precautionary behaviors related to social distancing, the trend was different between men and women. Among men who had mild depressive symptoms, nonobservance of maintaining physical distance increased by more than that among men with clinically relevant depression. By contrast, the AOR of not maintaining physical distance in women was higher for those with clinically relevant depression

than for those with mild depression, showing a tendency to worsen as mental health deteriorated.

The data also showed different characteristics of COVID-19 fear between men and women. The AOR of the fear of infection was similar for women and men with clinically relevant depression. However, the fear of death due to infection was significant only in women for those with mild depressive symptoms. In the case of public criticism, a significant association appeared only among women with clinically relevant depression.

As depression increased in severity in both men and women, health behaviors likewise deteriorated. Changes in sleep duration, an increase in drinking amount, and smoking frequency more than doubled for both men and women with clinically relevant depression. Regarding delivery food consumption, the AOR was the highest for men with mild depressive symptoms, which was similar to that for women with clinically relevant depression.

Table 5. Adjusted odds ratios (95% CIs) for failure to comply with precautionary behaviors, health behavior deterioration during the COVID-19 outbreak, and COVID-19–related fear according to depression levels.^{a,b,c}

COVID-19–related questions	Men (n=92,739)			Women (n=112,048)		
	No depression ^d (0-4)	Mild depression (5-9)	Clinically relevant depression (≥10)	No depression ^d (0-4)	Mild depression (5-9)	Clinically relevant depression (≥10)
Failure to comply with precautionary behaviors						
Not covering mouth while coughing	1	<i>1.29 (1.13-1.46)</i> ^e	<i>1.56 (1.26-1.93)</i>	1	<i>1.38 (1.24-1.55)</i>	<i>1.65 (1.40-1.95)</i>
No proper ventilation	1	<i>1.54 (1.29-1.83)</i>	<i>1.73 (1.28-2.34)</i>	1	<i>1.59 (1.34-1.90)</i>	<i>2.22 (1.75-2.81)</i>
Not performing regular disinfection	1	<i>1.23 (1.16-1.31)</i>	<i>1.32 (1.16-1.50)</i>	1	<i>1.19 (1.13-1.25)</i>	<i>1.24 (1.13-1.36)</i>
Not wearing a mask indoors	1	<i>1.54 (1.04-2.27)</i>	<i>1.81 (1.07-3.06)</i>	1	<i>1.49 (1.02-2.18)</i>	<i>2.04 (1.21-3.44)</i>
Not wearing a mask when it was hard to maintain distance	1	<i>1.44 (1.12-1.85)</i>	<i>1.42 (0.90-2.23)</i>	1	<i>1.57 (1.21-2.02)</i>	<i>1.93 (1.35-2.77)</i>
Not keeping the minimum recommended physical distance	1	<i>1.41 (1.23-1.61)</i>	<i>1.34 (1.03-1.74)</i>	1	<i>1.49 (1.33-1.67)</i>	<i>1.57 (1.29-1.90)</i>
Not refraining from visiting hospitalized patients	1	<i>1.82 (1.41-2.35)</i>	<i>1.89 (1.14-3.13)</i>	1	<i>1.29 (1.02-1.62)</i>	<i>1.35 (0.93-1.94)</i>
Not refraining from going out	1	<i>1.55 (1.31-1.85)</i>	<i>1.51 (1.13-2.00)</i>	1	<i>1.56 (1.35-1.81)</i>	<i>1.36 (1.06-1.75)</i>
COVID-19–related fears						
Fear of infection	1	0.96 (0.87-1.05)	<i>0.72 (0.61-0.86)</i>	1	1.05 (0.95-1.15)	<i>0.74 (0.63-0.86)</i>
Fear of dying from infection	1	1.05 (0.98-1.12)	1.07 (0.94-1.22)	1	<i>1.09 (1.03-1.15)</i>	1.04 (0.94-1.14)
Fear of public criticism	1	0.95 (0.88-1.04)	0.85 (0.72-1.00)	1	1.07 (0.98-1.16)	<i>0.86 (0.75-0.99)</i>
Fear of a family member getting infected	1	1.06 (0.92-1.22)	0.83 (0.66-1.04)	1	1.12 (0.99-1.26)	0.94 (0.76-1.15)
Fear of economic loss due to infection	1	1.11 (1.00-1.23)	0.97 (0.79-1.19)	1	1.04 (0.95-1.13)	0.94 (0.80-1.10)
Health behavior deterioration						
Decreased physical activity	1	<i>1.17 (1.10-1.25)</i>	<i>1.4 (1.24-1.58)</i>	1	<i>1.28 (1.22-1.35)</i>	<i>1.31 (1.21-1.43)</i>
Changes in sleep duration	1	<i>1.62 (1.51-1.74)</i>	<i>2.28 (2.00-2.59)</i>	1	<i>1.71 (1.62-1.80)</i>	<i>2.15 (1.96-2.36)</i>
Increased consumption of instant meals/soda	1	<i>1.47 (1.35-1.60)</i>	<i>1.64 (1.40-1.93)</i>	1	<i>1.36 (1.27-1.45)</i>	<i>1.6 (1.43-1.80)</i>
Increased consumption of delivery food	1	<i>1.28 (1.19-1.39)</i>	<i>1.25 (1.07-1.45)</i>	1	<i>1.23 (1.15-1.31)</i>	<i>1.26 (1.12-1.41)</i>
Increased alcohol drinking	1	<i>1.51 (1.33-1.71)</i>	<i>1.95 (1.58-2.42)</i>	1	<i>1.53 (1.36-1.73)</i>	<i>2.25 (1.88-2.70)</i>
Increased smoking frequency	1	<i>1.64 (1.44-1.87)</i>	<i>2.55 (2.07-3.15)</i>	1	<i>1.53 (1.13-2.08)</i>	<i>2.71 (1.95-3.77)</i>

^aDepression level was classified according to scores on the nine-item Patient Health Questionnaire.

^bLogistic regression model adjusted for age, educational level, monthly household income, profession, region, heavy drinking, current smoking status, stress awareness, and subjective health status.

^cData were weighted to yield nationally representative estimates (total N=38,395,036).

^dReference category.

^eValues in italics indicate a statistically significant association.

Discussion

Principal Findings

The purpose of this study was to determine the effect of an individual's depression level on noncompliance precautionary behavior, COVID-19 fear, and health behavior deterioration, and to compare the different trends according to gender. Overall, there was a significant difference in noncompliance with

precautionary behavior and health behavior deterioration according to the degree of mental health. Additionally, some components pertaining to COVID-19 fear were different according to depression status. Men and women with clinically relevant depression were more likely to not comply with precautionary behaviors. Furthermore, as mental health deteriorated, health behaviors declined, which tended to be worse in women.

In the case of men with clinically relevant depression, not performing regular ventilation and not wearing a mask indoors significantly increased. Similarly, women with clinically relevant depression were more than twice as likely to not ventilate regularly or not wear a mask indoors than were women who were not depressed. These results are similar to those of several previous studies [23,38,39]; however, in some important ways, they conflict with the results of other studies. For example, one study indicated that poor mental health increased preventive activities, while another suggested that there was no association between precautionary behaviors and mental distress in those with severe mental illness [40,41]. This dichotomy may also exist in relation to COVID-19 fear. Generally, feelings of distress such as anxiety and fear are known to increase precautionary behavior [23,42,43]. However, in our study, the participants tended to have decreased levels of fear as their mental health deteriorated. This association between fear and precautionary behaviors suggests that reduced fear may increase precautionary behavior noncompliance.

Generally, health behaviors decrease as mental health worsens. Notably, women with clinically relevant depression showed a dramatic increase in heavy alcohol consumption and smoking frequency. Previous studies have also reported that women's drinking behaviors increased during the COVID-19 pandemic [44] and that depressive symptoms were also associated with an increase in heavy drinking [45].

However, an increase in social responsibility and a decrease in social support could worsen the mental health of women. In the context of the COVID-19 pandemic, women have been facing a variety of high-demand roles, including childcare and elder care, which most countries have traditionally imposed on them [17,46-48]. In addition, it is generally well known that social support has more of an effect on mental health for women than for men [49-51]. Restrictions on social gatherings, such as social distancing and guidelines that formed part of various quarantine measures, might have weakened the vital social support for women. In fact, various studies have provided empirical evidence that social distancing can affect mental health [52-54]. Moreover, research suggests that reduced physical activity due to social distancing may impair mental health [55]. Given that mental health is associated with smoking and drinking [56], changes in increased social responsibility and reduced social support can also worsen women's mental health and lead to dramatic increases in drinking and smoking.

Overall, the trend of noncompliance with precautionary behaviors and a decrease in health behaviors according to worsening depression showed a greater change in women than in men. Although precautionary behavior compliance is the

most important factor in responding to pandemic-related situations [57], health behaviors constitute the basic foundation for maintaining one's physical and mental health, not only in the present but also in the future. Therefore, interventions that consider the degree of depression are necessary to alleviate depression, which could affect the implementation of precautionary behavior and health behavior. Additionally, further studies should examine different ways of implementing such interventions depending on gender.

Study Limitations

This study had several limitations. First, the study did not consider time changes; it was difficult to ascertain causal relationships between the effects of depression and precautionary and health behaviors. In particular, since the KCHS data did not confirm the antecedent relationship between depression and COVID-19, it could not be confirmed whether the depression was due to COVID-19 or other factors. Second, in this study, the trends of precautionary behavior compliance, COVID-19 fear, and health behaviors according to the degree of depression were identified by gender, but it was not shown how vulnerable women were compared to men and their statistical significance. Third, because the data used in this research were collected in the early stages of the COVID-19 pandemic, the precautionary behavior compliance rate created a fairly high temporary bias. In other words, if the data were collected at the end of the pandemic, the results of precautionary or health behaviors may have changed. Finally, in light of the fact that a self-reporting survey was conducted, there is a possibility that measurement errors may have occurred because of the inherent difficulty in checking whether COVID-19 precautionary behaviors were actually being followed and whether health behavior had actually changed. However, this study was cross-sectional and used a representative sample from the entire Republic of Korea. Additionally, this study is valuable in that it examined how depressive symptoms and gender affect precautionary behaviors, even when social aspirations and interest in precautionary behaviors are high.

Conclusion

In this study, we were able to identify how precautionary behavior compliance, COVID-19 fear, and health behaviors change according to the degree of depression and trends according to gender. We found that regardless of gender, people suffering from clinically relevant depression were highly likely to infringe on precautionary behaviors and deteriorate health behaviors. Additionally, this trend was more noticeable in women. These results can be useful for developing related interventions and for future studies that consider both mental status and gender.

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Data Availability

The data set used in this study and more information about the data can be obtained from the official Korea Community Health Survey website [29].

Conflicts of Interest

None declared.

Multimedia Appendix 1

Crude odds ratios (95% CIs) for failure to comply with precautionary behaviors, health behavior deterioration during the COVID-19 outbreak, and COVID-19-related fear according to depression levels.

[\[DOCX File , 17 KB-Multimedia Appendix 1\]](#)

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Abbreviations

- AOR:** adjusted odds ratio
IRB: institutional review board
KCHS: Korea Community Health Survey
PHQ-9: Patient Health Questionnaire-9
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