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Gender difference in impact of mental health during the COVID-19 pandemic on sexual function

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Abstract

There is a paucity of research on the difference between men and women in the impact of mental health on sexual function during the coronavirus disease (COVID-19) pandemic. This study aims to explore sexual function changes and the effects of mental health on sexual function during the COVID-19 pandemic. The data from a self-administered online questionnaire completed by 180 healthy Korean volunteers were analyzed. During the COVID-19 pandemic, women tended to be more vulnerable than men in all subscales of the Depression, Anxiety and Stress Scale 21 (DASS-21), except for the stress subscale ($p < 0.001$). Regarding sexual function, overall sexual function, including both the total International Index of Erectile Function-5 (IIEF-5) score and total Female Sexual Function Index (FSFI) score, was lower during the pandemic compared to before the pandemic. All subscales of DASS-21 and total DASS-21 scores were negatively correlated with total IIEF-5 and total FSFI score in men and women, respectively. On a multivariate analysis, the anxiety subscale of DASS-21 was an independent risk factor for decreased total IIEF-5 score in men ($p < 0.05$). Mental health during the pandemic has negatively influenced sexual function in both sexes. Particularly, anxiety was a significant risk factor for decreased erectile function in men during the pandemic.

Keywords

COVID-19; Mental health; Sexual function; Korean population; Gender difference; Anxiety

1. Introduction

Coronavirus disease (COVID-19) originated in Wuhan, China [1]. The virus transmission rapidly expanded worldwide, provoking the World Health Organization to announce a global pandemic on 11 March 2020 [2]. Subsequently, the Korean government undertook several measures along with this global emergency, including social quarantine, mask mandate, limiting large gatherings, travel restrictions, telework and students' online education. The pandemic affected not only the physical health of the infected persons but also the mental health and well-being of the general public. A previous study reported on the significant psychosocial influence of a global epidemic [3].

The COVID-19 pandemic upended people's everyday life. Social disconnection and concerns about an uncertain future may have a negative effect on mental health [4]. Furthermore, the pandemic led to a significant decline in physical and social activities [5]. Some cross-sectional studies have already examined the impact of COVID-19 on mental health during the acute period. Clinical levels of depression, anxiety or stress were reported by 45% of the respondents [6]. Moreover, 18.8%, 10.6% and 5.1% of the individuals experienced depressive symptoms, anxiety symptoms and increased perceived stress, respectively, during the pandemic [7].

Accordingly, precautionary social restrictions have changed social and personal relationships, sexual life and stances [8, 9]. Sexual dysfunction due to organic causes, such as vascular, hormonal and neurogenic, and psychogenic causes, such as anxiety and depression, exerts a negative influence on the sexual lives of both men and women [10–12]. Often, elevated levels of stress and symptoms of anxiety and depression caused by the global pandemic lead to sexual problems. In addition, COVID-19-related social restrictions have been associated with a greater risk of sexual dysfunction in women, resulting in decreased libido levels, decreased sexual activity, and a higher incidence of depressive symptoms [13]. Furthermore, women are more strongly affected, with profound repercussions on their self-image and sexual and mental well-being [14].

Despite the impact of COVID-19 on public health and social life, limited studies have assessed the relationship between psychological and mental problems and sexual function during the pandemic in the general population. Moreover, mental health during the pandemic likely would have affected men's and women's sexual function differently. However, there is still a lack of research on the difference between men and

women in the impact of mental health on sexual function during COVID-19. Therefore, we hypothesized that mental health outcomes during the COVID-19 pandemic may affect sexual function differently between men and women.

2. Methods

This cross-sectional study was conducted according to the Good Clinical Practice Guidelines, Strengthening the Reporting of Observational studies in Epidemiology (STROBE) guidelines.

The inclusion criteria were as follows: healthy individuals aged >18 years in the Seoul metropolitan area (Seoul Capital and Gyeonggi Province around Seoul) who were in a stable relationship during the quarantine, regardless of whether they were living together with their partner. The participants' sexual orientation or gender identity was not considered in the exclusion criteria. All the participants were sexually active before the pandemic. Data were collected *via* online questionnaires between May 2022 and June 2022. The exclusion criteria were as follows: individuals who were sexually inactive; were aged <18 years or >60 years; were positive for COVID-19; had a sexual partner with COVID-19 infection; were pregnant; had any diseases that may have influenced sexual life and quality of life; and did not provide informed consent. We enrolled 254 participants in this study; 74 were excluded because they did not meet the inclusion criteria.

2.1 Questionnaires

We developed the questionnaires to compare the demographic characteristics of the participants and to understand the effect of these factors on mental health. The questionnaire contains nine questions regarding age, sex, educational background, marital status, smoking, alcohol, medication usage, vaccination status and comorbidity. Moreover, it contains four questions regarding sexual behavior (the change in sex frequency, masturbation and pornography use) and the change in economic status during the pandemic. The participants selected their responses from the following options: "no difference during the COVID-19 pandemic", "decreased during the COVID-19 pandemic" and "increased during the COVID-19 pandemic". They were instructed to respond with a "yes" or "no".

2.2 Measures of mental health

Initially, along with the demographic features, we used the short version of the Depression, Anxiety and Stress Scale 21 (DASS-21) [15] to measure the negative emotional states of depression, anxiety, and stress during pandemic-induced social restrictions. This instrument consists of 21 items based on a four-point Likert scale with seven items in each of the three scales (depression, anxiety and stress). The scores for each scale were added from 0 to 21 and multiplied by 2 to calculate the final scores; higher scores indicate greater depression, anxiety and stress. The final scores of each scale can be classified as follows: (i) for the depression scale, normal (0–9), mild (10–13), moderate (14–20), severe (21–27) and extremely severe (≥28); (ii) for the anxiety scale, normal (0–7), mild (8–9), moderate (10–14), severe (15–19) and extremely severe (≥20); and (iii) for the stress scale, normal (0–14), mild (15–18), moderate (19–25), severe (26–33) and extremely severe (≥34). In this study, we used the Korean version of the DASS-21 [16].

2.3 Measures of sexual function

To evaluate sexual function, we requested the men and women to complete the International Index of Erectile Function-5 (IIEF-5) questionnaire [17] and the Female Sexual Function Index (FSFI) questionnaire, respectively [18]. We used the Korean version of these questionnaires, which had been adapted and validated for assessing male erectile dysfunction and female sexual function in the Korean population [19, 20]. The IIEF-5 questionnaire is a five-item instrument that assesses erection confidence, erection firmness, maintenance frequency, maintenance ability and intercourse satisfaction over the previous 4 weeks. The total score was the basis for erectile dysfunction classification as follows: no dysfunction (22–25), mild dysfunction (17–21), mild to moderate dysfunction (12–16), moderate dysfunction (8–11) and severe dysfunction (5–7). The FSFI is a simple and objective questionnaire comprising six domains and 19 items, including sexual desire, sexual arousal, lubrication, orgasm, sexual satisfaction and pain during sexual intercourse, that measure sexual function in women over the previous 4 weeks. These items use a five-point Likert scale ranging from 1 to 5, with higher scores indicating greater levels of sexual functioning on the respective item. The total score was obtained by adding the six domain scores (maximum score 36), and higher scores represented better sexual function in women.

The participants were guided to complete the erectile and sexual function scales twice. First, we requested them to complete the form based on their experiences before the pandemic. Second, the IIEF and FSFI were completed based on their experiences during social distancing measures in response to the pandemic.

2.4 Data analysis

The collected data were analyzed using descriptive statistics, including proportions and mean ± standard deviations. Categorical variables were appropriately analyzed by the Chi-square test or Fisher's exact test. The Shapiro-Wilk test was performed to assess the normality of the distribution of continuous variables. An independent *t*-test and Mann-Whitney U test were used for comparing two independent groups, while the Wilcoxon test was used for comparing the dependent groups. The chi-square test was performed to assess the relationships between the categorical variables. The Spearman rank correlation coefficient was used for correlation assessment. Multiple regression analysis was performed for determining the independent risk factors for decreased sexual function during the COVID-19 pandemic. The univariate model was adjusted for age, pre-pandemic IIEF-5 or FSFI score, total DASS-21 score, DASS-21 subscale scores, economic status, smoking, drinking, comorbidity and medication; each variable was evaluated individually. The

result of multivariate analysis was the combined effect of all factors after adjustment for age, pre-pandemic IIEF-5 or FSFI score, total DASS-21score, DASS-21 subscale scores, economic status, smoking, drinking, comorbidity and medication. All tests were two-sided, and p-values < 0.05 were considered statistically significant. All statistical analyses were performed using the SPSS software (version 20, SPSS Inc, Chicago, IL, USA).

3. Results

Table 1 summarizes the sociodemographic status and mental health characteristics of the participants. The mean age was higher in men than in women (44.8 ± 7.4 years in men and 41 ± 7.7 years in women, $p = 0.001$). Compared with women, a greater percentage of men smoked ($p < 0.001$), consumed alcohol ($p = 0.005$), and had comorbidities ($p = 0.001$). Based on the DASS-21 score, women had more severe depression ($p < 0.001$) and anxiety ($p < 0.001$) than men. Stress did not vary significantly between men and women ($p = 0.267$).

Table 2 summarizes the mental health status of the participants during the COVID-19 pandemic. Each variable of the DASS-21 score was compared between men and women and indicated that the depression subscore ($p < 0.001$), anxiety subscore ($p < 0.001$) and total DASS-21 score ($p < 0.001$) were significantly higher in women. Hence, women were more vulnerable to depression and anxiety during the pandemic.

Table 3 summarizes the sexual function change before and during the COVID-19 pandemic. For men, all IIEF-5 subscale scores, namely, the maintenance ability ($p < 0.001$), maintenance frequency ($p = 0.013$), erection firmness ($p < 0.001$), erection confidence ($p = 0.019$), intercourse satisfaction ($p < 0.001$) and total IIEF-5 score ($p < 0.001$), exhibited a significant decrease during COVID-19 compared with before COVID-19. For women, certain FSFI subscale scores exhibited a significant decrease, namely, desire ($p = 0.013$), arousal ($p = 0.025$), lubrication ($p = 0.018$) and total FSFI score ($p = 0.012$), during COVID-19 compared with before COVID-19. Thus, sexual function decreased across all domains in men but only in certain domains, namely, desire, arousal and lubrication, in women during the pandemic.

Table 4 summarizes the changes in sexual behavior and economic status during the pandemic. No significant variation between men and women was observed in the frequencies of intercourse ($p = 0.676$), masturbation ($p = 0.759$) and use of online pornography ($p = 0.783$). Additionally, no difference in the change in economic status was seen between men and women ($p = 0.832$). Nonetheless, except for the cases with no differences between pre- and post-COVID-19, we observed a higher response rate for a decrease across all variables after the pandemic, suggesting a trend of decrease in sexual behavior and economic status after the pandemic.

Table 5 summarizes the correlations between sexual function, sexual behavior change and mental health status during the COVID-19 pandemic for men. The DASS-21 depression score was negatively correlated with each IIEF-5 subscore and total IIEF-5 score. The DASS-21 anxiety score was negatively correlated with total IIEF-5 score and the following IIEF-5 subscores: maintenance frequency, erection firmness and erection confidence. The DASS-21 stress score was negatively correlated with each IIEF-5 subscore and total IIEF-5 score. The total DASS-21 score was negatively correlated with each IIEF-5 subscore and total IIEF-5 score.

Table 6 summarizes the correlations among sexual function, sexual behavior change and mental health status during the COVID-19 pandemic for women. The DASS-21 depression score was negatively correlated with the FSFI subscores, namely, lubrication, satisfaction and pain, total FSFI score and frequencies of intercourse, masturbation and use of online pornography. The DASS-21 anxiety score was negatively correlated with the FSFI subscores, namely, desire, arousal, lubrication and satisfaction, total FSFI score and the frequency of intercourse. The DASS-21 stress score was negatively correlated with the FSFI subscores, namely, desire, arousal, lubrication, orgasm and pain, total FSFI score and the frequency of intercourse. The total DASS-21 score was negatively correlated with the FSFI subscores, namely, desire, arousal, lubrication, satisfaction and pain, total FSFI score and the frequencies of intercourse, masturbation and use of online pornography.

Table 7 presents the results of multiple regression analysis that identified the factors influencing the decreased total IIEF-5 score during the COVID-19 pandemic for men. The multiple regression analysis suggested that the pre-pandemic total IIEF-5 score (95% CI (Confidence Interval) 0.83–1.09, $p < 0.001$) and the DASS-21 anxiety subscore (95% CI 0.04–0.48, $p = 0.021$) were independent risk factors of sexual function in men during the pandemic.

Table 8 presents the results of multiple regression analysis that identified the factors influencing the total FSFI score during the COVID-19 pandemic for women. The multiple regression analysis suggested that the pre-pandemic total FSFI score (95% CI 0.50–0.91, $p < 0.001$) was the only independent risk factor of sexual function change in women during the pandemic.

4. Discussion

We determined the effects of mental health during the COVID-19 pandemic on sexual function in a healthy Korean population. We noticed that the impact of mental health during the COVID-19 pandemic on sexual function was different depending on gender. Global disasters exerting an influence on mental health and sexual function are rare, thus imposing a limitation to the study period. Conversely, the cumulative data of such studies will facilitate predicting the impact of a future global disaster on mental health and sexual function, with an advantage in developing respective measures. In addition, variations in such data across regions or groups will contribute to accurately predicting and developing countermeasures for the specific inducing factors.

Previous studies have investigated the changes in overall sexual function and sexual response in different phases during the COVID-19 pandemic. The most recognized study is by Güzel and Döndü [21], a Turkish study conducted on 240 healthy workers. All variables, including the sexual desire level, weekly sexual intercourse frequency, foreplay duration and coitus duration, decreased during the pandemic. More-

TABLE 1. Sociodemographic and mental health characteristics.

	Male	Female	*p*-value
Age, yr (%)			
20–29	2 (2.0)	2 (2.5)	
30–39	24 (24.0)	38 (47.5)	0.001
40–49	43 (43.0)	28 (35.0)	
50–60	31 (31.0)	12 (15.0)	
Age (mean ± SD)	44.8 ± 7.4	41 ± 7.7	0.001
Marital status (%)			
Married	100 (100)	100 (100)	
Unmarried	0 (0.0)	0 (0.0)	
Smoking (%)			
Yes	49 (49.0)	6 (7.5)	<0.001
No	51 (51.0)	74 (92.5)	
Alcohol (%)			
Yes	82 (82.0)	51 (63.8)	0.005
No	18 (18.0)	29 (36.2)	
Education (%)			
High school	6 (6.0)	6 (7.5)	
University	86 (86.0)	73 (91.3)	0.108
Post graduate	8 (8.0)	1 (1.3)	
Comorbidities (%)			
Hypertension	23 (23.0)	2 (2.5)	
Diabetes mellitus	2 (2.0)	2 (2.5)	0.001
Hyperlipidemia	8 (8.0)	7 (8.8)	
No	67 (67.0)	69 (86.3)	
Medication usage (%)			
Yes	21 (21.0)	14 (17.5)	0.576
No	79 (79.0)	66 (82.5)	
Latest COVID-19 vaccination (%)			
First	1 (1.0)	0 (0.0)	
Second	23 (23.0)	38 (47.5)	0.130
Third	74 (74.0)	33 (41.3)	
No	2 (2.0)	9 (11.3)	
DASS-21 Depression (%)			
Normal	59 (59.0)	1 (1.3)	
Mild	14 (14.0)	13 (16.3)	
Moderate	18 (18.0)	33 (41.3)	<0.001
Severe	5 (5.0)	16 (20.0)	
Extremely severe	4 (4.0)	17 (21.3)	
DASS-21 Anxiety (%)			
Normal	67 (67.0)	0 (0.0)	
Mild	5 (5.0)	0 (0.0)	
Moderate	14 (14.0)	8 (10.0)	<0.001
Severe	4 (4.0)	25 (31.3)	
Extremely severe	10 (10.0)	47 (58.8)	
DASS-21 Stress (%)			
Normal	72 (72.0)	60 (75.0)	
Mild	8 (8.0)	11 (13.8)	
Moderate	15 (15.0)	7 (8.8)	0.267
Severe	4 (4.0)	2 (2.5)	
Extremely severe	1 (1.0)	0 (0.0)	

COVID-19: coronavirus disease 2019; DASS-21: Depression, Anxiety and Stress Scale 21; SD: standard deviation.

TABLE 2. Mental health status during the COVID-19 pandemic.

Variables	Male (n = 100)	Female (n = 80)	*p*-value
DASS-21 score (mean ± SD)			
Depression	9.22 ± 8.11	20.52 ± 7.21	<0.001
Anxiety	6.52 ± 7.82	20.32 ± 4.55	<0.001
Stress	11.22 ± 8.14	12.12 ± 5.32	0.136
Total DASS-21	26.96 ± 22.42	52.97 ± 15.96	<0.001

DASS-21: Depression, Anxiety and Stress Scale 21; COVID-19: coronavirus disease 2019; SD: standard deviation.

TABLE 3. Comparison of sexual function changes before and during the COVID-19 pandemic.

	Before COVID-19	During COVID-19	*p*-value
Male, IIEF-5 (mean ± SD)			
Maintenance ability	3.50 ± 0.75	3.24 ± 0.74	<0.001
Maintenance frequency	3.65 ± 1.19	3.44 ± 1.23	0.013
Erection firmness	4.22 ± 1.05	3.45 ± 1.36	<0.001
Erection confidence	3.77 ± 1.20	4.01 ± 1.25	0.019
Intercourse satisfaction	3.67 ± 1.12	3.44 ± 1.25	<0.001
Total score	18.81 ± 4.37	17.58 ± 5.10	<0.001
Female, FSFI score (mean ± SD)			
Desire	3.19 ± 1.01	2.79 ± 1.03	0.013
Arousal	3.76 ± 1.02	3.36 ± 1.20	0.025
Lubrication	4.80 ± 0.85	4.40 ± 1.23	0.018
Orgasm	4.06 ± 1.13	3.68 ± 1.32	0.074
Satisfaction	4.07 ± 1.13	3.74 ± 1.23	0.086
Pain	4.44 ± 1.18	4.11 ± 1.38	0.107
Total score	24.33 ± 4.64	22.08 ± 5.66	0.012

IIEF-5: International Index of Erectile Function; FSFI: Female Sexual Function Index; COVID-19: coronavirus disease 2019; SD: standard deviation.

TABLE 4. Comparison of sexual behavior and economic status after the COVID-19 pandemic.

Variables	Male (n = 100)	Female (n = 80)	*p*-value
Frequency of intercourse (%)			
No difference	59 (59.0)	50 (62.5)	
Increase	8 (8.0)	6 (7.5)	0.676
Decrease	33 (33.0)	24 (30.0)	
Frequency of masturbation (%)			
No difference	69 (69.0)	52 (65.0)	
Increase	12 (12.0)	4 (5.0)	0.759
Decrease	19 (19.0)	24 (30.0)	
Frequency of using online pornography (%)			
No difference	59 (59.0)	44 (55.0)	
Increase	17 (17.0)	8 (10.0)	0.783
Decrease	24 (24.0)	28 (35.0)	
Economic status (income) (%)			
No difference	59 (59.0)	49 (61.3)	
Increase	7 (7.0)	5 (6.3)	0.832
Decrease	34 (34.0)	26 (32.5)	

COVID-19: coronavirus disease 2019.

TABLE 5. Relationship between sexual function and sexual behavior change and mental health status during the COVID-19 pandemic in men.

	Maintenance ability	Maintenance frequency	Erection firmness	Erection confidence	Intercourse satisfaction	Total IIEF-5	No. of intercourse	No. of masturbation	No. of online pornography
DASS-21 Depression	−0.258**	−0.363**	−0.393**	−0.331**	−0.302**	−0.386**	−0.039	−0.134	−0.029
DASS-21 Anxiety	−0.151	−0.231*	−0.319**	−0.291**	−0.191	−0.282**	−0.135	−0.021	−0.029
DASS-21 Stress	−0.277**	−0.319**	−0.364**	−0.366**	−0.289**	−0.374**	−0.171	−0.119	−0.030
Total DASS-21	−0.246*	−0.328**	−0.386**	−0.355**	−0.281**	−0.374**	−0.119	−0.138	−0.031

**Significant at 0.05 level; **Significant at 0.01 level. DASS-21: Depression, Anxiety and Stress Scale 21; COVID-19: coronavirus disease 2019; IIEF-5: International Index of Erectile Function.*

TABLE 6. Relationship between sexual function and sexual behavior change and mental health status during the COVID-19 pandemic in women.

	Desire	Arousal	Lubrication	Orgasm	Satisfaction	Pain	Total FSFI	No. of intercourse	No. of masturbation	No. of online pornography
DASS-21 Depression	−0.169	−0.212	−0.407**	−0.172	−0.303**	−0.300**	−0.330**	−0.262*	−0.223*	−0.236*
DASS-21 Anxiety	−0.229*	−0.311**	−0.448**	−0.193	−0.343**	−0.208	−0.282**	−0.271*	−0.194	−0.143
DASS-21 Stress	−0.262*	−0.254*	−0.451**	−0.451**	−0.185	−0.434**	−0.398**	−0.249*	−0.179	−0.184
Total DASS-21	−0.229*	−0.261*	−0.464**	−0.205	−0.389**	−0.313**	−0.387**	−0.290**	−0.221*	−0.227*

**Significant at 0.05 level; **Significant at 0.01 level. DASS-21: Depression, Anxiety and Stress Scale 21; COVID-19: coronavirus disease 2019; FSFI: Female Sexual Function Index.*

TABLE 7. Factors related to decreased total IIEF-5 scores during the COVID-19 pandemic in men: univariate and multivariate analysis.

	Univariate		Multivariate	
	Coefficient (95% CI)	*p*-value	Coefficient (95% CI)	*p*-value
Age (yr)	−0.17 (−0.30, −0.04)	<0.001	0.01 (−0.06, 0.08)	0.840
Pre-pandemic IIEF-5	1.00 (0.88, 1.12)	<0.001	0.95 (0.83, 1.09)	<0.001
DASS Depression	−0.24 (−0.36, −0.12)	<0.001	0.06 (−0.15, 0.28)	0.550
DASS Anxiety	−0.18 (−0.31, −0.05)	0.005	0.26 (0.04, 0.48)	0.021
DASS Stress	−0.23 (−0.35, −0.11)	<0.001	-	-
Total DASS-21	−0.08 (−0.12, −0.04)	<0.001	−0.26 (−0.52, −0.01)	0.053
Economic status (decrease referent)	−0.07 (−2.25, 2.10)	0.945	-	-
Smoking (no smoking referent)	−0.51 (−2.56, 1.54)	0.623	-	-
Drinking (no drinking referent)	−2.59 (−5.21, 0.01)	0.051	-	-
Comorbidity (no comorbidity referent)	−3.05 (−5.16, −0.94)	0.005	−0.24 (−1.72, 1.23)	0.742
Medication (no medication referent)	−3.17 (−5.60, −0.74)	0.011	0.01 (−1.67, 1.70)	0.986

DASS-21: Depression, Anxiety and Stress Scale 21; COVID-19: coronavirus disease 2019; IIEF-5: International Index of Erectile Function-5. CI: Confidence Interval.

TABLE 8. Factors related to decreased total FSFI scores during the COVID-19 pandemic in women: univariate and multivariate analysis.

	Univariate		Multivariate	
	Coefficient (95% CI)	*p*-value	Coefficient (95% CI)	*p*-value
Age (yr)	−0.01 (−0.17, 0.15)	0.927	-	-
Pre-pandemic FSFI	0.76 (0.55, 0.98)	<0.001	0.70 (0.50, 0.91)	<0.001
DASS Depression	−0.27 (−0.44, −0.11)	0.001	0.43 (−0.14, 1.00)	0.140
DASS Anxiety	−0.45 (−0.71, −0.19)	0.001	0.01 (−0.54, 0.56)	0.981
DASS Stress	−0.43 (−0.65, −0.21)	<0.001	-	-
Total DASS-21	−0.14 (−0.21, −0.06)	<0.001	−0.28 (−0.64, 0.07)	0.119
Economic status (decrease referent)	2.56 (−0.08, 5.20)	0.068	-	-
Smoking (no smoking referent)	−2.56 (−7.34, 2.21)	0.289	-	-
Drinking (no drinking referent)	0.68 (−1.95, 3.31)	0.607	-	-
Comorbidity (no comorbidity referent)	−1.25 (−4.92, 2.43)	0.500	-	-
Medication (no medication referent)	−0.24 (−3.58, 3.09)	0.884	-	-

DASS-21: Depression, Anxiety and Stress Scale 21; COVID-19: coronavirus disease 2019; FSFI: Female Sexual Function Index. CI: Confidence Interval.

over, the multivariate logistic regression analysis suggested that the risk factors for sexual dysfunction were female sex, high anxiety score and decreased quality of social time with spouse. Numerous studies have reported an overall reduction in sexual function during the pandemic, despite contrasting results. Contrary to the general belief that psychosocial risk factors exert a negative effect on sexual desire in women, a study reported increased sexual desire in women during the pandemic [22], which was attributed to the increased time and resulting intimacy with a spouse due to social distancing. However, the effect was not as high as in men. In this study, both men and women exhibited a reduction in overall sexual function, in line with previously reported trends [23–25]. Despite variations, all IIEF-5 subdomains, including erectile function, were reduced in men, whereas certain FSFI subdomains were not significantly reduced in women. This finding was consistent with numerous studies reporting that various factors, including intimacy, could influence sexual function in women more than in men [13, 14, 21].

Partnered sexual activity generally decreased during the pandemic [26–28]; however, some studies reported an increase or a lack of significant difference in sexual activity [29–31]. The sexual frequency in unmarried individuals decreased because of reduced opportunities to meet people in person, and the sexual frequency in married individuals increased because of improved intimacy with a spouse due to telecommuting. Our results indicated a trend of reduced sexual activity, although the participants were married individuals, in contrast to the reported trend. This finding is presumably attributed to the strong negative effect of emotional stress caused by strict social distancing in South Korea.

Previously, several studies reported on an increasing trend of online pornography usage during the pandemic, particularly in men [32, 33]. This finding agrees with the general assumption that online pornography usage for visual stimulation has augmented because of the increased frequency of masturbation in lieu of sexual intercourse caused by social distancing during the pandemic. On the contrary, our results indicated a decline in the frequency of masturbation and online pornography usage, despite reduced sexual intercourse in both men and women. One possible explanation could be blocked accessibility to most pornography websites, such as Pornhub, in South Korea, along with the emotional stress caused by strict social distancing.

Regarding mental health vulnerability during the COVID-19 pandemic, we clearly noticed a difference between men and women: women were more susceptible to depression and anxiety symptoms than men. This is in line with the results of a literature review [34–36]. Various studies have analyzed the correlation between mental health and sexual dysfunction [37–39]. Most studies reported on a correlation analysis. They indicated that COVID-19-induced deterioration in mental health, such as stress, anxiety and depression, negatively impacted sexual activity, functioning and satisfaction. In this study, we identified several independent risk factors for decreased sexual function by using the univariate analysis but none of the mental health outcomes by using the multivariate analysis in women; we identified anxiety as an independent risk factor for decreased sexual function by using both univariate and multivariate analyses in men. The present study suggests that a mental health outcome, such as anxiety, could be a significant risk factor for worsening of erectile function in men during the COVID-19 pandemic. The role of anxiety in erectile functioning has not been clearly determined but a previous systematic review suggested a high prevalence of erectile dysfunction in those with an anxiety disorder [40].

The strengths of this study are as follows:

First, we performed a multiple regression analysis, whereas previous studies had performed only a univariate analysis. The multiple regression analysis enabled minimizing of in-

teractions across different factors to identify the independent risk factors. To our knowledge, this is also the first report that mental health during the pandemic affected men's and women's sexual function differently.

Second, a noteworthy finding of this study was the decreased frequency of masturbation and online pornography usage, in contrast to the general perception. Previous results suggested that a decrease in intercourse because of social distancing would increase the frequency of masturbation and pornography usage or that the decreased economic status would increase the relatively low-cost masturbation and pornography usage. Our contrasting result is presumably related to the overall interruption in access to most pornography websites that decreased the drive toward all sexual behavior.

Third, this study demonstrated the effects of mental health status during the COVID-19 pandemic on sexual function and sexual behavior. Despite studies conducted in other countries, our study may provide reliable data to assess the impact of strict social distancing on sexual function and sexual behavior. This is because social distancing in South Korea has been relatively stricter than in other countries from the early to the recent stage of the pandemic.

However, this study had some limitations. First, we performed a cross-sectional study based on a retrospective dataset dependent on the participants' recall and experience. However, it is difficult to design a prospective study in practice because of the challenge of predicting a pandemic.

Second, we could investigate only a specific period of time during the pandemic. The results would have been more significant upon conducting a serial study that includes comparisons of each year, strict *vs.* flexible social distancing and complete lifting of social distancing.

Finally, our results may not be generalized to all disaster situations or individuals because we focused on the impact of mental health during the COVID-19 pandemic on sexual function and sexual behavior in a healthy Korean population.

5. Conclusions

Social distancing caused by the COVID-19 pandemic exerted a negative impact on mental health in South Korea, particularly in women. The pandemic reduced sexual function in both men and women. Notably, mental health during the pandemic affected men's and women's sexual function differently, which is that a mental health outcome, such as anxiety, is the most significant risk factor for worsening of sexual function in men during the COVID-19 pandemic. The results can be used to better understand how men's and women's sexual function react to mental health outcomes resulting from prolonged social distancing. These findings can be used to conduct well-being interventions in future pandemic conditions.

ABBREVIATIONS

COVID-19, coronavirus disease; IIEF-5, International Index of Erectile Function-5; FSFI, Female Sexual Function Index; DASS-21, Depression, Anxiety and Stress Scale 21.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

AUTHOR CONTRIBUTIONS

JDC—conceptualized and designed the study, besides performing the statistical analysis. TKY, JYK, JHL and HDJ—collected the original data. JDC and HDJ—wrote the article. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

All study participants provided informed consent, and the study design was approved by the Institutional Review Board of Nowon Eulji University Hospital (approval number: EMC 2021-07-006).

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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