Scientific Research Publishing

Health, 2024, 16, 37-51
https://www.scirp.org/journal/health
ISSN Online: 1949-5005
ISSN Print: 1949-4998

Risk and Protective Factors Associated with Depression and Anxiety among Pregnant Women during the COVID-19 Pandemic

Maiko Manaka[1], Miyako Tsuda[2], Moe Fujitani[2], Ai Sawada[2], Nanae Akatsuka[3], Ayako Sasaki[1]

[1]Faculty of Nursing, Osaka Medical and Pharmaceutical University, Takatsuki, Japan
[2]Osaka City Juso Hospital, Osaka, Japan
[3]Osaka City General Hospital, Osaka, Japan
Email: maiko.manaka@ompu.ac.jp

How to cite this paper: Manaka, M., Tsuda, M., Fujitani, M., Sawada, A., Akatsuka, N. and Sasaki, A. (2024) Risk and Protective Factors Associated with Depression and Anxiety among Pregnant Women during the COVID-19 Pandemic. *Health*, **16**, 37-51.
https://doi.org/10.4236/health.2024.161004

Received: December 24, 2023
Accepted: January 16, 2024
Published: January 19, 2024

Abstract

Background: The coronavirus disease (COVID-19) pandemic has impacted perinatal women's mental health. However, protective factors associated with depression among pregnant Japanese women during the pandemic have not been reported. **Purpose:** The present study investigated the risk and protective factors associated with depression and anxiety among pregnant women during the COVID-19 pandemic. **Methods:** An online questionnaire was administered to 157 pregnant women between October 2022 and May 2023 at two general hospitals in Japan. The Japanese versions of the Patient Health Questionnaire-9 (PHQ-9) and General Anxiety Disorder-7 (GAD-7) were used to assess symptoms of depression and anxiety. The χ^2 test or *Fisher's* exact test and multivariate logistic regression model were used to examine factors associated with depression and anxiety among pregnant women. **Results:** Overall, 47.1% and 35.7% of the pregnant women reported depressive and anxiety symptoms, respectively. A "history of mental illness" was a risk factor for depression and anxiety among pregnant women during the COVID-19 pandemic. Additionally, unmarried status was a risk factor for anxiety among pregnant women, whereas outdoor and indoor exercises were protective factors against depression and anxiety, respectively. **Conclusions:** Exercise may have protected pregnant women from depression and anxiety during the COVID-19 pandemic. Encouraging exercise may help maintain the mental health of pregnant women who do not have exercise restrictions.

Keywords

Depression, Anxiety, Factors, Pregnancy, COVID-19 Pandemic

1. Introduction

The COVID-19 pandemic may have impacted society, particularly the mental health of perinatal women. In Japan, the first case of infection was confirmed and announced in January 2020. A state of emergency was declared in Osaka four times between 2020 and 2021, making it advisable to stay outside the city. The World Health Organization (WHO) had recommended pregnant women to take precautions to protect themselves against COVID-19 as changes in the body and immune system may increase their susceptibility to the serious consequences of some respiratory infections [1]. Therefore, pregnant women were expected to be concerned about COVID-19 and engage in precautionary behaviours to avoid it.

A study of 105 pregnant and 105 non-pregnant women surveyed four times during the COVID-19 pandemic for anxiety and depression reported that pregnant women had a more pronounced increase and a weaker decrease in initial symptoms than non-pregnant women [2]. Pregnant women may have become more depressed and anxious because of the fear of COVID-19. The rate of depression among pregnant women during the COVID-19 pandemic was reportedly 25% - 30% [3] [4] [5] [6]. The rate of depression among pregnant women before the COVID-19 pandemic was 16.4% [7], which is likely to have increased after the pandemic.

The risk factors associated with depression among pregnant women during COVID-19 were "distress from COVID-19-related experiences", "reduced/low income", "unemployment", "anxiety", "history of mental illness", "lack of social support", and "reduced/lack of exercise". However, protective factors associated with pregnant Japanese women were not reported [8]. Studies of pregnant women during the COVID-19 pandemic predicted the potential association of prenatal depression and anxiety with postpartum depression [9]. Therefore, there is a need to identify protective factors associated with depression and anxiety among pregnant women in Japan. This study investigated the risk and protective factors associated with depression and anxiety among pregnant Japanese women during the COVID-19 pandemic.

2. Methods

2.1. Study Design and Participants

This cross-sectional online survey was conducted using Survey Monkey's online system. This system is ISO 27001 certified as an international standard for information security. Data were collected between October 2022 and May 2023, *i.e.* from the "8th wave" of the COVID-19 pandemic to just before it was labelled as a "Class 5 Infectious Disease".

Pregnant women were recruited from two general hospitals in Osaka, Japan. Inclusion criteria were: pregnant women aged ≥ 18 years, those with ≥22 weeks' gestation beyond the time of the miscarriage, and those who attended antenatal health examinations at obstetrics. Pregnant women whose native language was

not Japanese were excluded. Pregnant women who met the inclusion criteria were informed of the survey while they waited for their prenatal health examinations in an outpatient obstetric clinic. Pregnant women who consented to participate in the study were asked to complete an online questionnaire.

The sample size was 134 participants, which was calculated using the power analysis software G * Power with a significance level of 0.05, power of 0.8, and effect size of 0.5.

2.2. Measures

2.2.1. Characteristics

The participants were asked to provide information regarding their gestational age, delivery history, marital status, financial concerns, infertility treatment, pregnancy complications, history of mental illness, changes in work patterns due to the COVID-19 pandemic, partner telecommuting due to the COVID-19 pandemic, postpartum support, and decreased support due to the COVID-19 pandemic.

2.2.2. Behaviour

Participants were asked if they attempted to behave according to the following 18 items. They were asked to answer using four options: not at all, rarely, sometimes, and always.

The 18 items were regular life, getting enough sleep, early to bed and early to rise, exposure to sunlight, three meals a day, nutritional balance, frequent hand washing, alcohol disinfection, frequent ventilation, getting information about COVID-19, going out to avoid crowds, communication with partner, communication with family members, exercise, exercise at home, exercise outside the home, hobbies and mood swings, and getting support.

2.2.3. Depression

The Japanese version of the Patient Health Questionnaire-9 (PHQ-9) was used to assess depressive symptoms. The PHQ-9 was developed by Kroenke *et al.* [10] and translated into Japanese by Muramatsu *et al.* [11]. This scale has 10 questions scored from 0 to 3 points, with total scores ranging from 0 to 27. Scores of 0 - 4, 5 - 9, 10 - 14, 15 - 19, and 20 - 27 represent minimal, mild, moderate, moderately severe, and severe depression, respectively [12]. The sensitivity and specificity of the Japanese version of the PHQ-9 are 90.5% and 76.6%, respectively [12].

2.2.4. Anxiety

Anxiety was assessed using the Japanese version of the General Anxiety Disorder-7 (GAD-7) scale. The GAD-7 was developed by Spitzer *et al.* [13] and translated into Japanese by Muramatsu *et al.* [14] [15]. This scale has seven questions scored from 0 to 3 points, with total scores ranging from 0 to 21. Scores of 0 - 4, 5 - 10, 10 - 14, and 15 - 21 represent minimal, mild, moderate, and severe anxiety, respectively [15]. The sensitivity and specificity of this scale are 89% and

82%, respectively [13].

2.3. Statistical Analysis

Descriptive statistics were used to describe the participants' characteristics and behaviours. The χ^2 test or *Fisher's* exact test was used to examine factors associated with depression and anxiety during pregnancy. In addition, a multiple logistic regression analysis using the method of increasing variables (likelihood ratio) was conducted, with the presence or absence of depressive and anxiety symptoms among pregnant women as the dependent variable and participants' characteristics and behaviours as independent variables.

All statistical analyses were performed using the SPSS Statistics software (version 27.0; International Business Machines Corporation, NY, USA). The statistical significance level was set at 5%.

2.4. Ethical Considerations

This study was approved by the Ethics Committees of University A (approval number: 2022-076), Hospital B (2022-1), and Hospital C (5648). All participants were informed about the study. Consent was obtained by submitting the online questionnaire and responding to the check-in consent box.

3. Results

Of the 312 pregnant women approached, 159 (51.0%) agreed to participate in our study. The analysis included 157 (50.3%) participants, excluding two who reported < 22 weeks of gestation.

3.1. Characteristics of Participants

The participant characteristics are presented in **Table 1**.

In this study, the mean age of the 157 pregnant women was 32.18 ± 5.31 years; 94 were primiparas (59.9%), 147 (93.6%) were married, 77 (49.0%) reported financial concerns, and 22 (14.0%) had a history of mental illness.

3.2. Depression and Anxiety

Of the 157 participants, 74 (47.1%) with scores of ≥5 reported more than mild depressive symptoms on the PHQ-9 and 56 (35.7%) with scores of ≥5 reported more than mild anxiety symptoms on the GAD-7 (**Table 2**). In this study, 47.1% of the participants scored ≥ 5 while 14.6% of the participants scored ≥ 10 on the PHQ-9 scale. Furthermore, 35.7% of the participants in this study scored ≥ 5 on the GAD-7 scale.

3.3. Behaviour

The behavioural methods used by the participants are summarised in **Table 3**. In this study, 90 women (57.3%) were engaged in some form of "exercise", 55 (35.0%) were engaged in "exercise at home", and 78 (49.7%) were engaged in

Table 1. Participant characteristics (n = 157).

Variable		n (%); mean ± SD
Gestational weeks	Second trimester	60 (38.2)
	Third trimester	97 (61.8)
Age (years)		32.18 ± 5.31
Delivery history	Primiparas	94 (59.9)
	Multiparous	63 (40.1)
Marital status	Unmarried	10 (6.4)
Financial concerns	Yes	77 (49.0)
Infertility treatment	Yes	49 (31.2)
Complications in pregnancy	Yes	27 (17.2)
History of mental illness	Yes	22 (14.0)
Changes in work patterns due to the COVID-19 pandemic	Yes	27 (17.2)
Partner telecommuting due to the COVID-19 pandemic	Yes	25 (15.9)
Postpartum support	Yes	134 (85.4)
Decreased support due to the COVID-19 pandemic	Yes	26 (16.6)

Table 2. Severity of depression (PHQ-9) and anxiety symptoms (GAD-7) (n = 157).

	Severity	Score	n (%)			
Depression [PHQ-9]	None-minimal	0 - 4	83	(52.9)		
	Mild	5 - 9	51	(32.5)		
	Moderate	10 - 14	13	(8.3)	74	(47.1)
	Moderately severe	15 - 19	5	(3.2)		
	Severe	20 - 27	5	(3.2)		
Anxiety [GAD-7]	Minimal	0 - 4	101	(64.3)		
	Mild	5 - 10	41	(26.1)		
	Moderate	10 - 14	9	(5.7)	56	(35.7)
	Severe	15 - 21	6	(3.8)		

Note: Abbreviations: PHQ-9 = Patient Health Questionnaire-9, GAD-7 = General Anxiety Disorder-7.

"exercise outside the home". In addition, 147 women (93.6%) were engaged in "letting the sun in", and 134 women (85.4%) were engaged in "hobbies or mood swings".

3.4. Participants' Characteristics Associated with Depression and Anxiety

Table 4 lists the results of the χ^2 test or *Fisher's* exact test for participant characteristics associated with depression and anxiety symptoms. "History of mental

Table 3. Participant behaviours (n = 157).

Variable	n (%)			
	Yes		No	
Regular life	140	(89.2)	17	(10.8)
Getting enough sleep	152	(96.8)	5	(3.2)
Early to bed and early to rise	132	(84.1)	25	(15.9)
Three meals a day	142	(90.4)	15	(9.6)
Nutritional balance	147	(93.6)	10	(6.4)
Frequent hand washing	150	(95.5)	7	(4.5)
Alcohol disinfection	136	(86.6)	21	(13.4)
Frequent ventilation	138	(87.9)	19	(12.1)
Getting information about COVID-19	109	(69.4)	48	(30.6)
Going out to avoid crowds	120	(76.4)	37	(23.6)
Communication with partner	152	(96.8)	5	(3.2)
Communication with family members	144	(91.7)	13	(8.3)
Getting support	111	(70.7)	46	(29.3)
Letting the sun in	147	(93.6)	10	(6.4)
Exercise	90	(57.3)	67	(42.7)
Exercise at home	55	(35.0)	102	(65.0)
Exercise outside the home	78	(49.7)	79	(50.3)
Hobbies or mood swings	134	(85.4)	23	(14.6)

Table 4. Participant characteristics associated with depression and anxiety symptoms.

Variable	n (%)				p-value	n (%)				p-value
	Depression symptom					Anxiety symptom				
	None	(n = 83)	Present	(n = 74)		None	(n = 101)	Present	(n = 56)	
Gestational weeks										
Second trimester	31	(51.7)	29	(48.3)	.813a	34	(56.7)	26	(43.3)	.115a
Third trimester	52	(53.6)	45	(46.4)		67	(69.1)	30	(30.9)	
Age (years)										
<35 years	48	(47.5)	53	(52.5)	.072a	65	(64.4)	36	(35.6)	.993a
≤35 years	35	(62.5)	21	(37.5)		36	(64.3)	20	(35.7)	
Delivery history										
Primipara	49	(52.1)	45	(47.9)	.821a	44	(69.8)	19	(30.2)	.238a
Multipara	34	(54.0)	29	(46.0)		57	(60.6)	37	(39.4)	
Marital status										
Married	80	(54.4)	67	(45.6)	.192b	98	(66.7)	49	(33.3)	.035b*

Continued

Unmarried	3	(30.0)	7	(70.0)		3	(30.0)	7	(70.0)	
Financial concerns										
Yes	10	(37.0)	17	(63.0)	.070a	56	(70.0)	24	(30.0)	.131a
No	73	(56.2)	57	(43.8)		45	(58.4)	32	(41.6)	
Infertility treatment										
Yes	29	(59.2)	20	(40.8)	.285a	33	(67.3)	16	(32.7)	.595a
No	54	(50.0)	54	(50.0)		68	(63.0)	40	(37.0)	
Complications in pregnancy										
Yes	10	(37.0)	17	(63.0)	.070a	14	(51.9)	13	(48.1)	.137a
No	73	(56.2)	57	(43.8)		87	(66.9)	43	(33.1)	
History of mental illness										
Yes	7	(31.8)	15	(68.2)	.033a*	9	(40.9)	13	(68.2)	.013a*
No	76	(56.3)	59	(43.7)		92	(68.1)	43	(43.7)	
Changes in work patterns due to the COVID-19 pandemic										
Yes	12	(44.4)	15	(55.6)	.335a	13	(48.1)	14	(51.9)	.054a
No	71	(54.6)	59	(45.4)		88	(67.7)	42	(32.3)	
Partner telecommuting due to the COVID-19 pandemic										
Yes	13	(52.0)	12	(48.0)	.925a	13	(52.0)	12	(48.0)	.160a
No	70	(53.0)	62	(47.0)		88	(66.7)	44	(33.3)	
Postpartum support										
Yes	74	(55.2)	60	(44.8)	.101a	88	(65.7)	46	(46.0)	.313a
No	8	(36.4)	14	(63.6)		12	(54.5)	10	(45.5)	
Decreased support due to the COVID-19 pandemic										
Yes	10	(38.5)	16	(61.5)	.115a	15	(57.7)	11	(42.3)	.455a
No	72	(55.4)	58	(44.6)		85	(65.4)	45	(34.6)	

Note. a: χ^2 test, b: *Fisher's* exact test, *$p < .05$.

illness" was found to be a significant characteristic among participants for both depression ($p = .033$) and anxiety ($p = .013$). Anxiety was found to be significant for those who were "unmarried" ($p = .035$).

3.5. Behaviours Associated with Depression and Anxiety Symptoms

Table 5 lists the results of the χ^2 test or *Fisher's* exact test for the behaviours associated with depression and anxiety symptoms among pregnant women. "Exposure to sunlight" ($p = .047$), "exercise" ($p = .006$), "exercise at home" ($p = .020$), "exercise outside the home" ($p = .002$), and "hobbies and mood swings" ($p = .020$) were found to be significantly associated with depression symptoms

Table 5. The behaviors associated with depression and anxiety symptoms among pregnant women.

Variable	*n* (%)				*p-value*	*n* (%)				*p-value*
	Depression symptom					Anxiety symptom				
	None	(*n* = 83)	Present	(*n* = 74)		None	(*n* = 101)	Present	(*n* = 56)	
Regular life										
Yes	76	(54.3)	64	(45.7)	.307a	92	(65.7)	48	(34.3)	.299a
No	7	(41.2)	10	(58.8)		9	(52.9)	8	(47.1)	
Getting enough sleep										
Yes	82	(53.9)	70	(46.1)	.189b	99	(65.1)	53	(34.9)	.248b
No	1	(20.0)	4	(80.0)		2	(40.0)	3	(60.0)	
Early to bed and early to rise										
Yes	73	(55.3)	59	(44.7)	.160a	87	(65.9)	45	(34.1)	.343a
No	10	(40.0)	15	(60.0)		14	(56.0)	11	(44.0)	
Exposure to sunlight										
Yes	81	(55.1)	66	(44.9)	.047b*	97	(55.1)	50	(44.9)	.169b
No	2	(20.0)	8	(80.0)		4	(20.0)	6	(80.0)	
Three meals a day										
Yes	76	(53.5)	66	(46.5)	.613a	92	(64.8)	50	(35.2)	.713a
No	7	(46.7)	8	(53.3)		9	(60.0)	6	(40.0)	
Nutritional balance										
Yes	78	(53.1)	69	(46.9)	1.000b	95	(64.6)	52	(35.4)	.745b
No	5	(50.0)	5	(50.0)		6	(60.0)	4	(40.0)	
Frequent hand washing										
Yes	80	(53.3)	70	(46.7)	.708b	96	(64.0)	54	(36.0)	1.000a
No	3	(42.9)	4	(57.1)		5	(71.4)	2	(28.6)	
Alcohol disinfection										
Yes	72	(52.9)	64	(47.1)	.962a	88	(64.7)	48	(35.3)	.803a
No	11	(52.4)	10	(47.6)		13	(61.9)	8	(38.1)	
Frequent ventilation										
Yes	75	(54.3)	63	(45.7)	.316a	89	(64.5)	49	(35.5)	.909a
No	8	(42.1)	11	(57.9)		12	(63.2)	7	(36.8)	
Getting information about COVID-19										
Yes	57	(52.3)	52	(47.7)	.829a	72	(66.1)	37	(33.9)	.497a
No	26	(54.2)	22	(45.8)		29	(60.4)	19	(39.6)	
Going out to avoid crowds										
Yes	67	(55.8)	53	(44.2)	.180a	79	(65.8)	41	(34.2)	.479a

Continued

No	16	(43.2)	21	(56.8)		22	(59.5)	15	(40.5)	
Communication with partner										
Yes	82	(53.9)	70	(46.1)	.189b	100	(65.8)	52	(34.2)	.055b
No	1	(20.0)	4	(80.0)		1	(20.0)	4	(80.0)	
Communication with family members										
Yes	79	(54.9)	65	(45.1)	.096a	93	(64.6)	51	(35.4)	1.000b
No	4	(30.8)	9	(69.2)		8	(61.5)	5	(38.5)	
Exercise										
Yes	56	(62.2)	34	(37.8)	.006a**	62	(62.2)	28	(37.8)	.167a
No	27	(40.3)	40	(59.7)		39	(40.3)	28	(59.7)	
Exercise at home										
Yes	36	(65.5)	19	(34.5)	.020a*	44	(65.5)	11	(34.5)	.003a**
No	47	(46.1)	55	(53.9)		57	(46.1)	45	(53.9)	
Exercise outside the home										
Yes	51	(65.4)	27	(34.6)	.002a**	53	(65.4)	25	(34.6)	.347a
No	32	(40.5)	47	(59.5)		48	(40.5)	31	(59.5)	
Hobbies and mood swings										
Yes	76	(56.7)	58	(43.3)	.020a*	92	(56.7)	42	(43.3)	.006a**
No	7	(30.4)	16	(69.6)		9	(30.4)	14	(69.6)	
Getting support										
Yes	59	(53.2)	52	(46.8)	.911a	73	(65.8)	38	(34.2)	.560a
No	24	(52.2)	22	(47.8)		28	(60.9)	18	(39.1)	

Note. a: χ^2 test, b: *Fisher's* exact test, * $p < .05$, ** $p < .01$.

among pregnant women, while "exercise at home" ($p = .003$) and "hobbies and mood swings" ($p = .006$) were significantly associated with anxiety symptoms.

The results of the multivariate logistic regression analysis are presented in Table 6. Factors associated with depression included a "history of mental illness" and "exercise outside the home". "History of mental illness" was a risk factor (odds ratio [OR]: 3.279, 95% confidence interval [CI] for OR: 1.202 - 8.946), while "exercise outside the home" was a protective factor against depression among pregnant women during the COVID-19 pandemic. The odds ratio of having depressive symptoms was 0.332 (95% CI: .168 -.652) for pregnant women who were committed to "exercise outside the home". Factors associated with anxiety were being "unmarried", having a "history of mental illness", and engaging in "exercise at home". Being "unmarried" (OR: 6.146, 95% CI: 1.418 - 26.637) and having a "history of mental illness" (OR: 3.981, 95% CI: 1.489 - 10.644) were risk factors, while "exercise at home" was a protective factor for

Table 6. Results of multivariate logistic regression analysis of the factors associated with depression and anxiety symptoms.

Variable	*B*	SE	Wald	*df*	*p-value*	Odd's Ratio (OR)	95% Confidence Interval for OR
Depression Symptoms							
History of mental illness	1.118	.512	5.377	1	.020	3.279	1.202 - 8.946
Exercise outside the home	−1.104	.345	10.215	1	.001	0.332	.168 - .652
Anxiety Symptoms							
Unmarried	1.816	.748	5.889	1	.015	6.146	1.418 - 26.637
History of mental illness	1.382	.502	7.584	1	.006	3.981	1.489 - 10.644
Exercise at home	−1.230	.416	8.746	1	.003	0.292	.129 - .661

Note: OR and 95% Confidence Interval for OR derived from a multivariate logistic regression model. Abbreviations: *B* = unstandardized coefficient, SE = standard error of the mean, Wald = Wald test, *df* = degree of freedom.

anxiety in pregnant women during the COVID-19 pandemic. The odds ratio of having anxiety symptoms was .292 (95% CI: .129 - .661) for pregnant women who were committed to "exercise at home".

4. Discussion

In the present study, 47.1% of the participants scored ≥ 5 while 14.6% of the participants scored ≥ 10 on the PHQ-9 scale. Previous studies have reported that 25.8 to 48.7% pregnant women scored PHQ-9 scores ≥ 5, while 5.3% to 59.2% scored PHQ-9 scores ≥ 10 during the COVID-19 pandemic [16]-[26]. Furthermore, 35.7% of the participants in the present study scored ≥ 5 on the GAD-7 scale. In a systematic review of the effects of the COVID-19 pandemic, the rate of anxiety symptoms among pregnant women was 34% - 40% [4] [27]. Thus, the depression and anxiety levels of the participants in the present study did not differ from those reported in previous studies.

In this study, "exercise outside the home" was found to be a protective factor against depression among pregnant women during the COVID-19 pandemic. A lack of or decreased exercise has been reported as a risk factor for depression [18] [22] [28] [29], but not a protective factor against depression among pregnant women during the COVID-19 pandemic. Therefore, this result is significant. Light exercise outside the home, such as walking, may have had a protective effect against depression among pregnant women during the COVID-19 pandemic. Recommending exercise to pregnant women without exercise restrictions may help prevent depression.

Exercise at home was a protective factor against anxiety among pregnant women during the COVID-19 pandemic. For pregnant women with concerns regarding infection during outdoor activities during the COVID-19 pandemic, exercising inside their homes may have been reassuring. Lebel *et al.* reported that anxiety symptoms among pregnant women during the COVID-19 pandemic decreased when they engaged in extensive physical activity [30]. However,

pregnant women who can exercise may include those without physical complications or abnormalities during pregnancy. Therefore, this result should be interpreted with caution.

In addition, 71.6% of pregnant women reported not exercising in the post-pandemic era [22] and 61.8% of pregnant women reduced their physical activity during the lockdown [31]. In this study, 42.7% of pregnant women did not engage in exercise, and 50.3% did not engage in outdoor exercise; these percentages were smaller than those in previous studies. This might be because the present study was conducted in the "8th wave" of the COVID-19 pandemic, just before the disease became a category 5 infectious disease and the threat of infection eased. In addition, 30.6% of pregnant women continued to exercise at home compared with 8% of non-pregnant women in the early stages of the COVID-19 pandemic [32]. In the present study, 35.0% of the participants exercised at home, a percentage similar to that reported in a previous study. This is likely because pregnant women behave independently of the idea of having a healthy life with their foetuses.

A history of mental illness was a risk factor for depression and anxiety among pregnant women during the COVID-19 pandemic. It has also been reported as a risk factor for depression among pregnant women during [33] [34] [35] [36] [37] and before the pandemic [38] in previous studies. In addition, being "unmarried" was a risk factor for anxiety among pregnant women during the COVID-19 pandemic. Pregnant women with a single/divorced/widowed marital status were reported to have a higher risk of anxiety than married pregnant women during the COVID-19 pandemic in a previous study [22]. Although the odds ratio in this study was higher than in previous studies, unmarried pregnant women had a higher risk of anxiety than married pregnant women, and the presence of a husband was thought to alleviate pregnant women's anxiety.

Thus, our study revealed risk and protective factors associated with depression and anxiety among pregnant women during the COVID-19 pandemic. These results may be useful in providing psychological support to pregnant women following the COVID-19 outbreak.

5. Limitations

This study has two limitations. First, we did not examine the relationship between pregnant women's behaviours and exercise limitations. Second, we did not examine the exercise content of pregnant women, such as exercise type, intensity, frequency, or duration. Therefore, future studies can explore the potential individual differences in their perception of exercise.

6. Conclusion

In the present study, a history of mental illness was found to be a risk factor for depression and anxiety among pregnant women during the COVID-19 pandemic, whereas unmarried status was a risk factor for anxiety. In contrast, out-

door and indoor exercises were protective factors against depression and anxiety, respectively. Therefore, exercise may have protected pregnant women from depression and anxiety during the COVID-19 pandemic. Encouraging exercise may help maintain the mental health of pregnant women who do not have exercise restrictions.

Acknowledgements

We are grateful to the participants and hospital staff for their cooperation.

Funding

This work was supported by the JSPS KAKENHI Grant-in-Aid for Research Activity (start-up number: JP22K21187).

Complement

This study will be partially published by the 19th Japan Society of Perinatal Mental Health in 2023.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] World Health Organization (WHO) (2020) Novel Coronavirus Infection (COVID-19): Pregnancy and Childbirth. https://extranet.who.int/kobe_centre/ja/covid/qa/q27_pregnancy

[2] López-Morales, H., Del-Valle, M.V., Andrés, M.L., Gelpi Trudo, R., Canet-Juric, L. and Urquijo, S. (2021) Longitudinal Study of Prenatal Depression and Anxiety during the COVID-19 Pandemic. *Archives of Women's Mental Health*, **24**, 1027-1036. https://doi.org/10.1007/s00737-021-01152-1

[3] Tomfohr-Madsen, L.M., Racine, N., Giesbrecht, G.F., Lebel, C. and Madigan, S. (2021) Depression and Anxiety in Pregnancy during COVID-19: A Rapid Review and Meta-Analysis. *Psychiatry Research*, **300**, Article ID: 113912. https://doi.org/10.1016/j.psychres.2021.113912

[4] Sun, F., Zhu, J., Tao, H., Ma, Y. and Jin, W. (2021) A Systematic Review Involving 11,187 Participants Evaluating the Impact of COVID-19 on Anxiety and Depression in Pregnant Women. *Journal of Psychosomatic Obstetrics and Gynaecology*, **42**, 91-99. https://doi.org/10.1080/0167482X.2020.1857360

[5] Fan, S., Guan, J., Cao, L., Wang, M., Zhao, H., Chen, L. and Yan, L. (2021) Psychological Effects Caused by COVID-19 Pandemic on Pregnant Women: A Systematic Review with Meta-Analysis. *Asian Journal of Psychiatry*, **56**, Article ID: 102533. https://doi.org/10.1016/j.ajp.2020.102533

[6] Manaka, M., Sasano, N., Chikazawa, S. and Sasaki, A. (2023) Review of the Depression Rate among Pregnant Women during the COVID-19 Pandemic. *Health*, **15**, 33-47. https://doi.org/10.4236/health.2023.151003

[7] Okagbue, H.I., Adamu, P.I., Bishop, S.A., Oguntunde, P.E., Opanuga, A.A. and Akhmetshin, E.M. (2019) Systematic Review of Prevalence of Antepartum Depres-

sion during the Trimesters of Pregnancy. *Open Access Macedonian Journal of Medical Sciences*, **7**, 1555-1560. https://doi.org/10.3889/oamjms.2019.270

[8] Manaka, M., Sasano, N., Chikazawa, S. and Sasaki, A. (2023) Review of Factors Associated with Depression among Pregnant Women during the COVID-19 Pandemic. *Health*, **15**, 161-176. https://doi.org/10.4236/health.2023.152013

[9] Kornfield, S.L., White, L.K., Waller, R., Njoroge, W., Barzilay, R., Chaiyachati, B.H., *et al.* (2021) Risk and Resilience Factors Influencing Postpartum Depression and Mother-Infant Bonding during COVID-19: Study Examines Postpartum Depression and Mother-Infant Bonding during the COVID-19 Pandemic. *Health Affairs*, **40**, 1566-1574. https://doi.org/10.1377/hlthaff.2021.00803

[10] Kroenke, K., Spitzer, R.L. and Williams, J.B. (2001) The PHQ-9: Validity of a Brief Depression Severity Measure. *Journal of General Internal Medicine*, **16**, 606-613. https://doi.org/10.1046/j.1525-1497.2001.016009606.x

[11] Muramatsu, K. (2014) An Up-to-Date Letter in the Japanese Version of PHQ, PHQ-9, PHQ-15. *Graduate School of Clinical Psychology*, *Niigata Seiryo University*, **7**, 35-39. (In Japanese) https://cir.nii.ac.jp/crid/1372823123423019009

[12] Muramatsu, K., Miyaoka, H., Kamijima, K., Muramatsu, K., Tanaka, Y., Hosaka, M., *et al.* (2018) Performance of the Japanese Version of the Patient Health Questionnaire-9 (J-PHQ-9) for Depression in Primary Care. *General Hospital Psychiatry*, **52**, 64-69. https://doi.org/10.1016/j.genhosppsych.2018.03.007

[13] Spitzer, R.L., Kroenke, K., Williams, J.B. and Löwe, B. (2006) A Brief Measure for Assessing Generalised Anxiety Disorder: The GAD-7. *Archives of Internal Medicine*, **166**, 1092-1097. ttps://doi.org/10.1001/archinte.166.10.1092

[14] Muramatsu, K. (2009) Validation and Utility of a Japanese Version of the GAD-7. *Japanese Journal of Psychosomatic Medicine*, **51**, 79. https://cir.nii.ac.jp/crid/1370009142655196420

[15] Muramatsu, K., Miyaoka, H., Kamijima, K., Muramatsu, Y., Fuse, K., Yoshimine, F., *et al.* (2010) Validation and Utility of a Japanese Version of the GAD-7. *Japanese Society of Psychosomatic Medicine*, **50**, 166. (In Japanese)

[16] Mei, H., Li, N., Li, J., Zhang, D., Cao, Z., Zhou, Y., *et al.* (2021) Depression, Anxiety, and Stress Symptoms in Pregnant Women before and during the COVID-19 Pandemic. *Journal of Psychosomatic Research*, **149**, Article ID: 110586. https://doi.org/10.1016/j.jpsychores.2021.110586

[17] Lin, W., Wu, B., Chen, B., Lai, G., Huang, S., Li, S., *et al.* (2021) Sleep Conditions Associated with Anxiety and Depression Symptoms among Pregnant Women during the COVID-19 Epidemic in Shenzhen. *Journal of Affective Disorders*, **281**, 567-573. https://doi.org/10.1016/j.jad.2020.11.114

[18] Lin, W., Wu, B., Chen, B., Zhong, C., Huang, W., Yuan, S., *et al.* (2021) Associations of COVID-19 Related Experiences with Maternal Anxiety and Depression: Implications for Mental Health Management of Pregnant Women in the Post-Pandemic Era. *Psychiatry Research*, **304**, Article ID: 114115. https://doi.org/10.1016/j.psychres.2021.114115

[19] Yang, X., Song, B., Wu, A, Mo, P.K., Di, J., Wang, Q., *et al.* (2021) Social, Cognitive, and eHealth Mechanisms of COVID-19-Related Lockdown and Mandatory Quarantine that Potentially Affect the Mental Health of Pregnant Women in China: Cross-Sectional Survey Study. *Journal of Medical Internet Research*, **23**, e24495. https://doi.org/10.2196/24495

[20] Mo, P.K.H., Fong, V.W.I., Song, B., Di, J., Wang, Q. and Wang, L. (2021) Association of Perceived Threat, Negative Emotions, and Self-Efficacy with Mental Health

and Personal Protective Behaviour among Chinese Pregnant Women during the COVID-19 Pandemic: Cross-Sectional Survey Study. *Journal of Medical Internet Research*, **23**, e24053. https://doi.org/10.2196/24053

[21] Zhou, Y., Shi, H., Liu, Z., Peng, S., Wang, R., Qi, L., *et al.* (2020) The Prevalence of Psychiatric Symptoms of Pregnant and Non-Pregnant Women during the COVID-19 Epidemic. *Translational Psychiatry*, **10**, Article No. 319. https://doi.org/10.1038/s41398-020-01006-x

[22] Wu, F., Lin, W., Liu, P., Zhang, M., Huang, S., Chen, C., *et al.* (2021) Prevalence and Contributory Factors of Anxiety and Depression among Pregnant Women in the Post-Pandemic Era of COVID-19 in Shenzhen, China. *Journal of Affective Disorders*, **291**, 243-251. https://doi.org/10.1016/j.jad.2021.05.014

[23] Wu, F., Zhou, L., Chen, C., Lin, W., Liu, P., Huang, W., *et al.* (2022) Association between Intimate Partner Violence and Prenatal Anxiety and Depression in Pregnant Women: A Cross-Sectional Survey during the COVID-19 Epidemic in Shenzhen, China. *BMJ Open*, **12**, e055333. https://doi.org/10.1136/bmjopen-2021-055333

[24] Luong, T.C., Pham, T.T., Nguyen, M.H., Do, A.Q., Pham, L.V., Nguyen, H.C., *et al.* (2021) Fear, Anxiety and Depression among Pregnant Women during COVID-19 Pandemic: Impacts of Healthy Eating Behaviour and Health Literacy. *Annals of Medicine*, **53**, 2120-2131. https://doi.org/10.1080/07853890.2021.2001044

[25] Fan, H.S.L., Choi, E.P.H., Ko, R.W.T., Kwok, J.Y.Y., Wong, J.Y.H., Fong, D.Y.T., *et al.* (2022) COVID-19 Related Fear and Depression in Pregnant Women and New Mothers. *Public Health Nursing*, **39**, 562-571. https://doi.org/10.1111/phn.13035

[26] de Pádua Borges, R., de Azevedo Jacob Reichelt, A., de Brito, A., Molino, G.O.G. and Schaan, B.D. (2021) Impact of the COVID-19 Pandemic on Mental Health of Pregnant Women with Diabetes Mellitus and Hypertension. *Revista da Associacao Médica Brasileira*, **67**, 1268-1273. https://doi.org/10.1590/1806-9282.20210504

[27] Shorey, S.Y., Ng, E.D. and Chee, C.Y. (2021) Anxiety and Depressive Symptoms in Perinatal Women during the COVID-19 Pandemic: A Systematic Review and Meta-Analysis. *Scandinavian Journal of Public Health*, **49**, 730-740. https://doi.org/10.1177/14034948211011793

[28] Gildner, T.E., Laugier, E.J. and Thayer Z.M. (2020) Exercise Routine Change Is Associated with Prenatal Depression Scores during the COVID-19 Pandemic among Pregnant Women across the United States. *PLOS ONE*, **15**, e0243188. https://doi.org/10.1371/journal.pone.0243188

[29] Sut, H.K. and Kucukkaya, B. (2021) Anxiety, Depression, and Related Factors in Pregnant Women during the COVID-19 Pandemic in Turkey: A Web-Based Cross-Sectional Study. *Perspectives in Psychiatric Care*, **57**, 860-868. https://doi.org/10.1111/ppc.12627

[30] Lebel, C., MacKinnon, A, Bagshawe, M., Tomfohr-Madsen, L. and Giesbrecht, G. (2020) Elevated Depression and Anxiety Symptoms among Pregnant Individuals during the COVID-19 Pandemic. *Journal of Affective Disorders*, **277**, 5-13. https://doi.org/10.1016/j.jad.2020.07.126

[31] Stampini, V., Monzani, A., Caristia, S., Ferrante, G., Gerbino Pedrini, A., *et al.* (2021) The Perceptions of Italian Pregnant Women and New Mothers about Their Psychological Well-Being, Lifestyle, Delivery, and Neonatal Management Experience during the COVID-19 Pandemic Lockdown: A Web-Based Survey. *BMC Pregnancy and Childbirth*, **21**, Article No. 473. https://doi.org/10.1186/s12884-021-03904-4

[32] Hu, W.S., Lu, S., Xu, M.Y., Zhou, M.C., Yuan, Z.M. and Deng, Y.Y. (2021) Beha-

vioural Responses of Pregnant Women to the Early Stage of COVID-19 Pandemic in the Network Era in China: Online Questionnaire Study. *Asian Nursing Research*, **15**, 215-221. https://doi.org/10.1016/j.anr.2021.06.003

[33] Berthelot, N., Lemieux, R., Garon-Bissonnette, J., Drouin-Maziade, C., Martel, É. and Maziade, M. (2020) Uptrend in Distress and Psychiatric Symptomatology in Pregnant Women during the Coronavirus Disease 2019 Pandemic. *Acta Obstetrica et Gynaecologica Scandinavica*, **99**, 848-855. https://doi.org/10.1111/aogs.13925

[34] Lequertier, B., McLean, M.A., Kildea, S., King, S., Keedle, H., Gao, Y., *et al.* (2022) Perinatal Depression in Australian Women during the COVID-19 Pandemic: The Birth in the Time of COVID-19 (BITTOC) Study. *International Journal of Environmental Research and Public Health*, **19**, Article 5062. https://doi.org/10.3390/ijerph19095062

[35] Lubian Lopez, D.M., Butrón Hinojo, C.A., Arjona Bernal, J.E., Fasero Laiz, M., Alcolea Santiago, J., Guerra Vilches, V., *et al.* (2021) Resilience and Psychological Distress in Pregnant Women during Quarantine due to the COVID-19 Outbreak in Spain: A Multicentre Cross-Sectional Online Survey. *Journal of Psychosomatic Obstetrics and Gynaecology*, **42**, 115-122. https://doi.org/10.1080/0167482X.2021.1896491

[36] Aba, Y.A., Dulger, O., Sik, B.A. and Ozolcay, O. (2022) Levels and Predictors of Anxiety and Depression in Turkish Pregnant Woman during the COVID-19 Pandemic. *Revista Brasileira de Ginecologia e Obstetrícia*, **44**, 100-108. https://doi.org/10.1055/s-0041-1741033

[37] Brik, M., Sandonis, M.A., Fernández, S., Suy, A, Parramon-Puig, G., Maiz, N., Dip, M.E., *et al.* (2021) Psychological Impact and Social Support in Pregnant Women during Lockdown due to SARS-CoV2 Pandemic: A Cohort Study. *Acta Obstetricia et Gynecologica Scandinavica*, **100**, 1026-1033. https://doi.org/10.1111/aogs.14073

[38] Biaggi, A., Conroy, S., Pawlby, S. and Pariante, C.M. (2016) Identifying the Women at Risk of Antenatal Anxiety and Depression: A Systematic Review. *Journal of Affective Disorders*, **191**, 62-77. https://doi.org/10.1016/j.jad.2015.11.014