

COVID-19 범유행 시 임신부의 스트레스 측정도구 개발

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Development of a Stress Assessment Scale for Pregnant Women During COVID-19 Pandemic

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[요 약]

본 연구의 목적은 COVID-19와 같은 감염병 범유행 시 조산과 같은 임신의 부정적인 결과를 예방하기 위한 스트레스 관리가 필요한 임신부를 선별할 수 있는 도구를 개발하기 위함이다. 도구의 예비문항은 임신부의 스트레스와 관련된 문헌고찰과 임신부를 대상으로 한 심층면담을 통해 구성된 개념적 기틀을 바탕으로 40개의 문항을 작성하였다. 이후 전문가 내용타당도 검증과 예비조사를 통하여 28개 문항의 예비도구가 만들어졌다. 연구대상자는 2021년부터 2022년도의 COVID-19 감염병 팬데믹 상황에서 출산 경험이 있는 여성이다. 자료수집은 2023년 11월 1일부터 2023년 11월 6일까지 진행하였다. 자료분석에는 문항분석, 탐색적 요인분석, Pearson 상관계수, Cronbach's alpha 값, 반분검사 신뢰도로 검증하였다. 최종적으로 산전관리 스트레스 5개 문항, 불확실성 스트레스 3개 문항, 사회적 제한 스트레스 3개 문항, 관계성 스트레스 2개 문항, 감염관리 스트레스 2개 문항으로 총 15개 문항, 5개 요인으로 구성된 도구가 개발되었다.

[Abstract]

This aims to develop an assessment scale for screening pregnant women who require stress management to prevent negative pregnancy outcomes, such as premature birth, during pandemics caused by infectious diseases, an example of which would be COVID-19. The scale initially consisted of 40 questionnaires based on a conceptual framework developed through a literature review on stress in pregnant women and through in-depth interviews with pregnant women. After content validation by experts and a pilot survey, a preliminary 28-item scale was developed. The study population is women who gave birth during the COVID-19 pandemic in 2021 and 2022. Data collection was conducted from November 1, 2023 to November 6, 2023. The data were analyzed using item analysis, exploratory factor analysis, Pearson correlation coefficient, Cronbach's alpha value, and half-test reliability. Finally, a tool consisting of 15 items and 5 factors was developed, including 5 items of prenatal care stress, 3 items of uncertainty stress, 3 items of social restriction stress, 2 items of relational stress, and 2 items of infection control stress.

색인어 : COVID-19, 임신부, 범유행, 스트레스, 도구개발**Keyword** : COVID-19, Pregnant Women, Pandemic, Stress, Scale Development<http://dx.doi.org/10.9728/dcs.2024.25.5.1233>

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I. Introduction

1-1 Background

COVID-19 has drastically changed the daily lives of pregnant women worldwide[1]. Pregnancy is a time of physiological and immunological changes that can increase vulnerability to specific infectious diseases, and viruses can affect both the mother and the fetus[2]. Influenza A has been reported as exhibiting a case fatality rate of 8% and a preterm birth rate of 30% in pregnant women[3], while SARS and MERS have been reported to show case fatality rates of 25.8% and 28.6%, respectively, in pregnant women[4]. COVID-19, caused by the SARS-CoV-2 virus, is associated with fetal asphyxia, pre-eclampsia, preterm birth, gestational diabetes, and low birth weight[4]-[7]. Thus, viral disease during pregnancy leads to severe risks for both the mother and the developing fetus, and can increase levels of stress and psychological distress[8].

Generally, prenatal stress affects the mental health of the mother, and inappropriate management of stress has been reported to lead to obstetric complications such as preterm birth, low birth weight, developmental delays, and congenital defects[9],[10]. Pregnant women with especially high stress levels are at high risk of spontaneous abortion or preterm birth[11]. The most frequent obstetric complication of COVID-19 is preterm birth, which is reported to occur in 41.1% of cases[4]. Pregnant women suffered severe stress during the COVID-19 pandemic[12]; in particular, infectious disease-related fear and uncertainty increase the level of stress in pregnant women, potentially leading to anxiety, depression, or other mental health problems[13]-[17]. Studies comparing pre- and post-pandemic periods also found that women who conceived during the pandemic exhibited higher levels of stress than those who conceived before the pandemic[18].

The World Health Organization (WHO) announced the end to COVID-19 as a global health emergency in May 2023[19]. Between 2009 and the present day, the WHO has declared a total of six global health emergencies, among which novel influenza and COVID-19 were upgraded to pandemic[20]. Experts are predicting that there will be regular outbreaks of life-threatening infectious diseases, and that the

intervals between infectious disease pandemic will decrease to less than 3 years[21].

This means that it will be essential to provide interventions to reduce or prevent stress in pregnant women in the event of an infectious disease pandemic. There is a need to provide continuous interventional management of stress to maintain a healthy pregnancy, prevent preterm birth, and ensure a safe delivery. We need to stop treating stress in pregnant women as their own problem, and to identify and eradicate sources of stress within the environment and family systems[10]. The PREPS (Pandemic-related Pregnancy Stress Scale) developed by Peris et al. has been useful as a measure of stress in pregnant women during the COVID-19 pandemic[1]. However, since it was developed in the early stages of the infectious disease before the pandemic was declared, it is difficult to say that it included all the stress during the pandemic. In addition, the Korean version of the Pandemic-related Pregnancy Stress tool (K_PREPS), verified by Kim & Heo in 2023, is considered limited for measuring pandemic-related stress in pregnant women due to its concise and limited items[22]. Therefore, To this end, it will be crucial to develop instruments that approach stress factors affecting pregnant women with a biopsychosocial integrative approach in order to measure stress and target interventions at the high-risk group.

1-2 Purpose

The purpose of this study was to develop a scale with high reliability and validity to integratively identify levels of physical, psychological, and social stress in pregnant women during the COVID-19 pandemic. More specifically, the study's goals were as follows:

- 1) To develop a scale to integratively measure physical, psychological, and social stress in pregnant women.
- 2) To test the validity of the scale.
- 3) To test the reliability of the scale.

II. Method

2-1 Study Design

This was a methodological study seeking to develop

a scale to identify stress risk factors in pregnant women during the COVID-19 pandemic, and to test the validity and reliability of the said scale.

2-2 Procedure

1) Selecting Preliminary Items

Based on the biopsychosocial model of Engel[23], we reviewed the Korean and international literature on stress in pregnant women, prepared a conceptual framework through in-depth interviews, and subsequently selected 40 preliminary items based on consideration of those item suitability, relevance, and readability.

A literature review integrated analysis was conducted on 13 papers selected through a search engine and peer review process from publications released between 2020 and April 2023, focusing on pregnant women in the context of the COVID-19 situation. Additionally, In-depth interviews were conducted with 12 pregnant women during the COVID-19 pandemic. Each person was interviewed 1-2 times for an average of 30-60 minutes. The research question was "What are the experiences of pregnant women during the COVID-19 pandemic?" Data analysis was conducted using the Colaizzi (1978) analysis method, and the data were analyzed using the Taguette program.

2) Expert Content Validation

Expert content validation methods were used to assess the appropriateness of the content of the preliminary questions and to determine the scale of the questions. When it comes to content validation of a scale's factors and items, it has been suggested that at least three, and no more than 10, experts is the preferred number[24]. On this basis, for our study, we constructed a panel of seven experts, consisting of two board-certified obstetricians, four nursing professors, and one obstetrics nurse with over 20 years' clinical experience. We calculated the content validity index (CVI) and asked the expert panel to evaluate and record the ambiguity, precision, and conciseness of each question. Items with a CVI value of 0.8 or higher were evaluated as having good content validity, and 6 items with a CVI value of less than 0.8 were removed, and a total of 34 items were selected after sufficient discussion and consensus with experts. The instrument consisted of a 5-point Likert scale and

the measurement method was self-report, where the questionnaire was read and marked by the subject.

3) Pilot Survey

A pilot survey was conducted over one week from October 16th to 20th, 2023, via convenience sampling of 30 women who visited one of two obstetrics departments in C-City for prenatal examinations, and who had given birth during the COVID-19 pandemic between 2021 and 2022. We evaluated the readability of the selected questionnaire and whether the language was suitable for the participants. Comprehension of the questionnaire was rated on a 4-point Likert scale, with possible scores in the range of 34 to 136 points, and higher scores indicating better comprehension. The mean score for comprehension of the preliminary questionnaire was high, at 134.94 ± 1.04 points. We also investigated whether there were any questionnaire that were difficult to understand or respond to, and these questionnaire were edited. Based on the results of the pilot survey, six questionnaire were removed, and a preliminary scale comprising 28 questionnaire was developed.

4) Reliability and Validity Testing

The study population is women who gave birth during the COVID-19 pandemic in 2021 and 2022. Data was collected between November 1st and 6th, 2023. With regard to the ideal number of participants, a sample of around 300 persons has been suggested as suitable[25],[26] and so, to account for dropout, the scale was administered to 350 persons. Finally, after excluding 20 inappropriate responses, the remaining 330 responses were analyzed.

2-3 Data Analysis

The SPSS Statistics 22 Program was used for data analysis. Frequencies and percentages were calculated for participants' general characteristics, obstetric characteristics, and COVID-19-related characteristics. Exploratory factors analysis was used to test the scale's construct validity. Item analysis was performed before factor analysis. The mean and standard deviation of each Item and the skewness and kurtosis were analyzed to test the Item bias. Items were considered appropriate if the absolute value of skewness was not greater than ± 2 and the absolute

value of kurtosis was not greater than ± 7 . We also calculated the item-item correlation, item-total correlation, and item-item correlation of all remaining items after deleting the item, and removed items with a correlation of less than .30 based on a correlation of .30. After item analysis, Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity were used to check whether the selected items were suitable for factor analysis. Factor extraction was performed by principal axis factor extraction method, and factor rotation was performed using Promax. The number of factors was determined by selecting items with an eigen value of 1 or more and a factor loadings of .5 or more, and factors were named based on the value of the factor loadings. The Korean version of the Pandemic-Related Pregnancy Stress Assessment Tool (K_PREPS)[22] was used as the instrument used for validity, and Pearson's correlation was analyzed to determine whether the newly developed instrument and K_PREPS showed a high correlation. The effect of stress on pregnancy outcome was compared between groups using t-test. The reliability of the tool was tested using Cronbach's alpha, the internal consistency coefficient, and split-reliability.

2-4 Ethical Considerations

Before starting the study, it was approved by the institution review board (IRB) of B-University in C-City (No: BUIRB-202308-HR-022).

Before administering the questionnaire, participants were provided with an explanation and consent form online, and the questionnaire was only administered after obtaining consent based on an understanding of the study purpose.

III. Results

3-1 The Participants' General Characteristics, Obstetric Characteristics, and COVID-19-Related Characteristics

The participants' mean age was 35.28 years, and the most common age group was 30-39 years (80.3%). In terms of employment status, 52.4% were employed, while 47.6% were full-time homemakers, and the most common educational status was university graduation (79.4%). Pregnancy or postnatal complications were

reported by 56.4% of participants, while 15.8% of participants experienced preterm labor (10.3%) or premature rupture of membranes (5.5%), and 14.5% experienced preterm birth. The percentage of participants who underwent COVID-19 vaccination during pregnancy was 14.5%, while the percentage infected with COVID-19 during pregnancy was 25.5%, and the percentage self-quarantined for COVID-19 was 22.1% (Table 4).

3-2 Item Analysis

As a basic step for question analysis in this study, to test the amount of bias for each question, the mean, standard deviation, skewness, and kurtosis were examined. If the absolute value of skewness was not greater than ± 2 and the absolute value of kurtosis was not greater than ± 7 , the items were considered appropriate. Item analysis was performed by calculating the item-total score correlation coefficient, and items with a coefficient of .3 or higher were considered appropriate[27]. A total of 28 items were analyzed, and all met the criteria.

3-3 Construct Validity

1) Exploratory Factor Analysis

When KMO and Bartlett's test of sphericity were analyzed, KMO was .90 and Bartlett's $\chi^2=4921.5$ (df=378), showing that the data was suitable for factor analysis with a significance level of $p<.001$ (Table 1).

Table 1. KMO and Bartlett's test

(N=330)		
Kaiser-Meyer-Olkin Measure	.859	
Bartlett's Test	Chi-Square	3415.191
	df	136
	p	<.001

Principal axis factoring and promax rotation were used. Factors with an eigenvalue ≥ 1 , and items with factor loading $\geq .5$ were selected. As regards the 28 items, the analysis was repeated after omitting those with a communality of $<.5$ in factor analysis (item 1, 4, 6, 7, 10, 11, 12, 15, 16, 19, and 28) (Table 5).

When the analysis was repeated using the remaining 17 items, item 13 and 14 showed a factor loading $<.5$; after removing these items, there were a total of 15 item and five factors.

Factor 1 showed an eigenvalue of 7.04 and explained variance of 41.4%, while Factor 2 showed an eigenvalue of 1.78 and explained variance of 10.5%, and Factor 3 showed an eigenvalue of 1.43, and explained variance of 8.4%; Factor 4 exhibited an eigenvalue of 1.15 and explained variance of 6.8%, and Factor 5 showed an eigenvalue of 1.02 and explained variance of 6.0%, meaning that the total explained variance of the five factors was 73.1% (Table 6).

Factor 1 consisted of five items on stress due to antenatal management during the COVID-19 pandemic. The factor's name was "stress due to antenatal management." Factor 2 consisted of three items related to uncertainty and anxiety about the possibility of becoming infected with COVID-19, whether the number of infections would increase, and how much longer the outbreak would last. The factor's name was "stress due to uncertainty." Factor 3 consisted of three items on stress related to isolation, and restrictions on social gatherings and daily living. The factor's name was "stress due to social restrictions." Factor 4 consisted of two items on stress received from people in one's surrounding environment. This factor was termed "stress due to relationships." Factor 5 consisted of two items on stress related to COVID-19 infection control and quarantine measures. This factor was named "stress due to infection control."

2) Criterion Validity

For criterion validity, we examined the correlation with K-PREPS. The total scores for each scale showed a significant correlation ($r=.595$, $p<.001$), but when we analyzed the correlations by factor, Factor 5 exhibited no correlation (Table 2).

Table 2. Correlation between somatopsychological risk and K_PREPS

(N=330)			
	Preparation stress	Perinatal infection stress	Stress
Factor 1	.48**	.61**	.59**
Factor 2	.53**	.64**	.63**
Factor 3	.42**	.41**	.46**
Factor 4	.14**	.27**	.22**
Factor 5	.10	.11	.11*
Total items	.50**	.60**	.60**

** Correlation is significant at the .01 level

* Correlation is significant at the .05 level

3) Group Comparisons

We used a t-test to analyze the differences between

the preterm birth and full-term birth groups. We found that stress was significantly higher in the preterm birth group ($t=2.28$, $p=.023$) (Table 3).

Table 3. Differences in stress depending on pregnancy outcome

(N=330)			
Characteristics	Categories	Stress	
		M (SD)	t (p)
Preterm birth	Yes	57.83 (11.25)	2.28 (.023)
	No	54.16 (10.16)	

4) Reliability Testing

When we tested reliability to analyze the internal consistency of the scale, Cronbach's alpha was .896. The Cronbach's alpha value for each factor was .884 for factor 1, .852 for factor 2, .863 for factor 3, .937 for factor 4, and .712 for factor 5. The 15 questions were divided into even and odd numbers, the Pearson correlation coefficient between the questions was calculated, and the reliability of the split-half test was tested using the Spearman-Brown formula. As a result, the reliability was confirmed to be .912 ($p<.001$).

IV. Discussion

Stress during pregnancy has negative effects on the health of the mother[16]-[18]. In particular, novel viruses such as COVID-19 have more negative effects on pregnancy outcomes[4]. The purpose of this study was to develop a scale that could measure physical, psychological, and social stress levels in pregnant women during an infectious disease outbreak such as COVID-19.

We analyzed the construct validity and criterion validity of the stress measurement scale for pregnant women developed in this study using factor analysis. In terms of construct validity, all questionnaire showed a factor loading with their related factor of $\geq .5$, and with other factors of $< .3$. The cumulative variance explained for stress was 73.1%, showing strong explanatory power.

To test criterion validity, we analyzed the correlation with K-PREPS. We found that the total scores of the two scales exhibited a statistically significant correlation ($r=.595$, $p<.001$), but in the analysis by factor, Factor 5 did not show any correlation. When we tested internal

consistency, we found that Cronbach’s alpha was .896. For the scale developed in this study, we identified five factors consisting of 15 items. The individual factors were named “stress due to antenatal management,” “stress due to uncertainty,” “stress due to social restrictions,” “stress due to relationships,” and “stress due to infection control.”

The existing Pandemic-related Pregnancy Stress Scale (PREPS) contains 15 items divided into three factors: perinatal infection stress, preparedness stress, and positive appraisal[1]. The PREPS has been validated and is being used in the US, Europe, and several countries across Asia.

However, the scale was developed in the early stages of the outbreak, before the declaration of a global pandemic, and so it may not be representative of the stress experienced during the whole pandemic[26]. In 2023, Kim and Heo adapted PREPS into a Korean version (K-PREPS). Compared to the original PREPS, K-PREPS consists of seven items and two factors, with the positive appraisal factor having been removed[22]. The categories in this scale are thought to be too small and simple to measure pandemic-related stress in pregnant women. By comparison, the scale developed in our study included factors not only for infection-related stress and antenatal stress, but also

Table 4. General characteristics, obstetric characteristics and infectious disease-related matters of participants

(N=330)

Characteristics	Categories	N	%
Age (year)	20~29	20	6.1
	30~39	265	80.3
	≥40	45	13.6
Housewife	House wife	157	47.6
	Office worker	125	37.9
	Service worker	17	5.2
	Production worker	4	1.2
	Office Health care provider	18	5.5
	Others	9	2.7
	<200	5	1.5
Monthly income (ten thousand won)	200~299	36	10.9
	300~399	76	23.0
	400~499	76	23.0
	≥500	137	41.5
	Middle School	4	1.2
Education status	High school	29	8.8
	University	262	79.4
	>University	35	10.6
	Christian	71	21.5
Religion	Catholic	31	9.4
	Buddhism	21	6.4
	None	206	62.4
	Others	1	0.3
	Complications during pregnancy	Preterm labor	34
Premature rupture of membranes		18	5.5
Bleeding during pregnancy		16	4.8
Incompetent internal os of cervix		9	2.7
Gestational diabetes mellitus		35	10.6
Intrauterine growth retardation		3	0.9
Pregnancy induce hypertension		19	5.8
Complications during postpartum period	Postpartum depression	52	15.8
Complications during pregnancy or in the postpartum period	None	144	43.6
	~27 ⁺⁶ wks	3	0.9
	28 ⁺⁰ ~36 ⁺⁶ wks	45	13.6
	37 ⁺⁰ wks~	282	85.5
Vaccination during pregnancy	No	282	85.5
	Yes	48	14.5
COVID-19 infection during pregnancy	No	246	74.5
	Yes	84	25.5
Self-quarantine due to COVID-19	No	257	77.9
	Yes	73	22.1

for stress due to uncertainty, stress due to social restrictions, and stress due to relationships. This shows that anxiety regarding infection, depression, and fear presented as stress due to uncertainty about information, and that excessive interest and worrying from family members and other acquaintances also acted as a source of stress. Moreover, social restrictions and infection control due to stronger quarantine measures were found to be an additional stressor.

Below, we consider each factor in more detail. Factor 1 consisted of items relating to “stress due to antenatal management,” demonstrating that the participants had concerns about antenatal management, including “worrying that antenatal management might not be consistent, worrying that they might not be able to receive antenatal care, and worrying about the lack of antenatal management guidelines.” Moreover, the question regarding “the lack of routes of communication relating to antenatal management during the pandemic”

shows that there were very insufficient and limited routes of communication available. The increased stress experienced by pregnant women during the pandemic is also related to changes in quarantine guidelines during the pandemic, causing discomfort due to antenatal care appointments to be cancelled or rescheduled, a shortage of antenatal education, and restrictions on partners’ involvement in antenatal management[12], [28],[29]. In the existing PREPS instrument, items related to antenatal stress included birth-related stresses, such as worrying about being separated from their child after delivery or that their partner would not be able to be present, as well as worrying about not being able to receive antenatal care[1]. This is somewhat consistent with the items on antenatal management-related stress in our study. Providing good quality antenatal care during the COVID-19 pandemic was extremely important for the happiness of both the mother and the fetus[28]. In the future, in the event of a novel infectious disease outbreak such as the

Table 5. Communalities

		(N=330)
NO	Item Contents	Communalities
1*	Breathing feels uncomfortable when wearing a mask for long periods of time during the COVID-19 pandemic.	.38
2	I am tired of performing disinfection and infection control measures related to the COVID-19 pandemic.	.69
3	I feel discomfort from following government quarantine rules related to the COVID-19 pandemic.	.54
4*	I feel more depressed during the COVID-19 pandemic.	.34
5	I am anxious about becoming infected with COVID-19.	.57
6*	I am anxious that I won't be able to receive antenatal education during the COVID-19 pandemic.	.48
7*	I am anxious because I became pregnant during the COVID-19 pandemic.	.45
8	I am anxious that the number of infected people will increase during the COVID-19 pandemic.	.75
9	I am anxious that the COVID-19 pandemic will go on for longer.	.69
10*	I am strict about following quarantine rules related to the COVID-19 pandemic.	.35
11*	I am worried about the health of the fetus during the COVID-19 pandemic.	.46
12*	I feel a sense of burden about my role within the family during the COVID-19 pandemic.	.42
13	I feel uncertainty about the safety of vaccinations related to the COVID-19 pandemic.	.59
14	I feel confusion about unconfirmed information relating to the COVID-19 pandemic.	.65
15*	It is difficult making efforts to obtain information relating to the COVID-19 pandemic.	.41
16*	I am worried that I or my husband might lose our jobs during the COVID-19 pandemic.	.28
17	I feel a sense of burden due to family worrying about my pregnancy during the COVID-19 pandemic.	.89
18	I feel a sense of burden about people in my surrounding worrying about my pregnancy during the COVID-19 pandemic.	.86
19*	I feel a sense of burden about childcare if I have to quarantine during the COVID-19 pandemic.	.39
20	I am worried about visiting the hospital for antenatal care during the COVID-19 pandemic.	.63
21	I am worried that antenatal care might not be consistent during the COVID-19 pandemic.	.64
22	I am worried at the lack of guidelines for antenatal care during the COVID-19 pandemic.	.73
23	I feel that there are insufficient routes of communication about antenatal management during the COVID-19 pandemic.	.67
24	I am worried that someone will be unable to accompany me for antenatal care during the COVID-19 pandemic.	.57
25	I am worried that I could be isolated in my house if I become infected with COVID-19.	.61
26	I am worried that social gatherings might be restricted during the COVID-19 pandemic.	.77
27	I am worried that daily living might be restricted during the COVID-19 pandemic.	.78
28*	I feel that there is a shortage of government support during the COVID-19 pandemic.	.26

*analysis was repeated

COVID-19 pandemic, since there is a tendency for quarantine and control guidelines to be strengthened, and for government quarantine guidelines to continually change depending on the situation, there is a very high risk of antenatal management-related stress in pregnant women. As such, it will be necessary to make efforts to improve the quality of antenatal management and education programs, and to reinforce antenatal management support systems at the national policy level, in order to guarantee healthy pregnancy and childbirth even in a pandemic.

Factor 2 was “stress due to uncertainty.” This included negative emotions such as anxiety, depression, and fear due to inaccurate information during the COVID-19 pandemic[14],[28],[29],[31]. The PREPS did not have a separate category for

stress due to uncertainty, and negative emotions were included in items about infection-related stress and preparedness stress[1]. When we consider the cause of negative emotions, our study showed that they are related to uncertainty. Thus, during a pandemic, lack of infection-related knowledge, and the spread of unconfirmed COVID-19-related information and social media, can be identified as factors causing psychological instability in pregnant women[31]. Psychological instability is a negative emotional response, and anxiety, depression, fear, and worrying act as stress factors in pregnant women[14],[16]-[18],[28]-[30],[32]. Therefore, in order to provide interventions to combat the psychological instability experienced by pregnant women during the pandemic, we believe it will be necessary to develop

Table 6. Factor analysis

(N=330)							
NO	Item contents	Factor					Communalities
		1	2	3	4	5	
13*	I feel uncertainty about the safety of vaccines related to the COVID-19 pandemic. (deleted)	.25	.28	.01	-.05	.13	.27
14*	I feel confusion about unconfirmed information relating to the COVID-19 pandemic. (deleted)	.34	.35	-.01	-.03	.10	.41
20	I am worried about visiting the hospital for prenatal care during the COVID-19 pandemic.	.58	.19	.01	.07	-.02	.55
21	I am worried that prenatal care might not be consistent during the COVID-19 pandemic.	.70	.10	.03	.07	-.10	.62
22	I am worried at the lack of guidelines for prenatal care during the COVID-19 pandemic.	.95	-.07	-.08	.00	.00	.75
23	I feel that there are insufficient routes of communication about prenatal care management during the COVID-19 pandemic.	.92	-.15	-.02	-.01	.01	.69
24	I'm worried about not being able to get prenatal care with someone during the COVID-19 pandemic.	.55	.09	.20	-.05	.00	.54
5	I am anxious about getting infected with COVID-19 pandemic.	.09	.69	-.09	-.03	.02	.48
8	I am anxious that the number of infected people will increase during the COVID-19 pandemic.	-.05	.93	-.03	.05	-.07	.78
9	I am anxious that the COVID-19 pandemic will go on for longer.	-.11	.89	.06	-.01	-.00	.74
25	I am worried that I could be isolated in my house if I become infected with COVID-19.	.16	.21	.53	-.08	-.02	.57
26	I am worried that social gatherings might be restricted during the COVID-19 pandemic.	-.03	-.12	.99	.02	-.00	.83
27	I am worried that daily living might be restricted during the COVID-19 pandemic.	-.03	.04	.86	.03	.02	.78
17	I feel a sense of burden due to family worrying about my pregnancy during the COVID-19 pandemic.	.04	-.02	-.00	.93	.02	.91
18	I feel a sense of burden due to people in my surroundings worrying about my pregnancy during the COVID-19 pandemic.	-.00	.01	.02	.91	.01	.85
2	I am tired of performing disinfection and infection control measures related to the COVID-19 pandemic.	-.08	.17	-.01	.03	.67	.50
3	I am discomfort from following government quarantine rules related to the COVID-19 pandemic.	.04	-.13	.01	-.00	.82	.65
	Eigen values	7.04	1.78	1.43	1.15	1.02	
	Explained variance (%)	41.4	10.5	8.4	6.8	6.0	
	Cumulative variance (%)	41.4	51.9	60.3	67.1	73.1	

* Items 13 and 14 were finally deleted

strategies for coping with uncertainty. In order to cope with uncertainty during an event such as the COVID-19 pandemic, the most important factor is the provision of reliable information via healthcare service providers, public health institutions, and healthcare-related websites. In addition, it is essential to always keep pregnancy- and COVID-19-related guidelines for pregnant women up to date.

Factor 3 was social stress. During a pandemic, pregnant women experience stress due to social restrictions and changes in their social support systems[14],[28],[29],[31]. As a result of strengthened quarantine rules, daily living and social gatherings are restricted. In addition, confirmed patients are isolated at home, leading to controlled daily lives. These strong social restrictions lead to changes in existing social support systems[28]. The PREPS did not include items on stress due to social restrictions[1]. This difference appears to be due to the time of development of the PREPS, as well as cultural differences. With the spread of infectious disease, as well as increasing levels of control, South Korea implemented a “vaccine pass” system, leading to stronger social restrictions, which are thought to have acted as an even greater stressor for pregnant women, who are vulnerable to infection. Managing stress due to these social restrictions is crucial for the happiness of the mother and the optimal development of the fetus. Since public health guidelines are continually changing during a pandemic, it is essential to develop graded programs that can help manage psychological stress due to social restrictions.

Factor 4 was stress due to relationships. Worrying by family and other acquaintances caused a sense of burden in pregnant women. Other studies have also reported that excessive worrying by family and acquaintances was a source of burden that caused stress in pregnant women during the COVID-19 pandemic[29]. Conversely, however, the PREPS does not include items related to this theme[1], suggesting that the aforementioned is the outcome of cultural differences and different social perspectives of pregnant women. Pregnancy is a major event affecting the whole family, and so interest and worrying about the mother are natural phenomena, even when there is no pandemic. In the unique circumstances of a pandemic, people are even more concerned about the mother due to uncertainty regarding maternal infection and the health of the fetus, but the expression of these

worries acts as a major source of burden for pregnant women[12],[29]. As such, it will be important to provide education about coping methods for the family of pregnant women.

Factor 5 was stress due to infection control, and consisted of items regarding pregnant women experiencing discomfort due to pandemic-related quarantine rules, and fatigue due to implementing disinfection and infection control practices. Although existing scales included infection-related stress, there was no separate category for stress due to infection control. Due to governmental infection control guidelines, the participants at the time of this study experienced fatigue related to adhering to the recommended guidelines, such as wearing masks, washing hands, and maintaining physical distance. By choosing specific strategies that prioritize the physical and mental well-being of everyone, it may be possible to reduce stress in pregnant women due to infection control during pandemic such as COVID-19.

Pregnant women’s stress during the COVID-19 pandemic had an effect on preterm birth[4]. To see whether we could also observe this effect, we separated participants into a preterm birth group and a full-term birth group and analyzed differences between the groups. We found that stress was significantly higher in the preterm birth group ($t=2.28$, $p=.023$). This clearly demonstrates the importance of stress management for pregnant women to prevent preterm births during an infectious disease pandemic. Considering the possibility that antenatal management may be neglected due to fear of infection and quarantine rules[12],[28],[29], it will be important to develop antenatal management and remote education programs via remote support.

The significance of this study lies in its ability to comprehensively measure the stress experienced by pregnant women in comparison to the PREPS tool developed in the early stages of infectious diseases. Furthermore, it addresses the limitations of the Korean version of PREPS by providing a tool that can measure the psychological, social, and physical stress experienced by pregnant women, thereby preparing for future pandemic or other forms of crises.

However, there were limitations in recruiting participants for the development of the measurement tool at the point when the COVID-19 pandemic had ended, as the sample consisted of pregnant women who

were pregnant during the pandemic. It should be noted that generalizing the findings to all pregnant women in Korea is restricted as the participants were recruited from a subset of the pregnant population in Korea.

V. Conclusion and Recommendations

The scale developed in this study can be used to measure physical, psychological, and social stress levels in pregnant women during the COVID-19 pandemic. We anticipate that this scale could be useful for stress management in pregnant women, who are a vulnerable group, in the event of another novel infectious disease outbreak.

Based on our findings, we make the following proposals for follow-up research to improve the level of stress management for pregnant women in the face of novel infectious diseases, such as the COVID-19 pandemic. First, it will be important to study the development of an application to allow pregnant women to easily measure their own stress levels during a novel infectious disease outbreak. Second, it will be important to perform replication studies developing instruments that can measure stress in pregnant women by investigating stress levels and characteristics depending on the form of public health response to novel infectious diseases. Third, there is a need to conduct research to construct integrative support systems for pregnant women during a novel infectious disease outbreak, and to develop programs to help pregnant women cope with stress. Lastly, this study is a survey of data based on current memories of past experiences, and temporal differences and distortions of memory may affect the research results. Therefore, in the event of an infectious disease such as COVID-19, the tool developed in this study can be repeated in the future. Research is needed.

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