

Original Paper

# Pregnancy-related Discomfort and Stress Levels in Pregnant Women

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(Accepted May 27, 2022)

Key words: pregnancy-related discomfort, stress level, pregnant women

## Abstract

This study aimed to determine pregnancy-related discomforts, and stress levels and their determinants in the second and third trimesters of pregnancy. We surveyed pregnant women at two maternity hospitals using self-reported questionnaires, including the Pregnancy-related Discomfort Scale (PDS). Analysis of 142 responses showed that the item median score on the PDS subscales was highest for "Arthrokinetic" symptoms. "Tiredness" and "frequent urination" were common in both trimesters. A Mann-Whitney U test showed significant differences in "breast tension" and "leg cramp" ( $p=0.023$ ,  $0.020$ , respectively) between trimesters. The mean stress level was  $4.85 \pm 2.40$  (Mean  $\pm$  SD). The most common stressor was "home environment" (22.1%) followed by "raising and educating children" (20.0%), "own health" (15.7%), and "household finances" (15.0%). The most common stress relief strategy was "shopping" (33.8%), followed by "chatting with friends" (31.0%), and "sleeping" (19.7%). Multiple regression analysis indicated that the PDS score ( $\beta=0.495$ ,  $p<0.001$ ) was a promoter of stress and the Prenatal Comfort Scale score ( $\beta=-0.210$ ,  $p=0.007$ ) was a reducer. With the PDS subscales as independent variables, only "General neuropsychiatric symptoms" ( $\beta=0.476$ ,  $p<0.001$ ) was a significant promoter of stress. We recommend providing emotional support to reduce stress during antenatal checkups, which allow for face-to-face communication between perinatal healthcare professionals and pregnant women.

## 1. Introduction

Pregnancy and childbirth are times of fulfillment and joy in the birth of a new family member but are associated with various developmental challenges that involve anxiety and worry<sup>1)</sup>. In addition, various hormonal secretions are altered during pregnancy, which reportedly affects mental function<sup>1)</sup>. Tateoka and Takahashi reported that stress-related salivary cortisol levels were markedly increased in the last trimester of pregnancy<sup>2)</sup>. A study by Kato et al. used non-linear analysis of fingertip pulse wave and found that fatigue and depression were elevated from early to mid and late pregnancy<sup>3)</sup>. Maternal anxiety during pregnancy was associated with a significantly increased risk of preterm birth and low birth weight<sup>4)</sup>. Animal and human studies have shown that prenatal maternal stress affects the offspring's cognition and behavior, and symptoms of maternal anxiety and depression increase children's risks of various emotional, behavioral, and

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cognitive problems later in life<sup>5,6</sup>). Hence, this study sought to examine pregnancy-related discomfort, stress levels, and the determinants of stress levels in pregnant women in the second and third trimesters.

## 2. Methods

### 2.1 *Participants and procedures*

We obtained the cooperation of two maternity hospitals in this study. After obtaining consent from the hospitals' administrators, anonymous self-report questionnaires were distributed to expectant mothers between June and September 2013. The questionnaires were given to the pregnant women when they visited the hospital for antenatal checkups and treatment. A written statement explaining the study's purpose, research methods, and ethical considerations was attached to the questionnaire. Participants completed the questionnaire anonymously and returned it to the researcher in a preaddressed stamped envelope. Participants were considered to have consented to participate in the study when they returned the questionnaire. All data were treated confidentially to protect the participants' privacy.

### 2.2 *Questionnaire*

The present study was part of a larger study and used anonymous self-administered questionnaires on pregnancy-related comfort and discomfort. The questionnaire covered the following domains: 1) participants' attributes and characteristics, 2) pregnancy-related comforts, 3) pregnancy-related discomforts, and 4) stress levels and causes of stress. Participants rated items in the Prenatal Comfort Scale (PCS) and the Pregnant-related Discomfort Scale (PDS). The PCS was developed by Takeishi et al.<sup>7</sup> and contains 35 items rated on a Likert scale ranging from 1-6 ("have not experienced" to "experienced often"). The reliability and validity of the scale was verified by the developers<sup>7</sup>. The total scores range from 35-210, and a higher score indicates a higher comfort level. Since this study is part of a larger study, the results obtained from these participants using the PCS have already been presented<sup>8</sup>.

The PDS developed by Shinkawa et al.<sup>9</sup> is a Likert scale ranging from 0-6 ("not at all" to "very strong, very often"). It consists of 47 items: eight gastrointestinal symptoms, eight urinary and genitourinary symptoms, five arthrokinetic symptoms, 10 general neuropsychiatric symptoms, six cardiovascular vasomotor symptoms, and 10 cutaneous and oral sensory symptoms. The reliability and validity of the scale was verified by the developer<sup>9</sup>. We also asked participants to rate their perceived stress level on a scale from 0-10 ("not at all" to "very much").

### 2.3 *Data analysis*

Descriptive statistics were used to examine the participants' attributes and the distribution of scores for each item. Categorical variables were expressed as counts and percentages. A *t*-test was used to examine differences in continuous variables regarding the participants' characteristics between primigravidae and multigravidae. A *t*-test was also employed to assess the difference in mean stress scores between the second and third-trimester pregnancy groups. Pearson's correlation coefficient was applied to correlate the stress score with the gestational weeks. The Kolmogorov-Smirnov test was conducted to confirm the normality of the response distribution. Because none of the PDS items were normally distributed, a Mann-Whitney U test was used to investigate the relationship between the scores and gestational stage (second and third trimesters).

To analyze important predictors of the participants' stress levels, a multiple regression analysis using the stepwise method was conducted with stress level as the dependent variable and PDS total score, PCS total score or subscale scores, age, gestational age, number of family members in the same household, parity, pregnancy stage, and employment status as independent variables. The parity, pregnancy stage, and employment status were converted to binary data and analyzed. Interaction terms of employment status and pregnancy stage, parity and employment status, and parity and pregnancy stage were also created and included in the analysis as independent variables. Variance inflation factor was used to verify the absence

of multicollinearity. The Durbin-Watson ratio was checked to confirm the normality of the residue. All statistical analyses were performed using SPSS version 23 (IBM, Tokyo, Japan.) Each test was conducted at a significance level of  $p < 0.05$ . Data are displayed as mean  $\pm$  SD or median.

### 3. Results

#### 3.1 Response status and characteristics of participants

Three hundred and sixty-five questionnaires were distributed, and 174 (47.7% response rate) were collected. Of these, 142 were valid (38.9% valid response rate) and were used in the final analysis.

Table 1 shows the participants' attributes and characteristics. The respondents' mean age was  $31.0 \pm 5.0$  years (range: 16-42), while it was  $30.0 \pm 5.0$  years (range: 16-39) for primigravidae and  $31.6 \pm 5.0$  years (range: 18-42) for multigravidae. A *t*-test indicated that the mean age was significantly higher in multigravidae. Gestational age ranged from 22-40 weeks, with a mean gestational age of  $32.5 \pm 4.4$  weeks. Of the respondents, 24 women (16.9%) were in the second trimester, 118 (83.1%) were in the third trimester, 55 (38.7%) were pregnant for the first time, and 87 (61.3%) were pregnant for at least the second time. The mean gestational age among the primigravidae was  $32.8 \pm 4.4$  weeks (range: 22-39), and it was  $32.3 \pm 4.4$  weeks (range: 22-40) among the multigravidae. No significant difference was found in gestational age between the two groups. The average number of children ranged from zero to three with a mean of  $0.8 \pm 0.8$ . The mean number of family members was  $3.2 \pm 1.3$  (range: 2-8).

#### 3.2 Comparison of score per item on the PDS subscales

The median score per item on the PDS subscales was highest for "Arthrokinetic symptoms" (3.90), followed by "Gastrointestinal symptoms" (3.88), "General neuropsychiatric symptoms" (3.70), "Cardiovascular vasomotor symptoms" (3.67), "Urinary and genitourinary symptoms" (3.50), and "Cutaneous and oral sensory symptoms" (3.10) (Table 2).

#### 3.3 Relationship between discomfort symptoms and pregnancy stages

The 20 most common discomfort symptoms for the entirety of pregnancy and the second and third trimesters in particular are given in Table 3. The top two items ("tiredness" and "frequent urination") were common for the entire period, the second trimester, and the third trimester. The *t*-test showed significant differences between trimesters two and three in two items ("breast tension," and "leg cramp,"  $p = 0.023, 0.020$ ) and three items each for both primigravidae ("breast tension," "stiff shoulders," and "lumbar pain,"  $p = 0.012, 0.029, 0.045$ ) and multigravidae ("lower abdominal tension and numbness," "increase in discharge," and "leg cramp," ( $p = 0.042, 0.036, 0.030$ ; Table 4).

##### 3.3.1 Stress levels, causes, and stress-relieving strategies

Stress levels, causes of stress, and stress-relieving strategies are shown in Table 5. The mean stress level was  $4.85 \pm 2.40$ , with a maximum frequency and median of six and five, respectively. A *t*-test revealed that neither parity nor gestational stage was associated with stress levels.

#### 3.4 Predictors of participants' stress levels

The findings of multiple regression analysis using the PDS total score and other factors as independent variables are shown in Table 6. The PDS score and the PCS score predicted statistically significant stress levels ( $F = 5.548, p < 0.001, R^2 = 0.263$ ); the PDS score was a promoting factor ( $\beta = 0.495, p < 0.001$ ), and the PCS score was a reducing factor ( $\beta = -0.210, p = 0.007$ ). The results of multiple regression analysis with the PDS subscales and other factors as independent variables are shown in Table 7. The "General neuropsychiatric symptoms" score and the PCS score predicted statistically significant stress levels ( $F = 5.548, p < 0.001, R^2 = 0.321$ ); the subscale score was a promoting factor ( $\beta = 0.476, p < 0.001$ ), and the PCS score was a reducing factor ( $\beta = -0.163, p = 0.034$ ). The five remaining subscale scores, age, parity, gestational age, number of

Table 1 Participants' characteristics

		( <i>n</i> =142)	
Attributes and characteristics	<i>n</i>	%	
Age (years)	31.0 ± 5.0 (mean ± SD; range: 16-42)		
16-19	2	1.4	
20-29	54	38.0	
30-39	82	57.7	
40-42	4	2.8	
Parity			
Primigravida	55	38.7	
Age (years)	30.0 ± 5.0 (mean ± SD; range: 16-39)		
Multigravida	87	61.3	
Age (years)	31.6 ± 5.0 (mean ± SD; range: 18-42)		
Gestational age (weeks)	32.5 ± 4.4 (mean ± SD; range: 22-40)		
2nd trimester	24	16.9	
3rd trimester	118	83.1	
Primigravida	32.8 ± 4.4 (mean ± SD; range: 22-39)		
Multigravida	32.3 ± 4.4 (mean ± SD; range: 22-40)		
Number of family members in the same household	3.2 ± 1.3 (mean ± SD; range: 2-8)		
2	49	34.5	
3	54	38	
4	18	12.7	
5	13	9.2	
6	3	2.1	
7	4	2.8	
8	1	0.7	
Number of children	0.8 ± 0.8 (mean ± SD; range: 0-3)		
0	55	38.7	
1	67	47.2	
2	14	9.9	
3	6	4.2	
Occupation			
Housewife	86	59.4	
Clerical	18	12.7	
Sales, customer service	5	3.5	
Professional work other than healthcare professionals or teachers	11	7.7	
Healthcare professionals	15	10.6	
Teachers	2	1.4	
Unskilled work	2	1.4	
Self-employed	3	2.1	
Technical work	2	1.4	
Other	3	2.1	

*n*: numbers, SD: Standard Deviation

Table 2 Comparison of scores per item on the PDS subscales

Subscale	Gastrointestinal symptoms	Urinary and genitourinary symptoms	Arthrokineic symptoms	General neuropsychiatric symptoms	Cardiovascular vasomotor symptoms	Cutaneous and oral sensory symptoms
Mean $\pm$ SD	3.75 $\pm$ 50.86	3.53 $\pm$ 0.81	3.76 $\pm$ 0.81	3.72 $\pm$ 1.38	3.52 $\pm$ 1.05	3.05 $\pm$ 0.97
Median	3.88	3.50	3.90	3.70	3.67	3.10
Range	1.75-5.50	1.88-5.75	1.00-5.80	1.30-5.70	1.17-5.83	1.00-5.70

*n*: numbers, SD: Standard Deviation

(*n*=142)

Table 3 The top 20 most common discomfort symptoms by pregnancy stage

	Entire (n=142)		2nd trimester (n=24)		3rd trimester (n=118)	
	Items	Mean $\pm$ SD per item	Items	Mean $\pm$ SD per item	Items	Mean $\pm$ SD per item
1	Tiredness †	5.00 $\pm$ 1.20	Tiredness †	4.96 $\pm$ 1.27	Tiredness †	5.01 $\pm$ 1.19
2	Frequent urination †	4.96 $\pm$ 1.00	Frequent urination †	4.92 $\pm$ 0.72	Frequent urination †	4.97 $\pm$ 1.05
3	Fatigue †	4.57 $\pm$ 1.39	Lumbar pain	4.75 $\pm$ 1.26	Fatigue †	4.58 $\pm$ 1.40
4	Gastric compression	4.42 $\pm$ 1.35	Marked sleepiness	4.63 $\pm$ 1.01	Gastric compression	4.50 $\pm$ 1.35
5	Lumbar pain	4.30 $\pm$ 1.49	Difficulty in defecation	4.58 $\pm$ 1.41	Insomnia	4.26 $\pm$ 1.61
6	Insomnia	4.23 $\pm$ 1.65	Fatigue †	4.50 $\pm$ 1.38	Abdominal compression	4.22 $\pm$ 1.29
7	Marked sleepiness	4.13 $\pm$ 1.44	Decrease in frequency of defecation/ stool volume	4.42 $\pm$ 1.35	Lumbar pain	4.20 $\pm$ 1.52
8	Abdominal compression	4.12 $\pm$ 1.32	Decrease in libido †	4.29 $\pm$ 1.43	Dullness and pain in the legs †	4.15 $\pm$ 1.52
9	Dullness in legs †	4.09 $\pm$ 1.50	Irritation	4.13 $\pm$ 1.36	Palpitations and shortness of breath †	4.09 $\pm$ 1.55
10	Palpitations and shortness of breath †	4.06 $\pm$ 1.54	Insomnia	4.04 $\pm$ 1.85	Marked sleepiness	4.03 $\pm$ 1.49
11	Decrease in libido †	4.01 $\pm$ 1.49	Marked appetite †	4.04 $\pm$ 1.33	Increase in discharge †	3.95 $\pm$ 1.21
12	Marked appetite †	3.96 $\pm$ 1.32	Gastric compression	4.04 $\pm$ 1.30	Decrease in libido †	3.95 $\pm$ 1.50
13	Difficulty in defecation	3.94 $\pm$ 1.74	Stiff shoulders	4.00 $\pm$ 1.64	Marked appetite †	3.94 $\pm$ 1.32
14	Increase in discharge †	3.92 $\pm$ 1.24	Palpitations and shortness of breath	3.92 $\pm$ 1.53	Increase in perspiration †	3.85 $\pm$ 1.74
15	Decrease in frequency of defecation/ stool volume	3.91 $\pm$ 1.59	Breast tension †	3.92 $\pm$ 1.64	Hot flashes in the body †	3.85 $\pm$ 1.72
16	Irritation	3.80 $\pm$ 1.60	Abdominal swelling related to stool / gas	3.92 $\pm$ 1.72	Difficulty in sleep induction	3.83 $\pm$ 1.77
17	Hot flashes in the body †	3.80 $\pm$ 1.67	Dullness and pain in the legs †	3.79 $\pm$ 1.38	Difficulty in defecation	3.81 $\pm$ 1.77
18	Increase in perspiration †	3.79 $\pm$ 1.71	Increase in discharge †	3.75 $\pm$ 1.39	Decrease in frequency of defecation/ stool volume	3.81 $\pm$ 1.62
19	Difficulty in sleep induction	3.76 $\pm$ 1.80	Nervousness †	3.71 $\pm$ 1.63	Irritation	3.73 $\pm$ 1.64
20	Abdominal swelling related to stool/gas	3.72 $\pm$ 1.64	Abdominal compression	3.67 $\pm$ 1.37	Abdominal swelling related to stool / gas	3.68 $\pm$ 1.63

† In Japanese, translated by the author of this article.

n: numbers, SD: Standard Deviation

Table 4 Significantly different items between the second and third trimesters

Items	Stage of pregnancy	Median	<i>p</i> -value
Total ( <i>n</i> =142)			
Breast tension †	2nd trimester ( <i>n</i> =24)	4.0	0.023
	3rd trimester ( <i>n</i> =118)	3.0	
Cramp in the legs †	2nd trimester ( <i>n</i> =24)	2.5	0.020
	3rd trimester ( <i>n</i> =118)	4.0	
Primigravida ( <i>n</i> =55)			
Breast tension †	2nd trimester ( <i>n</i> =8)	5.0	0.012
	3rd trimester ( <i>n</i> =47)	3.0	
Stiff shoulders	2nd trimester ( <i>n</i> =8)	5.0	0.029
	3rd trimester ( <i>n</i> =47)	3.0	
Lumbar pain	2nd trimester ( <i>n</i> =8)	5.5	0.045
	3rd trimester ( <i>n</i> =47)	4.0	
Multigravida ( <i>n</i> =87)			
Lower abdominal tension and numbness †	2nd trimester ( <i>n</i> =16)	3.0	0.042
	3rd trimester ( <i>n</i> =71)	4.0	
Increase in discharge †	2nd trimester ( <i>n</i> =16)	3.0	0.036
	3rd trimester ( <i>n</i> =71)	4.0	
Cramp in the legs †	2nd trimester ( <i>n</i> =16)	2.5	0.030
	3rd trimester ( <i>n</i> =71)	4.0	

† In Japanese, translated by the author of this article.

Table 5 Stress scores and causes

Stress score	Total	4.85 ± 2.40 (Mean ± SD)	
	Primigravida	4.59 ± 2.42 (Mean ± SD)	
	Multigravida	5.07 ± 2.34 (Mean ± SD)	
	Second trimester	5.25 ± 2.45 (Mean ± SD)	
	Third trimester	4.81 ± 2.36 (Mean ± SD)	
			<i>n</i>
	0	5	3.5
	1	11	7.7
	2	12	8.5
	3	14	9.9
	4	12	8.5
	5	19	13.4
	6	31	21.8
	7	21	14.8
	8	8	5.6
	9	8	5.6
	10	0	0.0
	No answer	1	0.7
Causes of stress (Yes)		<i>n</i>	%
	Home environment	32	22.5
	Raising and educating children	29	20.4
	Household finances	23	16.2
	Own health	22	15.7
	Work	16	11.3
	Relationships with people other than family members	11	7.7
	Relationships with family members	8	5.6
	Family's health	6	4.2
	Caring for family members	4	2.8
	Others	15	10.6
Stress-relieving strategies (Yes)		<i>n</i>	%
	Shopping	48	33.8
	Chatting with friends	44	31.0
	Sleeping	28	19.7
	Eating	23	16.2
	Crying	9	6.3
	Watching TV	7	4.9
	Taking a relaxing bath	6	4.2
	Online communication	4	2.8
	Exercise	3	2.1
	Others	18	12.7

*n*: numbers, SD: Standard Deviation



Table 6 Multiple regression analysis of stress levels using the PDS total score as an independent variable

Independent variables	B	SE	$\beta$	t-value	p-value	VIF
Age	-0.007	0.036	-0.014	-0.185	0.854	1.092
Gestational age	0.012	0.067	0.022	0.182	0.856	2.909
Number of family members in the same household	-0.231	0.161	-0.124	-1.437	0.153	1.421
PDS total score	0.036	0.006	0.495	6.594	0.000 **	1.070
PCS score	-0.023	0.008	-0.210	-2.731	0.007 *	1.122
Parity	0.585	1.037	0.120	-0.564	0.574	8.621
Pregnancy stage	-0.384	1.122	-0.061	-0.343	0.732	6.025
Work status	-0.052	0.799	-0.011	-0.065	0.948	5.180
Interaction term: parity and employment status	-0.063	0.748	-0.012	-0.084	0.933	3.672
Interaction term: parity and pregnancy stage	-0.021	1.013	-0.005	-0.021	0.983	8.691
Interaction term: pregnancy stage and employment status	-0.233	0.664	-0.044	-0.351	0.726	2.987

Multiple regression analysis using the stepwise method

VIF: variance inflation factor

\* $p < 0.01$ ; \*\* $p < 0.001$ , two-tailed tests

The Durbin-Watson ratio was 2.056, and the significance probability by the Shapiro-Wilk test was 0.448.

family members in the same household, pregnancy stage, and employment status were not associated with stress levels in either model. Variance inflation factors were less than 10 for all variables, and no multicollinearity was confirmed. Both the Durbin-Watson ratio and significance probability by Shapiro-Wilk's test verified the normality of the residues.

#### 4. Discussion

##### 4.1 Participants' characteristics

The participants' mean age was  $31.0 \pm 5.0$  years (16-42 years). According to the Demographic Statistics 2020<sup>10</sup>, the 30-34 age group had the highest total fertility rate, similar to our results. The range of the gestational period was 22-40 weeks, with 24 women in the second trimester and 118 women (over 80%) in the third trimester. Our study included first- to fourth-time expectant mothers with various occupations. The family structures included both nuclear and extended families. We believe that the inclusion of a diverse group of pregnant women reduces, to some extent, the limitation of generalizability in this cross-sectional survey conducted at only two institutions.

##### 4.2 Pregnancy-related discomfort

Among all participants, the highest scores were for "tiredness," followed by "frequent urination" and "fatigue." These were the same as the findings of Shinkawa et al<sup>9</sup>. The next highest average scores were for "gastric compression," "lumbar pain," "insomnia," "marked sleepiness," and "abdominal compression," in that order. Expectant mothers in the third trimester accounted for 83.1% of the participants, indicating that the top items in the third trimester ranked high.

The comparison of differences by gestational stage revealed differences among all participants, primigravidae, and multigravidae. Differences in the median were observed for two items, "breast tension" and "cramp in the legs" for all participants, and for three items, "breast tension," "stiff shoulders," and "lumbar pain" in the primigravidae. In the multigravidae, "lower abdominal tension and numbness," "increase in discharge," and "leg cramp" were noted. For primigravidae, all three items (breast tension, stiff shoulders,

Table 7 Multiple regression analysis of stress levels using the PDS subscale scores as independent variables

Independent variables	B	SE	$\beta$	t-value	p-value	VIF
Age	0.009	0.037	0.020	0.799	0.822	1.216
Gestational age	-0.003	0.065	-0.006	-0.048	0.962	2.956
Number of family members in the same household	-0.214	0.160	-0.115	-1.335	0.184	1.507
PDS subscale						
Gastrointestinal symptoms	0.046	0.031	0.134	1.495	0.138	1.623
Urinary and genitourinary symptoms	-0.021	0.033	-0.056	-0.629	0.531	1.613
Arthrokineic symptoms	0.033	0.033	0.076	0.867	0.388	1.563
General neuropsychiatric symptoms	0.110	0.024	0.476	4.545	0.000**	2.218
Cardiovascular vasomotor symptoms	-0.045	0.041	-0.118	-1.079	0.282	2.426
Cutaneous and oral sensory symptoms	0.043	0.024	0.173	1.802	0.074	1.862
PCS score	-0.018	0.008	-0.163	-2.143	0.034*	1.170
Parity	0.569	1.012	0.117	-0.563	0.575	8.743
Pregnancy stage	-0.135	1.098	-0.021	-0.123	0.902	6.146
Work status	0.367	0.807	0.076	0.454	0.650	5.634
Interaction term: parity and employment status	-0.106	0.749	-0.02	-0.141	0.888	3.924
Interaction term: parity and pregnancy stage	0.094	0.994	0.02	0.095	0.925	8.922
Interaction term: pregnancy stage and employment status	-0.455	0.653	-0.086	-0.697	0.487	3.08

Multiple regression analysis using the stepwise method

VIF: variance inflation factor

\* $p < 0.01$ ; \*\* $p < 0.001$ , two-tailed tests

The Durbin-Watson ratio was 2.255, and the significance probability by the Shapiro-Wilk test was 0.238.

and lumbar pain) were higher in the second trimester, with scores of at least five points. The small number of participants in the second-trimester group (8) may have affected higher scores for those individuals who felt particularly strongly on these items. However, the mammary glands develop significantly during the second trimester, and breast tension is physical change that primigravidae have never experienced before and thus is more likely to be felt by primigravidae. The three items "lower abdominal tension and numbness," "cramp in the legs," and "increase in discharge" were scored higher in the third trimester, with significant differences among multigravidae. The first two items may be related to daily labor, such as carrying the first child in their arms.

#### *4.3 Stress levels, causes, and stress-relieving strategies*

A survey conducted in April-May 2020 among pregnant women aged 19-45 years in Poland during the coronavirus disease 2019 (COVID-19) pandemic reported that the level of stress and anxiety experienced by survey participants was higher in the second trimester than in the third trimester of pregnancy<sup>12)</sup>. In contrast, some studies conducted in Japan in the non-pandemic period have found higher stress levels among pregnant women in the third trimester<sup>2,3,11)</sup>. However, there was no association between stress levels and pregnancy stages in this study. This difference in results between surveys may be due to the stress levels and anxiety of pregnant women in the early stages of pregnancy, such as concerns about the impact of infectious diseases on the fetus, and the effects of various circumstances influenced by social conditions, such as anxiety about childbirth and the costs associated with childcare in the later stages of pregnancy. Regarding the causes of stress, Shimabukuro et al.<sup>13)</sup> reported that the most common stressful events recently felt by pregnant women were relationships with family and relatives (29%), physical symptoms due to pregnancy (14.5%), and work-related obstacles caused by pregnancy (4.8%). In our study, "family relationships" accounted for only 5.6%, with "home environment" (22.5%) being the most common, followed by "raising and educating children" (20.4%) and "household finances" (16.2%). The Shimabukuro et al. study was conducted in 2004, and the "household finances" in this survey, conducted in 2013, may be due to an increase in the number of non-regular workers<sup>14)</sup>, higher costs for childbirth and childcare<sup>15)</sup>, and rising costs for children's education<sup>15)</sup>. The percentage for "own health" as a stressor was 15.7%, similar to the study by Shimabukuro et al.<sup>13)</sup>.

A modified  $R^2$ -value of  $> 0.5$ , indicating the model's goodness of fit, is ideal, but in the current result, it was as low as 0.263. None of the independent variables, such as occupational status, economic status, family relationships, non-family relationships, or their interaction terms, were predictors. This indicates that there must be other contributing variables besides the significant two (PDS and PCS scores). The aforementioned survey conducted in April-May 2020 among expectant mothers aged 19-45 years in Poland found that the levels of stress and anxiety experienced by survey participants ranged from moderate to high, with women having histories of mental health treatment, women in early pregnancy, and those who were single or in informal relationships more likely to experience higher levels of psychological distress and anxiety<sup>12)</sup>. Conversely, age, education, and childbearing history were statistically insignificant<sup>12)</sup>. Although the number of family members living with the respondent was included in the demographic characteristics of the survey, history of mental illness and marital status were not included but might have been significant if they had been included as independent variables in our survey. More research including these factors is therefore needed to clarify this. Furthermore, since only "general neuropsychiatric symptoms" were a promoter of stress in multiple regression analysis with the PDS subscales as independent variables, it is essential that perinatal professionals provide care and advice to pregnant women to reduce their tiredness, fatigue, irritation and associated symptoms.

The most common stress-relieving strategy was "shopping" (33.8%), followed by "chatting with friends" (31.0%). Only four respondents (2.8%) chose "online communication." This survey was conducted in 2013. Since then, the number of non-regular employees has increased in Japan<sup>16)</sup>, widening the economic gap between the affluent and the impoverished<sup>17)</sup>. Additionally, the prevalence of the "Sustainable Development

Goals" campaign adopted by the United Nations in 2015 has increased awareness of curbing mass consumption in Japan<sup>18)</sup>. Therefore, "shopping" may not be the most common stress-relieving strategy today. Although the "chatting with friends" factor which ranked second in this survey describes face-to-face communication, "online communication" via videophone is now more actively practiced because of the COVID-19 epidemic, as restrictions have been imposed on unnecessary outings in Japan. The antenatal checkup is a valuable opportunity for face-to-face communication between perinatal professionals and pregnant women. It is essential that emotional support is provided at this time to alleviate pregnant women's stress.

## 5. Conclusion

The pregnancy-related discomforts, stress levels, and causes and determinants of stress among pregnant women during trimesters two and three were investigated. From the results, we suggest it is essential for perinatal professionals to provide emotional support at antenatal checkups to reduce pregnant women's stress.

## Limitation

This study is limited by the small number of participants recruited through convenience sampling, and our results should be generalized with caution.

## Ethical considerations

This study was approved by the institutional ethics committee of Kawasaki University of Medical Welfare, Okayama, Japan (No. 387). Permission to transcribe the PDS for the questionnaire was obtained in writing from the developers.

## Acknowledgments

We thank all participants and the two maternity hospitals for cooperating in this study. This study was prepared by supplementing and modifying part of a master's thesis submitted to the Graduate School of Kawasaki University of Medical Welfare in 2014.

## Conflict of interest

None declared.

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