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ORIGINAL ARTICLE

Development of the Korean Pregnancy Stress Scale

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Abstract

Aim: This study was conducted in order to develop and evaluate a Pregnancy Stress Scale (PSS).

Methods: The PSS was developed according to Devellis' scale development process. Data that were collected from 388 pregnant women were used to evaluate the validity and reliability of the tool. An item analysis, factor analysis, Pearson's correlation coefficients, and Cronbach's α were used.

Results: The PSS comprised seven factors that can be applied to all pregnant women, with one additional factor that is dedicated specifically for working pregnant women, resulting in a total of eight factors with 43 items: physical and psychological changes, coping in daily life, health of the mother and baby, maternal role, family support, healthcare services, social atmosphere, and reconciliation of work life. The criterion validity was supported by the Revised Prenatal Distress Questionnaire and Edinburgh Postnatal Depression Scale. The reliability of the overall scale was adequate.

Conclusion: This scale would be useful for understanding the complex factors that contribute to pregnant women's stress and also would contribute to the process of developing nursing interventions to reduce pregnancy stress.

Key words: instruments, pregnant women, psychological stress.

INTRODUCTION

Pregnancy is a joyful and meaningful period, during which women prepare for the event of having a baby. However, during pregnancy, mothers are also subjected to social, economic, physical, and psychological changes and burdens (Furber, Garrod, Maloney, Lovell, & McGowan, 2009). In the past, a woman's life was considered to revolve around her role as a mother. But, in modern society, they commonly prioritize their own needs or desires and fulfill themselves through education, work, and leisure time. Therefore, becoming a mother is a restriction on a woman's personal freedom and they feel greater responsibility and dependency than in the past (Bergnéhr & Bernhardt, 2013).

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The burden of having a baby is also linked to the fertility rate; in particular, the fertility rate of most developed countries has remained low. Among them, South Korea has one of the lowest fertility rates worldwide, ranking 220 out of 224 countries (Central Intelligence Agency, 2015), and this rate has been declining rapidly. It is estimated that the burden of pregnancy is significant. Currently, Korean women frequently participate in economic activities and they comprise 51.3% of the entire workforce. Accordingly, the average age of a Korean woman's first marriage has gradually increased to 29.8 years, which is 5 years later compared with that of the 1990s. The birth rate of the generation in their 20s also has decreased, whereas the birth rate of women in their late 30s and early 40s is increasing (Statistics Korea, 2015). Alongside such changes in the family environment and increase in women's economic activities, pregnancy and childbirth are additional burdens on women who have multiple roles to be accomplished simultaneously. Currently, the Korean Government provides institutional strategies, including legal and

institutional systems such as pregnancy and maternity leave and flexible work hours. However, whether these strategies are of practical and significant service for pregnant women is questioned (Shin, 2010). Also, compared with advanced countries, where the whole society is liable for raising children, Korean society primarily places the responsibility of child care on individual families. Consequently, pregnant women are under considerable stress, with the additional concern of child care after giving birth (Choi, Henshaw, Baker, & Tree, 2005; Hays, 1996).

In order to understand how pregnant women perceive their stress, the authors referred to cognitive appraisal by Lazarus and Folkman (1984), who define stress as an occasion where an event or situation arises from interacting with one's environment that is then interpreted as harmful, threatening, or challenging. When a pregnancy is recognized as harmful, a mother-to-be might feel anger, hatred, disappointment, or sadness and, when recognized as a threat, it also could be accompanied by concern, anxiety, or fear. Therefore, it is essential to understand how pregnant women perceive their stress.

Pregnancy stress impacts a mother's mental health (Brummelte & Galea, 2010), which then can result in inadequate prenatal care (Woods, Melville, Guo, Fan, & Gavin, 2010), a shortened gestational period, low infant birthweight, or obstetric complications, such as structural birth defects (Zhu, Tao, Hao, Sun, & Jiang, 2010). Additionally, the child's physical and psychological development experiences negative effects, such as attention deficit hyperactivity disorder or intellectual disability (Rodriguez & Bohlin, 2005). Therefore, pregnant women's stress should be assessed and mediated.

Nonetheless, the scales that are used currently to measure pregnancy stress focus on either specific major events or groups. For example, the Prenatal Social Environment Inventory (PSEI) (Orr, James, & Casper, 1992) measures acute or chronic stressors, such as the death of a family member, accident, and unemployment, rather than specific stresses related to pregnancy. The High-Risk Pregnancy Stress Scale (HRPSS) (Goulet, Polomeno, & Harel, 1996) was developed for pregnant women with high risks, while the Rural Pregnancy Experience Scale (RPES) (Kornelsen, Stoll, & Grzybowski, 2011) was designed for pregnant women who reside in rural areas and have difficulty accessing healthcare services. The Antenatal Perceived Stress Inventory (APSI) (Razurel *et al.*, 2014) has a limitation in that it does not include socioeconomic factors that are related to employment. Additionally, social circumstances should be considered, such as where day care facilities are not favored due to recent disturbing incidents or accidents that are related to infants (Ministry of Health and Welfare, 2015). Consequently, pregnant women cannot help but be concerned about their immediate future, as well as their present situation. These pregnant women's stress cannot be measured by using existing scales. Therefore, a mandatory Pregnancy Stress Scale (PSS) needs to be developed for Korean pregnant women, regardless of specific events or the social groups to which they belong, and especially considering their sociocultural background.

In the present study, the aim was to understand pregnancy stress arising from the continuous interaction between the pregnant woman, the fetus, and the surrounding environment according to the perspective of Lazarus and Folkman (1984). Thus, a PSS was developed with a sufficient empirical foundation that is based on concept analysis that includes in-depth interviews with pregnant women. The scale that was developed in this study is expected to be used to assess and evaluate pregnancy stress in a comprehensive and multidimensional way. Additionally, the nurse, alongside a midwife as a primary healthcare provider in maternity care, can help pregnant women to reduce the stress that they experience during pregnancy with targeted intervention by using this developed scale.

METHODS

Study design

This study was designed as a cross-sectional survey to develop the PSS and to evaluate its reliability and validity.

Setting and sample

This study was conducted between July and August 2015 among pregnant women who were visiting for routine screening or prenatal education at a maternity hospital and a public health center in the Gyeonggi region. Among all the cities and provinces in South Korea, the Gyeonggi area has the highest population of women of child-bearing age, thereby qualifying it as representative of all other areas within the country. The exclusion criteria were: non-Korean national, aged <20 years or >45 years, or a difficulty with reading or writing in Korean. The number of samples was fivefold the number of items to ensure stable verification of the

reliability and validity of the scale, including factor analysis (Tabachnick & Fidell, 2001). In total, 57 items were derived as the initial items; therefore, data were collected from 400 participants. However, the data from 12 participants were excluded because of incomplete responses on the questionnaire, resulting in a total of 388 included participants. Among the 388 participants, 160 had jobs that meant they were classified as a subsample group of working pregnant women.

Ethical considerations

This study was conducted after acquiring approval from the Institutional Review Board (IRB) of Seoul National University, Seoul, South Korea (IRB No. 1507/001-015). The data collection proceeded after the purposes of the study were explained fully to the participants who then provided written consent.

Scale development

This study was conducted according to the instructions on scale development by DeVellis (2003).

Initial items

First, all usages of the concept of "pregnancy stress" were identified by using the literature, existing scales, and interviews according to the concept analysis of Walker and Avant (2005). Next, draft items were developed by using the literature review, existing scales, and interview results. Two nursing professors consulted on, and reviewed the adequacy of, the developed draft items in order to complete the initial items.

Content validity

The content validity was conducted by 10 experts (two nurses from a maternity ward and delivery room with >3 years of experience each, four professors in maternity nursing, and four doctoral students in maternity nursing) who assessed how accurately the developed items evaluate the properties of pregnancy stress along a five-point Likert scale by using the Content Validity Index (CVI), as developed by Fehring (1987). Each point had applied a weighted value (1 = 0; 2 = 0.25; 3 = 0.50; 4 = 0.75; 5 = 1.00) in order to calculate the average points of all the experts. Those items with a CVI of <0.50 were considered to have low validity and thus were excluded from the study, while those items with a CVI of between 0.50 and 0.79 were modified.

Pilot test

A pilot test was conducted on 20 pregnant women from a maternity hospital that was located in the Gyeonggi region. They offered their opinions regarding the clarity of the scale, such as terms or sentences that prevented them from understanding the test.

Scale evaluation

Data analysis

The statistical analyses were carried out by using IBM SPSS Statistics for Windows (v. 22.0; IBM Corporation, Armonk, NY, USA). Descriptive statistics were used to analyze the respondents' characteristics. The mean, standard deviation, skewness, and kurtosis of each item were checked to examine the degree of overvaluation of the items. A corrected item-total correlation coefficient was used to ensure that each item reflected the concept of the PSS. Those items with corrected item-total correlations of <0.20 were deleted (Streiner & Norman, 2008).

The Kaiser–Meyer–Olkin measure and Bartlett's chi-squared test of sphericity were used to ensure the adequacy of the exploratory factor analysis (EFA). A principal component analysis with an orthogonal varimax rotation was applied to the data, with a factor loading criterion set at >0.40 (Hair, Black, Anderson, & Tatham, 1995).

The criterion validity was assessed by examining the correlations between the PSS, the Revised Prenatal Distress Questionnaire (PDQ), and the Edinburgh Postnatal Depression Scale (EPDS). The Revised PDQ consists of 17 items with a three-score scale that was developed by Lobel *et al.* (2008) and has a Cronbach's α-value of 0.79. The current study used the scale after obtaining approval for its use, followed by translation and back-translation. The Korean version of the EPDS was verified for its reliability and validity by Kim, Hur, Kim, Oh, and Shin (2008) and the Cronbach's α-value was 0.87. The EPDS initially was developed to measure prenatal depression, but was found to be efficient (i.e. valid and reliable) for measuring pregnant women's depression (Chatillon & Even, 2010). The reliability of the PSS was confirmed by the Cronbach's α-value, which measures internal consistency.

RESULTS

Scale development

Initial items

Through concept analysis of pregnancy stress, eight constructs were identified: physical and psychological

changes, coping in daily life, health of the mother and baby, maternal role, family support, healthcare services, social atmosphere, and reconciliation of work life (added for working pregnant women). Based on these constructs, and for the concept analysis, 29, 88, and 43 draft items, respectively, were extracted from 13 existing scales, interviews with two full-time pregnant homemakers and four working pregnant women, and a literature search. The literature search included PubMed, EMBASE, CINHAL and KMBASE, KISS, Koreamed, DBpia, Riss4u, and the database of the National Assembly Library. Among these items, 44 draft items, such as "I am concerned about using a national/public daycare center or public nanny service in practice," were extracted from the interviews, whereas four draft items, such as "I am concerned about how to be a good mother," were extracted from the literature. In conclusion, 61 common draft items were extracted by using the existing scales, interviews, and literature to complete a total of 109 draft items.

The level of item adequacy was reviewed according to the constructs of pregnancy stress and by revising (e.g. "I am sensitive to trivial matters" was changed to "I am sensitive"), deleting, or adding items to complete a total of 52 initial items. A response scale was created so that the total number of responses was the even number of four in order to prevent the respondents' answers from converging into a middle score.

Content validity

Based on Fehring's (1987) standards for content validation, no item among the 52 initial items had a CVI of <0.5. However, two items that were considered to be similar or identical, based on the experts' opinions (e.g. "I stopped drinking and smoking" and "I do not take any drugs [drinking or smoking] that are harmful to the baby"), were deleted and items with a CVI of between 0.5 and 0.8 (e.g. "I interact with my baby" and "Attending prenatal education (*taegyo*) classes is burdensome") were modified.

According to the experts' opinions, four additional items were included, such as "It is difficult for me to calm my mind for the sake of my baby" and "I have difficulty choosing prenatal tests." As a result, a total of 54 items from eight constructs was chosen, including eight for "physical and psychological changes," five for "coping in daily life," eight for "health of the mother and baby," seven for "maternal role," seven for "family support," six for "healthcare services," five for "social atmosphere," and eight for "reconciliation of work life."

Pilot test

There was no unclear or ambiguous item that prevented the pregnant participants from understanding the meaning of the terms in the pilot test. However, three additional items were included after accepting the opinions of the respondents: "I feel uncomfortable having a male obstetrician for childbirth," "Our society is considerate of me as a pregnant woman," and "My work environment (job intensity and work hours) is adjustable." Therefore, a total of 57 items was established.

Scale evaluation

Demographic characteristics

Table 1 presents the demographics of the 388 participants. Their ages ranged from 20 to 44 years (mean = 31.57; standard deviation [SD] = 4.14), with 93 participants (24%) aged ≥35 years. Most (96.1%) of the participants were married and 68.6% had a college degree. Up to 41% of the participants were employed, with a monthly average income of 3.67 million KRW. Most (82%) were willingly pregnant, but the remaining 18% had an unwanted pregnancy. Most pregnancies (92.5%) were natural, with 7.5% having been artificially produced. The mean number of gestational weeks was 27.27 (SD = 8.93), while the percentage of participants in the first, second, and third trimester were 10.5, 28.9, and 60.6%, respectively. Up to 63.1% of the participants were primipara. Among the multiparas, only 1.5% had three children (including the fetus). In total, 16% of the participants had a history of pregnancy complications and 20.9% of the participants had current high-risk conditions, such as gestational diabetes and anemia.

Item analysis

As a result of the item analysis, item no. 13, "I do not take any drugs (drinking or smoking) that are harmful to the baby," showed an overvaluation for skewness (3.13) and kurtosis (9.45) and was subsequently deleted. As for the corrected item-total correlation coefficients, six items (no. 9, 10, 11, 12, 40, and 43) were <0.20. However, considering the importance of these items, the items for "coping in daily life" (no. 9, 10, 11, 12) could not be removed. Therefore, only two (40, 43) were removed and a total of 54 items was extracted. Among these 54 items, 45 were for all the

Table 1 Socioeconomic characteristics of the study's participants (n = 388)

Characteristic	Mean ± SD or N (%)
Age (years)	31.57 ± 4.14
20–34	295 (76.0)
35–44	93 (24.0)
Marital status	
Married	373 (96.1)
Single/Living together	15 (3.9)
Educational level	
≤High school	91 (23.5)
College graduate	266 (68.6)
≥Graduate school	31 (7.9)
Monthly income (10,000 won)	366.97 ± 194.25
Employment	
Yes	160 (41.2)
No	228 (58.8)
Wanted pregnancy	
Yes	318 (82.0)
No	70 (18.0)
Type of pregnancy	
Natural	359 (92.5)
Artificial	29 (7.5)
Gestational age (weeks)	27.27 ± 8.93
1–13	41 (10.5)
14–26	112 (28.9)
27–40	235 (60.6)
Number of children	
0	245 (63.1)
1	110 (28.4)
2	27 (7.0)
3	6 (1.5)
History of pregnancy complications	
Yes	62 (16.0)
No	326 (84.0)
Current high-risk conditions	
Yes	81 (20.9)
No	307 (79.1)
Other disease	
Yes	29 (7.5)
No	359 (92.5)

SD, standard deviation.

pregnant women, while the remaining nine were applied for just the working pregnant women.

Construct validity

In order to assess the construct validity, an EFA was conducted for each scale by using 45 items for a total of 388 pregnant women. For the working pregnant women as a subsample group that comprised 160 pregnant women, another 54 items were applied.

The sampling adequacy for the factor analysis was adequate using Bartlett's chi-squared test of sphericity ($P < 0.001$ and $P < 0.001$, respectively) and the Kaiser–Meyer–Olkin measure (0.81 and 0.73, respectively) for each of all the pregnant women and just the working pregnant women scales. In order to determine the number of factors, both a Scree plot and the minimum average partial were considered because the Kaiser rule tends to severely overestimate the number of factors (Zwick & Velicer, 1986). Therefore, this study assigned seven factors for all the pregnant women and eight factors for the working pregnant women.

The EFA was conducted for the 45 item scale for all the pregnant women and then nine items were removed, resulting in a total of 36 items being extracted. Among these, the communality of item no. 10, 11, and 12 of "coping in daily life" and item no. 1 was <0.40, but considering the factor loading value and the importance of these items, they were included in the results. The included items consisted of eight items for "physical and psychological changes," three for "coping in daily life," six for "health of the mother and baby," six for "maternal role," four for "family support," four for "healthcare services," and five for "social atmosphere." The percentage of explained variance for each factor was 11.4% for "health of the mother and baby," 9.1% for "maternal role," 8.6% for "physical and psychological changes," 8.4% for "social atmosphere," 6.3% for "family support," 6.1% for "healthcare services," and 4.3% for "coping in daily life," with a total explained variance of 54.2% (Table 2).

Another EFA was conducted for the 54 item scale for working pregnant women, resulting in the removal of 17 items, for a final total of 37 items. Those items consisted of four items for "physical and psychological changes," three for "coping in daily life," six for "health of the mother and baby," six for "maternal role," four for "family support," three for "healthcare services," four for "social atmosphere," and seven for "reconciliation of work life." The percentage of explained variance for each factor was 11.0% for "health of the mother and baby," 9.4% for "reconciliation of work life" and "maternal role," 7.2% for "social atmosphere," 7.0% for "physical and psychological change," 6.5% for "family support," 5.7% for "healthcare services," and 4.0% for "coping in daily life," with a total explained variance of 60.3% (Table 3). All the items for the working pregnant women were identical to the items of the seven factors for all the pregnant women, except for "My weight is

Table 2 Factor analysis of the 45 items for all the pregnant women (n = 388)

Item no.	Item	Factor loading						
		F1	F2	F3	F4	F5	F6	F7
Health of the mother and baby								
17	I am worried about having an abnormal fetus	0.86	0.07	0.06	0.10	0.06	0.03	0.02
16	I am feeling the strain of anticipating an abnormal result from a prenatal test	0.83	0.05	0.13	0.06	0.08	0.05	−0.03
14	I am worried about having a miscarriage	0.81	0.07	0.10	0.00	0.06	0.05	0.01
18	I am worried about whether the fetus is growing well	0.78	0.20	0.16	0.05	0.01	0.03	0.02
15	I am worried about whether I will have a premature delivery	0.73	0.08	0.11	0.12	0.01	0.08	−0.04
19	I am worried about the possibility of pregnancy complications	0.73	0.28	0.01	0.04	−0.02	0.01	−0.11
Maternal role								
23	Becoming a mother is a burden	0.04	0.77	0.07	0.11	0.12	0.09	−0.16
24	Attending prenatal education classes (*taegyo*) is burdensome	0.10	0.73	0.08	0.05	0.07	0.07	0.06
28	Preparing to take on the role of a mother is a burden	0.12	0.70	0.01	0.04	0.04	0.10	−0.05
22	I am worried about taking care of my baby	0.21	0.70	0.09	0.08	0.01	0.06	−0.17
26	I am worried about interacting emotionally with my baby	0.15	0.67	0.20	0.14	−0.04	0.08	0.18
25	It is difficult for me to calm my mind for the sake of my baby	0.16	0.57	0.33	0.13	0.15	−0.00	0.23
Physical and psychological changes								
3	I have difficulty breathing	0.05	0.11	0.71	0.02	0.01	−0.01	−0.16
5	I have difficulty sleeping deeply	0.09	0.09	0.61	0.03	−0.01	0.10	−0.14
2	I feel tired	0.06	0.12	0.58	0.12	0.14	0.00	0.14
4	I urinate frequently	0.06	0.19	0.57	0.08	−0.29	−0.03	−0.12
6	I feel down	0.14	0.18	0.55	0.00	0.20	0.04	0.24
8	I get cramps in my legs	0.02	0.05	0.55	0.04	0.12	0.09	−0.34
7	I am sensitive	0.19	0.17	0.53	0.12	0.22	0.02	0.18
1	I have morning sickness	0.07	−0.19	0.43	0.12	0.08	0.04	0.05
Social atmosphere								
47	If my baby has some problems, our society seems to believe that the mother is the main cause	0.05	0.10	0.09	0.82	0.16	−0.00	0.00
45	Our society seems to assume that the mother has the primary responsibility of nurturing	0.06	0.06	0.05	0.80	0.09	−0.04	−0.15
46	Our society seems to expect that a mother will find it difficult to live her own life after delivery	0.05	0.13	0.11	0.79	0.10	0.02	0.10
48	I am worried that our society lacks reliable childcare facilities	0.13	0.06	0.07	0.67	−0.06	0.16	−0.05
44	Our society has high expectations of what a good mother is	0.03	0.09	0.09	0.45	−0.06	0.09	−0.40
Family support								
34	I am disappointed that my husband is indifferent to me	0.10	0.04	0.11	0.03	0.75	0.03	−0.07
33	I am disappointed that my husband does not know my feelings	0.15	0.07	0.13	0.14	0.74	0.03	0.08
29	I am disappointed that my family is not considerate of me	0.02	0.03	0.24	0.10	0.65	0.06	−0.09
32	My husband helps with housework	−0.07	0.10	−0.08	−0.05	0.60	−0.03	0.11
Healthcare services								
37	I have difficulty determining prenatal tests	0.05	0.14	0.02	0.00	0.01	0.85	−0.05

Table 2 Continued

Item no.	Item	Factor loading						
		F1	F2	F3	F4	F5	F6	F7
36	I have difficulty understanding prenatal tests due to their complexity	0.00	0.06	−0.03	−0.08	0.13	0.82	−0.09
38	I feel burdened about the cost of prenatal tests	0.11	0.10	0.14	0.25	−0.06	0.70	0.10
39	I feel burdened about the cost of post-partum care	0.15	0.16	0.23	0.38	−0.06	0.43	0.14
Coping in daily life								
10	I eat a balanced diet	−0.01	0.06	0.10	−0.00	0.03	−0.04	0.53
11	I take iron supplements regularly	0.07	−0.01	−0.05	−0.22	0.10	0.09	0.52
12	I avoid long-distance travel	−0.18	−0.09	−0.15	0.10	−0.11	−0.00	0.52
	Explained variance	4.09	3.29	3.09	3.02	0.27	2.21	1.54
	Explained (%)	11.40	9.10	8.60	8.40	6.30	6.10	4.30
	Cumulative (%)	11.40	20.50	29.10	37.50	43.80	49.90	54.20
	Kaiser–Meyer–Olkin				0.81			
	Bartlett's chi-squared test of sphericity				χ^2 = 6619.36, d.f. = 990, P < 0.001			
	Total Cronbach's α = 0.85	0.90	0.82	0.74	0.79	0.67	0.73	0.27

under control" and the additional factor "reconciliation of work life."

Criterion validity

The criterion validity was assessed by examining the correlations between the PSS, the Revised PDQ, and EPDS. The scale for all the pregnant women was correlated with the Revised PDQ (r = 0.67) and with the EPDS (r = 0.53). The scale for the working pregnant women was correlated with the Revised PDQ (r = 0.69) and with the EPDS (r = 0.46) (Table 4).

Reliability

The Cronbach's α-value of the overall scale for all the pregnant women and the working pregnant women was 0.85 and 0.86, respectively. The reliability coefficient for each of the factors was between 0.65 and 0.90, except for "coping in daily life" (Cronbach's α = 0.27) (Tables 2–3).

Final scale

This study reanalyzed the items due to the low reliability of "coping in daily life." The findings showed that the reverse items had a low or inverse correlation with the other items. Therefore, these items were revised and reversed; for example, "I eat a balanced diet" was changed to "I am unable to eat a balanced diet." The final scale consists of 36 items for all pregnant women and 43 items for working pregnant women (including seven additional items for "reconciliation of work life").

DISCUSSION

This study aimed to develop and evaluate a PSS. The 36 items for all pregnant women comprised seven factors with an explained variance of 54.22% and the 37 items for working pregnant women comprised eight factors with an explained variance of 60.29%. Regarding the rhe reliability of the scale for all pregnant women, there was a Cronbach's α of 0.85 and a Cronbach's α of 0.86 for working pregnant women. Therefore, both the validity and reliability of the PSS were verified as required for scale development (Hair *et al.*, 1995; Streiner & Norman, 2008).

However, the reliability evaluation for "coping in daily life" was very low, at 0.27. The item analysis revealed that the reverse items of "coping in daily life" showed an inverse or low correlation with the other items. This result is consistent with previous findings (Rodebaugh *et al.*, 2004), where the respondents appeared more likely to be confused by the reverse items than the straightforward ones. Rodebaugh *et al.* suggested that the items that were presented in a straightforward manner are more reliable; therefore, this study modified the reverse items to be presented in a straightforward manner.

This study included important items representing pregnancy stress in the PSS despite them having a low communality, which indicates the amount of variance in each variable. The level of communality was <0.4 for the items comprising "coping in daily life" and the item "I have morning sickness." However, it was decided to include these items in the PSS because they form an

Table 3 Factor analysis of the 54 items for the working pregnant women (n = 160)

Item no.	Item	Factor loading							
		F1	F2	F3	F4	F5	F6	F7	F8
Health of the mother and baby									
16	I am feeling the strain of anticipating an abnormal result from a prenatal test	0.87	0.06	0.02	0.09	0.10	0.11	0.09	0.03
17	I am worried about having an abnormal fetus	0.85	0.12	0.07	0.10	−0.01	0.07	0.06	−0.02
18	I am worried about whether the fetus is growing well	0.76	0.18	0.20	0.05	0.29	0.04	−0.01	0.07
14	I am worried about having a miscarriage	0.73	0.10	0.18	−0.08	−0.02	0.01	0.05	0.05
19	I am worried about the possibility of pregnancy complications	0.67	0.08	0.37	−0.00	0.11	−0.05	−0.11	0.00
15	I am worried about whether I will have a premature delivery	0.64	0.09	0.20	0.08	0.07	−0.04	0.02	−0.11
Reconciliation of work life[†]									
51	I am worried about the disadvantages in the workplace related to pregnancy	0.14	0.78	0.08	0.21	0.01	0.12	0.04	0.07
52	I am worried about losing my job or changing my position because of my pregnancy	0.15	0.76	0.18	0.12	0.05	0.06	0.05	0.02
56	Colleagues at work understand me as a pregnant woman	0.01	0.73	−0.03	−0.18	−0.02	0.03	0.16	0.19
49	Colleagues at work feel burdened by my pregnancy	0.24	0.67	−0.03	0.08	0.01	−0.07	0.16	−0.10
50	My work efficiency has fallen since I became pregnant	−0.01	0.56	0.36	−0.09	0.16	0.04	−0.18	−0.22
54	Taking maternity leave is not easy	0.03	0.55	0.12	0.24	0.21	0.12	0.00	0.18
53	I am worried about harming my baby's health because of my working conditions	0.11	0.53	0.10	0.21	0.34	−0.06	−0.04	−0.02
Maternal role									
24	Attending prenatal education classes (*taegyo*) is burdensome	0.13	0.05	0.76	0.03	0.02	0.07	0.10	0.05
23	Becoming a mother is a burden	0.07	0.08	0.73	0.14	−0.04	0.02	0.21	−0.20
25	It is difficult for me to calm my mind for the sake of my baby	0.11	−0.04	0.71	0.12	0.24	0.11	0.03	0.20
26	I am worried about interacting emotionally with my baby	0.18	0.09	0.69	0.06	0.18	−1.5	0.07	0.16
28	Preparing to take on the role of a mother is a burden	0.26	0.19	0.64	0.02	−0.02	0.03	0.03	−0.02
22	I am worried about taking care of my baby	0.35	0.19	0.59	0.08	0.08	−0.07	0.13	−0.18
Social atmosphere									
47	If my baby has some problems, our society seems to believe that the mother is the main cause	0.11	0.05	0.08	0.82	0.10	0.15	−0.05	0.07
45	Our society seems to assume that the mother has the primary responsibility of nurturing	0.06	0.03	0.06	0.81	0.06	0.01	−0.04	−0.18
46	Our society seems to expect that a mother will find it difficult to live her own life after delivery	−0.04	0.23	0.16	0.78	0.02	0.12	−0.03	−0.02
48	I am worried that our society lacks reliable childcare facilities	0.08	0.15	0.02	0.57	0.18	−0.27	0.19	0.17
Physical and psychological changes									
3	I have difficulty breathing	0.06	0.03	0.09	0.03	0.72	0.15	−0.02	−0.10
8	I get cramps in my legs	−0.01	0.04	0.06	0.08	0.71	0.18	0.09	−0.18

Table 3 Continued

Item no.	Item	Factor loading F1	F2	F3	F4	F5	F6	F7	F8
4	I urinate frequently	0.18	0.07	0.18	0.08	0.70	–0.25	0.04	0.08
5	I have difficulty sleeping deeply	0.18	0.30	0.00	0.12	0.69	–0.06	–0.01	0.03
Family support									
34	I am disappointed that my husband is indifferent to me	0.04	–0.01	–0.02	0.02	0.03	0.77	–0.04	–0.03
33	I am disappointed that my husband does not know my feelings	0.11	0.05	0.12	0.09	0.06	0.72	–0.02	0.16
29	I am disappointed that my family is not considerate of me	0.15	0.13	–0.07	0.16	0.09	0.68	0.16	–0.07
32	My husband helps with housework	–0.18	0.03	0.01	–0.13	–0.10	0.62	–0.01	0.20
Healthcare services									
37	I have difficulty determining prenatal tests	0.08	0.06	0.21	0.00	0.02	0.01	0.86	0.04
36	I have difficulty understanding prenatal tests due to their complexity	–0.06	0.10	0.09	–0.10	–0.09	0.12	0.83	–0.08
38	I feel burdened about the cost of prenatal tests	0.15	0.10	0.15	0.15	0.31	–0.15	0.59	–0.19
Coping in daily life									
9	My weight is under control	0.02	0.03	0.04	–0.04	–0.14	0.15	–0.19	0.73
10	I eat a balanced diet	0.06	0.05	0.04	–0.02	0.02	0.11	0.07	0.49
12	I avoid long-distance travel	–0.24	0.05	–0.10	0.09	–0.16	–0.18	–0.13	0.43
	Explained variance	4.08	3.47	3.47	2.67	2.60	2.40	2.12	1.50
	Explained (%)	11.00	9.40	9.40	7.20	7.00	6.50	5.70	4.00
	Cumulative (%)	11.00	20.40	29.80	37.00	44.00	50.50	56.20	60.30
	Kaiser–Meyer–Olkin	0.73							
	Bartlett's chi-squared test of sphericity	$\chi^2 = 4149.79$, d.f. = 1431, $P < 0.001$							
	Total Cronbach's $\alpha = 0.86$	0.88	0.82	0.83	0.78	0.74	0.65	0.71	0.27

† Factor of "reconciliation of work life" could only be applied to the working pregnant women.

important construct representing the difficulty one faces regarding controlling daily life in the concept analysis of pregnancy stress. Additionally, "I have morning sickness" was included in the PSS because it was considered as a representative symptom of pregnancy, with a factor loading value of >0.4. Pregnant women usually experience morning sickness during early pregnancy, but most of the participants were in their third trimester in this study, which is assumed to have low variance.

There are seven PSS factors for all pregnant women, and by adding one more, there are eight PSS factors for working pregnant women that reflect multidimensional properties of pregnancy stress. In this study, pregnancy stress was defined as the following:

> *Pregnancy stress occurs through the interaction between the pregnant woman and the fetus, family, and environment. Pregnancy stress refers to the perceived burden and worry and difficulty with the physical, psychological, and socioenvironmental factors that are associated with pregnancy.*

Furthermore, the constructs of the concept of pregnancy stress were based on Walker and Avant (2005). As a result, "coping in daily life," "social atmosphere," and "reconciliation with work life" were revealed as unique factors of pregnancy stress through the concept analysis, which differentiates the PSS from the existing scales. Each factor's properties are described below, depending on the period from antepartum to postpartum and the dimensions of the pregnant woman, her fetus, family, health care, and the environment.

"Coping in daily life" corresponds with a pregnant woman's difficulty to endure without any specific way to avoid or relieve daily life's changes and discomfort during the antepartum period. Although existing scales (Lobel *et al.*, 2008) focused on the change of pregnancy, the PSS reveals the hardship of self-control in daily life as a specific factor. For example, the items "I am unable to eat a balanced diet" and "I am unable to take iron supplements regularly" comply with the guideline for healthy eating during pregnancy. The results of this

Table 4 Correlation of the Pregnancy Stress Scale for all the pregnant women with the Revised Prenatal Distress Questionnaire (PDQ) and Edinburgh Postnatal Depression Scale (EPDS)

Measurement	Physical and psychological changes		Coping in daily life		Health of the mother and baby		Maternal role		Family support		Healthcare services		Social atmosphere		Reconciliation of work life†	Total	
	A-PSS	W-PSS	A-PSS	W-PSS	A-PSS	W-PSS	A-PSS	W-PSS	A-PSS	W-PSS	A-PSS	W-PSS	A-PSS	W-PSS	W-PSS	A-PSS	W-PSS
Revised PDQ	0.39	0.33	–0.01	–0.15	0.47	0.54	0.56	0.59	0.26	0.13	0.38	0.31	0.32	0.25	0.50	0.67	0.69
P-value	<0.001	<0.001	0.877	0.055	<0.001	<0.001	<0.001	<0.001	<0.001	0.108	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	< 0.001
EPDS	0.45	0.24	0.08	0.07	0.23	0.18	0.37	0.35	0.46	0.32	0.21	0.11	0.23	0.13	0.43	0.53	0.46
P-value	<0.001	0.002	0.115	0.367	<0.001	0.023	<0.001	<0.001	<0.001	<0.001	<0.001	0.179	<0.001	0.108	<0.001	<0.001	< 0.001

† Factor of "reconciliation of work life" could only be applied to the working pregnant women.
A-PSS, Pregnancy Stress Scale for all the Pregnant Women; W-PSS, Pregnancy Stress Scale for the Working Pregnant Women.

study are consistent with those of Kim (2009). Despite pregnant women being aware that iron or folic acid intake is important, they experience difficulty when selecting and eating a balanced meal that includes iron or folic acid. Only ~66% of them took iron supplements. Thus, "coping in daily life" highlights the importance of nursing prenatal education or care to help pregnant women to reduce experienced pregnancy stress.

"Social atmosphere" refers to the stress of pregnancy, delivery, and child care within one's social environment. This study found that pregnant women were stressed by high social expectations of being a good mother, social pressure that forces mothers to make sacrifices for their child, and concern regarding using daycare services. Despite sociocultural changes, Korean society's expectations for a "good mother" remain deeply rooted in culture. A social belief exists that children should be raised by their own mother (Choi *et al.*, 2005; Hays, 1996) and that mothers should search for a reliable daycare center in light of recent incidents or unexpected events that are related to infants and children at such facilities (Ministry of Health and Welfare, 2015). Therefore, pregnancy stress is not caused solely by a pregnant woman herself, but a great portion of the stress is also derived from the social environment. This study highlights the importance for society to participate in and support the series of processes that women experience from the antepartum to post-partum period.

"Reconciliation with work life" represents the burden one faces regarding welfare policy and workplace conditions from antepartum to post-partum. That is, pregnant women are not only burdened by pregnancy itself, but also by considerable hardship that is experienced in their workplace. Responses to the item "Colleagues at work feel burdened by my pregnancy" revealed that pregnancy was regarded as an unwelcome and unproductive event. This explains why pregnant women hesitate to notify others of their pregnancy in the workplace. They are concerned about increasing their colleagues' workloads (Millward, 2006). This study showed that "reconciliation with work life" is a major and important stress factor with which pregnant women must deal.

When the PSS is compared with other available scales, the major differences can be summarized as follows. First, this scale improves on the existing scales' limitations regarding their broadness and difficulties in describing each specific symptom. For example, items such as "I have morning sickness," "I urinate frequently," and "I get cramps in my legs" in this PSS

are more specific and detailed in their meaning, compared with, for example, "I worry about the pregnancy" in the Tilburg Pregnancy Distress Scale (Pop *et al.*, 2011) and "Physical symptoms of pregnancy such as vomiting, swollen feet, or backaches" in the Revised PDQ (Lobel *et al.*, 2008). Additionally, differently from the PSEI (Orr *et al.*, 1992), the PSS attempts to include not only stressors, but also the responses of pregnant women, representing more of the actual degree of stress that is perceived by women using the Likert type, compared with the dichotomous ("yes"/"no"), type of scale. Third, while the HRPSS was developed merely for pregnant women with high risks (Goulet *et al.*, 1996) and the RPES was developed only for those living in the countryside (Kornelsen *et al.*, 2011), the PSS is targeted at a much broader group, with no limit on the specific identification of women. Fourth, using the PSS allows for the measurement of working women who are pregnant, unlike the APSI (Razurel *et al.*, 2014) scale. In particular, Nast, Bolten, Meinlschmidt, and Hellhammer (2013) and Witt, Litzelman, Cheng, Wakeel, and Barker (2014) highlighted that understanding a conceptualization of stress precedes through a review of the pregnancy measurement scale, as well as a suggested rationale of pregnancy stress factors. As such, this study is meaningful in that it suggests pregnancy stress factors with sufficient theoretical and empirical grounds through conceptualization procedures by Walker and Avant (2005). However, the weakness of the PSS is that it has an extensive number of items due to its attempts to identify specific and multidimensional presenting stress factors, thus resulting in the need for further studies to provide a briefer version of the PSS.

This study developed the PSS to expand the concept of pregnancy stress. This scale not only focuses on pregnant women and babies, but also their social context. In particular, the multidimensional constructs of the pregnant woman, baby, family, healthcare services, and environment are comprehensively and systematically presented. Therefore, this study is expected to contribute to the development of nursing theory on pregnancy stress.

A few limitations should be considered when interpreting the results of this study. First, this study developed a scale to comprehensively assess stress during the entire pregnancy period, but the PSS needs to be developed so that it can be applied equally to all pregnant women in trimesters one, two, and three. Second, further research is required to reverify the reliability of "coping in daily life" for PSS stability. Third, to overcome the insufficient number of working pregnant respondents in this research, future studies should include a larger sampling size.

CONCLUSION

This study developed a PSS that measures stress that is caused by interactions between a pregnant woman and her surrounding environment, based on the perspective on stress of Lazarus and Folkman (1984). The PSS includes 43 items under an umbrella of eight factors: "physical and psychological changes," "coping in daily life," "health of the mother and baby," "maternal role," "family support," "healthcare services," "social atmosphere," and "reconciliation of work life." This scale allows an efficient assessment of the complex factors that contribute to pregnant women's stress and is expected to contribute to developing a nursing strategy for stress relief.

CONFLICT OF INTEREST

No conflict of interest has been declared by the authors.

AUTHOR CONTRIBUTIONS

Y. K. and C.-W. C. contributed to the conception and design of this study; Y. K. carried out the statistical analysis of the data and drafted the manuscript; and Y. K. and C.-W. C. made critical revisions to the paper for important intellectual content.

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