Development and Psychometric Testing of the Self-Management Difficulty Scale for Pregnant Nurses

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Abstract: Pregnant nurses are at high risk of perinatal abnormalities due to occupational hazards and face difficulties in performing appropriate self-management. To facilitate self-management among pregnant nurses, it is necessary to assess their difficulties. This study aimed to develop a Self-Management Difficulty Scale to measure self-management difficulties of pregnant nurses and evaluate its psychometric properties. The scale was developed in three phases: Phase I involved drafting the scale through literature reviews, panel discussions with experts, and pre-testing with pregnant nurses, resulting in 41 draft items that constituted self-management difficulties. In Phase II, a preliminary survey was conducted with 232 nurses from four hospitals in Japan to validate these items. Item and exploratory factor analysis were performed, and 28 items remained. In Phase III, a psychometric testing was administered to 172 pregnant nurses from 20 hospitals across 10 Japanese cities.

Results of confirmatory factor analysis revealed that the 28-item Self-Management Difficulty Scale consisted of 4 subscales: 'duelling roles of a nurse and a pregnant woman,' 'prioritising the foetus,' 'unsure about management,' and 'perceiving one's limits,' and they showed good construct validity. Additionally, concurrent and convergent validity, as well as the adequate reliability of the total and subscales, were confirmed. In conclusion, the Self-Management Difficulty Scale has both accepted validity and reliability. It can be used for screening perinatal abnormality risk, early intervention, and promoting self-management behaviours. Further study is required to validate the construct validity of this scale using various types, the known-group technique, and predictive validity in other populations of pregnant women.

Keywords: Midwife, Nurse, Nursing management, Occupational health, Perinatal abnormalities, Pregnant midwives, Pregnant nurses, Self-management, Self-management difficulties scale

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Introduction

The continued employment of women during pregnancy is becoming increasingly common worldwide. In developed countries, the labour force participation rate of women during their childbearing years is approximately 80%, and more than 80% continue to work after giving birth.[1,2] In Japan, 69.5% of women continue to work before and after the birth of their first child, a number that is on the rise.[3] The Government of Japan has emphasized that promoting women's activities is essential to address the social issues of declining birth rates, an aging society, and a decline in the working-age labour force. The government aims to increase the rate of women remaining in employment before and after childbirth, ensure sustainable labour productivity, and raise the capacity for innovation.[3]

However, the risk of perinatal abnormalities, such as stillbirths and preterm births, among working pregnant women is higher than that among non-working pregnant women, with nurses and midwives specifically at a higher risk.[4] Work factors influence the risk of perinatal abnormalities, including night work, long working hours, standing work, heavy work, and handling of hazardous drugs.[5] Nurses perform these hazardous tasks on a combined daily basis, and the incidence of threatened preterm birth among them is 36%, which indicates that approximately one in three mothers' foetal lives are at risk.[6] In Japan, the Labor Standards Law and maternal protection provisions have been enacted to restrict or prohibit hazardous work. However, 47.6% of pregnant nurses obtain night work exemptions, and 19.0% obtain other exemptions, indicating that the maternal protection provisions are not fully applied.[7] Even in other countries, multiple nurses continue to work overtime and night shifts even after becoming pregnant.[8] This is related to various issues such as the busyness of clinical practice and the shortage of nurses.[7] Therefore, concrete measures to enable pregnant nurses to continue working healthily have not yet been considered.

Appropriate self-management behaviours by pregnant women are essential for preventing perinatal abnormalities.[9] This has been emphasised as particularly important for pregnant nurses in hazardous environments.[7] However, pregnant nurses face difficulties performing self-management behaviours, associated with psychosocial stressors specific to the nurses, as well as a harsh work environment.[10,11] Pregnant nurses suffer from the physical demands of work and a nursing organisational culture that ignores these difficulties or lacks maternal protection provisions.[12] Additionally, pregnant nurses have specifically high occupational stress compared to other professions.[13] Compared to other professions, nurses have a strong sense of duty to prioritise patients,[14] but face difficulties in prioritising the life of their foetus in the workplace.[13] The specific difficulties are one factor in preventing self-management behaviours among pregnant nurses.

However, the psychological characteristics of pregnant nurses have only been reported in qualitative studies, and tools to quantitatively measure them have not yet been developed. This means that there is no effective way to identify self-management difficulties or the risk status of pregnant nurses. To encourage self-management behaviours in pregnant nurses, a scale needed to be developed to clarify the background factors that contribute to self-management difficulties and affect the level of practice.

Conceptual Framework and Literature Review

Human self-management behaviour is explained as a complex and dynamic phenomenon influenced by condition and individual factors, physical and social environment, knowledge, beliefs, self-regulation abilities, and social facilitation.[15] Regarding the self-management of pregnant nurses, the influence of busy work and social environments is particularly

strong; therefore, health beliefs, as well as appropriate self-regulation skills and abilities, are crucial in promoting their self-management.[7] The self-management recognition model for pregnant nurses[10] effectively explains these characteristics of their self-management, and this study was guided by this model.

The model describes a central conceptual process of 'duelling roles' and four additional concepts.[10] Pregnant nurses are deeply aware of the 'weight of one's professional responsibilities' in the workplace. Therefore, regardless of physical concerns or anxiety, they strive to fulfil their nursing roles as reliable team members without burdening their colleagues or patients. However, through continued work, they are gradually 'perceiving one's limits' of being a nurse and of protecting their health and patients. Simultaneously, meaningful interactions with patients and colleagues lead to 'delight in nursing' and encourage continued work. Pregnant nurses thus discover the importance of 'prioritising the foetus' and develop a work style aligned with this, striving to continue working safely.[10]

Previous studies have demonstrated that this model accurately reflects the self-management difficulties experienced by pregnant nurses. For example, pregnant nurses' recognition of high levels of 'duelling roles of a nurse and a pregnant woman,' and 'perceiving one's limits,' and low levels 'prioritising the foetus' aspects was associated with lower self-management behaviours and sense of coherence[7] and higher levels of occupational stress.[13] This suggests that these concepts can have a profound impact on maternal and foetal health. However, there is a lack of a scale that can reflect pregnant nurses' self-management difficulties, and these difficulties cannot be measured quantitatively.

Study Aim

This study aimed to develop a Self-Management Difficulty Scale (SMDS) for pregnant nurses and evaluate its psychometric properties.

Methods

Design: This study employed the scale development procedure outlined by Boateng et al.,[16] comprising three phases: Phase I (scale drafting), Phase II (preliminary survey), and Phase III (psychometric testing). In Phase I, a literature review and focus group discussions were conducted to determine the content of the scale. In Phases II and III, cross-sectional studies were conducted. These studies were conducted in accordance with the STROBE guidelines[17] to enhance the reporting of observations.

Ethical Considerations: This study was approved by the Ethical Review Board of Hokkaido University (approval number: 22-19/23-76) and was conducted in accordance with the principles outlined in the Declaration of Helsinki.[18] The participants received a detailed explanation of the study and were assured that their involvement was entirely voluntary. Completing the questionnaire provided consent to participate in the study. The data were handled in strict confidentiality, and anonymity was maintained.

Instrument Development

Phase I. Scale Drafting: The scale drafting process consisted of the following three steps.

Step 1: *Item development.* Based on a self-management model for pregnant nurses,[10] 41 items that were considered components of their self-management difficulties were developed through a panel consensus of five experts—researchers with a doctoral qualification in nursing, and midwives and nurses with over 10 years' experience in clinical care—to avoid errors or divergent interpretations and ensure that each item did not deviate from the existing model. After several panel discussions, all item discrepancies were reconciled. Finally, 41 items were drafted (Draft 1) and rated on a 6-point Likert scale, with responses ranging from 1 (strongly disagree) to 6 (strongly agree).

Step 2: *Examining item content validity.* For Draft 1, content validity was examined by the same group of experts as earlier. The item content validity

index (I-CVI) ranged from 0.91 to 1.00, and the scale content validity index (S-CVI) was 0.96 for the 41 items (Draft 2).

Step 3: *Pre-test.* Three nurses who had experience working during pregnancy completed Draft 2. They were then interviewed using the cognitive interview method to assess the clarity and comprehensibility of each item in the questionnaire and to determine if any inappropriate wording was used. The results of the interviews revealed that only one item required adjustment to make the wording easier to understand while maintaining its meaning. No other items were found to be difficult or inappropriate for the participants to understand. Finally, 41 items were developed. (Draft 3)

Phase II. Preliminary Survey

The questionnaires (Draft 3) were distributed to 285 registered nurses and midwives who had worked during pregnancy in 87 wards of four general hospitals in Japan. The participation criteria were those who worked during pregnancy and those in the last trimester of pregnancy or within five years postpartum. The exclusion criteria were 17 years or younger, and nursing managers (excluding deputy nursing managers). The sample size was based on the fact that the ratio of the number of research participants (N) to the number of questions (q) in the developed questionnaire was between N:q = 5 or more:1,[19] which means that with q = 41, at least 205 participants were needed for this study. Therefore, to account for invalid responses, we assumed a response rate of 70% and a final distribution number of 285. Hospital administrators selected and recruited the participants based on the inclusion criteria and distributed the questionnaires. Consequently, a total of 235 participants (response rate: 82.5%) were recruited, of whom 232 (valid response rate: 98.7%) provided valid responses after excluding non-responses and those that did not satisfy the participant criteria.

The analysis of this preliminary survey consisted of the following three steps:

Step 4: *Item analysis.* In the item analysis, the frequency distribution, mean and standard deviation of each item were calculated, and the ceiling effect, floor effect and correlation between items (item-item [I-I] correlation analysis) as well as the correlation between each item and total scale were examined (item-total [I-T] correlation analysis). No items showed ceiling or floor effects. The I-I correlation analysis revealed strong correlations of 0.66-0.70 in 4 pairs (8 items), with only 1 item retained in each pair. Consequently, 4 items were excluded due to low factor loadings and reliability. In the I-T correlation analysis, three items with $r < 0.30$ were excluded.[20] This resulted in 34 items remaining (Draft 4) (Appendix 1).

Step 5: *Exploratory factor analysis.* Exploratory factor analysis (EFA) was conducted on Draft 4. Prior to EFA, the Kaiser-Meyer-Olkin measure of sampling adequacy for Draft 4 was 0.90, and Bartlett's sphericity test showed a significant difference ($\chi^2 = 2785.43$, df = 378, $p < 0.001$), confirming that it was suitable for factor analysis. The number of factors was determined using a scree plot of the factors before rotation and their cumulative contribution rates, and was set at 4, which showed a cumulative contribution rate of 51.6%. Factor analysis was conducted using the maximum likelihood method and promax rotation, with factor loadings of 0.40 or higher as the criterion.[21] Two items with high loadings on two or more factors and four items with factor loadings of less than 0.40 were deleted, resulting in the final selection of four factors and 28 items (Draft 5). The factors were named Factor 1 (duelling roles of a nurse and a pregnant woman), Factor 2 (prioritising the foetus), Factor 3 (unsure about management), and Factor 4 (perceiving one's limits). Inter-factor correlations ranged from 0.30 to 0.64, and Cronbach's alpha coefficient for the entire scale (28 items) was 0.92, while that for the 4 factors ranged from 0.70 to 0.89 **(Table 1).**

Table 1. Results of exploratory factor analysis and reliability coefficients for the Self-Management Difficulties Scale (n = 232)

No	Items	Factor			
		1	2	3	4
Factor 1: Duelling roles of a nurse and a pregnant woman (α = 0.89)					
17	I feel my mental strain is intensified by my work.	0.69	0.09	0.07	-0.14
10	I feel my physical strain is intensified by my work.	0.66	0.05	0.06	-0.09
31	I have fears for my own and foetal health at work.	0.66	0.03	0.27	-0.06
35	My work environment forces me to push myself.	0.64	-0.19	0.00	0.04
15	I sometimes feel that anomalies can occur at any time in the continuation of my work.	0.62	0.16	-0.04	0.02
30	I feel limited in managing my physical condition while continuing to work.	0.58	-0.11	0.20	-0.17
3	I struggle between my role as a mother of my foetus and my role as a nurse who should fulfil responsible duties.	0.51	-0.02	0.07	0.27
21	I cannot take time off or limit my work until some abnormality occurs.	0.50	-0.15	0.11	0.03
39	I sometimes give up dangerous work as long as I continue to work.	0.48	-0.24	0.03	0.20
2	During the undisclosed pregnancy, I was unable to avoid hazardous work.	0.43	-0.11	0.05	0.18
28	I sometimes work hard for fear that my relationships will deteriorate.	0.40	-0.23	0.09	0.27
41	As long as work continues, it is unavoidable that self-management will be inadequate.	0.40	-0.20	-0.01	0.21
Factor 2. Prioritising the foetus (α = 0.77)					
27	I select and coordinate my work to protect mine and my foetal health.	-0.13	0.67	0.19	0.11
8	At work, my first priority is the safety of the foetus.	0.14	0.62	-0.05	-0.28
38	I am able to work while putting the foetus first.	-0.09	0.60	0.00	-0.22
9	I work with the foetal health as a priority and do not over-emphasize relationships at work.	0.15	0.57	-0.05	-0.20
29	I am able to control my work well according to my physical condition.	-0.27	0.52	-0.10	0.18
40	I actively try to receive support from those around me.	-0.04	0.46	-0.02	0.02
13	I have found my own methods and tools to manage my health.	0.01	0.45	-0.06	0.20
Factor 3. Unsure about management (α = 0.77)					
24	I am unsure of effective methods of managing my condition.	-0.09	-0.15	0.94	-0.13
26	I have tried and failed to find the appropriate way to manage my physical condition and my work.	0.12	0.17	0.52	0.15
5	I am sometimes unsure whether my health condition is normal or abnormal.	0.21	0.10	0.41	0.09
32	I am unsure to what level is the safe range of my work.	0.20	-0.21	0.41	0.07
Factor 4. Perceiving one's limits (α = 0.70)					
37	I feel frustrated and helpless at work because of my pregnancy.	0.05	0.12	0.24	0.46
23	I sometimes feel guilty being in the workplace by being pregnant.	0.24	-0.11	0.16	0.45
12	I sometimes forget my pregnancy through concentration on my work.	-0.05	0.00	0.02	0.44
1	I was hesitant to disclose my pregnancy.	0.28	-0.14	-0.01	0.43
7	I sometimes find it difficult to perceive subjective symptoms during working.	0.20	0.03	0.09	0.40
	Inter-factor correlation: Factor 1	–	0.40	0.64	0.57
	Factor 2		–	0.30	0.31
	Factor 3			–	0.50
	Factor 4				–

Step 6: *Examining item content validity.* Six professionals examined the content validity of Draft 5: an obstetrician-gynaecologist researcher with a Doctor of Medicine qualification, researchers with a Doctor of Nursing qualification, as well as midwives and nurses with over 10 years' experience in clinical care and experience working while pregnant. The I-CVI ranged from 0.97 to 1.00, and the S-CVI was 0.96 for the 28 items; thus, Draft 5 was acceptable.

For psychometric testing, the Self-Management Difficulty Scale (SMDS) consisted of 28 items. Each item is scored on a 6-point Likert scale, with responses ranging from 1 (strongly disagree) to 6 (strongly agree). Seven positive items were reversed before the scores were summed. The overall score ranged from 28 to 168, with higher scores indicating greater levels of SMDS.

Phase III. Psychometric Testing

Sampling and Setting: The participants were registered nurses and midwives working in or attending 20 hospitals in 10 cities in Japan. The inclusion criteria were 1) pregnant women, and 2) continuing to work as nurses or midwives after pregnancy. The exclusion criteria were: 1) 17 years or younger, and 2) nursing managers (excluding deputy nursing managers). Based on the above sample size criteria with q = 28 questions, a minimum of 140 participants were required for this study.[19] Therefore, to account for invalid responses, we assumed a response rate of 70% and a final distribution number of 215. Hospital administrators selected participants and distributed questionnaires in accordance with the inclusion criteria.

Instruments: Four instruments were used for data collection. The Personal Demographic, Obstetric, and Working Conditions Questionnaire, and three other instruments to test concurrent and convergent validity, as follows.

The Personal Demographic, Obstetric, and Working Conditions Questionnaire: This questionnaire includes age, history of pregnancy, number of deliveries, history of miscarriage, medical history, and marital status, which were measured. Obstetric conditions were also assessed, including gestational age and pregnancy complications (e.g., threatened preterm birth). The working conditions were ascertained by the profession (nurse or midwife), employment type, and hazardous work status. Hazardous work included night work, heavy lifting, prolonged standing, overtime, and irregular break times. Night work was measured by 'Yes' or 'No,' and other hazardous work was measured on a four-point Likert scale from 'No' to 'Always.' Some of these items were used for hypothesis testing. It was hypothesized that younger age, fewer births, more gestational symptoms, frequent standing and heavy lifting, overtime work and less break time would be associated with higher SMDS.

The Self-Management Behaviours Questionnaire: This questionnaire complied with the World Health Organization[9] and Japan Midwifery Society Guidelines for Pregnancy,[22] and was developed by our research team. The questionnaire comprises six subscales (e.g., diet and nutrition), 35 items. A 6-point Likert scale ranging from 1 (not at all) to 6 (always) was used, and examples of items include 'I do not smoke.' The total scores ranged from 35 to 210, with higher scores indicating greater adherence to self-management behaviours. The questionnaire evaluates attributes of pregnant women and has been confirmed for reliability and validity.[7,13] Cronbach's alpha in the present study was 0.92. This questionnaire was used to test concurrent validity: the SMDS measures difficulties with self-management and is therefore hypothesizsed to be negatively correlated with this questionnaire score, which directly assesses the level of self-management behaviours.

The Brief Job Stress Questionnaire (BJSQ): The BJSQ was developed by Inoue et al., and its evaluation attribute was workers.[23] In this study, it was used to evaluate three key components: job demand, job control, and social support, each measured by three items. Social support was assessed across three sources: managers, colleagues, and family and friends. Responses to the items were rated on a 4-point Likert scale, with responses ranging from 1 (disagree) to 4 (agree). Examples of items include 'I have to work hard' and 'I can work at my own pace.' Each subscale—job demand, job control, and each source of social support—had

a total possible score ranging from 3 to 12, with higher scores indicating stronger perceptions of each dimension. To classify occupational stress levels, job demand and job control scores were divided at their median values (Mdn). Occupational stress levels were classified into three categories: high (job demand > Mdn and job control < Mdn), middle (either job demand > Mdn and job control > Mdn, or vice versa), and low (job demand < Mdn and job control > Mdn). The reliability and validity of the BJSQ have been confirmed by its developers.[23] The scale is a widely accepted instrument for occupational stress assessment in Japan and is recommended by the Ministry of Health, Labour and Welfare. In this study, Cronbach's alpha for job demand and control were 0.84 and 0.78, respectively. Cronbach's alpha for social support from managers, colleagues, and family and friends were 0.89, 0.85 and 0.88, respectively. This scale was used to test convergent validity. Previous studies reported that high levels of occupational stress is a similar concept related to the high levels of self-management difficulties of pregnant nurses.[13] Therefore, it was hypothesized that the SMDS score would positively correlate with the occupational stress score.

The Sense of Coherence Scale 13 (SOC-13): The Japanese version of the SOC-13 was used.[24] This SOC-13 is a shortened form of Antonovsky's SOC-29,[25] and translated into Japanese by Yamazaki.[24] It consists of 13 items and three subscales; comprehensibility, manageability, and meaningfulness.[24] Each item is evaluated using a 7-point Likert scale, with responses from 1 (strongly disagree) to 7 (strongly agree). Examples include, 'Do you ever lose confidence in maintaining self-control?' The total score was calculated by summing all 13 items, after the five negative items were reversed. The score ranged from 13 to 91. Higher scores indicated higher levels of SOC. The SOC scale has been verified for its reliability and validity.[26] Cronbach's alpha in the present study was 0.81. This scale was used to test convergent validity. Previous studies have suggested an association between high SOC-13 and high levels of self-management behaviours of pregnant nurses.[7] We hypothesized that low SMDS would also be associated with high SOC-13, based on a previous study.

Data Collection: The data collection period was from January to June 2024. After receiving approval, the researchers informed hospital administrators of the study's objectives and methodology. These administrators then relayed the information to hospital staff. Hospital staff identified eligible working pregnant nurses based on the inclusion criteria. They also distributed questionnaires and requested participants to complete them. The participants were instructed to place the completed questionnaires in a box at each hospital. No specific location was required for completing the questionnaires. The deadline for submission was set at 1-month post-distribution. All completed questionnaires were collected and mailed to the researchers by the hospital administrators.

Statistical Analysis: For the analysis, the consensus-based standards for the selection of health measurement instruments (COSMIN) checklist items[27] were used. Descriptive statistics were calculated for the individual attributes. The statistical significance was set at $p < 0.05$. Statistical analyses were conducted using JMP Pro software (ver. 16.1, SAS Institute Inc.).

A confirmatory factor analysis (CFA) was conducted to test construct validity. In the CFA, a model was created with the extracted factors as significant variables and the items belonging to them as observed variables. A covariance structure analysis was also conducted. The following evaluation indices were used to evaluate the model: root mean square error of approximation (RMSEA), adjusted goodness-of-fit index (AGFI), goodness-of-fit index (GFI), and comparative fit index (CFI). The model fit criterion values are RMSEA < 0.05, GFI > 0.90, AGFI > 0.90 and CFI ≥ 0.95.[28,29] Additionally, the Self-management Behaviours Questionnaire was used to verify concurrent validity, the BJSQ and SOC-13 were used to verify convergent validity, and each scale was confirmed using Shapiro-Wilk's normality test, followed by Spearman's rank correlation coefficient to confirm the concurrent and convergent validity. Occupational stress, as measured

by the BJSQ, was transformed into dummy variables ranging from low (1) to high (3) stress. The hypothesis verification was tested using items predicted to be related to the SMDS, such as the Personal Demographic, Obstetric and Working Conditions items. Cronbach's alpha coefficients and the split-half method were used to confirm the internal reliability of the SMDS.

Results

The results of 175 responses (81.3% response rate) and 172 valid responses (98.3% valid response rate) were analysed for reliability and validity. The mean (standard deviation) age of the participants was 31.7 (4.3) years (**Table 2**).

Table 2. Participant characteristics (n = 172)

Variables	Frequency (%) /Mean (SD)
Age (years); mean (SD)	31.7 (4.3)
Parity	
Primipara	80 (46.5)
Multipara	92 (53.5)
Gestation period	
First trimester	19 (11.1)
Second trimester	77 (44.8)
Third trimester	76 (44.1)
Marital status	
Married	163 (94.8)
Unmarried (single/divorced)	9 (5.2)
Medical history	
Yes	48 (27.9)
Previous abortions history	
Yes	30 (17.9)
BMI at non-pregnancy (kg/m^2); mean (SD)	21.4 (3.0)
Pregnancy conditions	
Threatened abortion	8 (4.8)
Threatened preterm birth	11 (6.6)
Hypertensive disorders of pregnancy	3 (1.8)
Gestational diabetes mellitus	4 (2.4)
Employment type	
Regular	157 (91.3)
Non-regular	15 (8.7)
Profession	
Registered nurse	158 (91.9)
Midwife	14 (8.1)
Department	
Outpatient	27 (15.7)
Ward	115 (66.9)
ICU-HCU	7 (4.1)
Operation room	5 (2.9)
Others	18 (10.5)

Note. SD = Standard deviation; BMI = Body mass index; ICU = Intensive care unit; HCU = High care unit

Reliability: Ceiling and floor effect, as well as I-T correlation analyses, were performed on 28 items. No items exhibited a ceiling or floor effect, and no items had I-T correlations of r < 0.30. Cronbach's alpha coefficient for the entire scale (28 items) was 0.92, and for the 4 factors ranged from 0.71 to 0.91. The reliability of the split-half reliability test was r = 0.91, indicating sufficient reliability.

Validity

Construct Validity: Confirmatory factor analysis showed the initial model fit was RMSEA = 0.063, GFI = 0.910, AGFI = 0.886, CFI = 0.881, AIC = 13429.469. After freeing some covariances for model modifications, the final model fit showed RMSEA = 0.043, GFI = 0.958, AGFI = 0.945, CFI = 0.950, and AIC = 13423.048. All factor loadings were more than 0.30, confirming the structural validity of the entire model **(Figure 1)**.

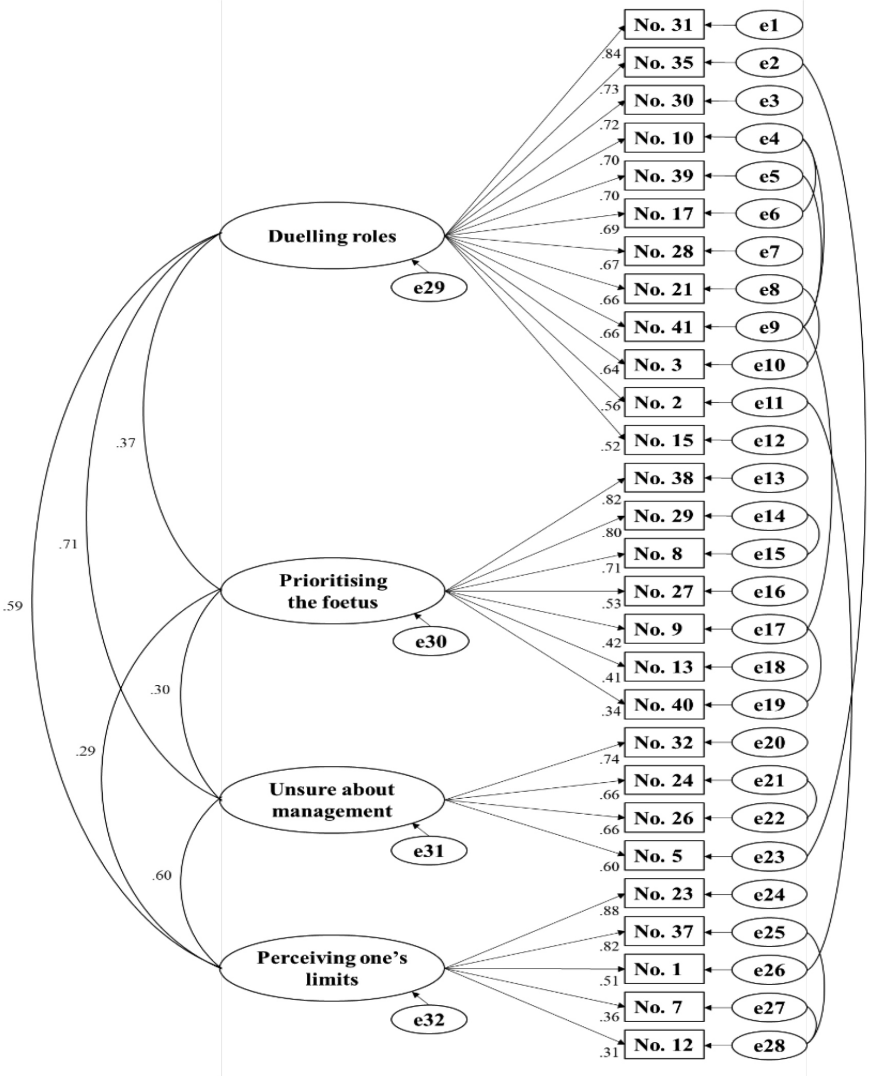

Figure 1. Structural equation model diagram (modified)

Note. Duelling roles = Duelling roles of a nurse and a pregnant woman

The SMDS consisted of four factors, which were defined as follows: Factor 1 (duelling roles of a nurse and a pregnant woman) refers to the conflict between the roles of a nurse and a mother. Factor 2 (prioritising the foetus) is the conscious prioritisation of the life of the foetus while at work. Factor 3 (unsure about management) is characterized by uncertainty and insecurity regarding how to manage one's health conditions. Factor 4 (perceiving one's limits) is one's perception of the limits of one's existence as a nurse while pregnant.

Concurrent and Convergent Validity: Spearman's rank correlation coefficient between the total score of SMDS and the self-management behaviours score was $r = -0.40$ ($p < 0.001$), a significant negative correlation, confirming the concurrent validity of the SMDS. Spearman's rank correlation coefficient between the total SMDS score and occupational stress was $r = 0.55$ ($p < 0.001$), and SOC-13 was $r = -0.47$ ($p < 0.01$), confirming significant correlations as hypothesized and confirming convergent validity.

Discussion

This study developed an SMDS for pregnant nurses and examined its psychometric properties. The analysis results confirmed good reliability and validity of the SMDS. The development of this scale began with the construction of a theory in a grounded theory study of health management among working pregnant nurses. Subsequently, we followed the scale development strategy proposed by Boateng et al.[16] in phases and confirmed its reliability and validity according to the COSMIN guidelines[27] in this study. This scale, developed through a rigorous process and repeated verification by experts, was appropriately adapted to the unique background of self-management difficulties among pregnant nurses.

The analysis revealed that the SMDS for pregnant nurses consisted of 4 subscales, 'duelling roles of a nurse and a pregnant woman,' 'prioritising the foetus,' 'unsure about management,' and 'perceiving one's limits,' and 28 items. All subscales were consistent with the concepts described in the health management theory for pregnant nurses,[10] which forms the basis of this scale. By removing items with high inter-item correlations and factor loadings of less < 0.40, the accuracy and statistical rigor of the constituent items were further ensured, further demonstrating the high applicability of SMDS to pregnant nurses.

The CFA results showed an excellent model fit and confirmed good construct validity. Furthermore, the correlations with self-management behaviours score, occupational stress, and SOC-13 fell within the range of 0.40–0.80, which is the cutoff value for correlations between scales for the same characteristics, ranging from 0.40 to 0.80,[30] thereby confirming concurrent and convergent validity. These findings suggest that this scale accurately captures theoretical constructs and provides a highly valid measurement for practical use. Regarding reliability, Cronbach's alpha for the overall scale and each subscale exceeded 0.70. This indicates that each subscale's items are highly interrelated and effectively measure the same dimension. It also demonstrates the scale's stability under similar conditions. The SMDS was confirmed to be a clinically useful scale that combines validity and reliability.

The SMDS evaluates psychological background factors that may influence the actual self-management behaviours of pregnant nurses, rather than their actual self-management behaviours. This study confirmed the concurrent validity of the SMDS and the Self-management Behaviours Questionnaire; however, further prospective research is needed to determine whether this scale can predict actual self-management behaviours, work, and perinatal abnormalities. Additionally, nurses have a high risk of chronic diseases, such as gestational diabetes, and in recent years, the difficulties of self-management of these diseases and work have also been recognised as issues.[31] The SMDS could also be useful for assessing self-management difficulties in nurses with such pregnancy complications,

and further verification is needed. Although this scale is intended for pregnant nurses, shift work, night shifts, and occupational ergonomic stress factors are also contributing to poor health and adverse pregnancy outcomes among non-nurse healthcare workers and working pregnant women.[32–34] Furthermore, the deterioration of the health of working pregnant women could lead to serious social issues, such as economic losses associated with sick leave.[35] To support the safe continuation of employment for pregnant women, early risk screening is important, and the SMDS can be a useful tool that is easy to use for this purpose. Further studies are needed to verify the applicability of the SMDS to pregnant women in other occupations.

Limitations

The study was reliable and validated according to the COSMIN but requires further validation for responsiveness and interpretability. Although the participants came from several regions, this study was restricted to women from Japan. This study also included only relatively healthy pregnant women. Therefore, participant and response biases may have occurred. Future research should expand the scale's validation to a broader range of study areas, countries, and subjects, and investigate its potential applications. Although this scale was designed for pregnant nurses, its applicability to pregnant women in other professions should be verified.

Conclusions

The SMDS for pregnant nurses was developed in this study, consisting of 28 items, and 4 subscales: 'duelling roles of a nurse and a pregnant woman,' 'prioritising the foetus,' 'unsure about management,' and 'perceiving one's limits.' The results of the item, exploratory factor, and confirmatory factor analyses confirmed the reliability and validity of the scale. Further study is required to validate the construct validity of this scale using various types, the known-group technique, and to assess the predictive validity of this scale in other populations of pregnant women.

Implications for Nursing Practice

The SMDS for pregnant nurses was reliable, validated, and clinically applicable. This scale will be beneficial for pregnant nurses, hospital managers, and healthcare providers. The scale measures factors that promote or inhibit self-management behaviours among pregnant nurses. Therefore, pregnant nurses can objectively understand the psychological characteristics related to self-management behaviours and use this information to review and improve their awareness, behaviours, and working style. For hospital managers and healthcare providers, this scale can be beneficial. To ensure the safe continuation of work for pregnant nurses, appropriate support from nursing managers and healthcare providers—who have the greatest influence on them—is essential.[13,36] However, assessing the risks for pregnant women at work is very challenging, as it requires sufficient knowledge and understanding from employers and healthcare providers.[35,37] In this regard, the use of the SMDS is useful for risk screening of pregnant nurses and for considering specific effective support measures. The scale is not influenced by the stage of pregnancy and can be used at any time. Therefore, measuring it at regular intervals, such as at the time of the pregnancy report or at mid-term, may help hospital managers and healthcare providers assess the effectiveness of their support.

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Appendix

Appendix 1. Results of item analysis (41 items version) (n = 232)

No	Items	Mean	SD	M+SD	M−SD	I−T	
1	I was hesitant to disclose my pregnancy.	3.66	1.56	5.22	2.09	0.50	
2	During the undisclosed pregnancy, I was unable to avoid hazardous work.	4.49	1.36	5.85	3.13	0.54	
3	I struggle between my role as a mother of my foetus and my role as a nurse who should fulfil responsible duties.	4.50	1.25	5.75	3.24	0.60	
4	I set aside time to confront my condition.	3.87	1.18	5.05	2.69	0.35	‡
5	I am sometimes unsure whether my health condition is normal or abnormal.	3.69	1.29	4.98	2.40	0.46	
6	I feel I have to fulfil my responsibilities as a nurse, even as a pregnant woman.	4.80	1.01	5.81	3.79	0.42	†
7	I sometimes find it difficult to perceive subjective symptoms during working.	3.97	1.25	5.22	2.72	0.54	
8	At work, my first priority is the safety of the foetus.	3.20	1.03	4.23	2.18	0.42	
9	I work with the foetal health as a priority and do not over-emphasise relationships at work.	3.75	1.23	4.97	2.52	0.40	
10	I feel my physical strain is intensified by my work.	4.45	1.11	5.56	3.34	0.50	
11	I sometimes feel I want to do more work.	3.11	1.30	4.41	1.80	0.25	†
12	I sometimes forget my pregnancy through concentration on my work.	3.32	1.41	4.73	1.90	0.35	
13	I have found my own methods and tools to manage my health.	3.90	1.26	5.16	2.64	0.32	
14	I am able to resolve my concerns and questions promptly.	3.28	1.05	4.34	2.23	0.59	‡
15	I sometimes feel that anomalies can occur at any time in the continuation of my work.	4.14	1.19	5.33	2.95	0.45	
16	My workload is commensurate with my physical condition.	3.56	1.03	4.59	2.53	0.54	‡
17	I feel my mental strain is intensified by my work.	4.03	1.26	5.29	2.76	0.45	
18	I am making innovations working methods for safety.	3.30	0.97	4.28	2.33	0.24	†
19	I manage my health well according to my physical condition.	3.40	1.08	4.48	2.31	0.40	†
20	I feel limited in the effectiveness of self-care and treatment to control pregnancy symptoms as long as to continue working.	3.78	1.44	5.22	2.33	0.59	†
21	I cannot take time off or limit my work until some abnormality occurs.	4.63	1.28	5.92	3.35	0.57	
22	I am able to practice my own way of coping with physical symptoms.	3.32	0.99	4.31	2.33	0.41	‡
23	I sometimes feel guilty being in the workplace by being pregnant.	4.02	1.38	5.40	2.64	0.56	
24	I am unsure of effective methods of managing my condition.	3.24	1.05	4.29	2.18	0.51	
25	My health management contribute to my wellbeing.	3.53	0.93	4.46	2.61	0.32	‡
26	I have tried and failed to find the appropriate way to manage my physical condition and my work.	3.81	1.01	4.82	2.81	0.34	
27	I select and coordinate my work to protect mine and my foetal health.	3.34	0.99	4.32	2.35	0.39	
28	I sometimes work hard for fear that my relationships will deteriorate.	3.97	1.35	5.32	2.62	0.66	

Appendix 1. Results of item analysis (41 items version) (n = 232) (Cont.)

No	Items	Mean	SD	M+SD	M-SD	I-T	
29	I am able to control my work well according to my physical condition.	3.63	0.95	4.58	2.68	0.59	
30	I feel limited in managing my physical condition while continuing to work.	3.75	1.29	5.05	2.46	0.71	
31	I have fears for my own and foetal health at work.	4.21	1.20	5.41	3.01	0.64	
32	I am unsure to what level is the safe range of my work.	4.16	1.34	5.49	2.82	0.64	
33	I fear that my pregnancy will worsen my relationship.	3.42	1.41	4.83	2.00	0.65	†
34	I am working in good health throughout the gestation period.	3.25	1.41	4.66	1.84	0.43	‡
35	My work environment forces me to push myself.	3.70	1.32	5.02	2.37	0.67	
36	I believe that the support of surroundings is essential for safe working.	1.88	0.85	2.73	1.04	0.11	†
37	I feel frustrated and helpless at work because of my pregnancy.	3.45	1.30	4.75	2.15	0.42	
38	I am able to work while putting the foetus first.	3.44	1.18	4.62	2.26	0.61	
39	I sometimes give up dangerous work as long as I continue to work.	4.09	1.19	5.28	2.90	0.69	
40	I actively try to receive support from those around me.	2.72	0.91	3.63	1.81	0.36	
41	As long as work continues, it is unavoidable that self-management will be inadequate.	3.97	1.05	5.02	2.92	0.47	

Note. M = Mean; SD = Standard deviation; I-T = Item-total correlation;
† = Items excluded by item analysis; ‡ = Items excluded by exploratory factor analysis

การพัฒนาเครื่องมือและการทดสอบคุณสมบัติเชิงจิตวิทยาของแบบประเมินความยากลำบากในการจัดการตนเองสำหรับพยาบาลที่ตั้งครรภ์

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บทคัดย่อ: พยาบาลที่ตั้งครรภ์มีความเสี่ยงสูงต่อความผิดปกติในระยะปริกำเนิด อันเนื่องมาจากปัจจัยเสี่ยงจากการทำงานและมีข้อจำกัดในการจัดการดูแลตนเองอย่างเหมาะสม ในการส่งเสริมการดูแลสุขภาพตนเองอย่างมีประสิทธิภาพจึงจำเป็นต้องมีการประเมินความยากลำบากในการจัดการตนเองของพยาบาลที่ตั้งครรภ์ การศึกษานี้มีวัตถุประสงค์เพื่อพัฒนาแบบประเมินความยากลำบากในการจัดการตนเองสำหรับพยาบาลที่ตั้งครรภ์ ร่วมกับประเมินคุณสมบัติเชิงจิตวิทยาของเครื่องมือดังกล่าว กระบวนการพัฒนาเครื่องมือมี 3 ระยะ ได้แก่ ระยะที่ 1 การออกแบบรายการประเมินโดยอาศัยการทบทวนวรรณกรรม การพิจารณาและปรับปรุงโดยผู้เชี่ยวชาญเฉพาะด้าน และการทดลองใช้ในพยาบาลตั้งครรภ์ ได้แบบร่างการประเมินจำนวน 41 ข้อ ระยะที่ 2 ทดสอบแบบประเมินในพยาบาลจำนวน 232 คนจากโรงพยาบาล 4 แห่ง ใน 2 เมืองของประเทศญี่ปุ่น หลังจากการวิเคราะห์รายข้อและวิเคราะห์องค์ประกอบเชิงสำรวจ จำนวนข้อคงเหลือ 28 ข้อ ระยะที่ 3 ทดสอบคุณสมบัติเชิงจิตวิทยาของแบบประเมินในพยาบาลที่ตั้งครรภ์จำนวน 172 คน จากโรงพยาบาล 20 แห่งใน 10 เมืองของประเทศญี่ปุ่น

ผลการวิเคราะห์องค์ประกอบเชิงยืนยัน พบว่า แบบประเมินความยากลำบากในการจัดการตนเองฉบับ 28 ข้อนี้ประกอบด้วยองค์ประกอบย่อย 4 ด้าน ได้แก่ 1) บทบาทสองสถานะระหว่างการเป็นพยาบาลกับหญิงตั้งครรภ์ 2) การให้ความสำคัญต่อสุขภาพของทารกในครรภ์ 3) ความไม่มั่นใจในการจัดการดูแลตนเอง และ 4) การรับรู้ข้อจำกัดของตนเอง ผลการวิเคราะห์พบว่าแบบประเมินมีความตรงเชิงโครงสร้างดีจากการทดสอบความตรงตามสภาพและความตรงสอดคล้องกับเครื่องมือวัดสิ่งเดียวกัน นอกจากนี้พบว่าแบบประเมินมีความเที่ยงในระดับเหมาะสมทั้งโดยรวมและรายด้าน โดยสรุป แบบประเมินความยากลำบากในการจัดการตนเองสำหรับพยาบาลที่ตั้งครรภ์ฉบับนี้ มีคุณภาพที่ยอมรับได้ทั้งด้านความตรงและความเที่ยง และสามารถนำไปใช้คัดกรองความเสี่ยงของความผิดปกติในระยะปริกำเนิด การวางแผนการดูแลเชิงรุก และส่งเสริมพฤติกรรมการดูแลสุขภาพของพยาบาลขณะตั้งครรภ์ ทั้งนี้ ควรมีการศึกษาต่อยอดในการประเมินความตรงเชิงโครงสร้างของแบบประเมินด้วยวิธีต่าง ๆ เช่น เทคนิคการนำไปประเมินกลุ่มที่รู้ลักษณะอยู่แล้ว และหาความตรงเชิงทำนายในกลุ่มประชากรหญิงตั้งครรภ์อื่น ๆ

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