

# Preventive Health Management Self-Efficacy related to Premature Labor (PHMSE-PL) scale for Korean women of childbearing age: instrument development and validation

Sun-Hee Kim<sup>1</sup>, Yu-Jin Lee<sup>2</sup><sup>1</sup>Professor, College of Nursing, Research Institute of Nursing Science, Daegu Catholic University, Daegu; <sup>2</sup>Assistant Professor, College of Nursing, Taegu Science University, Daegu, Korea

**Purpose:** This study aimed to develop and examine the validity and reliability of a self-efficacy scale for preventive health management related to premature labor (PHMSE-PL) for women of childbearing age. **Methods:** Instrument development and validation were undertaken in three steps: conceptualization through a literature review and in-depth interviews, item generation and evaluation of content validity, and evaluation of construct validity and reliability. The content validity, factorial structure validity, and internal consistency reliability of the PHMSE-PL were evaluated, and cognitive interviewing was undertaken. Data were analyzed using confirmatory factor analyses, Cronbach's  $\alpha$ , and 95% confidence intervals (CIs).

**Results:** The content validity was assessed by experts and was strengthened through cognitive interviews with women of childbearing age. The PHMSE-PL comprised 34 items across five factors. The construct validity of the PHMSE-PL was supported. Cronbach's  $\alpha$  for the total scale was .97 (95% CI=.96-.97). **Conclusion:** An evaluation of the psychometric properties of the PHMSE-PL scale found it to be a valid and reliable tool for women of childbearing age. The scale appears to be useful for women of childbearing age to self-assess their preventive health management self-efficacy related to premature labor and for health professionals to evaluate and promote women's preventive health management.

**Key words:** Obstetric labor, premature; Prevention and control; Self efficacy; Validation study

## Corresponding author

Yu-Jin Lee

College of Nursing, Taegu Science University, 47, Yeongsong-ro, Buk-gu, Daegu 41453, Korea  
TEL: +82-53-320-1060  
FAX: +82-53-320-1761  
E-MAIL: yjlee@tsu.ac.kr

Received Jul 7, 2022

Revised Jul 13, 2022

Accepted Jul 19, 2022

This is an Open Access article distributed under the terms of the Creative Commons Attribution NonCommercial License (<http://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted noncommercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## INTRODUCTION

The estimated global preterm birth rate in 2014 was 10.6% of live births, which declined to 9.8% in 2020 [1]. The number of premature births in South Korea decreased from 27,300 in 2010 to 22,900 in 2020, but given the fertility rate's continuous decline, the premature birth rate still increased from 5.8% in 2010 to 8.5% in 2020 [2]. Preterm birth increases mortality and morbidity among newborns and children under 5 years of age [3], increases medical costs [4,5], and can have a profound adverse effect on babies, families, and the country in both the short- and long-term. The main cause of premature birth is spontaneous preterm labor, which causes 40%-45% of premature births [6]. Therefore, understanding, predicting, and

preventing the precise pathological mechanisms of premature labor have long been global public health goals with profound implications.

Extensive research on the causes of preterm labor aiming to predict and prevent spontaneous preterm birth due to preterm labor has been conducted in recent decades. Two important predictors of spontaneous preterm birth are short cervical length observed via ultrasound during the second trimester and a history of spontaneous preterm birth. Methods for preventing premature birth include the administration of vaginal progesterone to asymptomatic women with short cervixes during the second trimester and the administration of 17- $\alpha$  hydroxyprogesterone caproate to women with previous spontaneous preterm birth experience [7]. However, these

preterm birth prevention methods treat these predictive factors only and have not significantly reduced the preterm birth rate. In 75% of preterm births, preterm labor occurs unexpectedly in low-risk women with no known maternal and fetal risk factors [8]. Therefore, the perception of risk related to premature birth must be controlled to enable healthy pregnancies, encourage interventions when needed, and prevent adverse outcomes [9]. Accordingly, high-risk women must actively receive early prenatal screening and treatment. Furthermore, if lower-risk women are aware of the risk factors for preterm labor and take preventive action, or if pregnant women can recognize and cope with the symptoms of preterm labor early, it would be possible to slightly or significantly delay premature birth to enable the continued maturation of the fetus. This could subsequently improve the health outcomes of premature infants.

However, most women who have never experienced a high-risk pregnancy and are uninformed about preterm labor and premature birth are only able to recognize their own risk factors after learning about them from health professionals [9]. Therefore, women should be encouraged to seek out antenatal care during pregnancy to identify high-risk factors and develop the ability to cope with premature labor at the onset of symptoms; in other words, they must have preventive health management self-efficacy related to premature labor. However, few studies have confirmed the self-regulatory capability of women of childbearing age and pregnant women regarding medical recommendations for the prevention of premature labor and preterm birth.

To evaluate and promote preventive health management self-efficacy related to premature labor in women of childbearing age, a measurement tool is needed. Existing scales for measuring childbirth-related self-efficacy in women include the Childbirth Self-Efficacy Inventory [10] and the Self-Efficacy Regarding Vaginal Birth Scale [11] only for pregnant women. The Childbirth Self-Efficacy Inventory measures outcome and self-efficacy expectancies for coping with a childbirth experience [10] and the Self-Efficacy Regarding Vaginal Birth Scale measures self-concept, self-control, and self-cognition regarding a vaginal birth [11]. No scale that measures preventive health management self-efficacy related to premature labor was identified.

Self-efficacy refers to an individual's beliefs concerning his or her ability to generate and use knowledge and skills to perform a specific behavior in a specific situation [12]. It is an important factor in health promotion or health management since it allows people to adopt active coping strategies, overcome obstacles, focus on opportunities, and solve problems effectively [12]. In the context of health behaviors, self-efficacy refers to an individual's perceived confidence to perform a be-

havior given various conditions or impediments [12,13]. Alternatively, in the health care domain, self-efficacy can refer to one's confidence about using appropriate skills to mobilize the resources necessary to meet situational needs and various regulatory functions, such as adherence to medical recommendations, management of positive and negative emotions, pain management, and coping with stress. It refers to one's belief in his or her confidence and ability to control the situation by enabling the individual to exert more persistent effort once taking action [12]. Therefore, the goals of self-efficacy in the health care domain are, first and foremost, to achieve health goals, in addition to understanding specific health-related situations and building self-confidence in one's ability to undertake health behaviors.

To reduce premature birth, neonatal mortality, and public medical expenses caused by premature labor, a self-measurement scale capable of evaluating preventive health management self-efficacy related to premature labor for women of childbearing age is needed. This study aimed to develop a scale to measure the preventive health management self-efficacy related to premature labor (PHMSE-PL) of women of childbearing age based on the conceptual definition of self-efficacy and to evaluate its validity and internal consistency reliability.

## METHODS

**Ethics statement:** This study was approved by the Institutional Review Board (IRB) of the researcher's affiliated university (No: CUIRB- 2020-0030). All participants participated in the qualitative interview or survey voluntarily, provided informed consent, and received remuneration after completing the questionnaire.

### 1. Study Design

This was a methodological study to develop the PHMSE-PL for women of childbearing age.

### 2. Conceptualization

According to the definition of self-efficacy concerning health behaviors [12], the prevention of preterm labor and preterm birth was set as the primary goal, and pre-pregnancy, pregnancy, and the early onset of preterm labor symptoms were set as the specific health-related situations. A literature review and qualitative interviews were conducted to identify what health behaviors should and could be taken to achieve the pre-determined health goal.

#### 1) Literature review

The literature search was conducted by searching the Medline, Cochrane Library, and CINAHL databases and combining text words and control terms such as "preterm labor", "premature labor", "preterm birth", "prevention & control", "care", "management", "education", "program", "intervention". Studies published during or after 2010 were searched, and 62 relevant articles were reviewed.

## 2) Qualitative interviews

In-depth, one-on-one interviews were conducted with women who experienced premature labor and were recruited through convenience sampling among the researchers' acquaintances. The 4 interviewees ranged from 33 to 41 years of age. Three were employed, and all were married. The number of pregnancies in 3 women was 2 and the number of pregnancies in 1 woman was 1. Two participants experienced preterm birth twice, while the other 2 experienced preterm birth once. The onset period of preterm labor ranged from 28 weeks to 33 weeks of pregnancy, and accompanying diseases during pregnancy included gestational hypertension (n=1), gestational diabetes and polyhydramnios (n=1), and cervical incompetence (n=1). The main questions were, "What kinds of symptoms did you have when you experienced preterm labor?", "What actions did you take when you suspected preterm labor was occurring?", and "What do you think should be done to prevent premature labor?" In addition, "What kind of management do you think is helpful when at risk for premature labor?" and other questions were asked based on the details of the interviews. The collected qualitative data were analyzed using the qualitative content analysis method [14] in NVivo (Release 1.0).

Four subcategories and 29 codes were extracted by synthesizing the content analysis results of the literature review and interviews [15]. Subcategories and codes were considered health behaviors for the prevention of preterm labor and the prevention of premature birth due to preterm labor. Thus, the PHMSE-PL was designed to measure respondents' confidence in their ability to acquire information about symptoms and prevention of premature labor; and to preventively manage risk factors, daily life, and high-risk health behaviors; to cope at the onset of preterm labor symptoms to prevent premature labor and premature birth before and during pregnancy and at the onset of preterm labor symptoms.

## 3. Item Generation and Evaluation of Content Validity

### 1) Item generation

The subcategories for the development of the items included in the PHMSE-PL were information-seeking on premature labor, preventive risk factor management, preventive

daily life management, and early coping at symptom onset, and 42 initial items were developed. A 5-point Likert scale ranging from 1 ("I can't do it at all") to 5 ("I can do it very well") was used to record participants' responses.

### 2) Expert content validity assessment

To test the expert content validity of the initial items, seven experts were surveyed, including two professors of women's health nursing, four nurses working in the intensive care unit for high-risk pregnant women, and one obstetrician. All experts were women. Their average age was 48.4 years, and their average clinical experience was 13.6 years. The sufficiency and relevancy of the subcategories and the relevancy of items were measured using a 4-point scale ranging from 1 (not relevant) to 4 (very relevant), and opinions on rating scale (a 5-point Likert scale), corrections, and supplementation were also collected. The validity criterion for the item-level content validity index (I-CVI) of the PHMSE-PL scale was .78 or higher [16]. The validity criterion for the average scale-level content validity index (S-CVI/Ave) was .90 or higher [16]. Items with an S-CVI of less than 80% were reviewed, and deletion and correction were considered [16].

### 3) Cognitive interviewing

After the experts' content validity evaluation, a researcher met with 12 women of childbearing age (average=28.7 years) on a one-on-one, face-to-face basis or over the phone for a cognitive interview about the revised PHMSE-PL. They included four women in their teens, two in their 20s, three in their 30s, and four in their 40s. Six had experienced childbirth and one had experienced premature labor.

Consent for audio recording was obtained from the participants before the start of the interview. Women read each item aloud one by one and expressed their understanding of each item's meaning verbally in real-time [17]. Women were asked to restate the words or sentences they found difficult to understand and recommend new words or phrases that would be more accurate [17]. Next, 12 women responded to each revised item using a 4-point scale ranging from 1 (I do not understand at all) to 4 (I understand it very well). Women gave their revised opinions on questions that were difficult to understand using a 5-point Likert rating scale.

## 4. Evaluation of Construct Validity and Reliability

### 1) Study participants

The participants in the survey included South Korean women of childbearing age between 19 and 49 years of age. Originally, two scales were developed simultaneously: the PHMSE-PL as well as a scale to measure preventive self-man-

agement knowledge related to premature labor. This study outlines the development of the PHMSE-PL, and a future study will outline the development of the knowledge scale. Data collection for evaluating both instruments was performed simultaneously. Since the required sample size for factor analysis in the construct validity test is 200 to 400 [18], at least 500 samples were needed to develop the 2 scales. Given a possible dropout rate of 5%, the final sample size was 527. The final collected data for factor analysis during tool development included 505 participants, and, among them, data from 2 participants who did not meet the inclusion criteria (over 50 years old) and 3 participants who consistently responded with the same number to all items were excluded, and the final data included 500 participants. For the factor analysis during the development of the scales, the data were sequentially divided (1:1) after stratification according to age and preterm birth experience since age and preterm birth experience would relate to the respondents' knowledge and management of pregnancy health. Data from 250 participants were ultimately used in this study.

## 2) Data collection

To recruit participants, physical and digital fliers were posted in internet cafes and on blogs, Twitter, and Facebook from December 10, 2020, to January 5, 2021. Those who wished to participate in the survey were asked to click the link to the online survey. It was designed for the participants to first read the study explanation on the initial screen, followed by the informed consent form on the next screen, after which they responded to the questionnaire. The questionnaire took approximately 20 to 30 minutes to complete.

## 3) Data analysis

Data were analyzed using SPSS (version 25.0) and AMOS (version 22.0; IBM Corp., Armonk, NY, USA). There were missing data for childbirth-related characteristics, but not for any PHMSE-PL items. The assumption of multivariate normality for confirmatory factor analysis (CFA) was not satisfied. Bootstrapping was thereafter used for the parameter estimation. The fit of the CFA model was evaluated using the following fit indices (with the acceptance criteria in parentheses). The model fit indices, including the normed  $\chi^2$  (NC;  $<5$ ), standardized root-mean-square residual (SRMR;  $<.08$ ), comparative fit index (CFI;  $>.90$ ), the root-mean-square error of approximation (RMSEA;  $<.06$ ), were confirmed [19,20]. In addition, the standardized factor loadings, squared multiple correlations (SMC), and error variance, which are model estimates, were checked. The items were deleted after considering the modification indices (MI), standardized factor loadings, error variance, and importance of the items.

The convergence validity of the component factors was confirmed based on standardized factor loadings of .50 or more (critical ratio  $>1.965$ ), construct reliability (CR) of .70 or more, and average variance extracted (AVE) of .50 or more. To test the discriminant validity of the component factors, the correlation coefficient between factors should be less than .80, the AVE of latent variables should be greater than the square of the correlation coefficient between latent variables ( $AVE > \Phi^2$ ), and the confidence interval (CI) of the correlation coefficient (correlation coefficient  $\pm 2 \times$  standardization error) should not include 1 [21]. The reliability of the PHMSE-PL was tested using Cronbach's  $\alpha$  coefficients and 95% CIs. The significance level of all statistical data was .05.

# RESULTS

## 1. Evaluation of Content Validity

The I-CVI of the 42 items was .89, which was above the standard value of .78 [16]. The S-CVI/Ave was .67, which did not satisfy the criteria of .90 or more [16]. Five duplicate items were deleted after reviewing the items with an S-CVI of less than 80%, and phrases were modified to clarify the meaning of the items. The remaining 37 items had an I-CVI of .81 and an S-CVI/Ave of .91, which exceeded the criteria, and none had an S-CVI of less than 80%.

Additionally, in the validity evaluation of the four subcategories, 71% of experts confirmed that the "information-seeking about premature labor" subcategory was relevant, and 100% of the experts confirmed that the other three subcategories (preventive risk factor management, preventive daily life management, and early coping during symptom onset) were relevant. Based on the experts' recommendations, preventive daily life management was divided into two subcategories ("preventive daily life management" and "preventive high-risk health behavior management"), with drinking, smoking, drug abuse, sex, and exercise in a vulnerable state being considered high-risk health behaviors. Following cognitive interviews on the 37 items, the word order of the items was changed, and words and phrases were slightly modified to enhance the meaning. The average level of comprehension was 3.90.

There were 37 final preliminary items across five subcategories: information seeking about premature labor (7 items), preventive risk factor management (8 items), preventive daily life management (6 items), preventive high-risk health behavior management (4 items), and early coping during symptom onset (12 items).

## 2. Evaluation of Construct Validity and Reliability

### 1) General characteristics of participants

In total, 122 (48.8%) participants were in their 30s, 160 (64.0%) were associate or bachelor's degrees, 109 (43.6%) were full-time workers, and 165 (66.0%) were married. Almost all participants (233, 93.2%) were non-pregnant. Their average number of pregnancies was 1.16 (standard deviation [SD]=1.10), and most participants (202, 81.1%) had not experienced preterm labor. The average number of childbirths was 1.00 (SD=0.94), and most of the participants (189, 75.6%) had never received any preterm labor education (Table 1).

### 2) Construction validity

Primary CFA was conducted for the 5 factors and 37 items. The model fit indices were NC=3.14 ( $\chi^2=1946.26$ ,  $df=619$ ,

$p < .001$ ), SRMR=.08, CFI=.84, and RMSEA=.09 (90% CI=.09-.10), which showed that this model had a poor fit for the data. Accordingly, item 23 (the restriction of movement when there is a risk factor for premature labor) was deleted due to its high MI, and its SMC was .34. As a result of the second and third CFAs, none of the model fit indices were reasonable (NC=3.06 [ $\chi^2=1785.96$ ,  $df=584$ ,  $p < .001$ ], SRMR=.08, CFI=.85, RMSEA=.09 [90% CI=.09-.10]). Item 11 (early antibiotic treatment in case of infection during pregnancy) and item 15 (hormonal drug administration in the case of a short cervix in the second trimester of pregnancy) were deleted sequentially due to high MI and error variance. Although item 26 (self-check for uterine contractions during pregnancy) had a high MI, it was not deleted since the experts agreed that the item was important for self-management. The fourth CFA was conducted. The fit indices of the model were NC=3.11 ( $\chi^2=1610.11$ ,  $df=517$ ,  $p < .001$ ), SRMR=.08, CFI=.86, and RMSEA=.09 (90% CI=.09-.10), which indicated a poor fit. Due to the high MI, the model fit, component factors, and items were reviewed, while sequentially setting correlations between error variables (covariances of error) as follows: 36 and 37, 1 and 2, 31 and 32, 26 and 29, 6 and 7, and 8 and 9. Finally, the model fit indices were acceptable (NC=2.49 [ $\chi^2=1274.51$ ,  $df=511$ ,  $p < .001$ ], SRMR=.08, CFI=.90, and RMSEA=.08 [90% CI=.07-.08]). Convergent validity of the component factors was confirmed using standardized factor loadings, CR, and AVE. All standardized factor loadings were .53 or more (criterion: >.50) with a critical ratio of 8.27 or more (criterion: >1.965). The CR was .86 or more (criterion: >.70), and the AVE was .81 or more (criterion: >.50). Therefore, the convergent validity of the component factors was supported (Tables 2 and 3). Discriminant validity of the component factors was confirmed using 2 methods. The correlation coefficient between factors ranged from .39 to .77, and that between the six errors ranged from .37 to .63, which were acceptable. All AVEs of the factors were greater than the square of all possible two-factor correlation coefficients ( $AVE > \phi^2$ ). The CI of the correlation coefficient ( $\phi \pm 2 \times \text{standard error}$ ) did not include 1. Therefore, the discriminant validity of the component factors was supported (Table 3). As a result of item analysis to confirm the convergent validity of individual items and the validity of factors' internal structures, the overall average of the items was 3.83, the SD was 0.73, and the standard error was 0.05. The item total correlation (ITC) between 1 item and all other items was .51 to .77, and the ITCs for all factors were .53 or higher, indicating acceptable validity of the items (Table 4).

The final scale contained 34 items across five factors: seven items on information-seeking about premature labor (factor 1), six items on preventive risk factor management (factor 2), six items on preventive daily life management (factor 3), three

**Table 1.** Demographic Characteristics of Participants (N=250)

Variables	Categories	n (%) or M±SD
Age (year)	19-29	66 (26.4)
	30-39	122 (48.8)
	40-49	62 (24.8)
		33.7±7.8
Education	High school or less	65 (26.0)
	Associate or bachelor's degree	160 (64.0)
	Master's or doctoral degree	25 (10.0)
Employment status	None	104 (41.6)
	Full time	109 (43.6)
	Part-time	29 (11.6)
	Others	8 (3.2)
Marriage status	Single	81 (32.4)
	Married	165 (66.0)
	Divorced or bereaved	4 (1.6)
State of pregnancy	Yes	17 (6.8)
	No	233 (93.2)
Number of pregnancies	0	93 (37.2)
	1	54 (21.6)
	2	80 (32.0)
	3 or more	23 (9.2)
		1.16±1.10
Experience of preterm labor*	Yes	47 (18.9)
	No	202 (81.1)
Number of childbirths*	0	99 (39.8)
	1	59 (23.7)
	2	82 (32.9)
	3	9 (3.6)
		1.00±0.94
Preterm labor education	Yes	61 (24.4)
	No	189 (75.6)

\*Missing data were excluded; M, mean; SD, standard deviation.

**Table 2.** Parameter Estimates, Convergent, and Discriminant Validity of the Preventive Health Management Self-Efficacy related to Premature Labor (PHMSE-PL) (N=250)

Factors*	Item	B	β	SE	Critical ratio	p	CR
F1	1	1.00	.74	-	-	.018	.91
	2	1.10	.78	.06	17.61	.015	
	3	1.08	.74	.09	11.77	.007	
	4	1.26	.86	.09	13.80	.012	
	5	1.31	.89	.09	14.06	.026	
	6	1.18	.83	.09	13.01	.011	
	7	1.11	.80	.09	12.46	.019	
F2	8	1.00	.74	-	-	.016	.89
	9	1.09	.82	.07	16.47	.005	
	10	0.92	.64	.09	10.03	.006	
	12	1.21	.83	.09	13.02	.019	
	13	1.18	.81	.09	12.62	.014	
	14	1.07	.85	.08	13.47	.009	
F3	16	1.00	.79	-	-	.021	.92
	17	0.96	.70	.08	11.85	.025	
	18	1.02	.78	.08	13.31	.030	
	19	1.27	.90	.08	15.98	.012	
	20	1.29	.90	.08	15.85	.021	
	21	1.00	.79	.07	13.72	.020	
F4	22	1.00	.64	-	-	.008	.86
	24	1.39	.88	.12	11.23	.016	
	25	1.53	.94	.13	11.46	.021	
F5	26	1.00	.53	-	-	.021	.95
	27	1.09	.71	.13	8.27	.007	
	28	1.17	.79	.13	8.78	.014	
	29	1.12	.66	.11	9.91	.030	
	30	1.25	.78	.15	8.64	.016	
	31	1.29	.86	.14	9.02	.030	
	32	1.29	.89	.14	9.15	.021	
	33	1.43	.89	.16	9.20	.010	
	34	1.39	.87	.15	9.16	.018	
	35	1.36	.85	.15	9.05	.018	
	36	1.22	.82	.14	8.86	.009	
37	1.17	.81	.13	8.79	.014		

\*F1: information seeking about premature labor, F2: preventive risk factor management, F3: preventive daily life management, F4: preventive high-risk health behavior management, F5: early coping during symptom onset; CR, construct reliability; SE, standard error.

items on preventive high-risk health behavior management (factor 4), and 12 items on early coping during symptom onset (factor 5) (Appendices 1 and 2).

### 3) Reliability

The Cronbach's α for all items was .97 (95% CI=.96-.97). It was .93 (95% CI=.92-.94) for factor 1, .90 (95% CI=.88-.92) for factor 2, .92 (95% CI=.90-.93) for factor 3, .85 (95% CI=.81-.88) for factor 4, and .95 (95% CI=.94-.96) for factor 5 (Table 5).

## DISCUSSION

### 1. Theoretical Perspectives on the Content of the PHMSE-PL Scale

According to self-management theory, individuals are better able to adopt healthy behaviors if they possess knowledge and health beliefs that are consistent with their behaviors, self-regulation skills and ability to change health behaviors, and the facilitation of positive social support [22]. Self-efficacy, which refers to confidence in one's ability to undertake self-management measures, is an important determinant of self-management [23]. Knowledge could also impact behavior-specific self-efficacy [22]. The symptoms of preterm labor are vague and difficult to distinguish from normal bodily changes during pregnancy [24]. Therefore, women should seek information, make long-term efforts to address the symptoms of premature labor, and adopt coping strategies for premature labor to promote self-efficacy. Self-efficacy has 2

**Table 3.** Correlation Matrix among Factors of the Preventive Health Management Self-Efficacy related to Premature Labor (PHMSE-PL) (N=250)

Factors*	F1	F2	F3	F4	F5	AVE
	$\varphi$ ( <i>p</i> )	$\varphi$ ( <i>p</i> )	$\varphi$ ( <i>p</i> )	$\varphi$ ( <i>p</i> )	$\varphi$ ( <i>p</i> )	
F1	-	.56-.80	.30-.50	.27-.51	.38-.58	.86
F2	.68 (.008)	-	.52-.72	.47-.71	.65-.89	.84
F3	.40 (.009)	.62 (.012)	-	.42-.66	.67-.87	.89
F4	.39 (.003)	.59 (.004)	.54 (.004)	-	.40-.60	.81
F5	.48 (.009)	.77 (.005)	.77 (.019)	.50 (.003)	-	.92

The upper part of the diagonal shows confidence intervals for the correlation coefficients; The lower part of the diagonal shows the correlation coefficients without measurement errors and significance levels; \*F1: information seeking about premature labor, F2: preventive risk factor management, F3: preventive daily life management, F4: preventive high-risk health behavior, management, F5: early coping during symptom onset; AVE, average variance extracted;  $\varphi$ : phi correlation coefficient.

**Table 4.** Descriptive Analysis of Items of the Preventive Health Management Self-Efficacy related to Premature Labor (PHMSE-PL) (N=250)

Subcategories*	Item No.	M±SD	SE	Skewness	Kurtosis	ITC
F1	1	2.99±1.11	0.07	0.01	-0.83	.75
	2	3.02±1.15	0.07	-0.05	-0.94	.79
	3	2.98±1.20	0.08	-0.01	-0.97	.72
	4	3.16±1.20	0.08	-0.17	-0.94	.82
	5	3.25±1.21	0.08	-0.13	-0.98	.84
	6	3.22±1.17	0.07	-0.11	-0.83	.80
	7	3.44±1.15	0.07	-0.33	-0.82	.76
	Subtotal	3.15±0.99	0.06	-0.05	-0.84	-
F2	8	3.92±1.04	0.07	-0.74	-0.18	.72
	9	4.08±1.03	0.07	-0.96	0.13	.80
	10	3.84±1.11	0.07	-0.79	0.03	.61
	12	3.76±1.14	0.07	-0.70	-0.31	.78
	13	3.80±1.13	0.07	-0.68	-0.36	.74
	14	4.14±0.98	0.06	-1.11	0.79	.79
	Subtotal	3.92±0.88	0.06	-0.92	0.73	-
F3	16	4.14±0.94	0.06	-1.05	0.66	.75
	17	3.74±1.02	0.06	-0.43	-0.43	.67
	18	4.06±0.97	0.06	-0.80	0.00	.74
	19	3.98±1.04	0.07	-0.91	0.29	.85
	20	3.87±1.06	0.07	-0.59	-0.49	.85
	21	4.15±0.94	0.06	-1.02	0.73	.74
	Subtotal	3.99±0.84	0.05	-0.89	0.89	-
F4	24	4.30±1.04	0.07	-1.60	1.93	.58
	25	4.52±1.05	0.07	-2.30	4.35	.76
	22	4.46±1.09	0.07	-2.11	3.49	.82
	Subtotal	4.43±0.93	0.06	-2.07	3.85	-
F5	26	3.34±1.22	0.08	-0.21	-0.85	.53
	27	4.08±0.99	0.06	-0.92	0.22	.71
	28	4.05±0.96	0.06	-0.80	0.06	.79
	29	3.37±1.11	0.07	-0.11	-0.68	.67
	30	3.94±1.05	0.07	-0.80	-0.04	.76
	31	4.16±0.98	0.06	-1.07	0.47	.83
	32	4.16±0.95	0.06	-1.00	0.49	.85
	33	4.01±1.05	0.07	-0.89	0.03	.84
	34	3.93±1.03	0.07	-0.75	-0.12	.83
	35	3.87±1.04	0.07	-0.69	-0.15	.82
	36	4.28±0.96	0.06	-1.47	1.79	.80
37	4.36±0.94	0.06	-1.53	1.91	.79	
	Subtotal	3.96±0.82	0.05	-0.96	1.01	-
Total items		3.83±0.73	0.05	-1.02	1.80	.51-.77

\*F1: information seeking about premature labor, F2: preventive risk factor management, F3: preventive daily life management, F4: preventive high-risk health behavior, management, F5: early coping during symptom onset; ITC, item-total correlation.

**Table 5.** Internal Consistency of the Preventive Health Management Self-Efficacy related to Premature Labor (PHMSE-PL) (N=250)

Subcategories*	Cronbach's $\alpha$	95% CI
F1	.93	.92-.94
F2	.90	.88-.92
F3	.92	.90-.93
F4	.85	.81-.88
F5	.95	.94-.96
Total	.97	.96-.97

\*F1: information seeking about premature labor, F2: preventive risk factor management, F3: preventive daily life management, F4: preventive high-risk health behavior, management, F5: early coping during symptom onset; CI, confidence interval.

forms: coping and regulatory [25]. Those with strong coping self-efficacy respond well to the onset of symptoms since they are able to adopt healthy behaviors despite initial setbacks or a lack of social support, and those with strong self-regulating efficacy are able to perform the target behavior in potentially disabling contexts [13]. Therefore, self-efficacy promotes health by enabling health-promoting actions in high-risk contexts. In this study, those with high self-efficacy were able to manage risk factors, identify symptoms, visit a doctor for early management, seek information about preterm labor, maintain a healthy lifestyle, and improve harmful habits. Therefore, all the components of this study correspond to the beliefs of self-regulation confidence and coping confidence, and the PHMSE-PL appears to accurately assess the preventive health management self-efficacy related to premature labor among women of childbearing age.

## 2. Psychometric Properties

Items were developed according to the concept of PHMSE-PL. In-depth interviews were conducted with women who experienced premature labor to minimize measurement errors due to misunderstanding [26], and further cognitive interviews were conducted with women of childbearing age to examine their understanding of the items and identify items requiring correction. The cognitive interviews were also conducted with women of different educational levels and ages to reduce differences in understanding between heterogeneous groups. The responses to the items improved after tailoring the items according to the women's perspectives. The interviewing process can help to ensure content validity [17]. In addition, it was important for health professionals to participate in the development of the items since they had expertise in managing premature labor, often advocated for women's

self-management, and could identify the most important health information suited to each subject [26]. Health professionals' participation increased the items' practicality, importance, and comprehensibility. Efforts were made to increase the content validity of the PHMSE-PL scale through a series of cognitive interviews with women of childbearing age and content validity testing based on expert testimony. As a result, the I-CVI, S-CVI/Ave, and S-CVI all exceeded the criteria, confirming content validity [16]. Only three of the 37 items were deleted, and the loading of standardized factors was generally high in this study.

The PHMSE-PL consisted of five subcategories based on the literature review and interviews, and the statistical validity of the five factors was confirmed via CFA. The RMSEA of the final model exceeded .06. However, the interval width of the RMSEA is affected by sample size and the number of items (freely estimated parameters) in the model [19,27]. In model identification, in addition to the fit indices of the model, various aspects of the model should also be considered [19,27]. Since the sample size was also somewhat small (N=250), the size of factor loading exceeded .50, and the other fit indices were somewhat good, an RMSEA of .077 may not be concerning in this study [27]. The PHMSE-PL had rigorous convergent and discriminant validity. All CRs and AVEs were high, and standardized factor loadings exceeded .50 for 4 items (items 10, 22, 26, and 29) and .70 for all other items. Additionally, a factor correlation exceeding .80 indicates poor discriminant validity [27]. In this study, all factor correlations were acceptable ( $\rho = .39-.77$ ). Both conditions of  $AVE > \phi^2$  and  $\phi \pm 2 \times SE$  for discriminant validity were supported.

In this study, error covariances were established based on high MIs. Despite the different contents of paired items within the same subcategories, the women were assumed to respond to the following items believing that each pair contained similar, highly relevant content: item 1 (risk factors for premature labor) and 2 (symptoms of premature labor), item 6 (daily activities that trigger premature labor) and 7 (health daily life guidelines), item 8 (regular hospital checkup) and 9 (hospital checkup in illness), item 26 (self-examination of uterine contractions) and 29 (recognition of symptoms of premature labor), item 31 (retest of premature labor) and 32 (receiving a vaginal discharge test), and item 36 (hospital visit in case of amniotic fluid leakage) and 37 (hospital visit in case of vaginal bleeding).

In this study, the Cronbach's  $\alpha$  values and 95% CIs for all questions and subcategories were .81 or higher, exceeding the recommended standard of .70 or higher [28]. Therefore, researchers will be able to use the PHMSE-PL with great confidence in their results.





9. Silva TV, Bento SF, Katz L, Pacagnella RC. "Preterm birth risk, me?" Women risk perception about premature delivery - a qualitative analysis. *BMC Pregnancy Childbirth*. 2021;21(1):633. <https://doi.org/10.1186/s12884-021-04068-x>
10. Lowe NK. Maternal confidence for labor: development of the Child-birth Self-Efficacy Inventory. *Research in Nursing and Health*. 1993; 16(2):141-149. <https://doi.org/10.1002/nur.4770160209>
11. Chu KH, Chen AC, Tai CJ, Chen SF, Chien LY. Development and validation of the self-efficacy regarding vaginal birth scale. *Journal of Obstetric, Gynecologic, and Neonatal Nursing: JOGNN*. 2017; 46(1):e13-e21. <https://doi.org/10.1016/j.jogn.2016.08.010>
12. Bandura A. *Self-efficacy: the exercise of control*. Basingstoke: Worth Publishers; 1997. p. 606.
13. Williams DM, Rhodes RE. The confounded self-efficacy construct: conceptual analysis and recommendations for future research. *Health Psychology Review*. 2016;10(2):113-128. <https://doi.org/10.1080/17437199.2014.941998>
14. Hsieh HF, Shannon SE. Three approaches to qualitative content analysis. *Qualitative Health Research*. 2005;15(9):1277-1288. <https://doi.org/10.1177/1049732305276687>
15. Walts C, Strickland OL, Lenz E. *Measurement in nursing and health research*. 5th ed. New York, NY: Springer Publishing Co.; 2017. p. 46-49.
16. Polit DF, Beck CT, Owen SV. Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. *Research in Nursing and Health*. 2007;30(4):459-467. <https://doi.org/10.1002/nur.20199>
17. Collins D. *Cognitive Interviewing Practice*. London: SAGE Publications Ltd.; 2015. p. 57-141.
18. MacCallum RC, Widaman KF, Zhang S, Hong S. Sample size in factor analysis. *Psychological Methods*. 1999;4(1):84-99. <https://doi.org/10.1037/1082-989X.4.1.84>
19. Kline RB. *Principles and practice of structural equation modeling*. 4th ed. New York, NY: The Guilford Press; 2015. p. 268-298.
20. West SG, Taylor AB, Wu W. Model fit and model selection in structural equation modeling. New York, NY: The Guilford Press; 2012. p. 209-231.
21. Bae BR. *Mplus 7.0 structural equation modeling*. Seoul: Chungnam Publishing; 2016. p. 39.
22. Ryan P, Sawin KJ. *The Individual and Family Self-Management Theory: background and perspectives on context, process, and outcomes*. *Nursing Outlook*. 2009;57(4):217-225.E6. <https://doi.org/10.1016/j.outlook.2008.10.004>
23. Liu T. A concept analysis of self-efficacy among Chinese elderly with diabetes mellitus. *Nursing Forum*. 2012;47(4):226-235. <https://doi.org/10.1111/j.1744-6198.2012.00282.x>
24. Patterson ET, Douglas AB, Patterson PM, Bradle JB. Symptoms of preterm labor and self-diagnostic confusion. *Nursing Research*. 1992;41(6):367-372. <https://doi.org/10.1097/00006199-199211000-00009>
25. Luszczynska A, Scholz U, Schwarzer R. The general self-efficacy scale: multicultural validation studies. *Journal of Psychology*. 2005;139(5):439-457. <https://doi.org/10.3200/jrlp.139.5.439-457>
26. Lovén Wickman U, Yngman-Uhlin P, Hjortswang H, Wenemark M, Stjernman H, Riegel B, et al. Development of a self-care questionnaire for clinical assessment of self-care in patients with inflammatory bowel disease: a psychometric evaluation. *International Journal of Nursing Studies*. 2019;89:1-7. <https://doi.org/10.1016/j.ijnurstu.2018.08.016>
27. Brown TA. *Confirmatory factor analysis for applied research*. 2nd ed. New York, NY: The Guilford Press; 2015. p. 461.
28. Iacobucci D, Duhachek A. Advancing alpha: measuring reliability with confidence. *Journal of Consumer Psychology*. 2003;13:478-487. [https://doi.org/10.1207/S15327663JCP1304\\_14](https://doi.org/10.1207/S15327663JCP1304_14)
29. Yu B, Jia P, Huang YL, Zhou JM, Xie T, Yu J, et al. Self-efficacy as a crucial psychological predictor of treatment adherence among elderly people living with HIV: analyses based on the health belief model. *AIDS Care*. 2021:1-7. <https://doi.org/10.1080/09540121.2021.1938964>

**Appendix 1. Preventive Health Management Self-Efficacy related to Premature Labor (PHMSE-PL) Scale (English version)**

Please read each of the following items and mark '✓' in the space that most closely indicates how much you agree with it.

No	Items	I can't do it at all	I can do a little	I can do it moderately	I pretty much can	I can do very well
01	I can learn the risk factors for premature labor.					
02	I can learn the symptoms of premature labor.					
03	I can learn the difference between false and true labor.					
04	I can learn that premature labor can occur even if you are not at term.					
05	I can learn about the serious consequences of premature birth.					
06	I can learn about daily activities that trigger preterm labor.					
07	I can learn about healthy daily life guidelines for pregnant women to prevent premature labor.					
08	I can have regular check-ups at the hospital for the early detection of preterm labor.					
09	If I have a disease that causes premature labor (twin pregnancy, excessive amount of amniotic fluid, leakage of amniotic fluid, genital infection), I can seek a medical examination.					
10	I can go to the dentist before pregnancy to treat rotten teeth and gum inflammation.					
11	I can visit a hospital during pregnancy to determine whether there are risk factors for premature labor in advance.					
12	If there are risk factors for preterm labor, even if there are no symptoms, I can check the shortening of the cervix via ultrasound during the second trimester of pregnancy.					
13	I can have the fetus regularly monitored at the hospital if there are medical or obstetric and gynecological problems.					
14	I can watch and protect my body sensitively during pregnancy.					
15	I can manage my stress during pregnancy to keep my mind at ease.					
16	I can eat a balanced diet regularly during pregnancy.					
17	I can adjust the amount of activity so that I do not feel tired during pregnancy.					
18	I can lead a regular life during pregnancy so as not to put any strain on my body.					
19	I can practice good oral hygiene during pregnancy.					
20	I can avoid sexual intercourse if there are risk factors for preterm labor.					
21	I can abstain from smoking or abusing drugs during pregnancy.					
22	I can abstain from drinking alcohol during pregnancy.					
23	I can self-check for uterine contractions during pregnancy.					
24	I can choose a hospital to visit during pregnancy that is as close to home as possible.					
25	If preterm labor is suspected, I can carefully monitor for changes in labor.					
26	I can identify the symptoms of preterm labor immediately.					
27	I can take a break immediately if I suspect preterm labor.					
28	If I suspect premature labor, I can contact or visit the hospital immediately.					
29	If I suspect preterm labor, I can do a labor test at the hospital immediately.					
30	If I suspect preterm labor, I can go to the hospital and have my cervix checked for shortening immediately.					
31	Even if my previous labor test results came out false, if I currently suspect preterm labor, I can be re-tested.					
32	If I suspect preterm labor, I can get a vaginal discharge test.					
33	If I suspect amniotic fluid leakage, I can go to the hospital immediately to check.					
34	If I experience vaginal bleeding during pregnancy, I can go to the hospital immediately.					

Since the cross-validity between Korean and English items has not been confirmed, it is recommended to check the cross-validity before using the English items.

**Appendix 2. Preventive Health Management Self-Efficacy related to Premature Labor (PHMSE-PL) Scale (Korean version)**

다음의 문항을 읽고 귀하의 의견과 일치하는 곳에 ✓ 표로 체크를 해주십시오.

번호	문항	전혀 할 수 없다	조금 할 수 있다	보통으로 할 수 있다	상당히 할 수 있다	매우 잘 할 수 있다
01	조기진통의 위험요인을 알아볼 수 있다.					
02	조기진통의 증상을 알아볼 수 있다.					
03	가짜 진통과 진짜 진통을 구분하는 법을 알아볼 수 있다.					
04	진짜 조기진통은 만삭이 아니어도 올 수 있다는 것을 알아볼 수 있다.					
05	조산의 심각한 결과에 대해 알아볼 수 있다.					
06	조기진통을 유발하는 일상활동에 대해 알아볼 수 있다.					
07	조기진통을 예방하기 위한 임신부의 건강한 일상생활 지침에 대해 알아볼 수 있다.					
08	조기진통을 조기에 발견하기 위해 정기적으로 병원 검진을 받을 수 있다.					
09	조기진통을 유발하는 질병 (쌍둥이 임신, 양수과다, 조기 양수 누출, 생식기 감염)이 있으면 병원 검진을 받을 수 있다.					
10	임신 전에 치과 치료를 받아 썩은 치아와 잇몸 염증을 치료할 수 있다.					
11	임신 중에 병원에 방문하여 조기진통의 위험요인이 있는지를 미리 확인할 수 있다.					
12	조기진통의 위험요인이 있으면 증상이 없어도 임신 중기에 미리 자궁경부의 짧아진 정도를 확인하기 위해 초음파 검사를 받을 수 있다.					
13	내과적, 산부인과적 문제가 있으면 병원에서 주기적으로 태아를 감시할 수 있다.					
14	임신 중에 신체를 민감하게 관찰하고 보호할 수 있다.					
15	임신 중에 마음이 편안하도록 스트레스를 조절할 수 있다.					
16	임신 중에 규칙적으로 균형 잡힌 식사를 할 수 있다.					
17	임신 중에 피곤하지 않도록 활동량을 조절할 수 있다.					
18	임신 중에 몸에 무리가 가지 않도록 규칙적인 생활을 할 수 있다.					
19	임신 중에 구강 위생 관리를 철저히 할 수 있다.					
20	조기진통의 위험요인이 있으면 성관계를 피할 수 있다.					
21	임신 중에 흡연이나 마약 남용을 하지 않을 수 있다.					
22	임신 중에 알코올을 섭취하지 않을 수 있다.					
23	임신 중에 자궁수축을 스스로 점검할 수 있다.					
24	임신 중 검진받을 병원은 집에서 가까운 곳으로 정할 수 있다.					
25	조기진통이 의심되면 진통의 변화를 주의 깊게 관찰할 수 있다.					
26	조기진통의 증상을 즉각 알아차릴 수 있다.					
27	조기진통이 의심되면 바로 설 수 있다.					
28	조기진통이 의심되면 즉시 병원에 연락하거나 방문할 수 있다.					
29	조기진통이 의심되면 즉시 병원에서 진통검사를 받을 수 있다.					
30	조기진통이 의심되면 즉시 병원에 가서 자궁경부의 짧아진 정도를 검사 받을 수 있다.					
31	과거 검사결과가 가짜 진통으로 나왔어도 현재 조기진통이 의심되면 재검사를 받을 수 있다.					
32	조기진통이 의심되면 질 분비물 검사를 받을 수 있다.					
33	양수가 새는 것이 의심되면 즉시 병원에 가서 확인할 수 있다.					
34	임신 중 질 출혈이 발생하면 즉시 병원에 갈 수 있다.					