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Research Article

Psychometric Properties of the Subhealth Measurement Scale V1.0 for Assessing Suboptimal Health Status of Midwives: A Multicentre Cross-Sectional Study

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Aim. Midwives are prone to suboptimal health status (SHS), while there is a lack of unified measurement standard of SHS for them to early detect and prevent SHS. This study aimed to evaluate validity and reliability of Subhealth Measurement Scale V1.0 (SHMS V1.0) in midwives. *Design and Methods*. The cross-sectional study had 842 midwives from 46 midwifery institutions in southeastern China completing the SHMS V1.0 with 39 items. Internal consistency, test-retest reliability, and concurrent validity of SHMS V1.0 were assessed. Project analysis and confirmatory factor analysis (CFA) were performed to assess construct validity. *Results*. SHMS V1.0 had acceptable reliability with Cronbach's alpha and a test-retest reliability coefficient of 0.908 and 0.804, respectively. The correlation coefficients between each item and corresponding dimension and those between dimension and corresponding subscale were all greater than 0.4. The CFA supported the structure of SHMS V1.0 with strong factor loadings and excellent fit indexes in the first-order and modified second-order factor model, illustrating that SHMS V1.0 had good construct validity among midwives. The concurrent validity for SHMS V1.0 showed large correlation with FS-14, but the social subscale showed medium correlations with fatigue, inferring that SHMS V1.0 can more comprehensively reflect SHS of midwives than FS-14, especially for social health symptoms. *Practice Implications*. SHMS V1.0 with excellent psychometric properties can accurately and reliably evaluate the SHS of midwives. These findings of our study provide an important measurement tool and inspiration for midwives to early detect and prevent SHS.

1. Introduction

As an integral part of healthcare professionals, midwives play an important role in ensuring and promoting the health of pregnant women and newborns [1]. In China, where there are no private midwifery offices, midwives primarily and specifically work in labor wards of midwifery institutions and provide women-centered maternity care and deliver babies independently. Midwives are prone to fatigue due to frequent rotating shift, shortage of human resources, and high work stress, especially for midwives who work in labor wards where they are responsible for both mothers and babies [2–4]. Midwives have reported moderate to severe levels of exhaustion on 22–50% of all shifts and rest days [5]. The State of the World's Midwifery 2021 report has pointed out that there was a large shortage of midwives in the world [6]. Furthermore, the number of older mothers and obstetric complications has increased without a proportional increase in midwives since the opening of Chinese two-child policy [7], which makes midwives bear more work load and suffer from sleep disorders, fatigue, anxiety, and burnout and then accounts for lower job satisfaction, higher turnover, and degradation in work quality [8–10]. All these symptoms are referred to as a suboptimal health status (SHS).

SHS is characterized as a decline in vitality, physiological function, and the capacity for social adaptation, with no clear disease in clinical diagnosis in traditional Chinese medicine (TCM) guidelines released by the China Association of Chinese Medicine [11]. The concept of SHS has been widely recognized in China and some other countries, including Japan, Ghana, and Australia [12, 13], but it has not been clearly used in western countries. It seems that chronic fatigue is a more common concern in western countries, which is an individualized feeling of weakness, lack of energy, and burnout, including physical and mental fatigue [14]. Chronic fatigue may be a sign of SHS, but there may be distinctions, and chronic fatigue is more prone to physiological difficulties. SHS is becoming a global health issue. The SHS was found in 71.7% of nurses [15], 69.46% of Chinese adults [16], and 15.3% of rural migrants [17]. There were 59.3% of midwives with SHS [4]. People with SHS without recognized and managed in time tend to suffer from chronic fatigue, headaches, dizziness, anxiety, depression, pain, and functional disorders of organ systems, which can impair quality of life or work and finally lead to a series of diseases [18–20], such as metabolic syndrome [12], cognitive impairment [19], and oxidative stress [13]. Thus, it might be of great importance for medicine staff, especially midwives, to early detect and prevent SHS resulting in chronic disease and other adverse impacts.

However, there is a lack of unified measurement standard for SHS. The diagnosis of SHS can be divided into subjective and objective measures, and the objective measurements for SHS such as blood pressure, pulse, lipids, and plasma glycoprotein are still being explored [21, 22]. Subjective measurement is the main clinical diagnostics for SHS after excluding specific disease according to comprehensive physical examination [11]. SHS questionnaires have been developed and are widely used as diagnostic instruments of SHS in China, including Subhealth Measurement Scale V1.0 (SHMS V1.0) [23], 36-item Short-Form Health Survey Questionnaire (SF-36) [24], and Suboptimal Health Status Questionnaire-25 (SHSQ-25) [25]. In particular, SHMS V1.0 is a multidimensional inventory that reports physiological, mental, and social symptoms [23], which is highly consistent with the WHO definition of health [26]. And SHMS V1.0 has been proved to have adequate psychometric properties in nurses (with Cronbach's alpha and split half reliability coefficient of 0.924, 0.863) [27], urban residents (with Cronbach's alpha and split half reliability coefficient of 0.928, 0.847) [28], and college students (with good construct validity) [29], which all indicate that it is a reliable and valid measurement scale for SHS. However, the reliability and validity of SHMS V1.0 in midwives are not known. Therefore, the purpose of this study was to determine whether SHMS V1.0 was a valid and reliable measure for assessing midwives' SHS.

2. Methods

2.1. Study Design and Participants. A multicentre cross-sectional study was conducted to investigate the psychometric properties of SHMS V1.0 among midwives through stratified cluster random sampling in Fujian province of China from March to June 2019. The sample size was calculated based on the item numbers of SHMS V1.0 with 35 items for analysis (35 items × 10 = 350) [30]. The minimum sample size was 420 after considering a 20% nonresponse rate. Therefore, 840 participants were needed, half for reliability analysis (including internal consistency and test-retest reliability), project analysis (exploratory factor analysis), and concurrent validity analysis and the other half for confirmatory factor analysis (CFA) because exploratory factor analysis and confirmatory factor analysis require different samples for analysis. The inclusion criteria for Chinese midwives were as follows: (1) registered midwives obtained professional qualification certificates; (2) work as independent position in labor wards of midwifery institutions; and (3) volunteer to participate in this study. The exclusion criteria were as follows: (1) took maternity leave or left their hospital for training for more than one month and (2) diagnosed as acute or chronic diseases.

Hospitals were selected if they were at the secondary level or higher and had at least 5 midwives in Fujian province, and their nursing departments approved to participate in the study. According to the annual report, there are 186 midwifery institutions meeting the inclusion criteria in the province, with 149 secondary midwifery institutions and 37 tertiary midwifery institutions (different levels of midwifery specialized institutions depending on the technical services provided by midwives in China). Based on the average number of midwives per midwifery institutions ($n = 19$) and proportion of secondary and tertiary midwifery institutions (149 : 37), 37 secondary and 9 tertiary midwifery institutions were needed in the study for meeting the sample size requirement and randomly selected from the corresponding level midwifery institutions by computer-generated random numbers. Then, all participants eligible from the 46 midwifery institutions (37 secondary and 9 tertiary midwifery institutions) in accord with inclusion and exclusion criteria were recruited into the study. For test-retest reliability reflecting the stability and reliability of an instrument over time, 10% to 15% of the total sample size is required for test-retest reliability based on experience [31]. A second measurement is normally performed after a two-week delay based on the stability of the variables assessed by the research tool [31]. Therefore, 70 participants were randomly selected from the part of participants two weeks after the initial test in this study, which were used for reliability analysis and project analysis.

3. Instruments

3.1. Sociodemographic Questionnaire. The sociodemographic questionnaire was designed by the researchers, including hospital nature, age, education level, years of midwifery experience, professional rank, professional position, marital status, and monthly income.

3.2. Subhealth Measurement Scale V1.0 (SHMS V1.0). The SHMS V1.0, developed by Xu et al. [23], is a self-reporting scale for providing assessment on health status during the

past month. SHMS V1.0 consists of 39 items with three subscales: physiological subhealth (PS), mental subhealth (MS), and social subhealth (SS), and 4 other items for overall evaluation of physiological, psychological, social, and general health. PS comprises four dimensions: physical condition (P1) (three items), organ function (P2) (six items), body movement function (P3) (three items), and vitality (P4) (two items); MS comprises three dimensions: positive emotion (M1) (four items), psychological symptoms (M2) (six items), and cognitive function (M3) (two items); SS comprises two dimensions: social adaptability (S1) (four items) and social resource and social support (S2) (five items). The 35 items were rated on a five-point Likert scale (1 = never, 2 = rarely, 3 = sometimes, 4 = often, and 5 = always), of which 15 items were reverse arranged. The total score for SHMS V1.0 was transformed to the percentage score ranging from 0 to 100, with the lower scores representing worse health status.

3.3. The 14-Item Fatigue Scale (FS-14). The FS-14 developed by Chalder et al. [32] was used to measure the severity of participants' fatigue over the last month. FS-14 comprises 14 items with two dimensions: physical (items 1–8) and mental (items 9–14) fatigue. The scoring pattern for each item is a four-point Likert scale (0 = less than usual, 1 = no more than usual, 2 = more than usual, and 3 = much more than usual). The total fatigue score obtained by adding up all items ranges from 0 to 42, with higher scores indicating more severe fatigue. The Chinese version of the FS-14 has been shown acceptable psychometric properties [33].

3.4. Data Collection. The questionnaire survey was conducted through an online platform named "Questionnaire Star" which was used to make the survey link. Before the survey, the head nurses in labor wards of the 46 midwifery institutions were selected as investigators. And then, they were trained and informed of the purpose of the research, the requirements of choosing participants, the filling method, and precautions of the questionnaire by phone, for making the follow-up survey guidance in different midwifery institutions consistent. The main researcher sent the survey invitation and questionnaire link to those head nurses through WeChat which is an online communication platform. Then, 46 head nurses selected the subjects according to the inclusion and exclusion criteria, explained the purpose of this study and the filling method of questionnaire, and sent the survey link to the eligible participants. All midwives who agreed to participate in the survey clicked on the survey link and completed and submitted the questionnaire. According to the data integrity of the "WenJuanXing" platform, this process was promoted by weekly reminders and data collection was completed after three reminders. Besides, 70 midwives received the same tests again to investigate the test-retest reliability of SHMS V1.0 two weeks after the initial test.

3.5. Data Analysis. All data were analyzed using the IBM SPSS 25.0 and IBM AMOS 24.0, which was used to conduct CFA. Frequency, percentage, means, and standard deviations (SDs) were used to describe sociodemographic characteristics of midwives. For the reliability of SHMS V1.0, the internal consistency and test-retest reliability were performed by Cronbach's alpha coefficient and Pearson correlation coefficient, with values of at least 0.70 indicating acceptable reliability [34]. For the validity of SHMS V1.0, project analysis (item-total correlation) was used to test the homogeneity of each dimension and subscale, as well as each item and dimension, with the correlation coefficient greater than 0.40 considered as acceptable homogeneity [30]. Given that there is no gold standard for measuring SHS which is conceptually similar with fatigue, the concurrent validity was evaluated by Pearson correlation analysis with FS-14, with the effect size as "Low" (the value of correlation coefficient varied around 0.1), "Medium" (the value of correlation coefficient varied around 0.30), and "Large" (the value of correlation coefficient varied more than 0.50) [35]. The construct validity was performed by CFA, with the factor loadings being at least 0.40 indicating a sufficient correlation [36]. Good fit indexes for the models were indicated by the ratio between χ^2 and the degrees of freedom of the model (χ^2/df) less than 2, root mean square error of approximation (RMSEA) less than 0.08, Incremental Fit Index (IFI), Tucker–Lewis Index (TLI) or Comparative Fit Index (CFI) greater than 0.90, and Parsimony Goodness-of-Fit Index (PGFI) greater than 0.50 [30, 37]. All tests were two-sided, and p values less than 0.05 were regarded as statistically significant.

3.6. Ethical Considerations. The study was approved by the Ethical Committee of Fujian Maternity and Child Health Hospital. Before the survey, oral informed consent was obtained from all nursing departments of the 46 hospitals and all participants. Participants were informed that their participation was voluntary, and they could withdraw from the research at any time. Their completion of the online questionnaire constituted consent to participate. Furthermore, the questionnaire did not use a real-name system, and all data were collected solely for research purposes.

4. Results

A total of 900 Chinese midwives were eligible and invited to participate in the study, of which 842 completed all questionnaires, with 25 without submitting questionnaire and 33 unaccomplished questionnaires. Thus, 421 participants were randomly selected from 842 participants for reliability analysis, project analysis (exploratory factor analysis), and concurrent validity analysis, and others were used for CFA.

4.1. Participant Characteristics. Those midwives were from general (65.80%), specialized (28.15%), and private (6.06%) hospital. The mean age of midwives was 31.41 years

(SD = 6.42). Most midwives (54.16%) had a junior college degree. Approximately half of midwives had less than five years of midwifery (45.25%) and senior professional rank (49.29%) with 58 nurses in charge (6.89%). Most midwives were married (71.85%), and 61.40% of midwives had monthly income ranging from 3000 to 5999RMB.

4.2. Reliability. In terms of internal consistency of SHMS V1.0, the total Cronbach's alpha coefficient of the scale was 0.908, indicating excellent internal consistency. Cronbach's alpha coefficients for physiological, mental, and social subhealth subscale were 0.714, 0.893, and 0.846, respectively. In terms of test-retest reliability of SHMS V1.0, the Pearson correlation coefficient was 0.804. The test-retest reliability for physiological, mental, and social subhealth subscale was 0.715 ($p < 0.001$), 0.861 ($p < 0.001$), and 0.503 ($p = 0.010$), respectively. Except for the social subscale's test-retest reliability, Cronbach's alpha coefficients and test-retest coefficients for SHMS V1.0 were all greater than 0.70, indicating acceptable reliability.

4.3. Project Analysis. The results of project analysis are shown in Tables 1 and 2. The correlation coefficients between each item and its associated dimension score ranged from 0.619 to 0.890, higher than those between the item and other dimensions, which were all statistically significant ($p < 0.01$). The correlation coefficients between each dimension and its associated subscale score ranged from 0.614 to 0.911, higher than those between the dimension and other subscales, which were all statistically significant ($p < 0.01$). The dimension-total correlations coefficients varied between 0.615 and 0.800, which were statistically significant ($p < 0.01$). Project analysis showed acceptable homogeneity of each dimension and subscale, with the correlation coefficient greater than 0.40.

4.4. Confirmatory Factor Analysis (CFA). The results of CFA including the first-order factor model, the second-order factor model, and the modified second-order model are shown in Figures 1–3. The fit indexes for CFA are shown in Table 3. For the first-order factor model, the loadings of each item in the corresponding dimension (35 items in corresponding P1, P2, P3, P4, M1, M2, M3, S1, and S2 dimensions) ranged from 0.45 to 0.82, all greater than 0.4. The fit indexes revealed the following results: χ^2/df was less than 2; RMSEA was less than 0.08; IFI, TLI, and CFI were greater than 0.90; and PGFI was greater than 0.50. For the second-order factor model, the loadings of each item in the corresponding dimension (35 items in corresponding P1, P2, P3, P4, M1, M2, M3, S1, and S2 dimensions) were greater than 0.4 and the loadings of each dimension in corresponding subscale (P1, P2, P3, P4, M1, M2, M3, S1, and S2 dimensions in corresponding PS, MS, and SS subscales) were greater than 0.6, but the model demonstrated no optimal fit indexes with χ^2/df greater than 2 and TLI less than 0.90. Based on modification indexes (modification indices for item 30 to 31 and item 20 to 21, which were the highest of all modification indices, were 32.245 and 25.401, respectively), two covariance factors between the errors for item 30 to 31 and item 20 to 21 were added successively. The modified second-order factor model showed good model fit indexes with χ^2/df less than 2, RMSEA less than 0.08, IFI, TLI, and CFI greater than 0.90, and PGFI greater than 0.50. After modification, SHMS V1.0 has good construct validity in the midwives.

4.5. Concurrent Validity. Correlation analysis between SHMS V1.0 and FS-14 is shown in Table 4. Large negative correlations were observed between the scores of SHMS V1.0 and FS-14 including total fatigue ($r = -0.609$, $p < 0.001$), physical fatigue ($r = -0.594$, $p < 0.001$), and mental fatigue ($r = -0.553$, $p < 0.001$). Physiological subhealth had large negative correlations with total fatigue and physical fatigue and medium correlation with mental fatigue. Mental subhealth had large negative correlations with total fatigue, physical fatigue, and mental fatigue, while social subhealth showed medium correlations with FS-14.

5. Discussion

SHS has become a global public health challenge, but there is no unified diagnostic standard for it. Therefore, research on the evaluation method of SHS has attracted the attention of researchers. Many scales for SHS measurement have been developed in China, but some of them are either limited to traditional Chinese medical symptoms or only focus on physiological indicators, which cannot reflect the connotation of SHS comprehensively. SHMS V1.0 was designed according to the definition of health from WHO, which defined health as a state of complete physiological, mental, and social well-being and not merely the absence of disease or infirmity [26]. All items of SHMS V1.0 have been selected through Delphi expert consultation and field investigation [23], which would ensure the authority and practicability of the selected indexes. It can be concluded that SHMS V1.0 has good content validity. Thus, the purpose of this study was to evaluate the reliability and validity of SHMS V1.0 in midwives, in order to confirm whether SHMS V1.0 can accurately and reliably reflect the SHS of midwives for further research.

Reliability refers to the stability and consistency of a tool when it is used to investigate the same object. The present study showed that Cronbach's alpha coefficient for SHMS V1.0 was greater than 0.90, which was considered as excellent internal consistency [35]. Cronbach's alpha coefficients for three subscales of SHMS V1.0 were all greater than 0.70, showing acceptable internal consistency. The test-retest coefficient for SHMS V1.0, physiological subscale, and psychological subscale was greater than 0.7, indicating acceptable reliability, but that for social subscale was lower than 0.7, maybe due to the small sample size for test-retest reliability. Overall, the overall reliability of SHMS V1.0 is good, and it can evaluate SHS of midwives stably.

Validity refers to the matching degree between scale structure and measurement results to evaluate the accuracy

Table 1: Correlation between item and dimension score of SHMS V1.0 (r).

Items	Dimensions								
	P1	P2	P3	P4	M1	M2	M3	S1	S2
SH1	0.694*	0.346*	0.287*	0.292*	0.339*	0.275*	0.183*	0.259*	0.192*
SH2	0.801*	0.456*	0.393*	0.377*	0.399*	0.376*	0.292*	0.280*	0.229*
SH3	0.776*	0.376*	0.310*	0.253*	0.339*	0.327*	0.253*	0.253*	0.197*
SH4	0.408*	0.696*	0.382*	0.332*	0.343*	0.382*	0.283*	0.269*	0.147*
SH5	0.411*	0.714*	0.377*	0.269*	0.275*	0.370*	0.302*	0.250*	0.179*
SH6	0.369*	0.708*	0.460*	0.334*	0.295*	0.314*	0.231*	0.215*	0.156*
SH7	0.377*	0.748*	0.476*	0.311*	0.309*	0.349*	0.240*	0.241*	0.186*
SH8	0.355*	0.735*	0.454*	0.317*	0.342*	0.402*	0.268*	0.262*	0.213*
SH9	0.299*	0.679*	0.466*	0.301*	0.308*	0.346*	0.256*	0.254*	0.165*
SH10	0.357*	0.523*	0.858*	0.409*	0.313*	0.347*	0.263*	0.304*	0.184*
SH11	0.329*	0.449*	0.816*	0.431*	0.330*	0.320*	0.270*	0.326*	0.199*
SH12	0.384*	0.530*	0.783*	0.459*	0.367*	0.386*	0.241*	0.311*	0.148*
SH13	0.388*	0.406*	0.486*	0.829*	0.427*	0.346*	0.314*	0.365*	0.270*
SH14	0.300*	0.342*	0.418*	0.874*	0.513**	0.354**	0.367**	0.413**	0.315**
SH16	0.365*	0.413*	0.381*	0.525*	0.826*	0.525*	0.497*	0.560*	0.442*
SH17	0.415*	0.322*	0.292*	0.434*	0.811*	0.483*	0.355*	0.476*	0.381*
SH18	0.373*	0.311*	0.293*	0.387*	0.794*	0.455*	0.336*	0.435*	0.343*
SH19	0.394*	0.375*	0.367*	0.459*	0.842*	0.533*	0.354*	0.490*	0.441*
SH20	0.395*	0.454*	0.396*	0.367*	0.454*	0.619*	0.334*	0.357*	0.271*
SH21	0.416*	0.418*	0.341*	0.333*	0.509*	0.737*	0.366*	0.407*	0.304*
SH22	0.387*	0.444*	0.378*	0.331*	0.484*	0.830*	0.329*	0.395*	0.297*
SH23	0.329*	0.392*	0.362*	0.356*	0.498*	0.829*	0.302*	0.419*	0.317*
SH24	0.320*	0.406*	0.335*	0.339*	0.518*	0.808*	0.326*	0.444*	0.397*
SH25	0.285*	0.351*	0.286*	0.272*	0.419*	0.753*	0.288*	0.402*	0.299*
SH26	0.316*	0.371*	0.333*	0.396*	0.419*	0.367*	0.890*	0.404*	0.342*
SH27	0.230*	0.244*	0.186*	0.276*	0.391*	0.317*	0.811*	0.556*	0.400*
SH29	0.260*	0.283*	0.330*	0.399*	0.459*	0.457*	0.387*	0.788**	0.381*
SH30	0.322*	0.278*	0.289*	0.344*	0.509*	0.422*	0.493*	0.814*	0.469*
SH31	0.265*	0.265*	0.248*	0.304*	0.525*	0.401*	0.473*	0.835*	0.400*
SH32	0.279*	0.306*	0.374*	0.439*	0.468*	0.419*	0.439*	0.817*	0.436*
SH33	0.210*	0.256*	0.230*	0.281*	0.419*	0.353*	0.362*	0.419*	0.735*
SH34	0.213*	0.177*	0.137*	0.214*	0.349*	0.300*	0.331*	0.389*	0.808*
SH35	0.232*	0.217*	0.160*	0.269*	0.385*	0.325*	0.381*	0.438*	0.821*
SH36	0.195*	0.143*	0.159*	0.306*	0.373*	0.308*	0.295*	0.414*	0.691*
SH37	0.146*	0.097*	0.102*	0.204*	0.291*	0.217*	0.203*	0.244*	0.623*

*Values are correlation coefficients between each item and dimension from project analysis. $^{*}p < 0.01$.

Table 2: Correlation between dimension and subscale score of SHMS V1.0 (r).

Dimensions	Physiological subhealth	Psychological subhealth	Social subhealth	Subhealth
P1	0.723*	0.518*	0.346*	0.653*
P2	0.894*	0.553*	0.330*	0.744*
P3	0.810*	0.488*	0.327*	0.677*
P4	0.674*	0.554*	0.449*	0.674*
M1	0.569*	0.868*	0.617*	0.800*
M2	0.569*	0.897*	0.523*	0.785*
M3	0.439*	0.614*	0.549*	0.615*
S1	0.465*	0.653*	0.825*	0.722*
S2	0.323*	0.520*	0.911*	0.624*

*Values are correlation coefficients between each dimension and subscale from project analysis. $^{*}p < 0.01$.

of the scale. In the study, the results of project analysis showed that the correlation coefficients between each item of SHMS V1.0 and its corresponding dimension, as well as those between each dimension and its corresponding subscale, were all greater than 0.6, indicating high homogeneity for each dimension and subscale; CFA showed that factor loadings in the first-order factor model and the second-order factor model were greater than 0.4, which indicated that all items and dimensions of SHMS V1.0 were designed reasonably. Furthermore, all fit indexes for CFA in the first-order and modified second-order factor model reached ideal values, showing a good fitting effect of the models. In the modified second-order factor model, there was error correlation between item 20 and 21, consistent with the study of

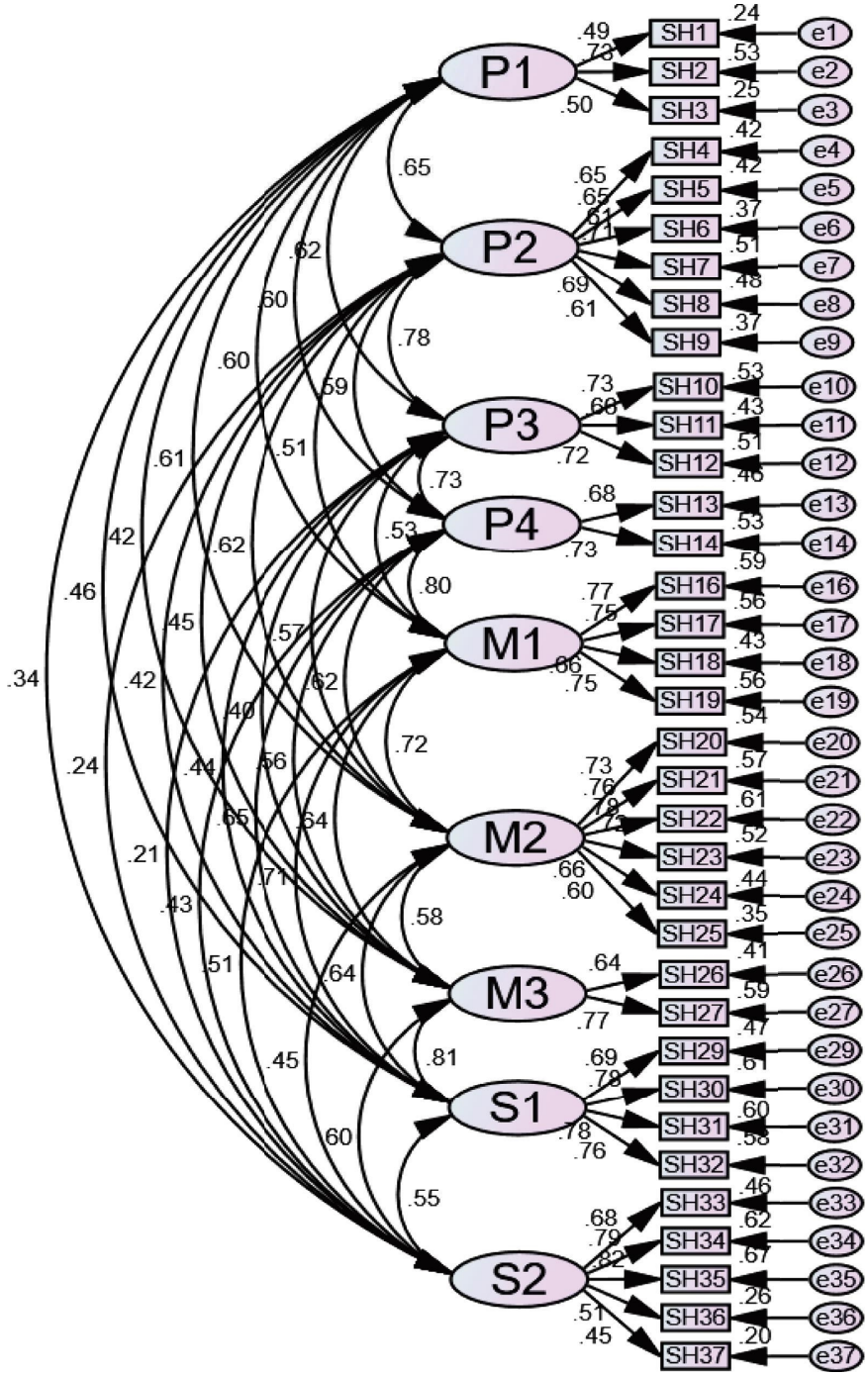

Figure 1: The first-order factor analysis for SHMS V1.0. *Note*. The loadings of each item in the corresponding dimension (35 items in corresponding P1, P2, P3, P4, M1, M2, M3, S1, and S2 dimensions) were greater than 0.4.

Cordova [38], which reported that spirit was associated with mood (item 20: Do you feel nervous? and item 21: Do you feel bad or depressed?). It indicated that items 20 and 21 measure comparable content and both belong to the psychological symptoms (M2) dimension. There was also error correlation between items 30 and 31 in the modified model, referring to the similar content (item 30: Are you satisfied with your interpersonal relationship in society? and item 31: Are you satisfied with your performance in life, work, and study?). Interpersonal relationship may lead to benefits in subjective well-being and performance [39]. Therefore, there are interacting effects between satisfaction with interpersonal relationships and performance in life, work, or study. In the future, it may be considered to merge item 20 with item 21 and item 30 with item 31 for reliability and validity testing to evaluate if it is more appropriate. Overall, the results illustrated that SHMS V1.0 had good construct validity among midwives after modified.

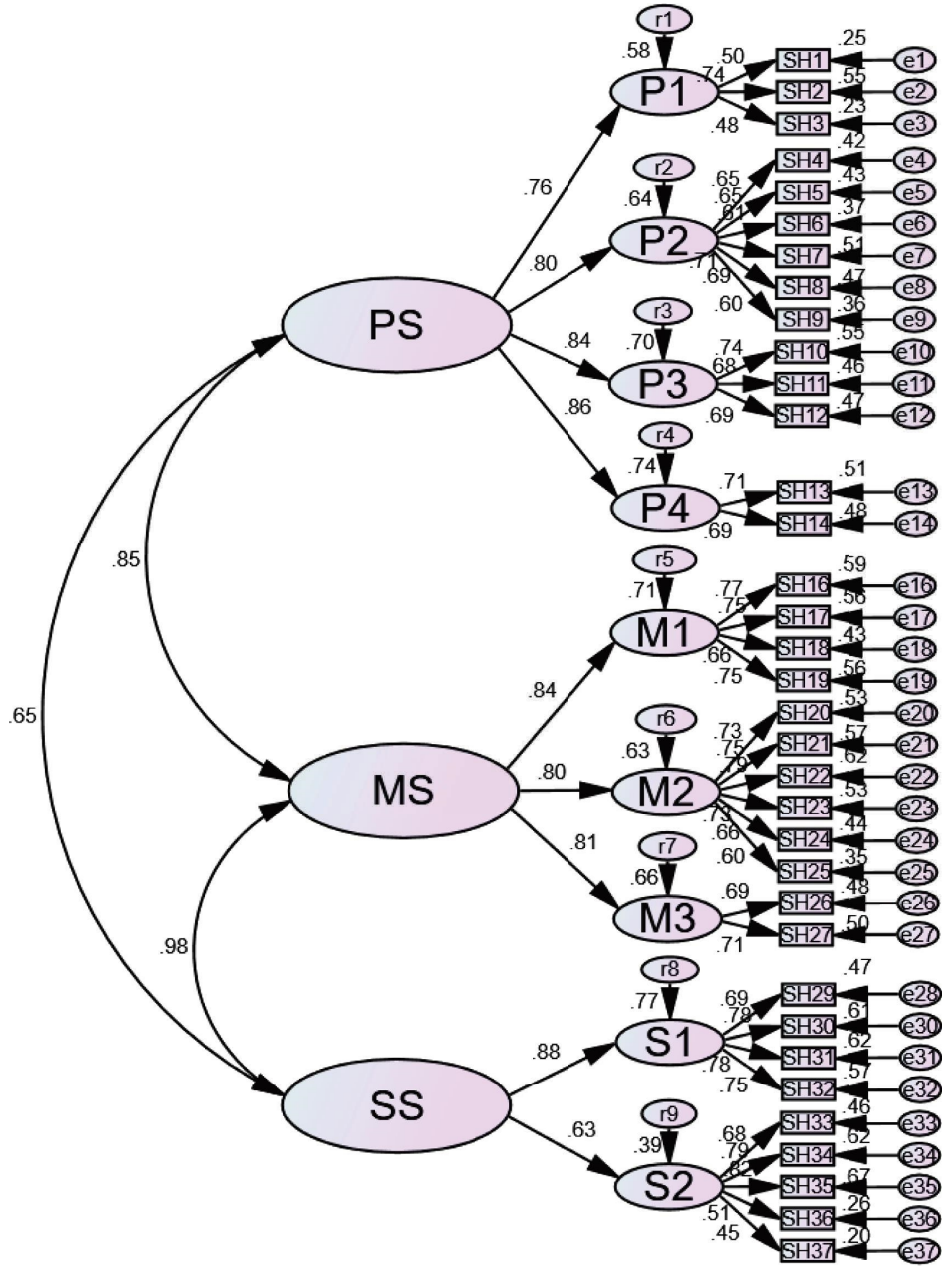

Figure 2: The second-order factor analysis for SHMS V1.0. *Note*. The loadings of each item in the corresponding dimension (35 items in corresponding P1, P2, P3, P4, M1, M2, M3, S1, and S2 dimensions) were greater than 0.4, and the loadings of each dimension in the corresponding subscale (P1, P2, P3, P4, M1, M2, M3, S1, and S2 dimensions in corresponding PS, MS, and SS subscales) were greater than 0.6.

Concurrent validity is to evaluate the effectiveness of the new tool by testing the correlation between the new tool and the reference standard. The present study took the FS-14 as a standard, which was used to measure physical and mental fatigue similar with SHS. Pearson correlation analysis showed strongly negative correlations between SHMS V1.0 and FS-14, but social subhealth showed smaller correlations with FS-14 including total fatigue, physical fatigue, and mental fatigue. Therefore, it can infer that SHMS V1.0 can more comprehensively reflect SHS of midwives than FS-14, especially for social health symptoms. Regarding physiological subhealth, bad posture (bending and twisting) and standing for long periods during the midwifery process make midwives physically tired [40]. Lack of sleep and biorhythm disorder which may be due to frequent rotating shifts work can also aggravate physiological subhealth [8]. For mental subhealth, it takes much time, energy, and emotion for midwives to deal with women's concerns and anxieties during the intrapartum period [41]. At the same time, high tension because of concerning the health of mothers and newborns, worrying about medical disputes, and facing further rescue in midwifery workplaces can easily lead to mental subhealth [42]. With regard to social subhealth, Chinese midwives are subordinate to the nursing

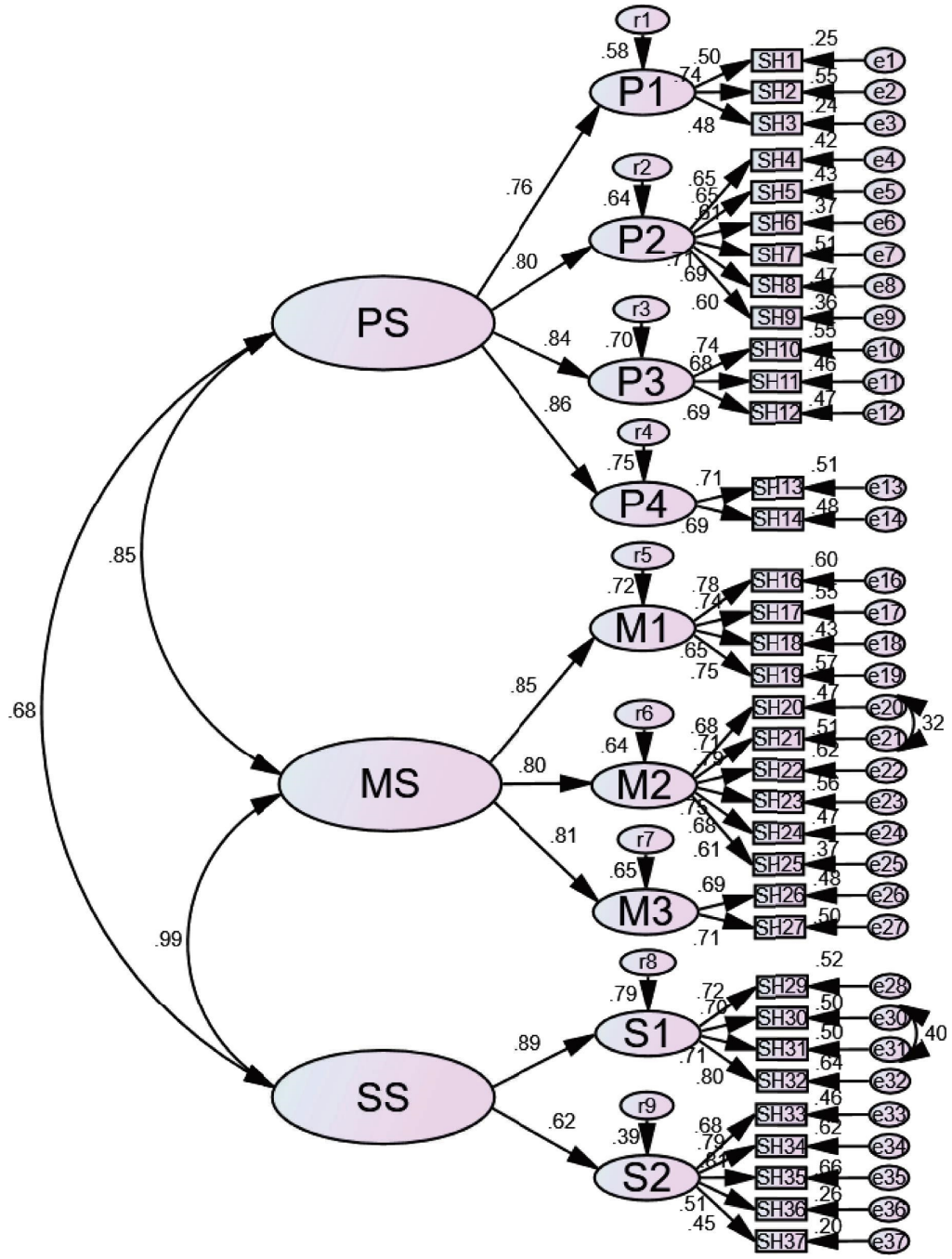

Figure 3: The modified second-order factor analysis for SHMS V1.0. *Note.* The loadings of each item in the corresponding dimension (35 items in P1, P2, P3, P4, M1, M2, M3, S1, and S2 dimensions) were greater than 0.4, and the loadings of each dimension in corresponding subscale (P1, P2, P3, P4, M1, M2, M3, S1, and S2 dimensions in PS, MS, and SS subscales) were greater than 0.6 after modified.

Table 3: The fit indexes for confirmatory factor analysis.

Fit index	$\chi^2\chi^2$/df	RMSEA	IFI	TLI	CFI	PGFI
Thresholds for good fit	<2.00	<0.08	>0.90	>0.90	>0.90	>0.50
The first-order factor model	1.958	0.048	0.919	0.907	0.918	0.726
The second-order factor model	2.087	0.051	0.903	0.894	0.902	0.750
The modified second-order factor model	1.955	0.048	0.915	0.907	0.915	0.757

Table 4: Correlation between the scores of SHMS V1.0 and FS-14 (r).

	Subhealth	Physiological subhealth	Mental subhealth	Social subhealth
Total fatigue	−0.609**	−0.526**	−0.591**	−0.406**
Physical fatigue	−0.594**	−0.517**	−0.577**	−0.393**
Mental fatigue	−0.553**	−0.474**	−0.538**	−0.374**

** $p < 0.001$.

profession and there is no independent policy and professional system for midwives, which make them lack social recognition. In addition, most midwives are women who have more family responsibility than men, which weaken social support and social adaptation of professional women leading to SS [43]. Therefore, SHMS V1.0 is suitable for measuring the SHS of midwives.

5.1. Strengths and Limitations. The results of this study contribute to the limited research on the measurement of midwives' SHS. And it was the first and a multihospital study, with enough samples to evaluate the psychometric properties of SHMS V1.0 in midwives, which provide an inspiration for measuring SHS of midwives. Meanwhile, there are several limitations in this study. First, the study was only conducted in one province of China, which might limit the generalizability to all Chinese midwives. Second, considering that the participants were limited to one cultural or geographic group, the characteristics of the sample usually affect the reliability and validity of questionnaires in general, so the universal applicability of SHMS V1.0 should be carefully considered.

6. Conclusion

The internal consistency coefficient and test-retest reliability coefficient showed that SHMS V1.0 had acceptable reliability. Project analysis and CFA showed that SHMS V1.0 had good construct validity. The concurrent validity analysis indicated that SHMS V1.0 was an available tool to measure SHS of midwives including fatigue. In conclusion, SHMS V1.0 with excellent psychometric properties can accurately and reliably evaluate the SHS of midwives. These findings of our study provide an important measurement tool and inspiration for midwives to early detect and prevent SHS. In the future, we will carry out surveys in more populations to inform all healthcare professionals for consideration of future healthcare practices.

Data Availability

The data used to support the findings of this study are available from the corresponding author on reasonable request.

Ethical Approval

The study was approved by the Ethical Committee of Fujian Maternity and Child Health Hospital, College of Clinical Medicine for Obstetrics and Gynecology and Pediatrics, Fujian Medical University, China (No.: 2018-206).

Disclosure

A preprint has previously been published [44]. The funder had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

All authors contributed to the study conception and design. Material preparation and data collection were performed by Xiao-Qian Chen, Qing-Xiang Zheng, Yan Bian, and Yu-Qing Pan. Data analysis was performed by Xin-Xin Huang and Gui-Hua Liu. The first draft of the manuscript was written by Xiao-Qian Chen. Xiu-Min Jiang and Qing-Xiang Zheng commented on the previous versions of the manuscript. Xiao-Qian Chen, Xiu-Min Jiang, and Yan Bian revised the final updated version of the manuscript.

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