

RESEARCH

Open Access



Translation and validation of the Chinese version of the maternal postpartum stress scale

Yanchi Wang^{1,2,3†}, Qian Gao^{3†}, Jin Liu², Feng Zhang^{2*} and Xujuan Xu^{3*}

Abstract

Objective To translate the Maternal Postpartum Stress Scale (MPSS) into Chinese and validate its psychometric properties in postpartum women.

Methods A total of 406 postpartum women were recruited from six hospitals in Nantong, Jiangsu Province, China. Cronbach's α co-efficient, split-half reliability, and test-retest reliability were used to evaluate the reliability of the translated scale. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were used to evaluate the structural validity of the scale. The Edinburgh Postnatal Depression Scale, Depression Anxiety Stress Scale-21 anxiety dimension, and Perceived Stress Scale were used as calibration scales to measure the correlation of MPSS. All data were analyzed using SPSS 25.0 and Amos 24.0.

Results The Cronbach's α co-efficient of the Chinese version of MPSS and its three dimensions were 0.940 and 0.882–0.911, respectively. The split-half reliability was 0.825, and the test-retest reliability was 0.912. The scale's content validity index was 0.926. Three common factors were extracted from the EFA. The CFA validated the explored 3-factor structure, and the indicators were fitted well ($\chi^2/Df = 2.167$, comparative fit index = 0.918, Tucker–Lewis index = 0.907, incremental fit index = 0.919, and root mean square error of approximation = 0.075).

Conclusion The translated Chinese version of MPSS had suitable reliability and validity in assessing postpartum stress in Chinese women. The translated scale can also help with the early identification of postpartum stress and provide a scientific basis for the formulation of early personalized intervention measures. Overall, the scale has certain clinical value and practical significance for enhancing the physical and mental health of postpartum women. However, future studies including large, diverse populations are warranted.

Keywords Maternal Postpartum stress scale, Reliability, Validity, Exploratory factor analysis, Confirmatory factor analysis

[†]Yanchi Wang and Qian Gao contributed equally to this work.

*Correspondence:

Feng Zhang
zhangfeng820909@163.com
Xujuan Xu
2205434494@qq.com

¹Affiliated Nantong Hospital of Shanghai University (The Sixth People's Hospital of Nantong), Nantong, Jiangsu, China

²Medical School of Nantong University, Nantong, Jiangsu, China

³Department of Nursing, Affiliated Hospital of Nantong University, Nantong 226001, Jiangsu, China



© The Author(s) 2023. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated in a credit line to the data.

Introduction

Postpartum is a critical period for the mother and child, which may negatively affect maternal health [1]. Postpartum stress is usually conceptualized as a negative psychological response to the numerous obligations associated with raising children, and its presence is the rule rather than the exception [2]. Women with postpartum stress have intense, excessive, and persistent concerns and fears regarding various situations such as transitioning into parenthood, the baby's health, and their personal health [3, 4]. In addition, they tend to have self-doubt, thus challenging their sense of self-evaluation and eventually developing severe postpartum mental diseases, such as postpartum depression [5]. Postpartum stress is reportedly more common than postpartum depression and affects a considerable proportion of mothers [6]. Therefore, an in-depth study of the causes of postpartum stress and its interventions is crucial.

Postpartum stress is often unrecognized and underdiagnosed because it is frequently comorbid or co-occurs with numerous other psychiatric disorders, such as anxiety disorders and major depression [7, 8]. This makes the treatment even more challenging, resulting in low remission rates and worse prognosis. Although structured interviews are widely used to diagnose postpartum stress, they are often time-consuming and require trained professionals to administer them [9]. As the first step in screening and early detection of postpartum stress, self-report measures are good, efficient, and easier. Although Hung Postpartum Stress Scale (HPSS) [10] is reliable and valid in assessing postpartum stress, its application of some items is limited to the early postpartum period (within 6 weeks after delivery). In addition, there were relatively too much items in the scale. Therefore, developing effective, easy, reliable and specific assessment tools to timely and accurately assess postpartum stress and effectively screen and control the symptoms of postpartum stress is crucial.

In 2021, Nakić Radoš et al. [11] developed the Maternal Postpartum Stress Scale (MPSS) to assess maternal stress during postpartum maternity leave. The introduction of MPSS has enriched the evaluation tools for postpartum stress and has helped understand maternal stress at various postpartum time points and identify women at high risk for postpartum stress, which may be beneficial for formulating personalized interventions. To the best of our knowledge, except for the original English version, the MPSS has not been validated in other ethnic groups. In this study, the English version of MPSS was translated into Chinese accompanied by cultural modification, and the psychometric properties of the translated version were validated in general Han Chinese postpartum women which were recruited from Nantong (Located in eastern China), Jiangsu Province, China.

Methods

Participants and procedures

Using the convenience sampling method, 406 postpartum women who underwent physical examination 42 days after delivery at six hospitals (The Affiliated Hospital of Nantong University, The First People's Hospital of Nantong, The Second People's Hospital of Nantong, The Third People's Hospital of Nantong, The Affiliated Maternity and Child Health Care Hospital of Nantong University, and The Sixth People's Hospital of Nantong) in Nantong, Jiangsu Province, China, between August and November 2022 were selected as research participants.

According to Kendall's sample size calculation method, the sample size should be 5–10 times the number of items in the questionnaire [12]. Therefore, given that the MPSS comprises 22 items, the sample size required for our study was 110–220 participants. However, assuming a 20% dropout rate, the required sample size was 132–264 participants. Because the recruitment rate was higher than expected, we were able to obtain 425 participants for our study, which met the sample size requirements. Of 425, 406 participants completed the MPSS in Chinese version, with a response rate of 95.53%. The final participants were subsequently divided into two groups using the split-sampling random procedure: Group 1, which included 200 participants, was assigned to exploratory factor analysis (EFA), and Group 2, which included 206 participants, was assigned to confirmatory factor analysis (CFA) [13]. During the survey, standardized instructions were presented to the participants with detailed explanations of the content and purpose of the investigation. All participants were informed that the participation was voluntary, their responses were confidential, and they could withdraw at any time. The survey lasted for approximately 20–30 min.

The inclusion criteria were as follows: (a) maternal age ≥ 18 years; (b) no malformations or serious complications in the newborn; (c) willingness to cooperate with the survey, ability to communicate effectively, and ability to understand the contents of the questionnaire and complete it independently; and (d) voluntary participation. The exclusion criteria were as follows: (a) unmarried mothers; (b) preterm births or twins; (c) comorbid psychosomatic diseases, such as chronic urticaria, neurodermatitis, hyperthyroidism, migraine, muscle pain, rheumatoid arthritis, sleep disorders, and malignant tumors; (d) mental illnesses (other than depression and anxiety), severe organic diseases such as heart, liver, and kidney diseases, and severe complications during pregnancy; (e) low intelligence and inability to understand the contents of the questionnaire; and (f) poor compliance and unwilling to cooperate in the study.

Prior to the survey, written informed consent was also obtained from all participants. Ethical approval for this

study was obtained from the Research Ethics Committee of the Affiliated Hospital of Nantong University (approval number: 2022-K50-01).

Measures

A questionnaire consisting of sociodemographic questions and 22 items from the translated MPSS was constructed. The Edinburgh Postnatal Depression Scale (EPDS) [14] and Depression Anxiety Stress Scale-21 (DASS-21) [15] were applied to evaluate divergent validity, and the 10-item Perceived Stress Scale (PSS-10) [16] was applied to evaluate convergent validity.

MPSS

MPSS [11] is a reliable and valid instrument that measures self-reporting postpartum stress. It contains 22 items and three subscales: personal needs and fatigue (9 items), infant nurturing (7 items), and body changes and sexuality (6 items). Each item is scored on a 5-point Likert scale, ranging from 0 (not at all) to 4 (completely). A higher MPSS total score indicates a higher postpartum stress level.

Translation of the MPSS

After obtaining permission from the original authors, MPSS was translated into Chinese using the classical “backward and forward” procedure following a modified Brislin translation model [17]. Two independent bilingual Chinese native psychologists performed the forward translation of items from English into Chinese. Following discussion and revision by all the authors and translators, a consensus forward Chinese version of the instrument was developed. Subsequently, the reconciled forward version of the scale was back-translated into English by two independent bilingual psychologists who were blinded to the original English version. In the third step, the original and back-translated English versions of the scale were compared according to the cross-cultural adaptation guidelines of the scale [18] and reviewed by a 15-member expert panel, including sociologists, psychologists, nursing education experts, clinical experts, and obstetric nursing experts. The findings showed that the versions were semantically equivalent. Next, cognitive interviews were conducted with 30 postpartum women to investigate the comprehensibility of the Chinese version of MPSS, and revisions were made [19]. The English version of MPSS is presented in Supplementary Table 1

EPDS

The Chinese version of the EPDS [14] was used to assess postpartum depression status. The scale comprises 10 items [20]. Each item response is divided into four levels, reflecting the different severity of symptoms, from “never” to “always” with a score of 0–3, respectively. The

scores of the 10 items were summed to obtain the total individual score, which ranged from 0 to 30. We used 10 as the cutoff point [21].

DASS-21

DASS-21 [15] was used to measure depressive, anxiety, and stress symptoms among participants. It comprises 21 self-reporting items, with 7 items each in the 3 subscales: depression, anxiety, and stress. Respondents rate each item ranging from 0 (did not apply to me at all) to 3 (applied to me very much) in the past week. To ensure compatibility with DASS-42, the DASS-21 score is multiplied by 2. Psychometric properties of the scale in assessing depression, anxiety, and stress were well established, including among pregnant and postpartum women. In this study, the focus is on the anxiety dimension of the scale [22].

PSS-10

The validated Chinese version of the PSS-10 [16], which has been widely used in clinical research to measure general stress levels, was used to assess stress severity. Each item is rated on a 5-point scale, ranging from 0 (never) to 4 (very often), with a total score ranging from 0 to 40, whereby a higher score indicates a higher stress level [23].

Statistical analyses

The EFA and CFA were used to explore and verify the potential factor structure of the scale, respectively. The scale is suitable for EFA only when the Kaiser-Meyer-Olkin (KMO) > 0.6 and Bartlett's sphericity test were statistically significant ($P < 0.05$) [24]. Amos software (24.0) was used to validate the consistency of the model structure with the explored factor structure. These indices were used to examine the model's goodness of fit: comparative fit index (CFI). When Chi-square/Df (χ^2/Df) was < 3.000, root mean square residual was < 0.050, root mean square error of approximation (RMSEA) was < 0.080, and value incremental fit index (IFI), Tucker-Lewis index (TLI), and CFI exceeded 0.900 [25], the model was well fitted. Cronbach's α coefficient was used to determine the internal consistency reliability of the scale. Cronbach's α coefficient exceeding 0.7 was considered acceptable [26]. The two-sided chi-squared test was used to statistically evaluate differences in demographic characteristics between the EFA and CFA groups. Student's t-test was used to statistically evaluate differences in total MPSS and subscale scores for postpartum women in different statuses. All data were analyzed using SPSS 25.0 and Amos 24.0, with a significant α threshold of 0.05 (two-tailed).

Results

Demographic information

The characteristics of participants in the EFA (n=200) and CFA (n=206) groups are summarized in Table 1. All the variables were comparable between both groups ($P>0.05$).

Among the total 406 participants, the median score of the MPSS was 15, while the median scores of the three subscales of the MPSS were 5 (personal needs and fatigue), 6 (infant nurturing), and 3 (body changes and sexuality), respectively. Details of the number of participants in each score group were showed in Fig. 1.

Item analysis

The Chinese version of MPSS of the 406 survey respondents was sorted by their score, with those in the top 27% categorized into the high-stress group and those in the bottom 27% as the low-stress group. The mean of each item score in both groups was calculated. The two-tailed independent samples t-test showed a significant difference between the items in the two groups ($P<0.05$). The specific statistical results are shown in Supplementary Table 2. The correlation analysis results (Table 2) revealed that Pearson's correlation coefficient among all items in the scale was >0.2 . The results of the discrete trend method (Supplementary Table 3) showed that the coefficient of variation of each item was >0.80 , and all items met the inclusion criteria.

Content validity index (CVI).

As shown in Supplementary Tables 4, the CVI of each item in the MPSS was 0.88–1, suggesting that the items were comprehensible to the target users, and the scale's CVI (S-CVI) was 0.926.

Reliability analysis.

The Cronbach's α coefficient of the total MPSS was 0.940 and that of the three subscales were 0.903, 0.911, and 0.882, respectively. The half-test reliability was 0.825, and the retest reliability was 0.912, indicating good reliability (Supplementary Table 5). Supplementary Table 6 shows the correlation coefficient between the 22 items of the questionnaire and the total score and presents the Cronbach α coefficients after removing an item from the questionnaire, all of which were lower than 0.90 prior to removal.

Validity analysis

EFA

KMO was 0.910, and Bartlett's sphericity test was statistically significant ($\chi^2=3511.060$, $P<0.01$), indicating that the translated MPSS was suitable for factor structure analysis. A total of three factors with eigenvalues >1 were extracted, and a total of 65.716% of data discrepancies were explained. Furthermore, EFA results showed that each factor load was >0.4 . Therefore, all items were retained. The specific results can be found in Table 3.

Table 1 Characteristics of the subjects enrolled in this study

Variables		EFA ¹ (n = 200)	CFA ² (n = 206)	P	Variables	EFA ¹ (n = 200)	CFA ² (n = 206)	P	
Age	< 30	106(53.00%)	122(59.22%)	0.206	Years of marriage	≤ 5	160(80.00%)	164(79.61%)	0.922
	≥ 30	94(47.00%)	84(40.78%)			> 5	40(20.00%)	42(20.39%)	
Educational level (PE ³)	Below bachelor	75(37.50%)	83(40.29%)	0.564	Abortion history	No	136(68.00%)	138(66.99%)	0.828
	Bachelor or above	125(62.50%)	123(59.71%)			Yes	64(32.00%)	68(33.01%)	
Educational level (husband)	Below bachelor	91(45.50%)	80(38.83%)	0.174	Parity	Primipara	154(77.00%)	163(79.13%)	0.605
	Bachelor or above	109(54.50%)	126(61.17%)			Multipara	46(23.00%)	43(20.87%)	
Family monthly income (CNY)	< 5000	5(2.50%)	10(4.85%)	0.259	Assisted reproduction	No	173(86.50%)	172(83.50%)	0.397
	5000–10,000	77(38.50%)	64(31.07%)			Yes	27(13.50%)	34(16.50%)	
	10,001–20,000	84(42.00%)	99(48.06%)		BMI	Normal	123(61.50%)	122(59.23%)	0.861
	> 20,000	34(17.00%)	33(16.02%)			Overweight	46(23.00%)	52(25.24%)	
Medical insurance	No	24(12.00%)	32(15.53%)	0.302	Obesity	31(15.50%)	32(15.53%)	0.927	
	Yes	176(88.00%)	174(84.47%)			Complications of pregnancy	No		138(69.00%)
Mode of Feeding	Breast-feeding	80(40.00%)	83(40.29%)	0.829	Birth weight	Yes	62(31.00%)	63(30.58%)	0.323
	Mixed-feeding	99(49.50%)	105(50.97%)			< 3 kg	37(18.50%)	32(15.53%)	
	formula-feeding	21(10.50%)	18(8.74%)			3–4 kg	147(73.50%)	149(72.33%)	
Mode of delivery	Vaginal	83(41.50%)	96(46.60%)	0.462	Infant caretaker	> 4 kg	16(8.00%)	25(12.14%)	0.686
	Vaginal (lateral episiotomy)	39(19.50%)	32(15.53%)			Only PE ³	56(28.00%)	54(26.21%)	
	Cesarean section	78(39.00%)	78(37.86%)			Involving others	144(72.00%)	152(73.79%)	

¹ EFA: exploratory factor analysis;

² CFA: confirmatory factor analysis;

³ PE: postpartum women

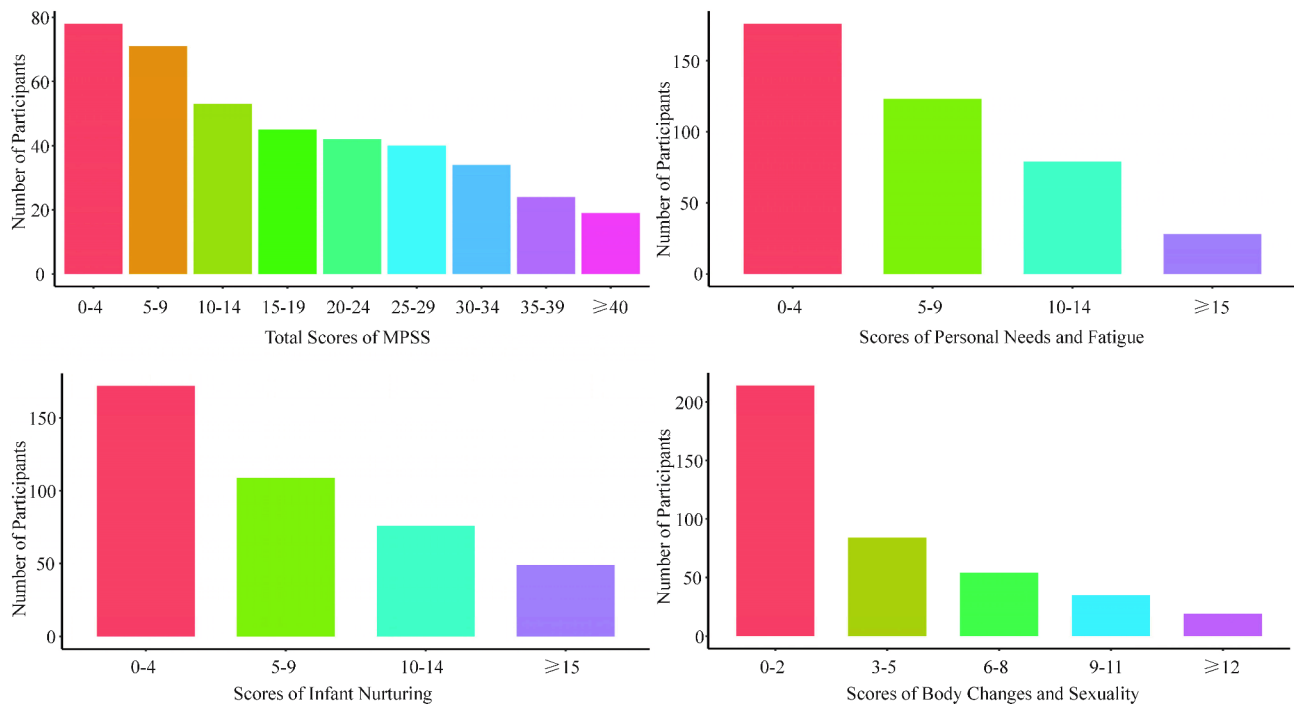


Fig. 1 Number of participants in each MPSS and subscale groups

CFA

CFA was used to determine whether the structure of the questionnaire used was consistent with the theoretical structure of the original questionnaire. Furthermore, it was used to validate whether the relationship between each item and the factors is consistent with the hypothesis. The results after model modification are shown in Fig. 2, which indicated that the fittings were good. The values of the indicators were $\chi^2/Df=2.167(<3, P<0.05)$, $CFI=0.918(>0.9)$, $IFI=0.919 (>0.9)$, $TLI=0.907 (>0.9)$, and $RMSEA=0.075 (<0.08)$ (Supplementary Table 7).

Calibration correlation validity

EPDS, DASS-21 anxiety dimension, and PSS-10 were used as calibration scales. The EPDS test results (Fig. 3) showed that there were 75 women with postpartum depression (18.47%). The MPSS scores of the women with postpartum depression were significantly higher than those with no depression, with a statistically significant difference ($P<0.001$). Similarly, the MSPP subscale scores of the women with postpartum depression were higher than those with no depression ($P<0.001$). The results of the anxiety subscale in DASS-21 showed that 68 women (16.75%) were in anxious status. Their MPSS scores were significantly higher compared to those without anxiety ($P<0.001$), and the MPSS subscales also showed the same trend ($P<0.05$). The PSS results showed that the MPSS score of the postpartum women with high perceived stress score was significantly higher than those with low perceived stress score ($P<0.001$), and the MPSS subscales

also showed the same trend ($P<0.001$). The Pearson correlation coefficients between the revised Chinese version of MPSS and EPDS, DASS-21 anxiety dimension, and PSS were 0.502, 0.404, and 0.476 ($P<0.001$), respectively. The correlation coefficients between each subscale of MSPP and EPDS, DASS-21 anxiety dimension, and PSS are shown in Fig. 4.

Correlation between the total items of MPSS and each subscale

In order of magnitude, each subscale of postpartum stress had an impact on the total score of postpartum stress: personal needs and fatigue ($r=0.890, P<0.001$), infant nurturing ($r=0.870, P<0.001$), and body changes and sexuality ($r=0.796, P<0.001$). Personal needs and fatigue had the closest relationship with infant nurturing ($r=0.640, P<0.001$). The relationship between each subscale and the total items MPSS is shown in Fig. 5.

Discussion

Maternal postpartum stress is an important aspect of postpartum women's mental health [27]. Although scales that evaluate postpartum stress exist, they lack specificity, and most are universal scales. Even if they have specificity, certain limitations remain, such as the measurement time being too early or too late or too much content [28–30]. At present, there is no specific tool that measures postpartum stress from multiple perspectives. When the MPSS was developed in Croatia, it was only applicable to women within 1 year of childbirth. This is

Table 2 The results of the discriminant validity analysis using the Pearson's correlation coefficient

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	Total score
A1	1	0.623**	0.513**	0.650**	0.639**	0.586**	0.380**	0.469**	0.390**	0.353**	0.288**	0.255**	0.283**	0.371**	0.305**	0.271**	0.291**	0.381**	0.468**	0.412**	0.320**	0.399**	0.687**
A2	0.623**	1	0.613**	0.585**	0.587**	0.496**	0.445**	0.494**	0.485**	0.356**	0.271**	0.252**	0.326**	0.301**	0.270**	0.260**	0.262**	0.440**	0.501**	0.369**	0.407**	0.451**	0.679**
A3	0.513**	0.613**	1	0.577**	0.584**	0.490**	0.466**	0.446**	0.442**	0.352**	0.208**	0.341**	0.312**	0.351**	0.288**	0.246**	0.285**	0.345**	0.443**	0.377**	0.322**	0.355**	0.653**
A4	0.650**	0.585**	0.577**	1	0.839**	0.735**	0.456**	0.465**	0.391**	0.370**	0.275**	0.338**	0.362**	0.388**	0.349**	0.294**	0.312**	0.415**	0.479**	0.446**	0.337**	0.408**	0.743**
A5	0.639**	0.587**	0.584**	0.839**	1	0.759**	0.473**	0.466**	0.417**	0.390**	0.267**	0.338**	0.314**	0.362**	0.324**	0.296**	0.298**	0.417**	0.477**	0.420**	0.361**	0.411**	0.741**
A6	0.586**	0.496**	0.490**	0.735**	0.759**	1	0.548**	0.456**	0.426**	0.406**	0.295**	0.348**	0.334**	0.355**	0.319**	0.308**	0.334**	0.355**	0.483**	0.435**	0.412**	0.431**	0.726**
A7	0.380**	0.445**	0.466**	0.465**	0.473**	0.548**	1	0.465**	0.437**	0.385**	0.266**	0.230**	0.290**	0.299**	0.240**	0.247**	0.239**	0.337**	0.404**	0.328**	0.381**	0.343**	0.595**
A8	0.469**	0.494**	0.446**	0.465**	0.466**	0.456**	0.465**	1	0.699**	0.556**	0.507**	0.479**	0.357**	0.373**	0.353**	0.312**	0.320**	0.591**	0.746**	0.451**	0.594**	0.578**	0.752**
A9	0.390**	0.485**	0.442**	0.391**	0.417**	0.426**	0.437**	0.699**	1	0.532**	0.386**	0.441**	0.275**	0.334**	0.322**	0.274**	0.281**	0.527**	0.596**	0.367**	0.568**	0.524**	0.678**
A10	0.353**	0.356**	0.352**	0.370**	0.390**	0.406**	0.385**	0.556**	0.532**	1	0.367**	0.452**	0.350**	0.374**	0.362**	0.296**	0.266**	0.544**	0.549**	0.410**	0.554**	0.538**	0.653**
A11	0.288**	0.271**	0.208**	0.275**	0.267**	0.295**	0.266**	0.507**	0.386**	0.367**	1	0.489**	0.290**	0.309**	0.304**	0.348**	0.218**	0.415**	0.484**	0.297**	0.433**	0.427**	0.534**
A12	0.255**	0.252**	0.341**	0.338**	0.338**	0.348**	0.230**	0.479**	0.441**	0.452**	0.489**	1	0.320**	0.364**	0.349**	0.331**	0.241**	0.359**	0.512**	0.334**	0.413**	0.467**	0.572**
A13	0.283**	0.326**	0.312**	0.362**	0.314**	0.334**	0.290**	0.357**	0.275**	0.350**	0.290**	0.320**	1	0.611**	0.591**	0.528**	0.461**	0.452**	0.466**	0.509**	0.438**	0.400**	0.615**
A14	0.371**	0.301**	0.351**	0.388**	0.362**	0.355**	0.299**	0.373**	0.334**	0.374**	0.309**	0.364**	0.611**	1	0.844**	0.572**	0.526**	0.449**	0.431**	0.603**	0.406**	0.411**	0.672**
A15	0.305**	0.270**	0.288**	0.349**	0.324**	0.319**	0.240**	0.355**	0.322**	0.362**	0.304**	0.349**	0.591**	0.844**	1	0.604**	0.480**	0.466**	0.422**	0.526**	0.447**	0.425**	0.637**
A16	0.271**	0.260**	0.246**	0.294**	0.296**	0.308**	0.308**	0.247**	0.331**	0.320**	0.304**	0.331**	0.528**	0.572**	0.604**	1	0.374**	0.398**	0.385**	0.419**	0.434**	0.415**	0.565**
A17	0.291**	0.262**	0.285**	0.312**	0.298**	0.334**	0.239**	0.320**	0.281**	0.266**	0.218**	0.241**	0.461**	0.526**	0.480**	0.374**	1	0.455**	0.393**	0.698**	0.410**	0.367**	0.574**
A18	0.381**	0.440**	0.345**	0.415**	0.417**	0.355**	0.337**	0.591**	0.527**	0.544**	0.415**	0.359**	0.452**	0.449**	0.466**	0.398**	0.455**	1	0.671**	0.531**	0.633**	0.570**	0.718**
A19	0.468**	0.501**	0.443**	0.479**	0.477**	0.483**	0.404**	0.746**	0.596**	0.549**	0.484**	0.512**	0.466**	0.431**	0.422**	0.383**	0.393**	0.671**	1	0.519**	0.648**	0.592**	0.785**
A20	0.412**	0.369**	0.377**	0.446**	0.420**	0.435**	0.328**	0.451**	0.367**	0.410**	0.297**	0.334**	0.509**	0.603**	0.526**	0.419**	0.698**	0.531**	0.519**	1	0.468**	0.459**	0.704**
A21	0.320**	0.407**	0.322**	0.337**	0.361**	0.412**	0.381**	0.594**	0.568**	0.554**	0.433**	0.413**	0.438**	0.406**	0.447**	0.434**	0.410**	0.633**	0.648**	0.468**	1	0.674**	0.703**
A22	0.399**	0.451**	0.355**	0.408**	0.411**	0.431**	0.343**	0.578**	0.524**	0.538**	0.427**	0.467**	0.400**	0.411**	0.425**	0.415**	0.367**	0.570**	0.592**	0.459**	0.674**	1	0.706**
Total score	0.687**	0.679**	0.653**	0.743**	0.741**	0.726**	0.595**	0.752**	0.678**	0.653**	0.534**	0.572**	0.615**	0.672**	0.637**	0.565**	0.574**	0.718**	0.785**	0.704**	0.703**	0.706**	1

Table 3 Exploratory factor analysis of the MPSS in Chinese version (n = 200)

Items	fac- tor 1	fac- tor 2	fac- tor 3
A21 Impossibility to complain to someone	0.805		
A8 Adjustment to frequent wake-ups	0.759		
A9 Baby's irregular patterns of daily sleep	0.754		
A22 Loneliness at home with the baby	0.737		
A18 Lack of time for socializing with friends	0.731		
A10 My fatigue and exhaustion	0.669		
A19 Lack of time for myself	0.650		
A12 Lack of help with the baby and household chores	0.604		
A11 The amount of the household chores	0.571		
A5 Baby's health problems		0.827	
A4 Baby's development		0.823	
A6 Recognizing the baby's needs		0.763	
A3 Insufficient milk supply when breastfeeding		0.759	
A2 Baby's irregular feeding pattern		0.743	
A1 Choosing the appropriate way of feeding the baby		0.625	
A7 Impossibility to soothe a crying or upset baby		0.560	
A15 Insufficient enjoyment in sexual intercourse			0.856
A14 Insufficient frequency of sexual intercourse			0.833
A13 Being uncertain when to resume intercourse after childbirth			0.737
A16 The thought that my partner finds me unattractive			0.713
A20 Physical appearance after childbirth			0.704
A17 The impossibility to return to the pre-pregnancy weight			0.644
Eigenvalues	10.486	2.153	1.595
Cumulative variance contribution rate (%)	23.439	45.415	64.699

because women in Croatia are entitled to 1-year fully paid maternity leave after childbirth. Therefore, this scale can also be applied to postpartum women in China to measure postpartum stress during maternity leave, thus providing clinical workers with a tool to quickly identify postpartum stress or those at risk. Moreover, this can enable effective and accurate management of postpartum women's health psychology.

In this study, the guidelines for cross-cultural adaptation of MPSS were strictly followed. We tested the psychometric properties of MPSS in the Chinese population. The MPSS was finally formed through the cultural modification of expert letter consultation and cognitive interview. The 15-member expert panel, which included clinicians and experts in obstetrics and gynecology, nursing, sociology, pediatrics, psychology, and statistics, was highly professional. Given that these members have strong comprehensive strength and comprehensive

involvement in the field, it promotes the objectivity and professionalism of the scale evaluation. A formal survey of the included postpartum women showed that the Chinese version of MPSS had good reliability and validity. The translated version of MPSS contains 22 items and 3 subscales. The scale items are moderate, and the completion time is less than 5 min. The contents of the items are clear and easy to understand. Most importantly, the Chinese version of MPSS evaluates postpartum stress from multiple dimensions, including personal needs and fatigue, infant nurturing, and body changes and sexuality. Subsequently, this data can assist medical staff in better evaluating, developing personalized intervention programs, and improving postpartum stress.

The S-CVI of the Chinese version of MPSS was $0.926 > 0.900$, and the item CVI was $0.88-1.00 > 0.800$. After the cognitive interview, respondents systematically and deeply analyzed the contents of each item of the scale, optimized the scale to adapt it to the Chinese cultural background, and improved the understanding and acceptance of each item of the scale. This indicated that the content validity of the scale was good. In the translated version, saturated with three factors explaining 65.716% of the items' variance. However, in the original scale, saturated with three factors explaining 36.1% of the items' variance. In this study, both EFA and CFA suggested that the scale structure was stable. In addition, EPDS and DASS-21 anxiety subscale were applied to evaluate divergent validity, and PSS-10 was applied to evaluate convergent validity. The correlation coefficients between the Chinese version of MPSS and EPDS, DASS-21 anxiety subscale, and PSS-10 were 0.502, 0.404, and 0.476 ($P < 0.01$), respectively. The total scale and all subscales correlated moderately with general perceived stress. Of all, the personal needs and fatigue subscale had the highest correlation with general perceived stress. In line with this finding, some studies suggested that mothers in the postpartum period reported a lack of time for themselves and exhaustion [31]. The total scale and all subscales also correlated with depression and anxiety, in line with the finding of a previous study, which suggested that mothers who experience more stress are at risk for mental health issues [32]. However, it should be noted that the convergent validity was only moderate, with the MPSS and general stress scale sharing only 47.6% of the variance. Similar patterns were seen in other postnatal stresses, suggesting a small overlap between specific and general postnatal stress [33–35].

Reliability reflects the internal consistency and stability of the results measured by the tool. In this study, Cronbach's α coefficient of the total scale was 0.940, while Cronbach's α coefficients of the three subscales were 0.903, 0.911, and 0.882, respectively. Cronbach's α coefficient of the original scale was 0.880, while Cronbach's α

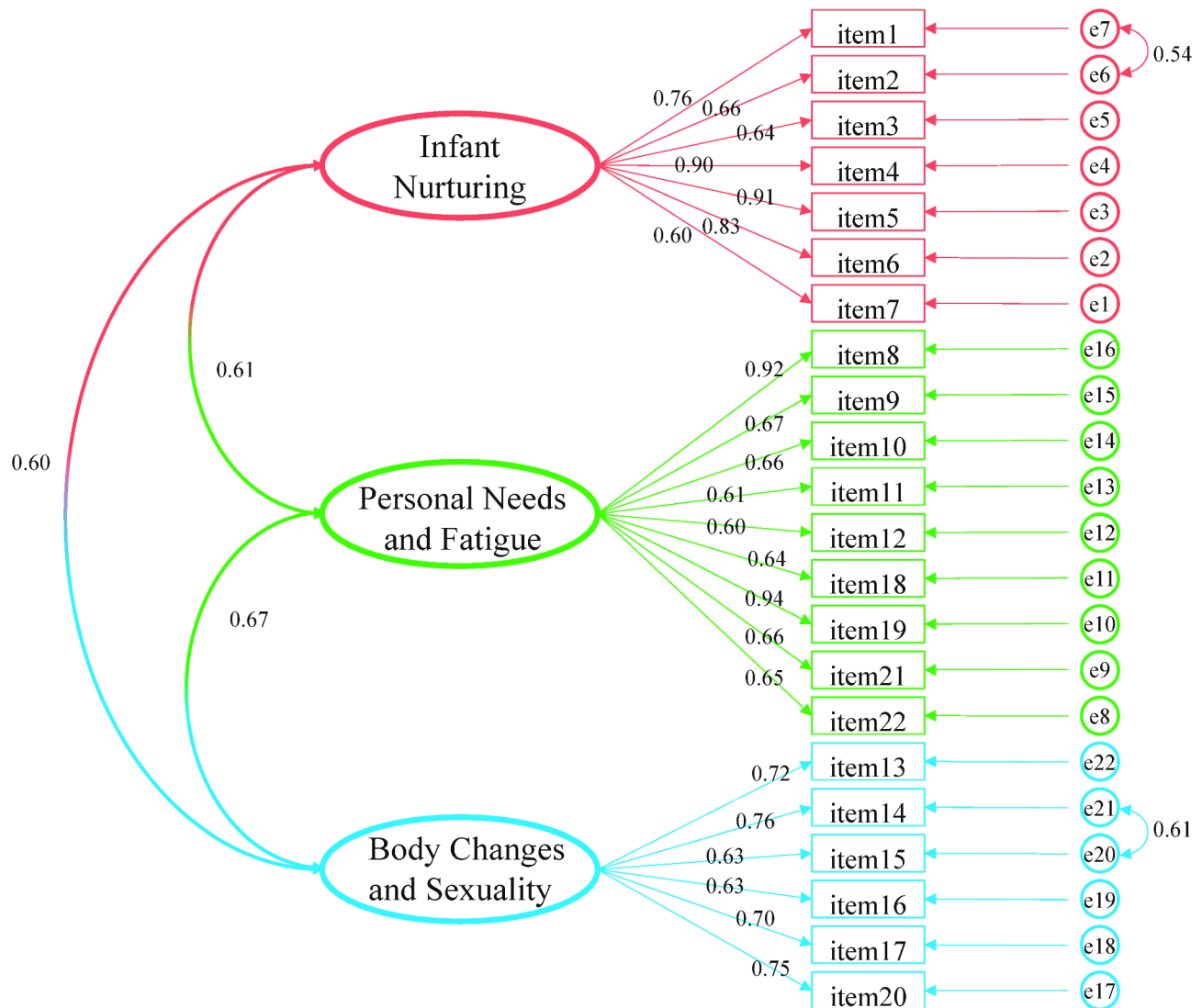


Fig. 2 Confirmatory factor analysis model of the Chinese version of MPSS

coefficients of the three subscales were 0.850, 0.830, and 0.790, respectively, which were all higher than the original scale. The Cronbach's α coefficient of all dimensions was greater than 0.8, indicating good internal consistency. The half-point reliability was $0.825 > 0.7$, indicating high internal consistency. The retest reliability was 0.912, and the reflection scale has good stability. Overall, the MPSS has good reliability. To our knowledge, this was the first study to validate the tool in different languages. The results of our study may be useful for future research and clinical practice concerning maternal postpartum stress.

As we collected the questionnaire from the postpartum clinic, all the women were the ones who underwent the postpartum check-up 6 weeks after delivery. While also breastfeeding, most postpartum women put all their energy into their children, need more social and family support [36], need intimate relationship support [37],

experience increased fatigue, and seldom focus on self-care. These changes influence their identity as mothers. Changes in hormone secretion levels [38] coupled with China's conservative outlook on sex result in higher stress levels, particularly in personal needs and fatigue and infant nurturing, although body changes and sexuality are higher. Personal needs and fatigue have the closest relationship with infant nurturing, while infant nurturing has the weakest relationship with body changes and sexuality.

Overall, the MPSS demonstrated good internal consistency and significant inter-item and item-total correlations, indicating that the Chinese MPSS could confidently be used to assess maternal postpartum stress. The correlation between MPSS and EPDS, DASS-21 anxiety dimension, and PSS-10 also supports the structural validity of MPSS. The results are consistent with previous

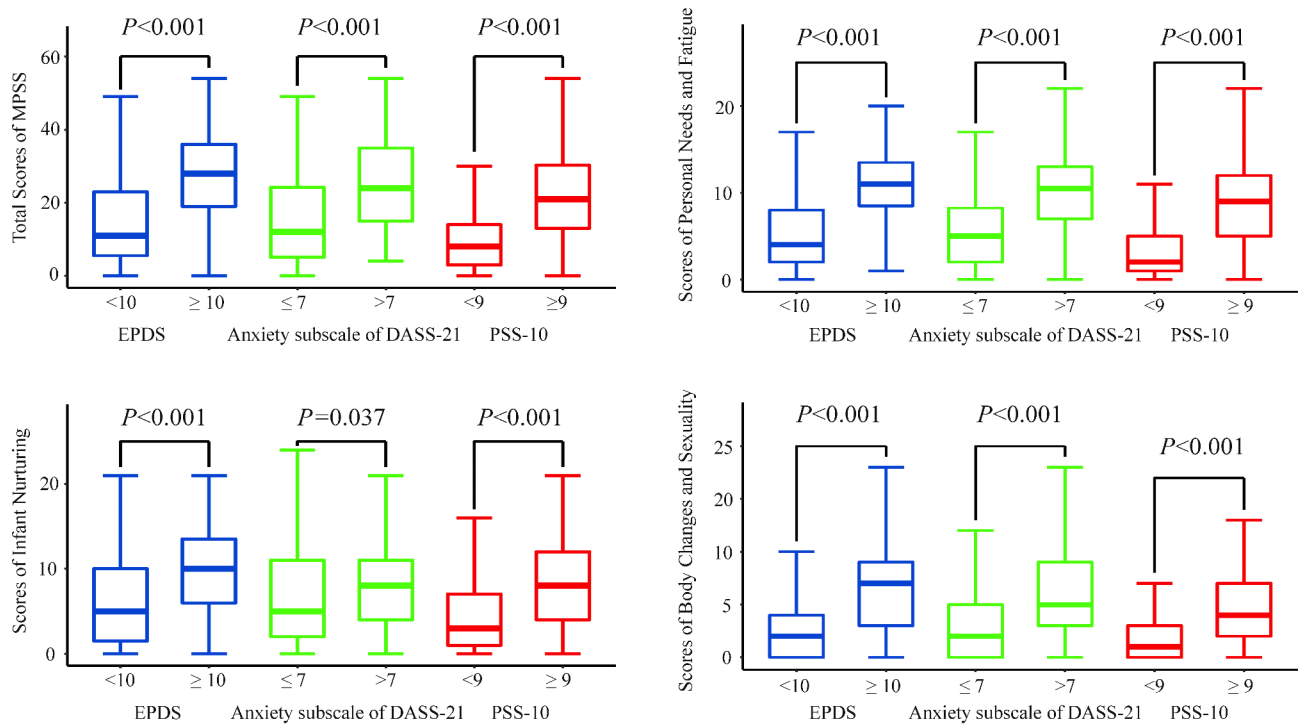


Fig. 3 The Scores of MPSS for Maternity in Different Status

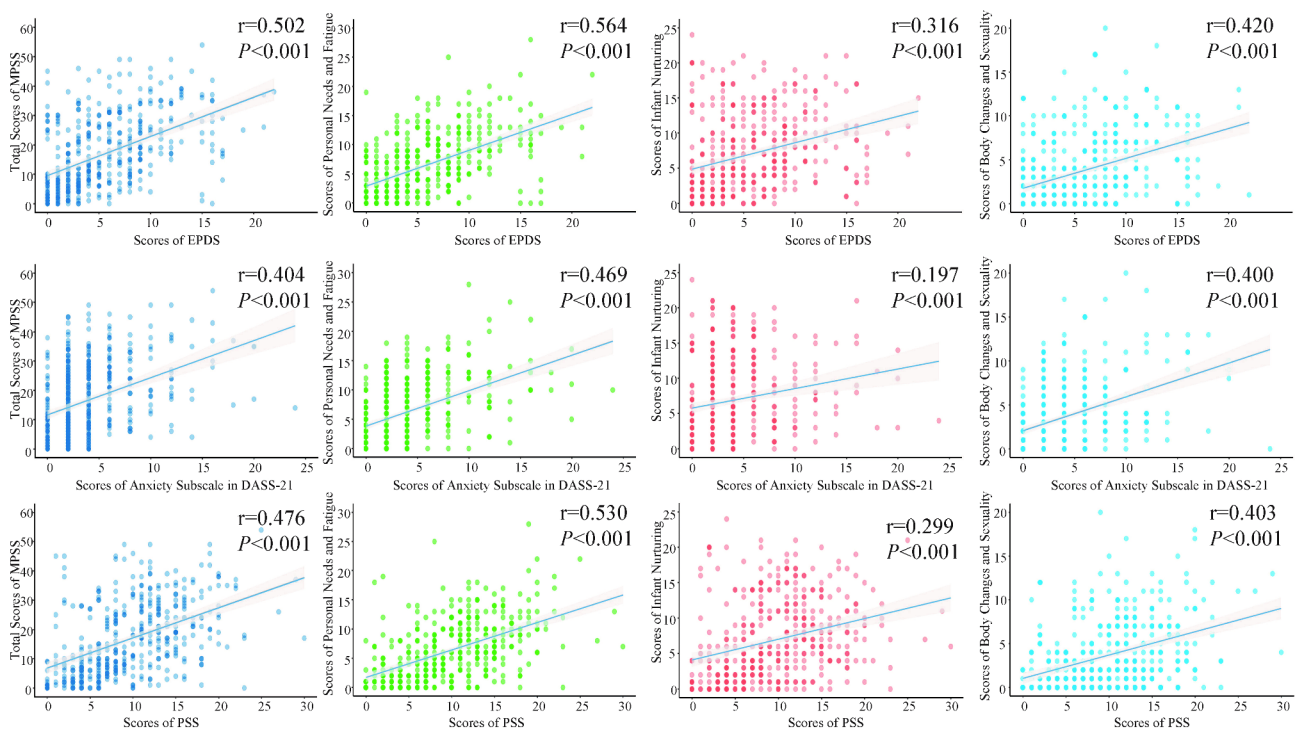


Fig. 4 Correlation between EPDS, DASS-21, PSS-10, and the Chinese version of MPSS

research [11]. However, the study has some limitations. First, all the participants were postpartum women from six hospitals in Nantong City, China. Therefore, future studies should include women from other regions to

effectively validate the Chinese version of MPSS. Second, because only participants who met certain requirements were selected, there were some deviations in participant selection. Subsequent studies should measure maternal

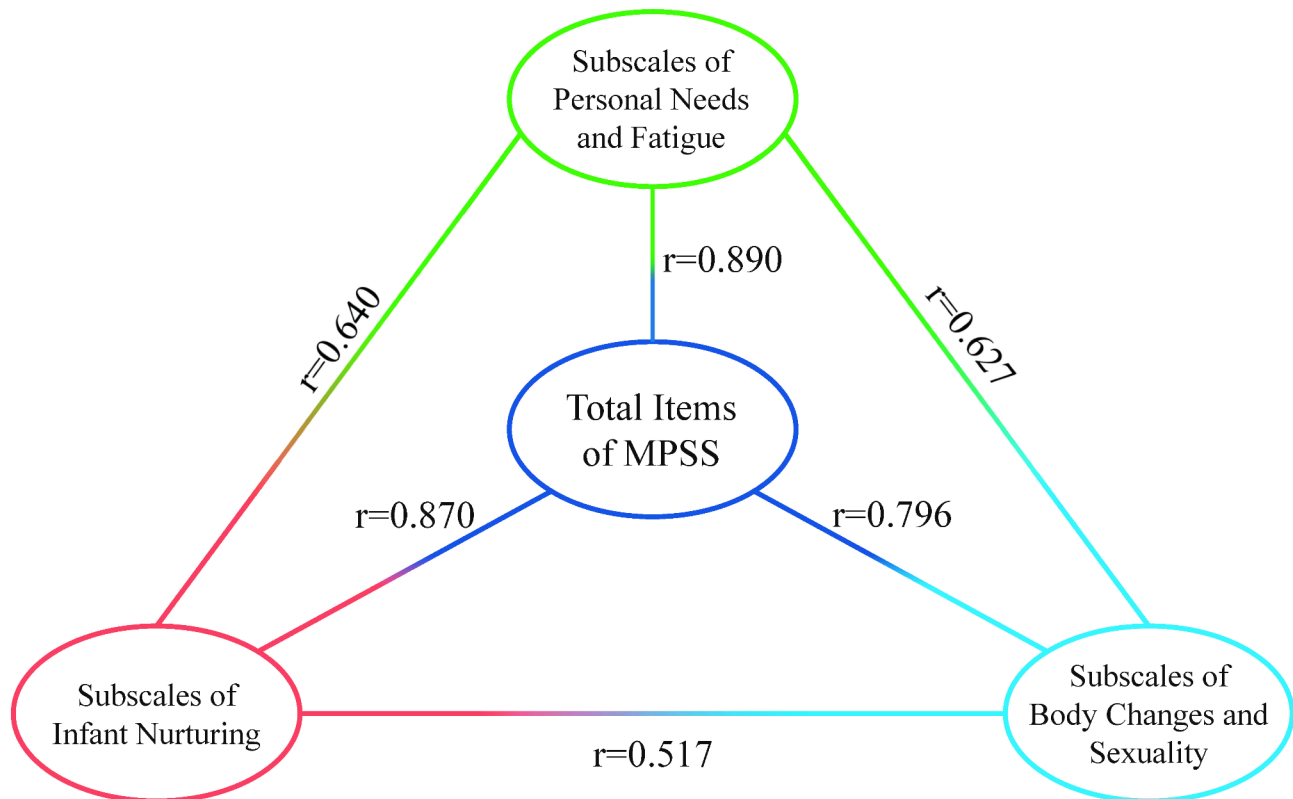


Fig. 5 Correlation between total items of MPSS and each subscale

stress at various postpartum time points and compare the maternal stress of postpartum women with multiple births, premature births, advanced age, and different marital statuses. Third, some Pearson's correlation coefficients in the item analysis section were 0.2–0.4, indicating weak correlation. Further studies with larger sample sizes are warranted to validate this finding. In addition, this is a cross-sectional study, and stress may have existed by chance. Therefore, as emphasized previously, further cohort studies should be conducted to investigate maternal stress at different time points.

Conclusions

The English version of MPSS was translated into Chinese, and the translated version's psychometric properties were validated to determine its reliability and validity. The Chinese version of MPSS contains 22 items and 3 subscales, with good reliability and validity. After cultural adaptation, it has been used well among postpartum women in China. The MPSS is expected to provide a scientific basis for the early identification of postpartum women's stress and formulation of early personalized intervention measures, thus having certain clinical value and practical significance for postpartum women's physical and mental health.

Abbreviations

MPSS	Maternal Postpartum Stress Scale
EFA	Exploratory factor analysis
CFA	Confirmatory factor analysis
EPDS	Edinburgh Postpartum Depression Scale
DASS-21	Depression, Anxiety, and Stress Scale-21
PSS-10	10-item Perceived Stress Scale
S-CVI	Content validity index of the scale
HPSS	Hung Postpartum Stress Scale
I-CVI	Item Content Validity Index
IFI	Increment fitting index
TLI	Tucker Lewis index
CFI	Comparative fitting index

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12884-023-05990-y>.

Supplementary Material 1

Acknowledgements

The authors give thanks for all participants who volunteered to participate in this study. We thank Wangqin Shen, Yan Song, Minjie Chu and Feng Zhang that participate in the translation of the questionnaire. We thank the 15-member expert panel, including sociologists (Guilin Geng), psychologists (Fangfang Zhao), nursing education experts (Feng Zhang, Jing Cheng, Chunxiu Zhou, Yi Shen, Aixia Zhang, Zhu Zhu, Aixia Zheng, and Xiuming Ji), clinical experts (Min Su and Xiaoli Sun), and obstetric nursing experts (Zhifang Chen, Xiaoxia Gu, and Huahua Liu) that participate in the cultural modification.

Authors' contributions

Yanchi Wang completed the writing of this article. Qian Gao and Jin Liu played a key role in part of the data collection. Feng Zhang and Xujuan

Xu put forward important revision suggestions and made corresponding modifications for this article. All authors contributed to the article and approved the submitted version.

Funding

This work was supported by Social Science Foundation of Jiangsu Province (22SHB014). The funding sources had no role to play in the study design, the collection and interpretation of the data, writing of the report, or decision to submit this paper for publication.

Data Availability

The raw data of the current study would be available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The study was reviewed and approved by the Ethics Committee of Affiliated Hospital of Nantong University (approval number: 2022-K50-01). All methods were performed in accordance with the relevant guidelines and regulations (Declaration of Helsinki). All participants have signed the Informed Consent.

Consent for publication

Not Applicable.

Competing interests

No potential conflicts of interest relevant to this article were reported.

Received: 19 January 2023 / Accepted: 11 September 2023

Published online: 22 September 2023

References

- Hung CH, Lin CJ, Stocker J, Yu CY. Predictors of postpartum stress. *J Clin Nurs*. 2011;20(5-6):666-74.
- Cmic KA, Greenberg MT. Minor parenting stresses with young children. *Child Dev*. 1990;61(5):1628-37.
- Khayamim N, Bahadoran P, Mehrabi T. Relationship between fatigue and sleepiness with general health of mothers in the postpartum period. *Iran J Nurs Midwifery Res*. 2016;21(4):385-90.
- Rouhi M, Stirling CM, Crisp EP. Mothers' views of health problems in the 12 months after childbirth: a concept mapping study. *J Adv Nurs*. 2019;75(12):3702-14.
- Scheyer K, Urizar GG Jr. Altered stress patterns and increased risk for postpartum depression among low-income pregnant women. *Arch Womens Ment Health*. 2016;19(2):317-28.
- Fairbrother N, Janssen P, Antony MM, Tucker E, Young AH. Perinatal anxiety disorder prevalence and incidence. *J Affect Disord*. 2016;200:148-55.
- Yim IS, Tanner Stapleton LR, Guardino CM, Hahn-Holbrook J, Dunkel Schetter C. Biological and psychosocial predictors of postpartum depression: systematic review and call for integration. *Annu Rev Clin Psychol*. 2015;11:99-137.
- Vliegen N, Casalin S, Luyten P. The course of postpartum depression: a review of longitudinal studies. *Harv Rev Psychiatry*. 2014;22(1):1-22.
- Critchlow E, Birkenstock L, Hotz M, Sablone L, Riley AH, Mercier R, Frasso R. Experiences of New Mothers during the Coronavirus Disease 2019 (COVID-19) pandemic. *Obstet Gynecol*. 2022;139(2):244-53.
- Hung CH, Chung HH. The effects of postpartum stress and social support on postpartum women's health status. *J Adv Nurs*. 2001;36(5):676-84.
- Nakic Rados S, Brekalo M, Matijas M. Measuring stress after childbirth: development and validation of the maternal postpartum stress scale. *J Reprod Infant Psychol*. 2023;41(1):65-77.
- Zhang H, Liu H, Li Z, Li Q, Chu X, Zhou X, Wang B, Lyu Y, Lin F. Early mobilization implementation for critical ill patients: a cross-sectional multi-center survey about knowledge, attitudes, and perceptions of critical care nurses. *Int J Nurs Sci*. 2022;9(1):49-55.
- McDonald RP, Ho MH. Principles and practice in reporting structural equation analyses. *Psychol Methods*. 2002;7(1):64-82.
- Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh postnatal depression scale. *Br J Psychiatry*. 1987;150:782-6.
- Lovibond PF, Lovibond SH. The structure of negative emotional states: comparison of the Depression anxiety stress scales (DASS) with the Beck Depression and anxiety inventories. *Behav Res Ther*. 1995;33(3):335-43.
- Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav*. 1983;24(4):385-96.
- Wang Y, Li S, Zou X, Xu L, Ni Y. Cross-cultural adaptation and validation of the Chinese version of the loneliness scale for older adults. *Geriatr Nurs*. 2022;48:190-6.
- Sousa VD, Rojjanasrirat W. Translation, adaptation and validation of instruments or scales for use in cross-cultural health care research: a clear and user-friendly guideline. *J Eval Clin Pract*. 2011;17(2):268-74.
- Guillemin F, Bombardier C, Beaton D. Cross-cultural adaptation of health-related quality of life measures: literature review and proposed guidelines. *J Clin Epidemiol*. 1993;46(12):1417-32.
- Zhao A, Huo S, Tan Y, Yang Y, Szeto IM, Zhang Y, Lan H. The Association between Postpartum Practice and Chinese Postpartum Depression: identification of a Postpartum Depression-Related Dietary Pattern. *Nutrients* 2022, 14(4).
- Lau Y, Wang Y, Yin L, Chan KS, Guo X. Validation of the Mainland Chinese version of the Edinburgh postnatal depression scale in Chengdu mothers. *Int J Nurs Stud*. 2010;47(9):1139-51.
- Jiang LC, Yan YJ, Jin ZS, Hu ML, Wang L, Song Y, Li NN, Su J, Wu DX, Xiao T. The Depression anxiety stress Scale-21 in Chinese Hospital Workers: reliability, latent structure, and Measurement Invariance Across Genders. *Front Psychol*. 2020;11:247.
- Wu D, Yang T, Herold F, Hall DL, Mueller N, Yeung A, Kramer AF, Guo T, Zou L. Validation of the 4-Item and 10-Item uncertainty stress scale in a community-based sample of Chinese adults. *Psychol Res Behav Manag*. 2022;15:2803-13.
- Wang L, Liang C, Yu H, Zhang H, Yan X. Reliability and validity evaluation of the appropriate antibiotic use self-efficacy scale for Chinese adults. *BMC Public Health*. 2022;22(1):1344.
- Qiu H, Huang C, Liu Q, Jiang L, Xue Y, Wu W, Huang Z, Xu J. Reliability and validity of the healthy fitness measurement Scale Version 1.0 (HFMS V1.0) in Chinese people. *BMJ Open*. 2021;11(12):e048269.
- Koo TK, Li MY. A Guideline of selecting and reporting Intraclass correlation coefficients for Reliability Research. *J Chiropr Med*. 2016;15(2):155-63.
- Deave T, Johnson D, Ingram J. Transition to parenthood: the needs of parents in pregnancy and early parenthood. *BMC Pregnancy Childbirth*. 2008;8:30.
- Gjerdingen DK, Froberg DG, Kochevar L. Changes in women's mental and physical health from pregnancy through six months postpartum. *J Fam Pract*. 1991;32(2):161-6.
- Wynter K, Rowe H, Fisher J. Common mental disorders in women and men in the first six months after the birth of their first infant: a community study in Victoria, Australia. *J Affect Disord*. 2013;151(3):980-5.
- Razurel C, Bruchon-Schweitzer M, Dupanloup A, Irion O, Epiney M. Stressful events, social support and coping strategies of primiparous women during the postpartum period: a qualitative study. *Midwifery*. 2011;27(2):237-42.
- Negrón R, Martín A, Almog M, Balbierz A, Howell EA. Social support during the postpartum period: mothers' views on needs, expectations, and mobilization of support. *Matern Child Health J*. 2013;17(4):616-23.
- Hung CH. The Hung Postpartum stress scale. *J Nurs Scholarsh*. 2007;39(1):71-4.
- Green JM, Kafetsios K, Statham HE, Snowdon CM. Factor structure, validity and reliability of the Cambridge worry scale in a pregnant population. *J Health Psychol*. 2003;8(6):753-64.
- Huizink AC, Mulder EJ, Robles de Medina PG, Visser GH, Buitelaar JK. Is pregnancy anxiety a distinctive syndrome? *Early Hum Dev*. 2004;79(2):81-91.
- Nakic Rados S, Soljagic Vranes H, Sunjic M. Sexuality during pregnancy: what is important for sexual satisfaction in expectant fathers? *J Sex Marital Ther*. 2015;41(3):282-93.
- Li H. Maternal-infant attachment and its Relationships with Postpartum Depression, anxiety, affective instability, stress, and Social Support in a Canadian Community Sample. *Psychiatr Q*. 2023;94(1):9-22.
- Woolhouse H, McDonald E, Brown S. Women's experiences of sex and intimacy after childbirth: making the adjustment to motherhood. *J Psychosom Obstet Gynaecol*. 2012;33(4):185-90.
- Chen Q, Zhuang J, Zuo R, Zheng H, Dang J, Wang Z. Exploring associations between postpartum depression and oxytocin levels in cerebrospinal fluid, plasma and saliva. *J Affect Disord*. 2022;315:198-205.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.