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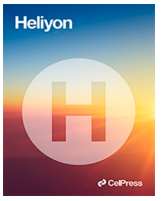

The cross-cultural adaptation and psychometric properties of the menstrual symptom questionnaire (MSQ) among Chinese women of reproductive age

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ABSTRACT

Objective: This study reports on a translation of the Menstrual Symptom Questionnaire (MSQ) into Chinese, a cross-cultural adaptation among Chinese women of reproductive age, and an assessment of its reliability and validity.

Methods: Previously published translation guidelines were followed to translate and cross-culturally adapt the English version of MSQ to produce a Chinese version. This Chinese version was then administered to 2800 Chinese women of reproductive age recruited by convenience sampling method. The reliability of the Chinese MSQ was tested for internal consistency and test-retest reliability. The concurrent and construct validity of the questionnaire was evaluated using correlation and factor analysis.

Results: The Chinese version of the MSQ showed no linguistic or semantic issues. The internal consistency of the Chinese MSQ Cronbach'$\alpha = 0.912$, and the test-retest reliability $r = 0.911$. The exploratory factor analysis identified four factors. The confirmatory factor analysis demonstrated that the four factor structure of the Chinese version of the MSQ (Pain Experience, Emotional Changes, Pain Coping Strategies, and Other Physical Symptoms) is reasonable among Chinese women of reproductive age. There was a significant correlation found between these four factors and both the Pittsburgh Sleep Quality Index and the SF-8 Health Survey.

Conclusion: The Chinese version of the MSQ achieved semantic equivalence in translation and demonstrated good reliability and validity among Chinese women of reproductive age. Thus, it can serve as an effective tool to assess the experience of menstrual symptoms among Chinese women.

1. Introduction

Menstruation is an physiological event experienced by women. Based on a global survey, the prevalence of menstrual symptoms among women worldwide ranges from 17% to 90%, with these symptoms comprising primarily physical symptoms (bleeding, pain,

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and other chronic physical illnesses in different parts of the body such as diarrhea, constipation, fatigue, vomiting, dizziness, and others [1–4]) and psychological symptoms (menstrual-related mood disorders, such as anxiety, depression, irritability, loss of interest in most activities, and others [5–12]).

The monthly occurrence of these symptoms for several decades can cause significant disruption to women's lives, thereby resulting in considerable distress. For example, menstrual symptoms can impact women's academic performance, professional endeavors, and economic income [13–15]. Moreover, certain cultural attitudes surrounding menstruation can result in social withdrawal or marginalization at school [16–18]. Menstrual symptoms can also disrupt women's normal sleep patterns [18,19], resulting in daytime dysfunction, psychological and behavioral problems, as well as physical impairments for women [20,21], even increasing the risk of self-harm and suicide [22–24]. The occurrence of menstrual symptoms leads to significant economic burdens on society, amounting to approximately $1.231 billion annually from both direct and indirect factors [25].

The impact of menstrual symptoms on women extends across several important areas related to health and development. Therefore, assessing symptoms is a crucial step in achieving effective symptom management. Effective menstrual symptom assessment tools can quantify and investigate the symptoms experienced during the menstrual cycle in women. Corresponding measures can be taken to improve the menstrual symptoms experienced by women [15], reduce the impact of menstrual symptoms on women, and also alleviate the economic losses caused to women because of menstrual symptoms, thereby reducing the economic burden on society.

In 1975, Chesney and Tasto published the menstrual symptom questionnaire (MSQ) based on the current theory proposed by Dalton. The MSQ was specifically developed to differentiate women with menstrual symptoms into two groups, i.e., those with spasmodic dysmenorrhea, and those with congestive dysmenorrhea [26–28]. The questionnaire comprises 25 items divided into two factors. Factor 1 encompasses 12 items that measure characteristics of primary spasmodic dysmenorrhea (characterized by cramping pain resulting from uterine contractions starting on the first day of menstruation) while Factor 2 includes another 12 items that evaluate symptoms of primary congestive dysmenorrhea (characterized by a dull pain accompanied by drowsiness and depression before the onset of menstruation). Initially, the test-retest reliability was found to be 0.87 [27].

Since its publication, various scholars have explored and validated the content and structure of the MSQ in different populations [9, 29–31]. These studies have provided evidence for the MSQ factor structure having a range of factors, from two to seven. In addition, Cox and Monagle et al. [30,32], among others, have tested the test-retest reliability of the MSQ by grouping subjects under different conditions. Regardless of whether there were confounding factors or not, the MSQ has demonstrated good test-retest reliability with a coefficient between 0.8 and 0.9 (Table 1). Overall, the factor structure of MSQ appears to be robust and capable of withstanding the impact of confounding factors. The reliability studies indicate that MSQ is a highly dependable tool for menstrual symptoms measurement [30]. However, previous research also suggests that the MSQ is sensitive to changes in the testing environment, possibly due to variations in the menstrual social and cultural environments that women experience, thus may exhibit different factor structures across different cultural contexts [33].

Furthermore, in various subsequent studies, MSQ has been used not only to distinguish between the two types of dysmenorrhea pain symptoms but also to measure menstrual symptoms, more generally [33]. MSQ has now been employed in research investigating menstrual symptoms in multiple countries [5,34–38]. China has over 600 million women, thereby making it the country with the largest female population. In China, research on menstrual symptoms experienced by women has primarily been conducted through qualitative studies and self-designed questionnaires. Although qualitative research can reveal more nuanced experiences of menstrual symptoms among different women [39], it is also helpful to use established questionnaires to depict the prevalence and experience of menstrual symptoms among Chinese women. Additionally, utilizing established and widely used survey questionnaires allows for cross-national comparisons of menstrual symptoms among Chinese women and offers a research tool for future multi-center studies involving various countries. Therefore, a Chinese version of the MSQ was developed. Specifically, this study reports on the (1) translation of the Menstrual Symptom Questionnaire and cross-culturally adapts it for use in Chinese women of reproductive age and

Table 1
Summary of psychometric evaluation studies of menstrual symptom questionnaire.

Author	Year of publication	Sample age (mean ± SD* or range)	Number of samples	Factor structure	Internal consistency	Rest-retest reliability
Chesney & Tasto	1975	NP	N = 48	2	NP	$r = 0.87$ (2 weeks)
Cox	1977	18~31	N = 16	Two-factor structure is not supported	NP	$r = 0.80$ (45 days)
Webster	1980	NP	N = 275	7	NP	NP
Stephenson et al.	1983	19.4 (17–42)	N = 294 N = 423	6 7	NP	NP
Monagle et al.	1985	25.3 ± 5.5	N = 330	6	Cronbach 's α = 0.896	NP
Wildman et al.	1986	18.8 (17–25)	302	3	NP	NP
Negriff	2009	15.69 ± 1.74 (11.07–17.99)	210	3	Factor 1, $r = 0.86$ Factor 2 $r = 0.84$ Factor 3, $r = 0.84$	NP
Gülten Güvenç et al.	2014	21.35 ± 1.12(18–23)	356	3	Cronbach 's α = 0.92	$r = 0.89$ (3 weeks)

Note: *SD = standard deviation; NP=Not published with the original report.

(2) the examination of the psychometric properties of the Chinese version of the MSQ in this population, namely its internal consistency, reliability, test-retest reliability, and construct and concurrent validity.

2. Method

2.1. Translation procedure

Standard translation guidelines were followed in the translation and cross-cultural adaptation of the MSQ [40–45].

2.1.1. Initial translation

Four bilingual translators were individually responsible for translating the MSQ. Two of whom were female native Chinese speakers with a good command of English and have a menstrual cycle and a certain understanding of it, thereby making them "informed translators." The other two translators were male native Chinese speakers with a good command of English. Initially, the translation of the MSQ was carried out independently, with no discussion among the translators. Four first-version translated MSQ were produced through the translation process.

2.1.2. Synthesis of the translations

A meeting was held with the translation team, during which the participants discussed and consolidated the four Chinese-translated questionnaires into one version. This round of discussion continued until all translators agreed on the translation results, thereby resulting in the second version of the Chinese MSQ.

2.1.3. Back translation

Two Chinese-speaking English linguistic professors from the university back-translated the second version of the Chinese MSQ into English and sent the back-translated version to the original author for review. Then, a comparison was made between the Chinese and back-translated MSQ based on feedback received. Modifications were made to the second version of the Chinese MSQ to ensure as much semantic consistency as possible with the original MSQ and to align with the Chinese linguistic expression habits. These two experts were unaware of the content of the original MSQ, thus avoiding information bias caused by subjective factors.

2.1.4. Expert committee

Two bilingual clinical obstetrics and gynecology professors, and one bilingual obstetric and gynecological nursing expert conducted a comprehensive discussion and comparative evaluation of the English original MSQ, the Chinese-translated version of the questionnaire, and the back-translated version of the MSQ. This was done to further confirm whether or not there were any errors in terms of concepts, semantics, habits, experience, and other aspects, and modifications were made accordingly to create the pre-survey questionnaire for the Chinese version of the MSQ.

2.1.5. Testing pre-final version

Convenience sampling was used to select 40 women aged 15–49 years for cognitive interviews to test the linguistic appropriateness, correct understanding, and acceptability of the Chinese version of the MSQ. Subsequently, participants were asked to complete the questionnaire, and the researchers recorded characteristics such as their age and time required to complete the questionnaire. After completing the questionnaire, the researchers had one-on-one discussions with the participants to explore the following issues: (1) the level of difficulty in understanding the questionnaire; (2) whether or not the instructions were clear; (3) whether or not the item options were clear; (4) whether or not the wording of the questionnaire was accurate; and (5) whether or not the participant's interpretation of the items matched the content that the questionnaire sought to measure. During the interview, the researchers recorded the participants' understanding and feedback on the items, and each participant's testing process lasted approximately 25–50 min.

2.1.6. Coordinating Committee for Appraisal of the adaptation process

A meeting was convened with all research personnel to address the issues raised during cognitive interviews and other concerns that emerged during the questionnaire translation. A thorough review was conducted to revise the Chinese version of the MSQ, with thorough attention given to preserving the conceptual integrity and cultural equivalency of the questionnaire. Finally, the final version of the Chinese MSQ was confirmed.

2.2. Measures

2.2.1. The menstrual symptom questionnaire

This questionnaire was developed by Chesney and Tasto in 1975 and is suitable for the general assessment of menstrual symptoms [2,27,28,46]. This questionnaire employs a 5-point rating scale, ranging from never, rarely, sometimes, often, and always, with scores of 1–5 assigned to each respective response. Items 1, 3, 5, 9, 11, 13, 16, 17, 19, 20, 22, and 23 are reverse scored. The higher the total score on the scale, the more severe the menstrual symptoms are [2,35].

2.2.2. Pittsburgh Sleep quality Index (PSQI)

This scale is a self-report questionnaire that measures *sleep quality and disturbances over a* 1-month *time* [47,48]. The Chinese version of the PSQI used in this study was translated by Pei-Shan Tsai et al. [49]. In this study, 18 self-assessment items were used. These 18 items were further categorized into 7 components, with each component scored on a scale ranging from 0 to 3. The cumulative scores of all components constituted the PSQI total score, which ranged from 0 to 21. A higher score on this scale indicates poorer sleep quality. The Cronbach's α of the PSQI in this study was 0.603.

2.2.3. SF-8 Health Survey (SF-8)

The SF-8 is a new generic scale developed based on the SF-36 and has been translated into over 40 languages, including Chinese [50]. This questionnaire consists of eight items, including two comprehensive measurement dimensions. Each item measures one dimension of quality of life. The dimensions include physiologically-related quality of life (items 1–4 measuring physical function, physical role, bodily pain, and general health) and psychologically-related quality of life (items 5–8 measuring vitality, social function, emotional role, and mental health) [51], The scale uses a 5-point rating system, and the item scores of SF-8 require weighted processing. The scale's Cronbach's α in this study was 0.862. The SF-8 scoring can be done using the published algorithm [52] or by using online scoring services available on the internet such as http://www.qualitymetric.com [50,53].

3. Participants

Women were recruited mainly from two provinces in China, Gansu and Guangxi, using a convenience sampling method. Research team members recruited participants and obtained consent from their respective organizations, including middle and high schools, factories and a university. For minors, their legal guardians signed an informed consent form before their participation. Women who agreed to participate in the survey were compensated with a small snack.

Recruitment was conducted by placing posters in the pre-approved locations mentioned earlier. Women who showed interest in participating were then personally met by project staff to confirm their eligibility based on the following inclusion criteria: (1) they must be females with menstrual cycles, and (2) they should possess sufficient reading comprehension skills (completion of six years of primary education in China and graduation with passing grades) to be able to complete the three questionnaires for the study (the MSQ, PSQI, and SF-8). The exclusion criteria consist of (1) being pregnant or nursing; (2) experiencing primary or secondary amenorrhea; (3) taking psychiatric medications; (4) having a history of neurological diseases; (5) having physical disabilities or enduring long-term health problems; (6) suffering from other life-threatening diseases; and (7) having any other gynecological diseases that can cause dysmenorrhea.

During the implementation phase of the on-site survey, apart from the volunteers who agreed to participate in the retest for assessing test-retest reliability one month later (requiring them to provide their real names and contact information for follow-up testing), all other participants completed the survey anonymously. After two months recruitment, we collected 3012 samples. After excluding incomplete questionnaires, 2800 samples were ultimately included in the analysis (completion rate = 92.96%). This study conformed the Enhancing the Quality and Transparency Of health Research (EQUATOR) network guidelines. The implementation of this study followed the principles of the Helsinki Declaration and was approved by the Ethics Committee of Guangxi Medical University.

4. Data analysis

Demographic variables are analyzed by calculating percentages, means, and standard deviations. The internal consistency of the MSQ is assessed using Cronbach's α. Test-retest reliability and concurrent validity are evaluated through bivariate correlation analysis, with a significance level set at $P < 0.05$. To determine the factor structure of the questionnaire, a principal component analysis is conducted using principal factor extraction and varimax rotation. The number of factors to be retained is determined by examining the eigenvalues and Scree plot of each factor. For a factor to be considered, items must have a loading greater than 0.40. Data analyses are performed using SPSS 25.0. In the confirmatory factor analysis (CFA), several fit indices are used to assess the model. Acceptable fit criteria include a $\chi 2/df$ value between 1 and 5, AGFI and GFI greater than 0.08, TLI and NFI greater than 0.09, and RMSEA less than 0.08. The CFA is conducted using AMOS 24.

5. Results

5.1. Cross-cultural adaption

During the translation and back-translation process, no significant semantic or linguistic difficulties were observed with the Chinese version of the MSQ. However, during the cognitive interview phase, some participants pointed out that item 12 "I take aspirin for the pain during my period" did not align with the common practice among Chinese women of using non-prescription painkillers such as ibuprofen during menstruation. This could cause misunderstandings in item interpretation. Similarly, the way item 15 "During the first day or so of my period, I feel like curling up in bed, using a hot water bottle on my abdomen, or taking a hot bath." Suggests using a hot water bag during menstruation is now uncommon in China. Therefore, after the interviews, while respecting the original author's intention, item 12 was modified to "I take non-prescription painkillers for menstrual pain relief, such as ibuprofen and aspirin", and item 15 was modified to "On the first day of my period or during menstruation, I feel like curling up in bed, applying heat

to my abdomen, or taking a hot bath" to improve the understanding of these items.

5.2. Participant description

We provided a full summary of the descriptive statistics for the main variables of participants (Table 2).

5.3. Reliability testing

5.3.1. Internal consistency testing

Herein, the internal consistency of the Chinese version of the MSQ was tested and a Cronbach'α coefficient of 0.912 was obtained. After individually deleting items from the MSQ and calculating Cronbach'α, Cronbach'α remained stable when any item was removed. However, after removing item 6, the internal consistency of the questionnaire measured by Cronbach's alpha increased. We also summarized the item-total correlations for the 24 items. Except for item 6, "I only know that my period is coming by looking at the calendar." All other items showed moderate or higher correlation (range = 0.521–0.671). Overall, the Chinese version of the MSQ demonstrated excellent internal consistency (Table 3).

5.3.2. Test-retest reliability

After a one-month interval, we used the contact details provided during the initial assessment to reach out to participants. We sent them the questionnaire for the second round of testing. A total of 100 participants completed both surveys, the correlation coefficient between the two sets of scores was calculated and found a Pearson correlation coefficient of $r = 0.911$ (95%CI: 0.867–0.939, $P < 0.001$). The intraclass correlation coefficient was also 0.910 (95%CI: 0.869–0.939, $P < 0.001$), thereby indicating that the Chinese version of the MSQ is highly stable in different situations.

5.4. Validity

5.4.1. Construct validity

Before conducting the principal factor analysis to examine the factor structure of the scale, we conducted a Kaiser-Meyer-Olkin (KMO) test to assess the sampling adequacy. The KMO value was 0.926, and Bartlett's test of sphericity was significant ($\chi^2 = 13161.649$, df = 253, $P < 0.001$), thereby indicating that the sample size was sufficient for factor analysis.

Afterward, we explored the factor structure of the Chinese version of the MSQ through exploratory factor analysis and identified four factors based on scree plot analysis, which explained 55.8% of the total variance. Nevertheless, items with a loading of at least 0.40 were retained and we did not observe any cross-loading across factors. Factor loading for item 6 was less than 0.4, meanwhile, the factor loadings for all other items ranged from 0.584 to 0.878 (Table 4).

Based on the outcomes of the factor analysis and the descriptions of item content, Factor 1 was designated as the "Pain Experience" because it included items related to physical pain during menstruation. Meanwhile, Factor 2 was labeled as the "Other Physical

Table 2
Characteristics of participants (N = 2800).

	N (%) or mean ± SD*
N	2800
Age, years	27.54 ± 10.91
Menarche age, years	12.88 ± 1.39
BMI, kg/m2	
< 18.5 kg/m2	1034 (36.9%)
18.5–24 kg/m2	1591 (56.8%)
> 24 kg/m2	175 (6.3%)
Duration of menstrual cycle	
<25 days	150 (5.4%)
25~30 days	1521 (54.3%)
31~35days	468 (16.7%)
36~40 days	89 (3.2%)
>40 days	34 (1.2%)
Irregular	417 (14.9%)
Don't know	121 (4.3%)
Days of blood loss per cycle	
< 3 days	52 (1.9%)
3~6 days	2141 (76.5%)
7~10 days	594 (21.2%)
> 10 days	13 (0.5%)
Household location	
Rural area	1756 (62.7%)
Town area	567 (20.3%)
City area	477 (17.0%)

Note: *SD = standard deviation.

Table 3
Item-total correlations of the final Chinese version of MSQ.

Items	Median	IQR	Cronbach's Alpha*	Item-total correlation
Item1	3	2–3	0.910	0.521
Item2	3	2–4	0.907	0.663
Item3	3	2–3	0.910	0.547
Item4	3	2–4	0.907	0.659
Item5	3	2–3	0.908	0.611
Item6	2	2–3	0.916	0.219
Item7	2	1–2	0.908	0.630
Item8	2	2–3	0.907	0.671
Item9	2	2–3	0.910	0.538
Item10	2	2–3	0.909	0.567
Item11	3	2–4	0.908	0.615
Item12	2	1–3	0.907	0.653
Item13	3	2–3	0.909	0.586
Item14	2	2–3	0.908	0.614
Item15	2	2–3	0.909	0.593
Item16	2	2–3	0.910	0.506
Item17	2	1–3	0.910	0.538
Item18	3	2–3	0.908	0.611
Item19	3	2–4	0.910	0.550
Item20	2	2–3	0.908	0.616
Item21	3	2–4	0.909	0.593
Item22	3	2–3	0.908	0.622
Item23	2	1–3	0.910	0.547
Item24	2	1–3	0.909	0.603

Note: *Cronbach's alpha if the item is removed.

Symptoms," while Factor 3 was named the "Pain Control Strategies" because its items pertained to strategies for managing pain during menstruation. Factor 4 was titled "Emotional Changes" because its items were associated with emotional changes during menstruation. Moreover, tests to determine the correlation between factors were conducted and found that four of them exhibited moderate correlation (Table 5).

Herein, we randomly selected half of the sample data (N = 1400) from the total 2800 samples and conducted a confirmatory factor analysis (CFA) based on the 23 items retained from EFA to examine the four-factor model. In this model's data fit analysis, the χ^2/df value was 3.071, while the AGFI, GFI, TLI, NFI, and RMSEA values were 0.947, 0.957, 0.963, 0.952, and 0.038, meanwhile, we showed the factor loadings of all items (Fig. 1).

Table 4
Factor loadings for Menstrual Symptom Questionnaire exploratory factor analysis in Chinese reproductive age women (N = 1400).

Item	Factor 1	Factor 2	Factor 3	Factor 4
	Pain Experience	Other Physical Symptoms	Pain Control Strategies	Emotional Changes
Item 2	0.712			
Item21	0.663			
Item4	0.655			
Item14	0.652			
Item18	0.647			
Item19	0.635			
Item11	0.614			
Item13	0.590			
Item24	0.584			
Item17		0.697		
Item23		0.665		
Item20		0.663		
Item5		0.660		
Item22		0.658		
Item16		0.657		
Item8		0.640		
Item10		0.612		
Item12			0.878	
Item7			0.867	
Item15			0.816	
Item3				0.841
Item1				0.808
Item9				0.710
Common factors with eigenvalue	7.704	1.993	1.693	1.446
Cumulative variance contribution rate	33.495	8.664	7.360	6.289

Table 5
Correlation among the MSQ factors, SF-8, PSQI (N = 2800).

	MSQ Total score	MSQ factor 1	MSQ factor 2	MSQ factor 3	MSQ factor 4	SF-8	PSQI
MSQ Total score	1						
MSQ factor 1	0.628**	1					
MSQ factor 2	0.882**	0.434**	1				
MSQ factor 3	0.723**	0.369**	0.557**	1			
MSQ factor 4	0.829**	0.472**	0.571**	0.491**	1		
SF-8	−0.321**	−0.253**	−0.269**	−0.234**	−0.276**	1	
PSQI	0.275**	0.195**	0.246**	0.198**	0.234**	−0.590**	1

Note: $^{**}P < 0.01$; MSQ factor 1: Pain Experience, MSQ factor 2: Other Physical Symptoms, MSQ factor 3: Pain Control Strategies, MSQ factor 4: Emotional Changes.

5.4.2. Correlations with related variables

The distribution of all measurement data was significantly different from a normal distribution. Therefore, Spearman's rank correlation coefficient was used to examine the relationship between MSQ and theoretical variables related to the quality of life and sleep quality. The total score of SF-8 was significantly negatively correlated with MSQ factors, meanwhile, the total score of PSQI was significantly positively correlated with MSQ factors (Table 5).

6. Discussion

The objective of this investigation was to linguistically translate and culturally adapt the MSQ into Chinese, and to evaluate its psychometric attributes within a sample of Chinese women in their reproductive years. In extending the scope of the MSQ's relevance, our study encompassed a broader age spectrum of female participants, addressing an age range that had not been previously covered in available data. Notably, our research pioneers the inclusion of Chinese women aged 15–49 within the study, thereby introducing fresh insights into the cross-cultural adaptation and psychometric validation of the MSQ within the Chinese female populace. Consequently, this study contributes significantly to the contextual integration of the questionnaire within the Chinese cultural milieu.

Furthermore, previous investigations have already underscored the robust reliability of the MSQ, as well as its capacity to accommodate variations in sample characteristics. Our research not only upholds and substantiates the questionnaire's reliability and validity but also unveils a distinct four-factor structure heretofore unrecognized among the female reproductive-age cohort in China.

During the translation and cross-cultural adaptation stages, we consulted several existing guidelines on translation and cross-cultural adaptation. We attempted to translate the scale into Chinese using simple words and did not encounter any significant difficulties during translation. There are significant differences in both natural and social conditions between Eastern and Western environments, which translate into differences in people's thinking habits and modes of expression [54]. The cross-cultural results of this study indicate that the Chinese version of the MSQ was successfully translated and culturally adapted, thereby achieving semantic, idiomatic, experiential, and conceptual equivalence.

In this study, the Chinese version of the MSQ demonstrated good psychometric properties, thereby showing a high level of internal consistency with Cronbach's $\alpha = 0.912$. This, combined with previous research on the MSQ with Cronbach'α coefficients ranging from 0.89 to 0.92 [30,55], suggests that the MSQ has high internal reliability. Previous studies have reported test-retest reliability values for the MSQ ranging from 0.80 to 0.89 [27,32,55], Thus, in this study, the Chinese version of the MSQ demonstrated the highest level of test-retest reliability within the existing research on this questionnaire's test-retest reliability ($r = 0.911$). Taken together with previous research results, it can be concluded that the MSQ has high stability across different environments.

In the present study, a four-factor structure of the Chinese version of the MSQ was discovered through factor exploration analysis among Chinese women of reproductive age. However, this finding is unprecedented in previous research. Notably, multiple studies have yielded diverse factor structures for the MSQ through factor analysis conducted in different contexts. Our Factor 3 is consistent with the findings of Gülten Güvenç et al. as compared with previous research given that both studies have identified this factor as the "Pain Control Strategies" [56]. Our Factor 4 exhibits similarities to the analyses conducted by Monagle et al., Webster, and Stephenson et al. Particularly, their research findings indicate that items 1, 3, 5, and 9 belong to the same factor. Webster and Stephenson et al. referred to this factor as "premenstrual negative affect," while Monagle et al. included item 17 and named it "menstrual pain" [9,30,31]. On the contrary, we have named this dimension "emotional changes", and our other two factors differ significantly from those found in prior research.

In the current study, the lack of factor attribution for item 6 is likely due to the fact that it is relevant to those women who do not experience any symptoms, i.e., neither physical pain nor negative affect indicating that their period is coming. However, it can still be used to differentiate those women, as they may not have a clear sense of the onset of their menstrual cycle unless they track it through a calendar. Additionally, this item may have different scoring in the assessment of menstrual symptom treatment [9], and retaining item 6 is beneficial for comparing different studies. Therefore, it is meaningful to include it in the translated questionnaire. Although it was not loaded onto the same factor as the other entries, it does not imply that it is unimportant or useless. With more research, we may discover its significance in the assessment and treatment of menstrual symptoms. The stability and reliability of the multi-factor structure for grouping menstrual symptoms can also be inferred by comparing the existing classifications. This phenomenon may be due to the changes in the test subjects and cultural differences. Therefore, it is recommended that researchers from different countries verify the factor structure model of menstrual symptoms in their specific samples to further examine the cross-cultural

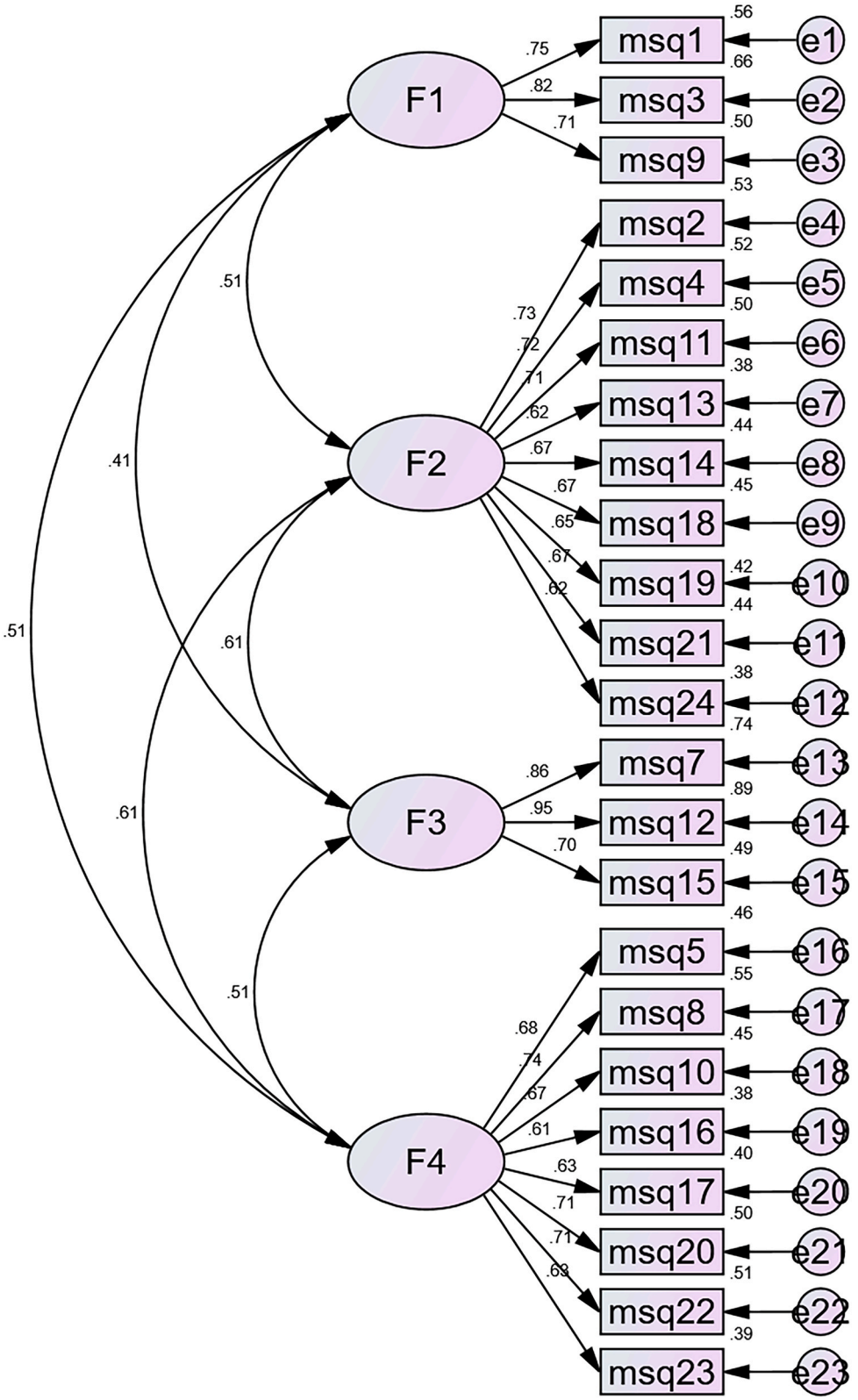

Fig. 1. CFA of the modified four-factor model of the MSQ (N = 1400).

equivalence of the MSQ structure and the possibility of factor structure in different populations.

The factor analysis in this study differed from previous research in that premenstrual and menstrual symptoms were not loaded onto separate factors. This could be due to recall bias, wherein participants mistakenly recalled premenstrual symptoms as menstrual symptoms. It is also possible that some menstrual symptoms occur continuously throughout the menstrual cycle, thereby making it difficult to categorize them. Furthermore, the lack of clear definitions for various menstrual-related symptoms may lead to cognitive biases among participants, thereby making it difficult to make clear distinctions between symptoms. These factors could have contributed to the results observed in this study [29]. However, previous research did not conduct a confirmatory factor analysis of the factor analysis results of the MSQ. Therefore, this study is the first to conduct a confirmatory factor analysis of the factor structure of the MSQ, and the findings indicate that the proposed model aligns highly with the data structure, as evidenced by the ideal fit indices. The model fits well with the data, thereby demonstrating that the four-factor structure of the Chinese version of the MSQ is capable of effectively measuring women's menstrual symptoms.

In addition, this study found that the Chinese version of the MSQ has good concurrent validity and is expected to be related to the quality of life and sleep quality. Previous research has also indicated that menstrual symptoms may disrupt women's sleep [10,57], which can impact their quality of life [58,59]. During the analysis, the pain experience factor, emotional changes factor, and other physical symptom factors of the Chinese version of the MSQ were positively correlated with the PSQI total score and negatively correlated with the SF-8 total score. These correlations were statistically significant and consistent with previous research findings. However, the control methods factor was negatively correlated with the overall score of the quality-of-life questionnaire and positively correlated with sleep quality, which raises some questions that require further investigation. The control methods factor primarily describes the methods used to control menstrual symptoms, particularly dysmenorrhea. If women use effective control methods to alleviate their pain symptoms, we would expect an improvement in their quality of life and sleep quality. However, our research evidence indicates the opposite. Thus, it is possible that during menstruation, improving only women's pain symptoms may not effectively improve their quality of life or sleep experience. This suggests that focusing solely on pain relief may not correspondingly improve women's sleep quality and quality of life during the menstrual cycle. Therefore, future research should focus on exploring the significance of improving other symptoms besides pain for enhancing women's quality of life and sleep quality during menstruation. Longitudinal studies should also be conducted to investigate the mechanisms linking these factors with women's quality of life and sleep quality and to explore solutions that can improve women's menstrual health and reduce the impact of menstrual symptoms on them.

A reliable and valid Chinese version of the questionnaire can be developed as an effective tool for measuring menstrual symptoms in Chinese women of reproductive age by translating the MSQ into Chinese, adapting it for cross-cultural use, and validating its psychometric properties. With a large population of Chinese women, it is crucial to have a reliable tool to measure symptoms in this population, not only for research on the experience of menstrual symptoms in Chinese women but also for international comparative studies and the conduct of effective multicenter studies involving different countries to contribute to the attention and promotion of global women's health. Furthermore, our study has confirmed the relationship between menstrual symptoms and quality of life and sleep, which can provide references for taking appropriate intervention measures in clinical practice and public health policies.

Furthermore, in regard to measuring symptoms associated with secondary dysmenorrhea, factors such as the impact of the COVID-19 pandemic on menstrual symptoms are noteworthy. SARS-CoV-2 infection has been linked to changes in menstrual flow and cycle length, characterized by reduced flow and extended cycles [60–62]. Additionally, conditions like endometriosis can lead to menstrual irregularities, chronic pelvic pain, dysmenorrhea, dyspareunia, and infertility [63–65]. These symptoms affect women's social relationships, sexual behavior, reproductive capacity, and mental well-being. However, there is limited research on questionnaires for testing secondary dysmenorrhea symptoms in Chinese women. Therefore, we encourage researchers who focus on Chinese women's menstrual health to develop a more comprehensive MSQ that includes a broader range of menstrual symptoms.

This study has some limitations. First, it is a self-report survey, and participants' responses are subjective, thereby leading to potential biases in their selection of options. Second, given that the MSQ was developed some time ago, some menstrual symptoms may not be included in the questionnaire because of new developments in the understanding of menstrual symptoms. Although the Chinese version of the MSQ demonstrated good cross-cultural adaptability and psychological measurement characteristics, it may still not measure some menstrual symptoms that are not included in the questionnaire. Furthermore, because the focus of this study was primarily on the general population, some individuals with factors like the use of psychotropic medications, a history of neurological disorders, life-threatening illnesses, and other gynecological conditions, as well as menopausal women, were excluded. Future research could validate the reliability and validity of the scale among these specific groups. This study could serve as a reference for such investigations.

7. Conclusion

The findings of this study reveal that the Chinese version of the MSQ, which was adapted to ensure cross-cultural compatibility, has achieved notable semantic consistency and outstanding psychological measurement capabilities. These results suggest that the Chinese iteration of the MSQ is a viable, dependable, and efficient self-report instrument to explore and examine menstrual symptom experiences among women of reproductive age in China.

Ethical statement

The implementatthis study followed the principles of the Helsinki Declaration and proved by the Ethics Committee of Guangxi

Medical University (approval number KY0159).

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Additional information

No additional information is available for this paper.

Author contribution statement

Xiuxia Li: Binfeng Zhang: Peixuan Tan: Guanghui nie: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Margaret Chesney: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Tingting Zhang: Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

Data availability statement

Data will be made available on request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e20450.

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