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Validation of the premenstrual symptoms questionnaire among Mongolian nursing school students

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Abstract

Background Premenstrual disorders (PMDs) significantly affect the daily lives of women. This study evaluated the reliability and validity of the Mongolian-translated Premenstrual Symptoms Questionnaire (PSQ) among female nursing students at the Mongolian National University of Medical Sciences.

Methods This cross-sectional study was conducted from February 2023 to January 2024. The PSQ was translated into Mongolian, and its reliability and validity were assessed. A total of 431 participants completed the translated PSQ along with the Premenstrual Dysphoric Disorder (PMDD) Scale, Somatic Symptom Scale (SSS-8), Patient Health Questionnaire (PHQ-9), and Beck Anxiety Inventory (BAI). Reliability was evaluated via Cronbach's alpha. Internal consistency was assessed via factor analysis and correlations with external measures.

Results The internal consistency of the Mongolian PSQ was 0.945. Factor analysis supported the tool's construct validity, which revealed a one-factor structure consistent with that of the original Japanese PSQ. The PSQ had strong positive correlations with the PMDD Scale ($r = 0.760$), SSS-8 ($r = 0.640$), PHQ-9 ($r = 0.580$), and BAI ($r = 0.620$), which indicated good convergent validity.

Conclusion The Mongolian-translated PSQ is a reliable and valid tool for assessing premenstrual symptoms in female nursing students. These findings suggest that the PSQ is a useful tool for screening PMDs in this population.

Keywords Validity, Reliability, Premenstrual symptoms questionnaire, Nursing, Students, Mongolia

Background

Premenstrual syndrome (PMS) and premenstrual dysphoric disorder (PMDD) are significant health concerns for women worldwide that affect their physical, emotional, and social well-being [1]. Research indicates that more than 90% of women experience some form of premenstrual symptoms during their reproductive years [2, 3]. Notably, the burden of premenstrual symptoms extends beyond individual experiences to encompass broader societal implications, such as reduced productivity and quality of life [4, 5]. Symptoms of PMS have been recognized as a common menstrual problem among

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adolescents and young women in various cultural contexts, including those in Japan and Mongolia. A Japanese study found that approximately one in nine female high school students reported missing school owing to severe symptoms of PMS [6]. In Mongolia, a regional progress review of menstrual health in East Asia and Pacific countries revealed that services and guidelines were implemented for education, information, and access to materials; however, menstrual healthcare support, a supportive social environment, non-discrimination, and participation were not adequately addressed. This gap may exacerbate the impact of PMS and PMDD on young women's health [7]. Furthermore, research evidence in this area is lacking, underscoring the need for further investigation into menstrual health issues in Mongolia.

Research conducted in Mongolia revealed a higher prevalence of PMS and PMDD at 23.8% and 4.7%, respectively among female college students than in China and Japan [8]. According to the Global Burden of Disease Study 2019, the burden of PMS is highest and lowest in low-middle, which includes Mongolia, and high socio-demographic index (SDI) regions, respectively. Factors, such as rising obesity rates and increasingly westernized diets, contribute to elevated prevalence in middle-income countries. Additionally, women with PMS have an increased risk of hypertension, suggesting a potential link between PMS and cardiovascular health issues. Socio-cultural influences, including taboos and limited awareness in some regions, may also lead to underreporting of PMS while lower socioeconomic status can impede access to diagnosis and treatment, which can complicate care efforts [9]. Globally, a pooled analysis revealed a 47.8% prevalence of PMS, although this rate varied widely; France and Iran reported the lowest (12%) and highest (98%) rate, respectively. These regional differences, with Asia and Europe exhibiting the highest and lowest prevalence, respectively, are influenced by various factors, such as age, physical activity, and nutrition. Differences in measurement tools across studies also contribute to the variability in reported rates [3, 10].

Therefore, diagnosing and assessing the severity of the symptoms of PMS is challenging owing to the lack of standardized criteria and assessment tools, especially in the Mongolian language. Traditional methods, such as prospective daily charting of symptoms, are time-consuming and may result in reduced compliance [11]. Furthermore, the existing diagnostic criteria, including those outlined in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV and DSM-V), lack specificity for determining PMDD's severity. Hence, scholars have developed a significant number of screening tools, likely related to the evolution and improved conceptualization of female-specific psychiatric illnesses [12]. The Premenstrual Symptoms Questionnaire (PSQ), comprising 14

items, offers a comprehensive assessment of premenstrual symptoms and has been validated for use in epidemiological studies and clinical settings in both Japan and Mongolia [6, 13]. Its potential applications extend to diagnostic purposes, academic research, and evaluation of treatment outcomes in clinical trials.

This study assumed that a culturally adapted PSQ could improve assessment consistency for PMS in Mongolia.

Therefore, our study aimed to evaluate the validity and reliability of the PSQ as a patient-reported outcome measurement (PROM) tool to assess PMS among Mongolian students. We sought to validate the PSQ and contribute toward the enhancement of assessment accuracy and better management of PMS in clinical practice.

Methods

Participants

We recruited female students from the School of Nursing at the Mongolian National University of Medical Sciences (MNUMS) between February 2023 and January 2024. Inclusion and exclusion criteria were developed based on previous research [6, 13]. Inclusion criteria were female students who had not been pregnant or lactating within the past 12 months and had a regular menstrual cycle. Exclusion criteria included the use of psychotropic medication, suspicion of pregnancy or menopause, and medical conditions, such as endometriosis, acute thyroid or pituitary disorders, or any other acute issues that affected regular menstruation and rendered them ineligible to participate. Finally, data from 431 participants were analyzed, which resulted in a 14:30 ratio of the PSQ items to participants, which satisfied the statistical analysis requirements [14].

Ethical standards compliance

This study was approved by the Research Ethics Committee of the Mongolian National University of Medical Sciences (approval number: 2022/3–09). Prior to data collection, students who expressed interest in participating were provided with a consent form that detailed the study objectives and procedures. Participants were assured of their right to privacy and confidentiality. The study protocol followed the principles outlined in the 1964 Declaration of Helsinki and its subsequent amendments (see Fig. 1).

Demographic data

During the initial stages, demographic data, which included age, field of study, marital status, parental status, contraceptive and painkiller usage history, experiences with women's health issues, fibroid myomas, hormonal therapy, attendance at women's health checkups, consultations with healthcare providers for premenstrual

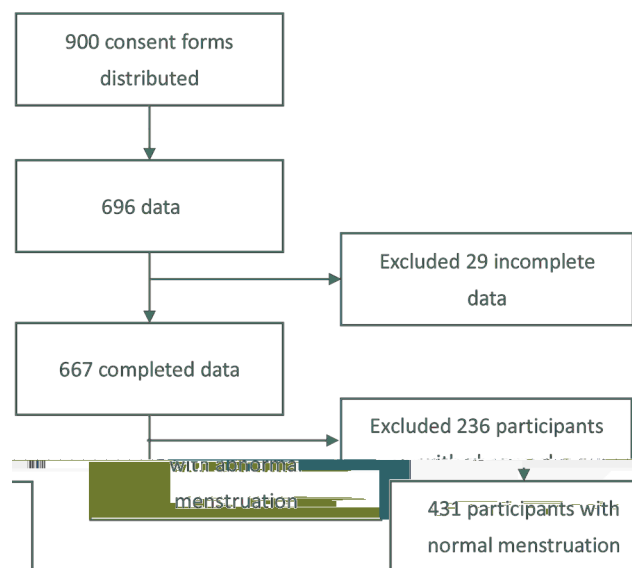


Fig. 1 Recruitment of the participants to assess the validity and reliability of the Mongolian version of Premenstrual Syndrome Questionnaire

syndrome (PMS), and coping strategies for menstrual tension, were obtained.

Instruments

Menstrual pain intensity

Menstrual pain intensity was assessed via a Numerical Rating Scale (NRS). Participants were asked to rate the severity of their menstrual pain over the preceding three months on a scale from 0 (no pain) and 10 (the most intense pain imaginable).

Premenstrual syndrome questionnaire (PSQ)

We used the PSQ, originally developed in Japanese by Takeda et al. in 2020. It comprised 11 items that corresponded to the symptoms listed in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) criteria for PMDD. The PSQ was rigorously tested for reliability and validity to serve as a PROM tool to assess the scope of premenstrual symptoms. Its reliability was demonstrated by a Cronbach's alpha of 0.93. For structural validity, confirmatory factor analysis supported both one-factor and two-factor models, which indicated excellent fit [6].

The premenstrual symptoms listed in PSQ included (i) depressed mood, (ii) anxiety or tension, (iii) tearfulness, (iv) anger or irritability, (v) decreased interest in work, home, or social activities, (vi) difficulty concentrating, (vii) fatigue or lack of energy, (viii) overeating or food cravings, (ix) insomnia or hypersomnia, (x) feeling overwhelmed, and (xi) physical symptoms, such as tender breasts, feeling of bloating, headache, joint or muscle pain, or weight gain. It also enquired whether the premenstrual symptoms experienced interfered with (a)

work efficiency, productivity, or home responsibilities, (b) social activities, or (c) relationships with coworkers or family. Participants were asked to rate the severity of their premenstrual symptoms and their interference with activities as follows: 1, not at all; 2, mild; 3, moderate; and 4, severe. The total score ranged between 14 and 56 points. Furthermore, participants were divided into three groups based on their premenstrual symptoms: PMDD, moderate to severe PMS, and no/mild PMS, according to Steiner et al.'s criteria [15].

The PSQ translation

The translation process from the original Japanese version to a Mongolian version adhered to the following seven steps to ensure accurate translation, cultural adaptation, and content validation of the PSQ for use in the Mongolian context [16]. Before the process, we identified the translation process and its components, established the rationale behind each step, and designated responsible individuals as forward and backward translators and expert team members for extensive discussion, which included obstetrician gynecologists, linguists, nurses, and medical doctors who spoke both Japanese and Mongolian and had experience of cognitive debriefing. Step (1) Forward Translation: Two independent translators, an expert medical linguist and English-proficient nurse, translated the PSQ from Japanese to Mongolian, which resulted in two separate Mongolian versions. Step (2) The two translated versions were compared by an expert committee that collaboratively reviewed them and resolved ambiguities, inconsistencies, and meanings to achieve a consensus. Step (3) Blind back-translation of the preliminary translated version: The Mongolian version was back-translated into Japanese by different medical linguistic translators and Japanese-proficient nurses. Step (4) Comparison of the two back-translated versions.

The translated versions were thoroughly examined and discussed by the study team. Discrepancies in format, wording, syntax, meaning, and relevance were identified and resolved. The team aimed to harmonize the translations for a consensus on the content accuracy and appropriateness. Step (5) Pilot testing of the preliminary version in the target language with a monolingual sample. The comprehensibility of the translated questionnaire was achieved via a cognitive debriefing test that involved 30 female students from the School of Nursing, MNUMS, who provided feedback for further refinement. The pilot study confirmed that no improvements were required to the Mongolian version of the PSQ, except question 12. Question 12 was made comprehensible to Mongolian participants via addition of examples. Step (6) Preliminary psychometric testing of the preliminary version of the translated instrument with a bilingual sample. The principal investigator reviewed the cognitive debriefing results

and identified any necessary modifications to enhance the questionnaire's understanding. The final version was released for psychometric testing among a sample of the target population.

External instruments for validation

Despite the absence of similar alternatives in Mongolia, four instruments—the premenstrual dysphoric disorder scale (PMDD), somatic symptom scale-8 (SSS-8), Patient health questionnaire-9 (PHQ-9), and Beck Anxiety Inventory (BAI)—were used. Through a forward-backward translation process and subsequent discussions within the study team, a final version was established, which demonstrated strong internal consistency in the pilot study with 30 students, $\alpha = 0.960$, $\alpha = 0.903$, $\alpha = 0.936$, $\alpha = 0.963$, respectively. This underscored the reliability of the translated PMDD scale, SSS-8, PHQ-9, and BAI employed in our validation study.

Premenstrual dysphoric disorder scale (PMDD scale)

The PMDD scale was developed based on the DSM-IV criteria by Miyaoka et al. [17] and was modified from the premenstrual symptom screening tool (PSST) developed by Steiner et al. [15]. It comprised two parts. Part A comprised 12 symptoms; of these, 10 were from DSM-IV and two additional questions were formulated by dividing “insomnia or hypersomnia” into “insomnia” and “hypersomnia” as separate symptoms. If one answered “yes” to at least one symptom in part A, the participant was required to answer part B of the DSM-IV criteria. The PMDD comprised three subscales: “fatigue and/or physical symptoms,” “depressive mood,” and “dysfunctional relationships and/or anger.” Participants were diagnosed as having PMDD if they answered “severe” for at least one of the following items in section A: depressive mood, anxiety, tearfulness, and anger; “moderate” or “severe” for at least four items in section A; and “severe” for at least one item in section B regarding the interference with activities and relationships. The PMDD scale was used to rate the severity of premenstrual symptoms and their interference with activities as follows: 1, not at all; 2, mild; 3, moderate; and 4, severe. The total score ranged between 17 and 68 [18]. The PMDD scale had high reliability, Cronbach's $\alpha = 0.91$, and demonstrated good concurrent validity. It was strongly correlated with the Self-rating Depression Scale (SDS) as well as confirmed its validity via the assessment that a significant portion of women with depressive disorders (43.1%) meet the criteria for PMDD. Previous studies revealed that the PSQ and its short-form were strongly correlated with the PMDD scale [6, 13].

Somatic symptom scale-8 (SSS-8)

The SSS-8 was first developed for the DSM-V field trials by Benjamin et al. in 2014, who investigated the newly established somatic symptom disorder. It was designed to be an abbreviated version of the established patient health questionnaire (PHQ-15). The SSS-8 had good reliability, Cronbach's $\alpha = 0.81$. It comprised eight items: (1) gastrointestinal disorders, (2) back pain, (3) arm, leg, or joint pain, (4) headache, (5) chest pain and shortness of breath, (6) dizziness, (7) fatigue and low energy, and (8) sleep disturbance. Responses were rated on a 5-point response format (0–4), which resulted in a total score that ranged between 0 and 32. The SSS-8 had good construct and criterion validity. It correlated well with other measures of social support and related constructs, such as well-being and mental health [19].

Patient health questionnaire (PHQ-9)

The PHQ-9 is a widely used self-report questionnaire that employs the DSM-IV nine-symptom criteria to diagnose major depressive episodes. A total score of 10 indicates a major depressive episode. The total PHQ-9 score was used to classify the severity of depressive episodes (minimal, mild, moderate, moderately severe, or severe). Cronbach's alpha for the PHQ-9 typically ranged from 0.86 to 0.89 in various studies, which indicated good internal consistency. The PHQ-9 demonstrated strong construct and criterion validity. It correlated well with other measures of depression, such as the Hamilton Depression Rating Scale (HAM-D) and Beck's Depression Inventory (BDI) [20].

Beck's anxiety inventory (BAI)

Anxiety symptoms were measured via Beck Anxiety Inventory (BAI), which comprised 21 self-rating items scored on a 4-point Likert scale that ranged from 0 to 3. It assessed the impact of each anxiety symptom in the preceding week of menstruation. The final score was obtained by summing the scores obtained for all the items and used to classify the anxiety severity into three categories (low, moderate, or high). The BAI demonstrated strong internal consistency, Cronbach's alpha values of approximately 0.92, which indicated excellent reliability. It also had good construct and criterion validity. It correlated well with other measures of anxiety, such as the Hamilton Anxiety Rating Scale (HAM-A) and State-Trait Anxiety Inventory (STAI) [21].

Statistical analysis

Descriptive statistics were used to summarize basic data features. Frequencies and percentages were calculated for categorical variables, whereas mean, minimum, and maximum values were computed for continuous variables. Chi-squared test of independence was used to

examine the differences between the demographic categorical variables in the Mongolian version of the PSQ. It determined whether a significant association existed between two categorical variables via a comparison of the observed frequencies in each category with the expected frequencies. Contingency tables were created for each pair of categorical variables and chi-square statistic was calculated. Prior analysis, the assumptions of the chi-squared test, which included the independence of observations and minimum expected cell frequency, were checked. Normality assumption of the data was assessed via the Kolmogorov-Smirnov test, which considered a test distribution as normal when the significance level was $p < 0.05$.

Reliability of the PSQ was evaluated via an assessment of the internal consistency of the items through Cronbach's alpha and split-half correlation methods. The split-half method involved division of the test into two halves and assessment of their correlation, where a higher correlation indicated better internal consistency. An alpha coefficient of ≥ 0.7 was considered satisfactory.

Validity was investigated via construct, criterion, and convergent validity. Kaiser-Meyer-Olkin (KMO) test was used to evaluate sampling adequacy for factor analysis. Furthermore, Bartlett's test of sphericity was employed to examine whether the correlations between variables were sufficiently large for the factor analysis to be meaningful. A KMO value of > 0.7 was considered acceptable. The p -value of < 0.05 was considered significant for Bartlett's test.

Construct validity was assessed via the factor structure of the PSQ and determined via an exploratory factor analysis (EFA) with principal component analysis (PCA) and varimax rotation. Factor-item loading values higher than 0.30 were considered as satisfactory allocation of that item to the relevant factor. A confirmatory factor analysis (CFA) that used the maximum likelihood estimation method was performed to assess how well the EFA-extracted model fit the observed data. To ensure no multicollinearity problems and a good model fit, the following values of fit indices were adopted: chi-squared/df < 5 , root mean square error of approximation (RMSEA) < 0.8 (95% CI), goodness of fit index (GFI), adjusted goodness of fit index (AGFI), comparative fit index (CFI), and Tucker-Lewis Index (TLI) > 0.9 . P values > 0.05 were considered significant.

Pearson's correlation coefficient was used to verify the criterion validity via an examination of the relationships between the PSQ and other scales, the SSS-8, PHQ-9, BAI, and the PMDD scale. Correlation values (r) of 0.3–0.5, 0.5–0.7, and 0.7–0.9 indicated moderate, good, and excellent correlations, respectively.

Convergent validity was evaluated via the intra-class correlation coefficient (ICC) and weighted kappa

statistics. They were used to assess the agreement between the PSQ and PMDD scale, which was already validated. Weighted Kappa values ranged from -1 to 1 , and higher values indicated better agreement. Based on the 95% CI of the ICC estimate, values < 0.5 , 0.5 – 0.75 , 0.75 – 0.9 , and > 0.90 indicated poor, moderate, good, and excellent coefficient, respectively. All statistical analyses, except CFA, were performed via IBM SPSS Statistics for Windows (Version 27.0; IBM Corp., Armonk, NY). Significance level was set at $p < 0.05$.

Results

Demographic characteristics

Data from 431 students with a normal menstrual cycle were analyzed. Study consent forms, along with information of the research background, were distributed to the students through their general university email addresses. Questionnaires were collected via Google Forms. Demographic characteristics revealed that three-fourths of the participants were aged between 16 and 25 years, and most were nursing students in their second year of study. Those who reported dysmenorrhea and a history of contraceptive or painkiller use as well as prior experiences with women's health issues were more prone to experiencing PMS and PMDD. Conversely, marital status, having children, history of fibroid myomas, hormonal therapy, routine women's health checkups, and seeking medical attention for premenstrual symptoms did not significantly influence premenstrual symptoms (Table 1).

Reliability analysis

Cronbach's alpha coefficient, a metric of internal consistency reliability, yielded a value of 0.945, while the split-half correlation coefficient was 0.828. These high coefficients underscored the reliability of the Mongolian version of the PSQ (Table 2).

Validity analysis

Construct validity

Application of the PCA as part of an EFA with varimax rotation to the Mongolian version of the PSQ yielded a one-factor solution, as shown in Table 3. This model explained 58.9% of the total variance across the 14 items. Factor loadings for this single factor ranged from 0.421 to 0.698, and all items had substantial loadings > 0.40 , which supported the uni-dimensionality of the scale. Analysis was conducted with 431 participants and deemed sufficient based on the criteria. The suitability of the factor model was further supported by a KMO value of 0.958 and significant p -value from Bartlett's test of sphericity ($p < 0.001$). Additionally, the scree plot and eigenvalues confirmed the presence of a single-factor structure.

Table 1 Participants' demographic characteristics (n = 431)

		Premenstrual syndrome			Chi-squared test P value
		Normal	PMS	PMDD	
Age	mean ± SD	20.75 ± 4.24			0.866
	16–25	220	72	33	
	25<	74	23	9	
Menarche age	mean ± SD	13.71 ± 1.47			
Major	nursing	266	86	39	0.881
	others	28	9	3	
Grade	rst	47	10	4	0.476
	second	191	65	26	
	third	40	17	9	
	fourth	16	3	3	
Marital status	married	28	8	0	0.113
	single	266	87	42	
Had a child	yes	36	12	1	0.154
	no	258	83	41	
Dysmenorrhea	yes	55	36	22	0.001***
	no	239	59	20	
Ever used contraceptives	yes	25	23	7	0.001***
	no	269	72	35	
Ever used pain killer	used	81	42	20	0.001***
	not used	213	53	22	
Ever had woman's disease	yes	73	35	18	0.010*
	no	221	60	24	
Ever had broid myoma	yes	3	3	0	0.218
	no	291	92	42	
Ever had hormonal therapy	yes	8	7	2	0.124
	no	286	88	40	
Ever had woman's check-up	yes	143	50	26	0.253
	no	151	45	16	
Ever see a doctor due to PMS	yes	23	9	8	0.064
	no	271	86	34	
Types of action taken owing to menstrual tension	no action	118	31	23	0.050
	taken	34	14	5	
	medicine				
	kept abdomen warm	43	21	7	
	sleep	44	20	4	
	others	55	9	3	

***p<0.001, *p<0.05

The one-factor model demonstrated a good fit, as indicated by various fit indices: a chi-squared/df ratio of 4.361 with a significance level of $p<0.001$, GFI=0.866, AGFI=0.817, TLI=0.906, normed fit index (NFI)=0.904, relative fit index (RFI)=0.886, incremental fit index (IFI)=0.921, CFI=0.924, parsimony normed fit index (PNFI)=0.765, parsimony comparative fit index (PCFI)=0.779, RMSEA=0.098 (with 95% CI), and

Table 2 Reliability of the Mongolian version of the PSQ (n = 431)

Number of Items	Item mean	Minimum	Maximum	Cronbach's alpha (95% CI)		Split-half correlation
14	2.161	1.768	2.608	0.945	(0.938 0.953)	0.828

Table 3 Exploratory factor analysis via varimax-rotation method of the Mongolian version of the PSQ (n = 431)

Item number	PSQ questions	Extraction
PSQ1	Feel sad, depressed, despairing, and worthless	0.588
PSQ 2	Anxiety, anger, and frustration	0.629
PSQ 3	Suddenly sad, too sensitive, or become susceptible	0.620
PSQ 4	Bored and irritated	0.556
PSQ 5	Daily life (work, friends, hobbies, schools) is not interested	0.634
PSQ 6	Cannot concentrate on something	0.698
PSQ 7	Inactive, get tired, and easily tired	0.630
PSQ 8	Stay hungry or eat more, or over love a specific	0.491
PSQ 9	Over sleeping, difficulty getting up or sleeping, waking up at midnight, or abnormal sleeping	0.541
PSQ 10	Feeling overwhelmed, difficult to react, and cannot make self-control	0.580
PSQ 11	Breast pain, headache, joint and muscle pain, weight gain, or edema	0.421
PSQ 12	I cannot do well of my job, my study at school, and daily chores at home	0.627
PSQ 13	I have lost part in hobbies or social activities or reduced participation in social activities	0.631
PSQ 14	Influenced my relationship with others	0.608

Table 4 Correlations and agreement between the Mongolian version of the PSQ and PMDD scale

	Pearson's r	ICC	Weighed Kappa agreement
PSQ classification vs. PMDD scale classification	0.445***	0.496***	0.492***
PSQ total score vs. PMDD scale total score	0.892***	0.884***	

***p<0.001

RMR=0.04. Collectively, these indices suggested that the proposed factor model was a suitable representation of the observed data.

Criterion validity

The Mongolian version of the PSQ demonstrated strong agreement with the PMDD scale, as shown in Table 4.

Convergent validity

The Mongolian version of the PSQ had good correlation with the SSS-8 (0.517, $p<0.001$), PHQ-9 (0.643, $p<0.001$), and BAI scores (0.499, $p<0.001$) and weak

correlation with pain intensity (0.253, $p<0.001$) during menstruation Table 5A and 5B.

Discussion

The PSQ was first translated into Mongolian and validated through rigorous analysis across multiple dimensions to establish its reliability and validity. This discussion synthesizes the findings from demographic characteristics, reliability analysis, EFA, criterion validity, and convergent validity. These findings confirmed that the Mongolian version of the PSQ was a robust tool to assess PMS in this population.

Participants' demographic characteristics suggested a representative sample across factors, such as age, major, marital status, and other relevant information. Noteworthy variables, such as dysmenorrhea, contraceptive usage, painkiller intake, and history of women's diseases, emerged as statistically significant factors that were linked to the classifications of PMS and PMDD, with a significance level of $p<0.05$. Existing research consistently highlighted a correlation between the severity of PMS/PMDD and dysmenorrhea, which indicated that as the severity of dysmenorrhea increases, so does the severity of PMS and PMDD [22]. Moreover, use of contraceptive medications was positively correlated with an increased risk of symptoms of PMS [23, 24]. Individuals with symptoms of PMS commonly resort to painkillers as part of their suggested treatment options [25]. Our study utilized the PSQ to succinctly capture these relationships. While some studies indicated that women under the 20 years of age and unmarried women were more vulnerable to PMS [26, 27], our findings did not indicate a significant impact of age and marital status on PMS, which was consistent with previous research outcomes [28]. In addition, we found that PMS correlated with the women's health history of the study participants, which highlighted the potential sensitivity of the Mongolian version of the PSQ and addition of a cultural and linguistic perspective to the findings. These findings aligned with those of previous studies, which highlighted the impact of these factors on PMS symptoms and underscored the importance of considering them in clinical assessments while validating the Mongolian version of the PSQ.

Cronbach's alpha for the 14-item PSQ was 0.945, which indicated excellent internal consistency. Cronbach's alpha values >0.9 were generally considered indicative of a highly reliable scale [29]. This suggested that the PSQ items consistently measured the same underlying construct of the symptoms of PMS. High Cronbach's alpha reflected that the questionnaire items were well correlated and that of the PSQ. Hence, the Mongolia version was a cohesive tool for assessing premenstrual syndrome symptoms. Its reliability was higher than that of the original Japanese version of the PSQ (Cronbach's alpha of

Table 5A Pearson's correlation coefficient between Mongolian version of PSQ, SSS-8, PHQ-9, BAI and pain intensity level (n

0.930) [6], short form of the PSQ (Cronbach's alpha of 0.930), and our previous findings (Cronbach's alpha of 0.868) [8]. While the PSQ was newly adapted into Mongolian, its strong internal consistency was similar with findings from other PMS assessment tools, such as the PSST used in Iranian (Cronbach's alpha of 0.930), Brazilian Portuguese (Cronbach's alpha of 0.910), and Italian (Cronbach's alpha of 0.890), which suggested that it was a reliable measure [30–32]. The split-half correlation coefficient was 0.828, which indicated good reliability. Split-half reliability assessed the extent to which all parts of a test contributed equally to what was being measured. A correlation value of 0.828 suggested that the two halves of the PSQ provided similar results, which affirmed that the scale was stable and reliable.

EFA via the varimax rotation method revealed satisfactory extraction values for all the items, which ranged from 0.421 to 0.698. Items, such as “cannot concentrate” (0.698) and “not interested in daily life (work, friends, hobbies, schools)” (0.634), had high factor loadings, which confirmed their strong contribution to the underlying construct of PMS symptoms. The lower loading for “breast pain, headache, joint and muscle pain, weight gain, or edema” (0.421) suggested a need for further examination; however, it still indicated a meaningful contribution. Overall, these results supported the multidimensional structure of the PSQ and its comprehensive coverage of PMS symptoms, which was similar to that of the original Japanese version [6]. Application of EFA with varimax rotation yielded a single factor that collectively accounted for 58.9% of the total variance among the 14 items. This percentage indicated that a single underlying construct effectively explained most of the variance in the PSQ items. The KMO measure of sampling adequacy was 0.958, which was well above the recommended threshold of 0.60, which indicated that the sample size was sufficient for factor analysis. Additionally, Bartlett's test of sphericity was highly significant ($p < 0.001$), which further supported the appropriateness of the factor analysis model. The scree plot and eigenvalues confirmed the presence of a single-factor structure, which reinforced the uni-dimensional nature of the PSQ. CFA results demonstrated a good fit for the one-factor model, as indicated by various fit indices. Chi-squared to degrees of freedom ratio (χ^2/df) was 4.361, which, despite being slightly above the ideal range, was still acceptable in larger samples ($p < 0.001$).

Criterion validity was established via a comparison of the PSQ and PMDD scale. The PSQ total score had a strong correlation with the PMDD total score (Pearson's $r = 0.892$, $ICC = 0.884$), which indicated excellent alignment between the two measures. This finding is similar with Japanese PSQ total score and the PMDD scale total score (Spearman's $r = 0.88$, $p < 0.001$) as well as the

PSQ-S (Short-form) total score demonstrated a strong correlation with the PMDD total score ($r = 0.854$), supports this validity and suggests cross-cultural robustness of the PSQ. However, moderate correlations for scale classifications (Pearson's $r = 0.445$ and $ICC = 0.492$) suggested some discrepancies in categorical classification, which may reflect differences in diagnostic criteria or symptom interpretation. The weighted kappa coefficient of 0.492 suggests a moderate, statistically significant level of agreement between PSQ and PMDD classifications for individual symptoms in this study. However, this level of agreement is notably lower than previous research findings, which reported a substantial agreement ($kappa = 0.650$). This difference suggests that, while the PSQ aligns well with the PMDD scale in assessing overall symptom severity, there may be more variability in symptom classification between the two scales in this study compared to prior results.

Convergent validity was assessed via correlations with the SSS-8, PHQ-9, BAI, and pain intensity levels. The PSQ demonstrated strong and significant correlations with these scales across all items, particularly the PHQ-9 (0.516–0.655) and SSS-8 (0.479–0.611). These correlations confirmed that the PSQ effectively captured the various symptoms associated with PMS, which included emotional, cognitive, and physical dimensions [33, 34].

The lower but still significant correlations with pain intensity levels highlighted the PSQ's ability to assess the physical discomfort associated with PMS, although less strongly than its emotional and cognitive symptoms. This pattern was consistent with previous research that indicated that while physical symptoms were a component of PMS [35], they were often secondary to emotional and cognitive symptoms regarding their impact on daily functioning [36].

A validation study of the Mongolian version of the PSQ provided strong evidence for its reliability and validity. High internal consistency, robust factor structure, strong criterion-related validity, and significant concurrent validity across multiple dimensions confirmed that the PSQ was a comprehensive tool for assessing PMS symptoms. These findings support its use in both clinical practice and research within the Mongolian context and contribute to better diagnosis and management of PMS.

Limitations

This study has several limitations. First, cultural differences. Although the PSQ was translated and culturally adapted to the Mongolian context, subtle cultural nuances might still influence how participants understood and responded to the questionnaire items. Cultural differences in the expression and perception of premenstrual symptoms may not have been fully captured by the translated PSQ. Second, availability of comparison

tools. While several external instruments (PMDD, SSS-8, PHQ-9, and BAI) were used for validation, the absence of similar validated premenstrual symptom questionnaires in Mongolia limited the comprehensive assessment of the validity of the PSQ against other established tools in the same language. First, this study was conducted solely among students from one university in Ulaanbaatar, which may not be representative of the broader Mongolian female population or different age groups. Further studies may explore the PSQ's applicability in different demographics or settings.

Future studies should also utilize this validated scale to conduct further in-depth research on premenstrual syndrome and contribute to women's health in Mongolia. Additionally, the PSQ can be effectively utilized in clinical settings for screening patients with PMS and PMDD. Integration of the PSQ into routine assessments can enable healthcare providers to better identify and address the needs of women experiencing these conditions, which can lead to improved patient care and outcomes.

Conclusions

The Mongolian version of the PSQ demonstrates high reliability and validity. It serves as an effective tool for accurately assessing premenstrual symptoms among Mongolian female university students.

Abbreviations

AGFI	Adjusted Goodness of Fit Index
BAI	Beck Anxiety Inventory
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
DSM	Diagnostic and Statistical Manual of Mental Disorders
EFA	Exploratory Factor Analysis
GFI	Goodness of Fit Index
ICC	Intraclass Correlation Coefficient
KMO	Kaiser-Meyer-Olkin
MNUMS	Mongolian National University of Medical Sciences
NRS	Numerical Rating Scale
PHQ-9	Patient Health Questionnaire
PMDD	Premenstrual Dysphoric Disorder
PMDs	Premenstrual Disorders
PMS	Premenstrual Syndrome
PSQ	Premenstrual Symptoms Questionnaire
RMSEA	Root Mean Square Error of Approximation
SSS-8	Somatic Symptom Scale
TLI	Tucker-Lewis Index

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Author contributions

Conception and design were performed by D.C., and H.S. Translation was performed by D.C., E.Y., S.O., T.S., O.B., A.S., Y.A. and H.S. Data were acquired by T.S., E.Y. and O.B. Statistical analyses were conducted by D.C., S.O. and H.S. The first draft of the manuscript was written by D.C. and H.S. All authors critically revised and approved the final version of the manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This study was approved by the Research Ethics Committee of the Mongolian National University of Medical Sciences (approval number: 2022/3–09). Prior to data collection, students who expressed interest in participating were provided with a consent form detailing the study objectives and procedures. Participants were assured of their right to privacy and confidentiality. The study protocol followed the principles outlined in the 1964 Declaration of Helsinki and its subsequent amendments.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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