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Developing The Menstrual Migraine Symptoms Scale

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ABSTRACT

Objective: The objective of this study was to develop the Menstrual Migraine Symptoms Scale (MMSS).
Methods: The study utilized a robust methodological design with a sample size of 582 participants. The data underwent a comprehensive analysis employing various statistical techniques, including item analysis, Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), Cronbach's alpha internal consistency coefficient, and the Intraclass Correlation Coefficient (ICC) for test-retest reliability.
Results: The two sub-dimensions of the scale, consisting of 19 items, demonstrated excellent internal consistency, with Cronbach's alpha coefficients ranging from 0.932 to 0.970. Furthermore, the total scale exhibited a high level of internal consistency, with a Cronbach's alpha coefficient of 0.976. The item correlation values within the scale ranged from 0.741 to 0.921, indicating strong relationships between the items.
Conclusion: The study findings conclusively demonstrated the validity and reliability of the MMSS as a robust measurement tool specifically designed for assessing female individuals.
Keywords: Menstrual migraine, scale development, symptom, reliability.

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Introduction

Migraine, a prevalent neurological disorder, affects a substantial portion of the global population, with an estimated prevalence of approximately 14% (Stovner et al., 2018). It ranks as the second most common disorder worldwide, and notably, it holds the highest prevalence among women of reproductive age (15-49 years) (Steiner et al., 2020; Stovner et al., 2018). Additionally, migraine is the leading cause of headaches in females (Barus et al., 2023; Dixon & Bergstrom, 2011).The incidence of migraine tends to increase after adolescence, affecting women more than men (Burch et al., 2018). Research suggests that hormonal fluctuations play a role in triggering this condition among women (Vetvik & MacGregor, 2017).

The International Classification of Headache Disorders (ICHD-III) defines migraine as a recurring headache disorder characterized by severe, unilateral, throbbing pain. However, it should be noted that some cases may present with bilateral or diffuse pain (Barus et al., 2023). Migraine-induced headaches impose a significant economic and social burden on patients and society at large due to loss of productivity and increased use of healthcare (Dixon & Bergstrom, 2011). This can lead to strained social relationships and reduced overall quality of life (Chen et al., 2020). Moreover, individuals with migraine are more susceptible to chronic pain, ischemic stroke, sleep disturbances, depression, anxiety, and stress (Saunders et al., 2008).

Migraine exhibits a higher prevalence and frequency in women, and there are variations in comorbidities and symptoms among individuals. For instance, women are more likely to experience accompanying symptoms like nausea, sensitivity to light (photophobia), and sensitivity to sound (phonophobia) during episodes of migraine (Ahmad & Rosendale, 2022). Studies have shown that around 60% of women with migraine experience headaches associated with menstruation, surpassing the number of non-menstrual-related migraine (Pavlović et al., 2015). Moreover, approximately 60% of women with migraine report a connection between their migraine and the menstrual cycle (Dixon & Bergstrom, 2011). It is hypothesized that the primary pathophysiological mechanisms triggering menstrual migraine (MM) attacks involve estrogen withdrawal and prostaglandin release (Ahmad & Rosendale, 2022; Vetvik & MacGregor, 2021). MM stands out from regular migraine due to its increased severity, longer duration, and reduced response to treatment.

MM also imposes personal and economic burdens, diminishing work performance, and interferes with the ability to fulfill family roles and responsibilities. A study revealed that more than half of women with migraines experienced a notable decrease in productivity at work, and that nearly 80% were unable to perform household chores during an episode of migraine (Dixon & Bergstrom, 2011).

The onset of an MM attack is believed to be pathologically linked to menstruation (Yang et al., 2022). The ICHD-III defines MM as migraines with or without aura occurring between -2 and +3 days of menstruation in at least two out of three menstrual cycles (IHS, 2018). Despite its high prevalence and adverse impact on quality of life, MM is widely acknowledged as being under-recognized and undertreated (Wang et al., 2023).

Menstrual migraine is a subtype of migraine that is closely associated with the menstrual cycle and is usually characterized by cyclic and severe symptoms (Wu et al., 2023). Although its clinical findings are well known, it is noteworthy that there is a lack of standardized and specific measurement tools to assess the unique symptoms of menstrual migraine from a patient's perspective. In general, current migraine scales assess general migraine attacks and cannot adequately reflect the physiological and emotional differences of menstrual migraine. This gap necessitates the development of a specific measuring tool that will systematically assess menstrual migraine symptoms, orient individualized care, and contribute to the relevant research.

Despite the large number of individuals suffering from MM, many do not seek treatment or receive ineffective treatment (Albarqi et al., 2022). Despite the disorder's prevalence and significant impact on individuals, MM has received limited research attention, and no scale specifically focusing on the disorder has been employed. In light of this, the current study was designed to develop the Menstrual Migraine Symptoms Scale (MMSS), addressing this research gap.

Methods

Research Design and Sample

This methodological study involved recruiting participants who met specific criteria. The inclusion criteria encompassed women who were at least 18 years old, literate in Turkish, voluntary participants, and who were within the reproductive age range of 15 to 49 years. On the other hand, the exclusion criteria involved individuals below 18 years of age, those who could not read or write Turkish, and those who did not provide their consent to participate.

To collect the data, a questionnaire was created using Google Forms, and it was shared with potential participants through social platforms such as WhatsApp, Instagram, and others. The participants were thoroughly informed about

the study, and their online consent was obtained before their involvement. Initially, a pilot study was conducted with 44 participants and based on the insights gained from this pilot study, the main study was subsequently conducted with a larger sample size of 582 participants.

The pilot study was conducted to determine how the scale items are perceived by the target audience and whether the reactions to the statements are as expected, and to identify ambiguities. With this application, the content validity findings received from expert opinions were supported, and a user-based assessment was ensured (DeVellis, 2016). In the pilot study, the sample size was kept small, and the data from this phase were not included in the scale validity analyses. In the main data collection phase, an Exploratory Factor Analysis (EFA) was conducted with 250 participants, and a Confirmatory Factor Analysis (CFA) was conducted with 332 participants. In the literature, it is recommended that EFA and CFA be conducted in separate samples (Brown, 2015; Worthington & Whittaker, 2006). Accordingly, both analyses were conducted in separate adequate sample groups.

To determine an appropriate sample size, the researchers took into consideration the recommendation that the sample size should be at least five times, or even ten times, the number of variables (Alpar, 2018; Bryman & Cramer, 2001; Tavşancıl, 2002). Therefore, the target was to reach a total of 550 participants, with 250 individuals designated for Exploratory Factor Analysis (EFA) and a minimum of 300 participants for Confirmatory Factor Analysis (CFA).

Ultimately, the study successfully reached and collected data from 582 participants, surpassing the intended sample size. In the initial stages of item analysis and EFA, 250 participants were involved, while the CFA was conducted with a separate group of 332 participants.

Data Collection

The Socio-Demographic Characteristics Form and MMSS were distributed to participants through various social platforms such as WhatsApp and Instagram. The participants completed the questionnaires using these online platforms.

Before filling in the questionnaire, the participants were informed about the purpose of the study, that the participation was based on volunteerism, and that the data would be kept confidential and only be accessed by the research team. It took an average of 10-12 minutes to complete the questionnaire. were stored in a safe encrypted digital environment that is accessible only to the research team. Although the online data collection method was advantageous in terms of reaching a large participant group, it had the potential to create selection bias since it was limited to individuals who had internet access. This limitation was taken into consideration when interpreting the study findings.

Ultimately, the study successfully reached and collected data from 582 participants, surpassing the intended sample size. In the initial stages of item analysis and EFA, 250 participants were involved, while the CFA was conducted with a separate group of 332 participants.

In the scale development process, it is recommended that EFA and CFA be conducted with different samples (Brown, 2015; Fabrigar et al., 1999). For these two analyses, however, equal sample size is not compulsory. In practice, smaller samples are generally preferred for EFA and larger samples for CFA. The main reason for this is that CFA is parametrically more complex, that the error terms and factor structure need to be clearly identified, and that the prediction by the model requires more information (sampling) (Kline, 2016). Accordingly, in this study, when the minimum recommended limit of 250 participants for EFA was reached, this group was separated for the analysis, and CFA was conducted with the remaining participants. Thus, the predictive and confirmatory power of the model was maximized by increasing the sample size in CFA. In addition, in both analyses, the sample size was above the minimum limits recommended for validity and reliability analyses in the literature (Tabachnick & Fidell, 2019; Worthington & Whittaker, 2006).

No a priori power analysis was conducted in the study. The main reason for this was that the determination of sample size in exploratory structural models such as factor analysis depends on the structure's unknown relationships (such as item factor loadings, number of factors, correlation structure) and that effect size cannot be reliably estimated in advance (MacCallum et al., 1999). Therefore, there are various "rule of thumb" recommendations in the literature. For example,Type of the Study

- Tabachnick and Fidell (2019) suggested that the sample size for EFA should be at least 100, preferably 300 and above.
- According to the COSMIN criteria, the sample size for factor analysis should be at least 100, ideally 5-10 times the number of items.
- For CFA, Kline (2016) and other studies recommended a minimum sample size of 150-200 people.
- An EFA sample of 250 participants corresponds to a total of 25 items, which meets the criterion of 10-fold per item.

- A CFA sample of 332 participants is well above the minimum recommended limit for CFA.

Furthermore, to support the adequacy of the sample, in the analyses, the KMO (Kaiser-Meyer-Olkin) measure for EFA was 0.961 (very high).

Measurement Tools

Socio-Demographic Characteristics Form, this questionnaire, which was developed by the researchers, included a total of 18 questions aimed at capturing various characteristics of the participants, such as age and marital status.

Menstrual Migraine Symptoms Scale (MMSS): Obtaining objective data in content validity calculations relies on the quality and number of experts involved in the process (Yeşilyurt & Çapraz, 2018). The initial version of the scale, comprising 25 items, was shared with 12 experts for their opinions. These experts included 11 faculty members specializing in Women's Health Nursing and one faculty member specializing in measurement and evaluation from the Department of Educational Sciences. The expert opinions were collected using an Expert Evaluation Form distributed via email.

The development of the MMSS began with the researchers creating an initial item pool based on a comprehensive literature review and expert opinions. PubMed, Scopus, and Web of Science databases were used for the literature search, with keywords including “menstrual migraine,” “migraine symptoms,” and “migraine scales” (Allais et al., 2018; Dixon & Bergstrom, 2011; Vetvik & MacGregor, 2017; Wang et al., 2023).

These resources provided insight into the symptomatology and clinical presentation of menstrual migraine and informed the content of the initial items. Additionally, the scale development process followed best practices in psychometric instrument development, including item generation, expert validation, and pilot testing (Boateng et al., 2018; DeVellis, 2016; Polit et al., 2007; Yeşilyurt & Çapraz, 2018).

The language and semantic coherence of the items were reviewed by experts in Turkish Language and Measurement & Evaluation. Then, 12 subject-matter experts (from nursing and obstetrics-gynecology) evaluated the items for content validity. Based on their suggestions, items were revised for clarity and relevance, and the item pool was finalized prior to pilot testing with a draft sample.

For the content validity study, the Lawshe technique was utilized to evaluate the expert opinions. This technique involved rating each item in the scale as "necessary," "useful, but not necessary," or "not necessary" (Doğan & Doğan, 2019). The ratings provided by the experts were used to calculate the content validity criterion (CVC) for each item. To meet the content validity criterion (CVC>0) at a significance level of α=0.05, the CVC value of each item was examined (Yeşilyurt & Çapraz, 2018).

Furthermore, the content validity index (CVI) was determined by calculating the average CVI value across all the items included in the final form. The Lawshe technique dictates that the CVI value should surpass the CVC value, signifying a greater degree of content validity. This methodology guarantees that the chosen items are deemed pertinent and suitable by the experts, thereby enabling effective measurement of the intended construct.

The scale was designed as a five-point Likert scale, ranging from 1 (“Never”) to 5 (“Always”). It comprises a total of 19 items organized into two sub-dimensions: Pain and Coping (PC), and Quality of Life (QoL). None of the items in the scale are reverse-coded. The maximum achievable score on the scale and its sub-dimensions is 100, while the minimum score is 20. A higher score on the scale indicates increased severity of symptoms of MM in female individuals.

The raw score on the scale is calculated by summing the scores from each item between 1-5. Thus, the theoretical score range for 19 items would be between 19 and 95. However, in this case, sub-dimensions with more items have a greater effect on the total score.

Statistical Analysis

Initially, 250 participants were randomly selected for EFA, while the remaining 332 participants were used for CFA. EFA involved assessing the sampling adequacy using the Kaiser-Meyer-Olkin (KMO) measure and testing the factorability using Bartlett's test of sphericity. For EFA, the factor extraction method employed was principal axis factoring, with promax chosen as the rotation method. The determination of the number of factors took into account both the scree plot (eigen value>1) and parallel analysis. Furthermore, the Cronbach's alpha value was calculated to evaluate internal consistency through item analyses. The Cronbach’s alpha coefficients obtained in all sub-dimensions of the scale developed in our study were above .80. This not only indicates acceptability, but also high internal consistency (DeVellis, 2016; Tavakol & Dennick, 2011).

CFA utilized the unweighted least squares (ULS) method for estimation. Confidence intervals for the calculated coefficients were determined using the bootstrap method with 1000 samples, and their significance was assessed. Fit statistics such as $\chi 2$, $\chi 2/df$, root mean square errors of approximation (RMSEA), standardised root mean square

residuals (SRMR), normed fit index (NFI), non-normed fit index (NNFI), comparative fit index (CFI), goodness of fit index (GFI), Hoelter's critical N, and R2 were reported. To determine a good fit, the criteria used were $\chi 2/df<3$; NFI, NNFI, CFI, GFI>0.90; and RMSEA and SRMR<0.08 (Erkorkmaz et al., 2013; Evci & Aylar, 2017; İlhan & Çetin, 2014).

For test-retest analysis, the intraclass correlation coefficient (ICC) was computed. ICC values ranging from 0.75 to 0.90 indicate good reliability, while values exceeding 0.90 indicate excellent reliability (Koo & Li, 2016). The analyses were performed using JASP software (version 0.16.1, University of Amsterdam).

Ethical Considerations

This study obtained written approval from the of Sinop University ensuring adherence to ethical standards (Date: 10.04.2023, Number: 2023/66). The study was conducted between April and May 2023, while complying with the ethical guidelines of the National Research Committee and the 1964 Declaration of Helsinki.

Results

Descriptive Statistics: Table 1 provides the distribution of participants based on their socio-demographic characteristics (Table 1).

Table 1.
Descriptive Statistics

	Study 1 (n=250)		Study 2 (n=332)	
	n	%	n	%
Marital status				
Single	195	78.00	260	78.3
Married	55	22.00	72	21.7
Educational status				
Postgraduate	25	10.00	25	7.5
High School	12	4.80	17	5.1
Secondary School	1	0.40	1	0.3
Undergraduate	212	84.80	289	87.0
Smoking				
Yes	44	17.60	56	16.9
No	188	75.20	230	69.3
Rarely	18	7.20	46	13.8
Drinking alcohol				
Yes	50	20.00	69	20.8
No	200	80.00	263	79.2
Are your periods regular?				
Yes	208	83.20	255	76.8
No	42	16.80	77	23.2
Your period cycle				
Less than 20 days	12	4.80	28	8.4
21-35 days	221	88.40	274	82.5
More than 35 days	8	3.20	13	3.9
More than 36 days	9	3.60	17	5.2
Are your periods painful?				
Always	84	33.60	116	34.9
Occasionally	147	58.80	198	59.6
Never	19	7.60	18	5.5
Do you have headaches during your periods?				
Yes	130	52.00	209	62.95
No	120	48.00	123	37.05
Have you been diagnosed with migraine?				
Yes	44	17.60	63	18.98
No	206	82.40	269	81.02
	M±SD	**Me (Min-Max)**	**M±SD**	**Me (Min-Max)**
Age	24.37±7.63	21 (15-50)	24.49±8.01	21 (18-51)
Severity of period pain	6±2.38	6 (1-10)	6±2.32	6 (1-10)
Menstrual headache severity	5.1±2.59	5 (1-10)	5.37±2.44	5 (1-10)
Migraine severity	5.93±2.84	6 (1-10)	5.78±3.25	6 (1-10)

M: Mean, SD: Standard Deviation, Me: Median, Min: Minimum, Max: Maximum

Table 2.
Item Pool

Item	Question
I-1	1. I have headaches more frequently during menstruation than during other periods.
I-2	2. My headaches during menstruation are more severe than my headaches outside of menstruation.
I-3	3. My headaches during menstruation are more sensitive to noise and sound than my headaches during other periods
I-4	4. I get nausea more often during menstruation than during other periods.
I-5	5. My headaches usually occur during my menstrual periods.
I-6	6. When I have a headache during my period, I feel the need to sleep more often than when I have headaches during other periods.
I-7	7. When I have a headache during my period, I need more silence than when I have headaches during other periods.
I-8	8. When I have a headache during my menstrual period, I need to rest in a darker environment compared to my headaches in other periods.
I-9	9. When I have a headache during my menstrual period, I use painkillers more than when I have headaches in other periods.
I-10	10. When I have a headache during my menstrual period, I do more sports than when I have headaches in other periods.
I-11	11. When I have a headache during my menstrual period, I use more non-pharmacological (non-drug) methods compared to my headaches in other periods.
I-12	12.My headaches during menstruation affect my work/school life more than my headaches in other periods.
I-13	13.My headaches during the menstrual period affect my social life more than my headaches in other periods.
I-14	14. My headaches during the menstrual period affect my concentration more than my headaches in other periods.
I-15	15.When I have a headache during menstruation, my sleep pattern changes more than when I have headaches during other periods.
I-16	16. When I have a headache during menstruation, my appetite decreases more than when I have headaches during other periods.
I-17	17. When I have a headache during menstruation, my appetite increases more than when I have headaches during other periods.
I-18	18. When I have a headache during menstruation, my daily fluid intake decreases more than when I have headaches during other periods.
I-19	19. When I have a headache during menstruation, my daily fluid intake increases more than when I have headaches during other periods.
I-20	20. When I have a headache during menstruation, I crave sweets more than when I have headaches during other periods
I-21	21. When I have a headache during menstruation, my daily life activities are affected more than when I have headaches in other periods.
I-22	22. When I have a headache during menstruation, it interferes with housework more than headaches in other periods.
I-23	23. When I have a headache during menstruation, I have less energy than when I have headaches in other periods.
I-24	24. I feel more tired when I have a headache during menstruation than when I have headaches during other periods
I-25	25. I feel more unhappy when I have a headache during menstruation than when I have headaches during other periods

Content Validity

The questions comprising the item pool can be found in Table 2. In previous literature, the CVC of the scale was reported to be 0.56 at a significance level of α=0.05 based on the opinions of 12 experts (Boateng et al., 2018; Yeşilyurt & Çapraz, 2018). In our study, the CVI of the scale was found to be 0.74, with CVC values ranging from 0.60 to 1.00. The higher CVI value obtained in our study compared to the critical CVC value indicates statistically significant content validity for the entire scale.

The revised scale, developed based on expert input, was administered to a pilot sample of 44 individuals. Following the pilot study, the scale underwent revisions based on the assessments of construct validity, item analysis, and internal consistency. Subsequently, the revised scale was administered to 99 participants at two-week intervals using the test-retest method to assess stability and determine the reliability coefficient.

Study 1

In this stage, a subset of 250 participants was randomly selected from the study's overall participant pool. EFA was conducted in sequential steps to refine the scale, eliminating items with low factor loadings, cross-loadings, or incompatible meanings. A summary of these procedures

can be found in Supplementary Table 1 after sources.

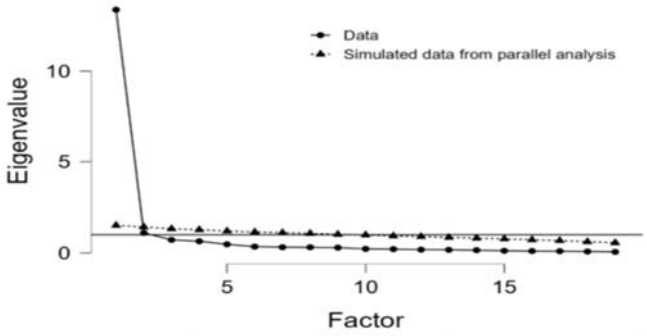

Figure 1.
Scree Plot

In the first step, items I-9 and I-11 were removed from the scale due to their factor loadings falling below 0.35. In the second step, item I-10 was excluded as its factor loading (0.316) was deemed low. Subsequently, item I-4 was eliminated from the scale as it loaded onto two different factors (0.349 and 0.458). Similarly, item I-20 was removed from the scale in the fourth step due to its association with two factors (0.482 and 0.404). In the fifth step, items I-17 and I-19, despite constituting a separate dimension, were removed because similar questions were included in a different dimension, and it was decided not to use a two-item dimension. Finally, item I-20 was reintroduced into the scale since no issues were observed with its factor loading.

Consequently, a two-factor structure was determined, supported by both the scree plot (eigen value>1) and parallel analysis methods (Figure 1).

The first factor, PC, comprised items 1, 2, 3, 5, 6, 7, and 8. The second factor, QoL, consisted of items 12, 13, 14, 15, 16, 18, 20, 21, 22, 23, 24, and 25. The KMO value for this two factor structure was 0.961, and Bartlett's test of sphericity yielded $\chi2=5796.69$ (df=171; $p<0.001$), indicating excellent sampling adequacy and factorizability (Figure 2).

The total explained variance ratio was calculated as 0.737 (0.473 for the PC factor and 0.264 for the QoL factor). The lowest factor loading obtained was 0.511. The calculated Cronbach's Alpha coefficients for the derived factors were 0.945 for PC, 0.970 for QoL, and 0.976 for the overall scale. Item analyses revealed high item-rest correlations across all items (ranging from 0.789 to 0.867 for the PC factor and from 0.741 to 0.921 for the QoL factor). Removal of any item did not improve the Cronbach's alpha value (Table 3).

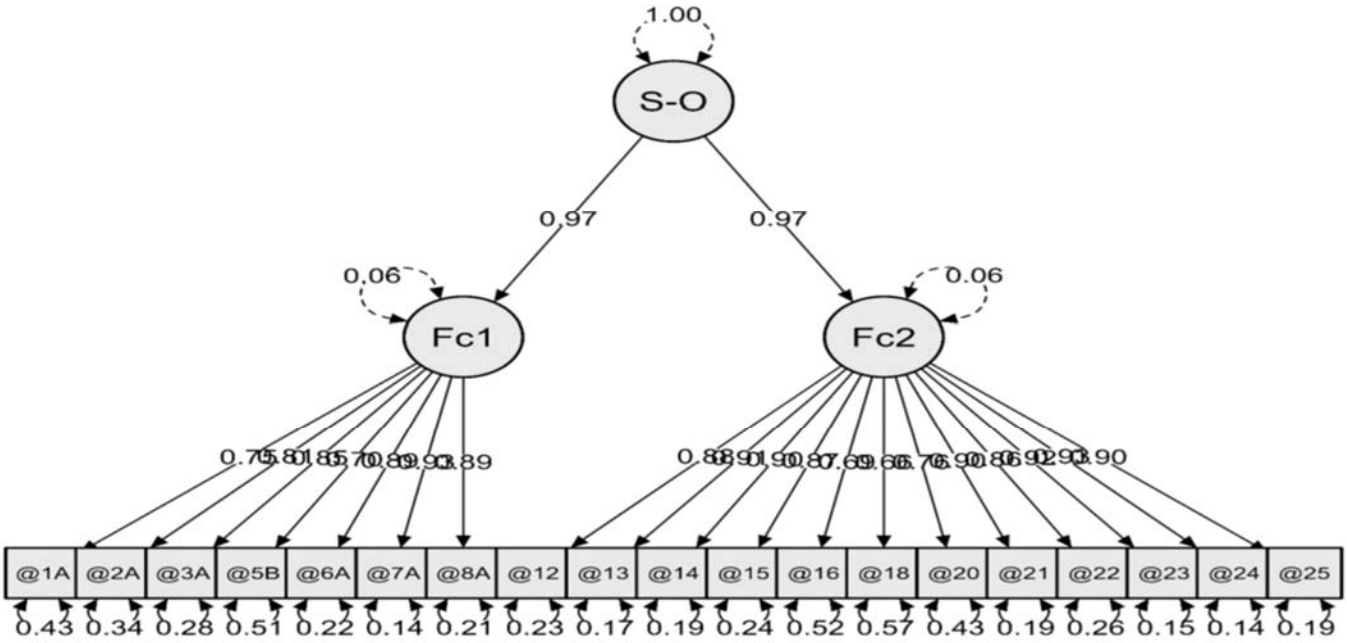

Figure 2.
Second order CFA

Table 3.
Results of Scale Adaptation Procedure

		Study 1 (n=250)				Study 2 (n=332)			ICC (n=99)
		Item Reliability Analysis			EFA[a,b]	CFA[d]			
	Item	M±SD	Item-rest correlation	Cronbach's Alpha if Item Deleted	Factpor Loadings	Est (95% CI) [e]	Std. Est.	R^2	
Pain and Coping (PC)									
	I-1	2.27±1.23	0.814	0.937	0.868	0.216 (0.173 to 0.259)	0.755	0.570	
	I-2	2.16±1.19	0.798	0.939	0.856	0.241 (0.196 to 0.287)	0.810	0.657	
	I-3	2.54±1.34	0.867	0.932	0.686	0.279 (0.231 to 0.328)	0.850	0.723	
	I-5	2.13±1.16	0.794	0.939	0.968	0.185 (0.146 to 0.224)	0.700	0.490	
	I-6	2.6±1.38	0.789	0.939	0.511	0.294 (0.241 to 0.348)	0.885	0.783	
	I-7	2.77±1.44	0.861	0.933	0.546	0.316 (0.262 to 0.37)	0.927	0.859	
	I-8	2.62±1.42	0.812	0.937	0.535	0.305 (0.251 to 0.359)	0.887	0.788	
	Total of PC	17.08±7.96	0.715[c]	CA=0.945	EV=0.473 EigV=13.429	4.005 (3.173 to 4.838)	0.970	0.941	0.900
Quality of Life (QoL)									
	I-12	2.59±1.32	0.857	0.967	0.648	0.3 (0.251 to 0.35)	0.880	0.775	
	I-13	2.57±1.31	0.888	0.966	0.781	0.309 (0.259 to 0.36)	0.911	0.829	
	I-14	2.57±1.3	0.876	0.967	0.683	0.301 (0.253 to 0.349)	0.900	0.810	
	I-15	2.56±1.33	0.882	0.966	0.736	0.289 (0.239 to 0.34)	0.872	0.761	
	I-16	2.33±1.27	0.741	0.970	0.647	0.22 (0.176 to 0.265)	0.695	0.483	
	I-18	2.13±1.17	0.683	0.971	0.634	0.193 (0.151 to 0.235)	0.655	0.429	
	I-20	2.88±1.52	0.775	0.969	0.754	0.286 (0.241 to 0.331)	0.758	0.574	
	I-21	2.66±1.36	0.881	0.966	0.946	0.31 (0.262 to 0.358)	0.899	0.808	
	I-22	2.25±1.27	0.806	0.968	0.657	0.29 (0.242 to 0.339)	0.859	0.738	
	I-23	2.73±1.44	0.921	0.965	0.978	0.319 (0.269 to 0.37)	0.923	0.852	
	I-24	2.78±1.44	0.903	0.966	0.968	0.325 (0.274 to 0.376)	0.929	0.864	
	I-25	2.75±1.41	0.876	0.966	0.931	0.324 (0.273 to 0.375)	0.901	0.812	
	Total of QoL	30.80±14.03	0.729[c]	CA=0.970	EV=0.264 EigV=1.12	3.834 (3.117 to 4.551)	0.968	0.936	0.877
Total of MMS		**47.88±21.24**	**0.685[c]**	**CA=0.976**	**EV=0.737**				**0.899**

a Extraction Method: Principal Axis Factoring. Rotation Method: Promax

b KMO=0.961 and Bartlett's Test of Sphericity: χ^2=5796.69, df=171; p<.001.

c Average interitem correlation

d Estimator: Unweighted Least Squares (ULS); Fit-statistics: χ^2 (df=150) = 245.45, p < .001; χ^2/df=1.64; RMSEA = 0.044; SRMR=0.038; NFI = 0.997; NNFI = 0.999; CFI = 0.999; GFI = 0.998; Hoelter's critical N (α = .05)=243.2.

e All Path coefficients are statistically signifcant at <0.001 significance level.

EFA: Exploratory Factor Analysis; CFA: Comfirmatory Factor Analysis; M=Mean; SD: Standard Deviation; Est= Unstandardized Factor Loadings; Std. Est= Standardized Factor Loadings; EV: Percentage of Explained Variance; EigV: Eigen Value; ICC: Intraclass Correlation Coefficient; CA:Cronbach's Alpha

Study 2

This stage involved a separate group of 332 individuals who were not part of the initial stage. The objective was to examine the factor structure obtained in the previous stage. The smallest standardized factor loading (Std. Est.) was determined to be 0.700 (R^2 = 0.490) for the first factor and 0.655 (R^2 = 0.429) for the second factor. Various fit statistics were calculated to evaluate the model's goodness of fit. The χ2 value with 150 degrees of freedom was computed as 245.45 (p < .001), resulting in a χ2/df ratio of 1.64. Other fit indices demonstrated excellent fit, including RMSEA = 0.044, SRMR = 0.038, NFI = 0.997, NNFI = 0.999, CFI = 0.999, and GFI = 0.998. Additionally, Hoelter's critical N (α = .05) was determined to be 243.2. Considering that the study was conducted with a sample size of 332 participants, exceeding the required sample size for the model at this stage (Hoelter's Critical N = 243.2), it can be concluded that the study had an adequate sample size. All fit statistics indicate a high level of model fit (Table 3).

Test-retest

The test-retest study involved 99 participants, and the ICC was calculated to assess the stability of the scale. The ICC value for the total scale was determined to be 0.899, indicating a high level of reliability. Specifically, the PC factor demonstrated an ICC of 0.900, while the QoL factor exhibited an ICC of 0.877 (Table 3).

Score Calculation

Our proposed method for calculating the scores of the scale factors and the total score is outlined below:

PC score = ((I-1 + I-2 + I-3 + I-4 + I-5 + I-6 + I-7 + I-8) / 8) × 20

QoL score = ((I-12 + I-13 + I-14 + I-15 + I-16 + I-18 + I-20 + I-21 + I-22 + I-23 + I-24 + I-25) / 12) × 20

MMS score = (PC score + QoL score) / 2

By applying this calculation, the factor and total scale scores were transformed into a standardized scale that ranges from a minimum score of 20 to a maximum score of 100. This approach ensures that the weights of the two factors are balanced for the total score.

A graphical representation of the distributions is given in Figure 3.

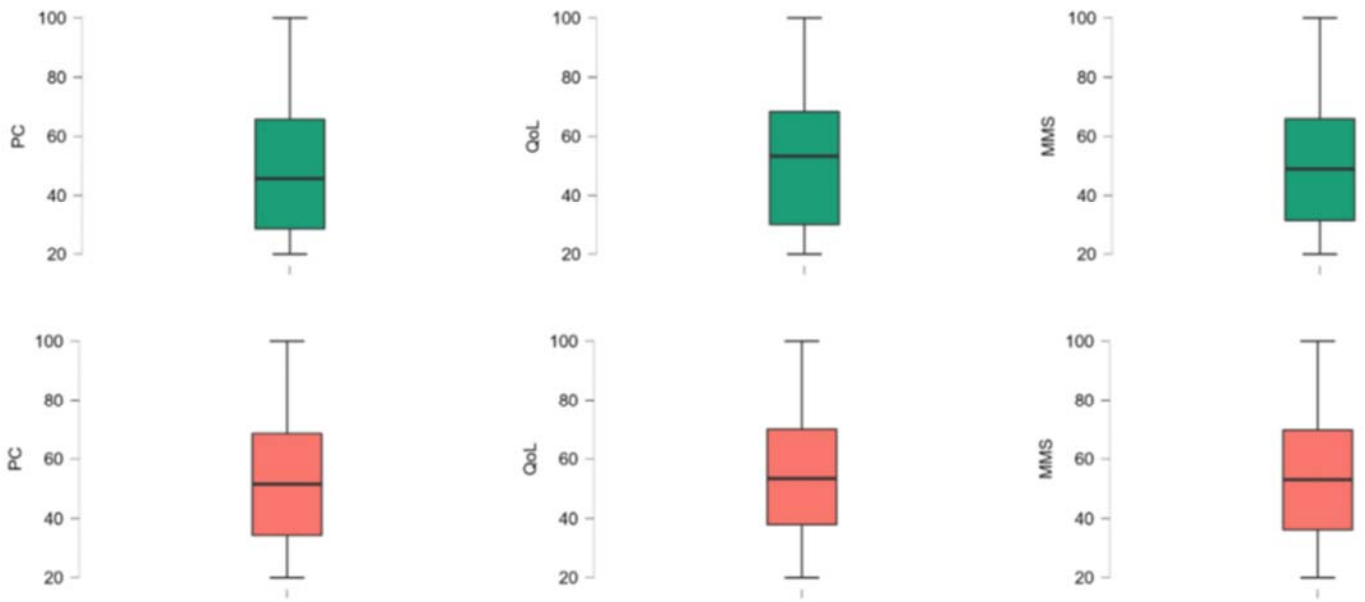

Figure 3.
Box and whisker plots for Factor and Total score of MMS (Study 1 is in first row and Study 2 is in second row)

Discussion

Migraine during menstruation can cause headaches and various symptoms in many women (Seng et al., 2022). Common symptoms include pain, nausea, vomiting, and sensitivity to sound, which can exacerbate other symptoms arttırabilmektedir (Wang et al., 2023). Additionally, various factors can trigger MM and negatively impact individuals'

quality of life (Pavlović et al., 2015). Rather than avoiding triggers, learning to cope with them can help reduce the frequency and discomfort of headache attacks (Seng et al., 2022). Therefore, the objective of this study was to develop the MMSS.

The study began by evaluating a question pool, created based on existing literature, with input from 12 academics. The items' appropriateness was assessed using a scale: 1 = "necessary item", 2 = "useful but insufficient item", 3 = "unnecessary item". The content validity rate was calculated using the Lawshe technique, and the study yielded a CVI of 0.74, which is considered acceptable (Polit, Beck, & Owen, 2007). The scale's CVC was found to be 0.56 at a significance level of $\alpha = 0.05$, indicating sufficiency based on the judgment of 12 experts (Boateng et al., 2018; Yeşilyurt & Çapraz, 2018).

Through EFA, the scale was determined to have a two-dimensional structure. The KMO measure was 0.961, and Bartlett's test of sphericity resulted in $\chi 2 = 5796.69$ (df = 171; p <.001). According to the literature, a KMO value above 0.60 and a statistically significant result for Bartlett's test of sphericity are desirable (Aslan, 2018; Bektaş, 2017; Kartal & Bardakçı, 2018).

In the pilot and general applications, the scale questions were found to be understandable, and there was a significant correlation between internal consistency scores. This demonstrates that individuals clearly comprehended the scale questions, indicating its high reliability. The reliability of the MMSS was determined to be Cronbach's $\alpha = 0.976$, indicating a highly reliable scale. The sub-dimension scores for PC yielded Cronbach's α values of 0.94, and the QoL sub-dimension had a Cronbach's alpha value of 0.97. The Cronbach's alpha coefficients obtained in all sub-dimensions of the scale developed in our study were above .80. This not only indicates acceptability, but also high internal consistency (DeVellis, 2016; Tavakol & Dennick, 2011).

In this study, both the total scale score and the sub-dimension scores exhibited high levels of reliability. Cronbach's alpha values between 0.60 and 0.79 indicate good reliability, while values greater than 0.80 indicate high reliability (Alpar, 2018). Item correlation values below 0.50 indicate poor reliability, values between 0.50 and 0.75 indicate moderate reliability, values between 0.75 and 0.90 indicate good reliability, and values above 0.90 indicate excellent reliability (Koo & Li, 2016). CFA was conducted to assess the contribution of the scale's sub-dimensions to the model and confirm the results.

The MMSS was developed with the aim of assessing the severity of symptoms experienced by women during menstruation, specifically related to MM. These symptoms have a significant impact on various aspects of women's lives, including their academic performance, work productivity, and social interactions, ultimately affecting their overall quality of life (Polat et al., 2020). Therefore, the utilization of the MMSS, a reliable and valid tool, is recommended to evaluate symptom severity in women experiencing MM. By employing this scale, healthcare professionals can effectively monitor and manage these symptoms, leading to improvements in women's quality of life.

In order to alleviate the burden of MM symptoms and headaches in women, it is crucial to identify the underlying factors contributing to this condition. This knowledge will enable the implementation of targeted interventions aimed at reducing symptom severity and improving quality of life. Therefore, further research studies are warranted to explore and compare different factors associated with menstrual migraines. The MMSS will make a valuable contribution to the existing literature by providing insights into the severity of MM symptoms in women and guiding the implementation of appropriate measures to address this issue.

Conclusion and Recommendations

In this present study, we developed the MMSS. Through rigorous evaluations, we have determined that the MMSS is a valid and reliable scale. Our aim is to introduce this scale to the scientific community as a robust and innovative measurement tool that offers a fresh perspective for women. Additionally, the scale is designed to be easily comprehensible and straightforward to answer. Considering these favorable qualities, we highly recommend the utilization of the MMSS in women with MM Syndrome. The results of our study demonstrate the scale's high validity and reliability.

Ethics Committee Approval: This study obtained written approval from the of Sinop University ensuring adherence to ethical s Informed Consent (Date: 10.04.2023 Number: 2023/66).
Informed Consent: Consent was obtained from the participating in the study.
Peer-review: Externally peer-reviewed.
Author Contributions: Concept – YÖG, MEA, AP; Design – YÖG, MEA; Supervision YÖG, MEA; Materials – YÖG, MEA, AP; Data Collection and/or Processing – YÖG,MEA,AP; Analysis and/or Interpretation - YÖG, AP; Literature Search - YÖG, MEA; Writing Manuscript – YÖG, MEA, AP; Critical Review YÖG, MEA, AP.
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Supplement Table 1.
Steps of EFA

	Step 1			Step 2			Step 3			Step 4			Step 5			Step 6		Step 7	
Item	F1	F2	F3	F1	F2	F3	F1	F2	F3	F1	F2	F3	F1	F2	F3	F1	F2	F1	F2
I-24	0.969			0.954			0.780			0.780			0.790			0.925		0.968	
I-23	0.948			0.943			0.797			0.796			0.816			0.958		0.978	
I-25	0.915			0.894			0.724			0.723			0.746			0.913		0.931	
I-21	0.908			0.914			0.832			0.833			0.852			0.944		0.946	
I-16	0.704			0.785		-0.346	1.033		-0.438	1.045		-0.444	1.034		-0.451	0.668		0.647	
I-13	0.695			0.695			0.639			0.648			0.674			0.811		0.781	
I-15	0.676			0.691			0.676			0.688			0.703			0.760		0.736	
I-20	0.666			0.673			0.485		0.407	**0.482**		**0.404**						**0.754**	
I-22	0.652			0.657			0.697			0.708			0.716			0.678		0.657	
I-18	0.569			0.609			0.783			0.799			0.791			0.662		0.634	
I-14	0.569			0.573			0.487			0.498			0.523			0.702		0.683	
I-12	0.547			0.559			0.472			0.485			0.508			0.669		0.648	
I-5		0.936			0.952			0.954			0.936			0.935			0.960		0.968
I-1		0.841			0.835			0.842			0.859			0.884			0.876		0.868
I-2		0.784			0.807			0.822			0.836			0.841			0.862		0.856
I-3		0.682			0.681			0.701			0.676			0.669			0.685		0.686
I-8		0.597		0.317	0.569			0.558		0.327	0.530		0.331	0.525		0.347	0.528		0.535
I-7		0.580		0.344	0.555			0.561		0.311	0.534		0.321	0.527		0.381	0.542		0.546
I-6		0.569			0.540			0.532			0.497			0.489		0.346	0.504		0.511
I-4		0.521		0.313	0.490		**0.349**	**0.458**											
I-17			0.931			0.973			0.924			0.930			**0.931**				
I-19			0.676			0.600			0.705			0.715			**0.667**				
I-10			0.406			**0.316**													
I-9	**0.328**																		
I-11		**0.344**																	

Note: Extraction Method: Principal Axis Factoring. Rotation Method: Promax