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RESEARCH

Validity and reliability of the Turkish version of the Ottawa sitting scale in patients with multiple Sclerosis

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Abstract

Purpose This study aimed to examine the validity and reliability of the Turkish version of the Ottawa Sitting Scale (OSS-TR) in patients with multiple sclerosis (MS).

Methods The study included 52 patients aged 29–45 who were diagnosed with MS based on McDonald criteria. To establish construct validity, structural (with confirmatory factor analysis, CFA) and convergent validity were examined. For convergent validity, the associations between the OSS-TR score with the Trunk Impairment Scale (TIS) and Berg Balance Scale (BBS) scores were analyzed. The average variance extracted (AVE) and construct reliability (CR) were calculated to enhance the assessment of convergent validity. To assess the reliability of the OSS-TR, the scale was re-administered to all participants seven days later by the same rater, and the intraclass correlation coefficient (ICC) was computed to determine the test–retest reliability.

Results According to the factor analysis results, the scale was found to have a single factor. CFA indicated that the model fit indices for the OSS-TR were acceptable, verifying its construct validity. Strong correlations between the OSS-TR score and BBS ($r=0.843$) and TIS ($r=0.867$) scores confirmed the convergent validity of the OSS-TR ($p<0.05$). Furthermore, the fact that the AVE score (0.578) was greater than 0.50 and the CR score (0.905) was greater than 0.70 supported convergent validity. The OSS-TR had high test–retest reliability (ICC = 0.953) and internal consistency (Cronbach's alpha = 0.934).

Conclusion According to the results of the study, the OSS-TR is a reliable and valid tool for assessing sitting balance in Turkish-speaking MS patients.

Keywords Sitting balance · Multiple sclerosis · Ottowa sitting scale · Validity · Reliability

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Introduction

Multiple Sclerosis (MS) is a autoimmune chronic neurological disorder primarily diagnosed in individuals aged 20 to 50 [1]. MS is characterized by central nervous system inflammation, which induces demyelination. This pathological process results in a diverse array of symptoms, including cognitive impairment, muscle weakness, diminished postural control, sensory disturbances, spasticity, fatigue, and urinary incontinence [2]. MS, the most common demyelinating disease, has a high prevalence in Europe and North America (100/100,000 population) and a relatively low prevalence in Africa and East Asia (2/100,000 population) [3]. Epidemiological studies in Turkey have found a relatively high prevalence of MS, ranging from 41 to 101.4 per 100,000 population [4].

Postural balance is divided into three as static, dynamic, and functional. Static sitting balance is the balance assessed with the extremities at rest on a stable surface. Dynamic sitting balance is the balance assessed on an unstable surface or during movements of the extremities. Functional sitting balance is the balance assessed while performing activities of daily living (eating, combing hair, etc.) for a specific purpose while in a sitting position [5]. People with MS frequently experience impaired postural balance.This impairment can result from cerebellar lesions that cause ataxia, but it may also be attributed to diplopia, vestibular dysfunction, muscle weakness in the limbs or trunk, decreased proprioception, or lower limb spasticity [6]. Research have indicated that postural control is significantly deteriorated in patients with MS compared to healthy individuals [7]. Generally, this deficit in postural control causes balance impairment in MS patients and exacerbates the risk of falls [7, 8]. A critical component of postural control is sitting balance, which is essential for participation in activities of daily living. Adequate sitting balance enables individuals with neurological diseases to participate safely and efficiently in these activities [9]. There are no specific measurement methods in the literature to assess sitting balance in neurological diseases; however, various scales and clinical assessment tools have been used to evaluate general balance in these diseases, including the Tinetti Balance Test [10], the Berg Balance Scale (BBS) [11], and Brunel Balance Assessment [12].

In neurological diseases, including MS, the examination of sitting balance with specific measurement methods may provide valuable insights with regard to designing assessment and treatment programs and revealing the efficacy of the interventions [13]. The Ottawa Sitting Scale (OSS) is a pratical and comprehensive 10-item tool designed to assess sitting balance in both foot-supported and foot-unsupported positions. It evaluates balance during reaching, trunk rotation, and hip movements while sitting. Thus, the OSS specifically measures functional sitting balance, distinguishing it from other balance assessment scales [14].

Assessment of sitting balance in patients with MS using a practical tool such as the OSS can assist clinicians and researchers in identifying the needs of these patients, selecting appropriate interventions, and monitoring the progress of treatment [13]. On the other hand, to the best of the authors' knowledge, the validity and reliability of the OSS, which could allow a practical evaluation of functional sitting balance in patients with MS, have not been investigated in these patients. A measurement tool needs to have its psychometric properties evaluated and its validity and reliability proven in order to be used accurately in a specific population and disease. Data collected from scales that have not undergone these processes may produce misleading results due to unverified reliability and validity [15]. Previously, the Turkish version of the OSS was investigated in patients surviving in the intensive care unit and was found to be a valid and reliable tool for assessing sitting balance in these patients [16]. In another study, the Turkish version of the OSS was revealed to be reliable and valid in evaluating sitting balance in patients with acute stroke [17].

Considering that the prevalence of MS is relatively high in Turkey and that sitting balance is impaired in MS patients as the prognosis worsens, the evaluation of sitting balance in MS patients with practical tools such as OSS may provide valuable insights to clinicians and researchers. In light of these, this study aimed to investigate the reliability and validity of the Turkish version of the OSS (OSS-TR) in Turkish-speaking patients with MS.

Materials and methods

Study design and ethical aspects

This cross-sectional research obtained approval from the local ethics committee (Number: 2024–12/94). In this study, which was conducted in compliance with the Declaration of Helsinki, written informed consent was also taken from the participants with MS.

Participants

Participants were recruited from the patients who attended the Neurology Clinic at Kırşehir Training and Research Hospital and consented to participate in the study. The study population comprised native Turkish-speaking patients diagnosed with MS by a specialist neurologist. The inclusion criteria for patients were as follows: being over 18 years of

age, meeting the McDonald criteria for the diagnosis of MS [18], having no communication or cooperation abnormalities. Patients with other central nervous system and musculoskeletal disorders, with a disease that may affect balance, with visual and hearing loss, and with psychiatric and cognitive disorders were excluded.

In psychometric studies, although there is no specific method to compute the sample size, the general consensus is to determine the sample size by considering a patient-item ratio that suggests 5–10 patients for each item [17]. Considering this information, since the OSS-TR is a 10-item instrument, a sample size of over 50 MS patients was considered sufficient for the present study.

Procedures

Firstly, the necessary permissions were received from the developer of the original version of the scale [14] and the authors of the Turkish version study [16]. To evaluate the test–retest reliability of the OSS-TR, the all participants were administered two tests 7 days apart by the same rater. The clinical and demographic properties of the participants were recorded. To analyze the validity of the OSS-TR, TIS, and BBS were administered to the participants once together with the OSS-TR.

Outcome measures

Ottawa sitting scale

The Turkish version of the OSS was used in the present study to assess the sitting balance of patients with MS [14, 16, 17]. The OSS comprises 10 items; 5 items with feet support and 5 items without feet support. These items are designed to assess both functional performance and measures of sitting balance. The scale evaluates: (a) static sitting balance of the patient independently, (b) the abilities to extend in four different directions without compromising balance while sitting on the bed's edge, (c) the ability to rotate the body to the right and left while keeping the hips fixed on the bed, and (d) the ability to move backward and forward on the bed using alternating pelvic elevations. Each item is scored on an ordinal scale ranging from 0 to 4, yielding a total possible score of 0 to 40. A higher score suggests greater sitting balance. The test can be finished in under 15 min. [14, 17].

Trunk impairment scale

Static sitting balance is the balance assessed with the extremities at rest on a stable surface. Dynamic sitting balance is the balance assessed on an unstable surface or during movements of the extremities. Functional sitting balance is the balance assessed while performing activities of daily living (eating, combing hair, etc.) for a specific purpose while in a sitting position.The TIS assesses trunk coordination and dynamic and static sitting balance [19]. It consists of 3 sub-tittle that evaluate static sitting balance (3 questions evaluating compensations of the trunk), dynamic sitting balance (10 questions evaluating selective lateral flexion), and coordination (4 questions evaluating selective rotation of the lower and upper part of the trunk, against time). The overall score range from 0–23, with a higher score referring to better trunk coordination and sitting balance [19, 20]. The Turkish version of the TIS has been reported to be reliable and valid for assessing sitting balance and trunk rotation in patients with neuromuscular diseases [20].

Berg balance scale

The BBS is a balance evaluation scale consisting of 14 items, each of which requires monitoring of the patient's performance. For each item, the patient is assigned a score ranging from 0 to 4. A score of 0 denotes a failure to carry out the activity, whereas a score of 4 indicates the ability to complete the activity independently. The total possible score is 56, with scores of 0–20 signifying impaired balance, 21–40 indicating acceptable balance, and 41–56 representing good balance [21, 22]. In the present study, the Turkish version of the BBS was used. The Turkish version of the BBS [22] has been shown to be valid and reliable for assessing balance.

Construct validity

Construct validity refers to the extent to which a test or questionnaire accurately measures the concept it is intended to assess. In essence, it evaluates how well the items within the test or questionnaire represent the target concept. The construct validity of the OSS-TR was examined in this study by assessing structural and convergent validity [23].

Structural validity

Confirmatory factor analysis (CFA) was utilized to analyze the construct validity. Exploratory factor analysis (EFA) and direct oblimin rotation methods were applied before CFA. Kaiser–Meyer–Olkin (KMO) and Bartlett's sphericity test were conducted to ascertain whether the data were eligible for factor analysis. Comparative fit index (CFI, >0.90), chi-square statistic according to degrees of freedom (χ^2/

df, ≤2), goodness of fit index (GFI, >0.90), non-normed fit index (NNFI, >0.90), root mean square error of approximation (RMSEA, ≤0.08) and standardised root mean square residual (SRMR, ≤0.08) indices were calculated to examine the fit of the structure [24]. During the CFA, model modifications were implemented to account for shared variance between specific item pairs that was not explained by the latent factors. Based on modification indices and theoretical considerations, error covariances were specified between items 1–9, 5–10, 3–10, and 4–6. These modifications reflect potential method effects and content overlap between these item pairs, improving model fit while maintaining theoretical integrity. The decision to allow these error correlations was guided by both statistical criteria and careful examination of item content to ensure that the modifications were theoretically relevant. All modifications were implemented sequentially, with model fit reassessed after each change to assess their impact on the overall model structure. The sequential application of both EFA and CFA serves distinct but complementary purposes in this psychometric investigation of the OSS-TR among MS patients. While the OSS has been previously validated in general populations, its factorial structure and psychometric properties cannot be assumed to remain invariant when applied to specific clinical populations, such as MS patients, who may exhibit distinct response patterns due to their unique symptomatology and functional limitations. The EFA was employed to examine the underlying factor structure without imposing a priori assumptions, allowing the data to reveal potential population-specific patterns, while the CFA was utilized to statistically test and validate the hypothesized factor structure. This dual-analytical approach enhances the robustness of the validation process by investigating whether the established factor structure is replicated in the MS population, identifying any potential population-specific variations, and providing empirical evidence for the scales' construct validity in this specific clinical context. This methodological decision aligns with best practices in psychometric validation when extending established instruments to new populations [25].

Convergent validity

To assess the convergent validity of the OSS-TR, the correlations between previously validated BBS and TIS scales measuring similar constructs and the OSS-TR were investigated by Pearson correlation analysis [23]. A correlation coefficient of less than 0.30 was interpreted as low; a value between 0.30 and 0.60 was regarded moderate; and a value greater than 0.60 was considered a strong correlation [26]. In addition, the construct reliability (CR) and average variance extracted (AVE) were utilized to enhance the assessment of convergent validity. The CR and AVE values higher than 0.70 and 0.50, respectively, were accepted as indicators of convergent validity [27].

Reliability

The OSS-TR's internal consistency was analysed through Cronbach's alpha coefficient and item-based correlations. An alpha coefficient greater than 0.70 was considered as acceptable, ≥0.80 as excellent internal consistency [28]. The test–retest reliability of the OSS-TR was analyzed by computing the intraclass correlation coefficient (ICC) for the total scale score. ICC values were classified as: good (0.76–1.00), moderate (0.51–0.75), fair (0.26–0.50), and poor (0.00–0.25) [28].

Statistical analysis

The statistical analyses were conducted via RStudio [29] based on R language v. 4.3.2, lavaan [30], semPlot packages [31], and IBM SPSS version 24.0 (Armonk, NY, IBM Corp.). The numerical variables were characterized with mean and standard deviation, whereas the categorical variables were represented by percentage and frequency values. The conformity of the variables in the data set to a normal distribution was analyzed by analytical and visual methods. Pearson correlation analysis was employed to evaluate the associations between with OSS-TR score and BBS and TIS scores. Statistical significance was set at $p < 0.05$.

Results

Of the 58 patients who were diagnosed with MS and referred to our clinic for evaluation, 6 did not meet the inclusion criteria, and the study was completed with 52 patients. For the retest assessment, all participants were re-completed the OSS-TR one week after the initial assessment. The demographic and clinical features of the participants were given in Table 1. The plurality of the patients were female (63.5%), and the majority in terms of MS type was in the Relapsing–remitting Multiple Sclerosis (RRMS) group with 35 participants (67.3%). The fact that no patient scored a minimum (0 points) or maximum (40 points) on the scale indicating that there is no ceiling or floor effect of the OSS-TR.

It was found that the data were eligible for factor analysis on the basis of Bartlett's test of sphericity and KMO. Table 2 summarizes the model fit criteria based on the CFA results. According to these criteria, it was determined that the model

Table 1 Demographic and clinical properties of the participants

Quantitative features		Mean ± SD	Minimum–maximum
Age (years)		38.54 ± 5.42	29–45
BMI (kg/m^2)		23.21 ± 1.63	22.31–24.43
Disease duration (years)		7.33 ± 2.27	6.12–8.79
EDSS score (point)		2.9 ± 1.11	2–3.5
OSS-TR score (point)		18.64 ± 3.39	14–20
OSS-TR re-test score (point)		19.77 ± 3.79	13–21
Berg Balance Scale score (point)		43.77 ± 4.49	28–47
Trunk Impairment Scale score (point)		10.49 ± 3.99	7–15
Qualitative features		**Count**	**%**
Gender	Male	19	36.5
	Female	33	63.5
MS type	RRMS	35	67.3
	PMS	17	32.7

SD: Standard deviation, BMI: Body mass index, EDSS: Expanded disability status scale, OSS-TR: Turkish version of the Ottawa Sitting Scale, MS: Multiple Sclerosis, RRMS: Relapsing–remitting Multiple Sclerosis, PMS: Progressive Multiple Sclerosis

has a good fit (χ^2/df = 1.225, GFI = 0.947, NNFI = 0.922, CFI = 0.980, SRMR = 0.044, and RMSEA = 0.066). During the confirmatory factor analysis process, the modification was implemented between some items (1–9, 5–10, 3–10 and 4–6) by using error covariances. Examining the factor loadings of the items, it was observed that the smallest value was 0.637 and the largest value was 0.785. As neither value was less than 0.50, it was concluded that all of the items should remain in the model and no item should be eliminated. Each parameter estimation was found to be statistically significant ($p < 0.05$).

There was a statistically significant, positive and strong correlation between OSS-TR and BBS ($r = 0.843$, $p < 0.001$) and TIS scores ($r = 0.867$, $p < 0.001$). Considering the AVE and CR criteria, the AVE score (0.578) was greater than 0.50 and the CR score (0.905) was greater than 0.70 on the overall scale, which supported convergent validity.

Table 3 Summary statistics of the OSS-TR items, internal consistency and test–retest reliability of the OSS-TR

Item	Mean	Standard Deviation	Corrected Total-Item Correlation	Cronbach's α if Item Deleted
1	1.67	0.90	0.727	0.927
2	1.88	0.92	0.689	0.929
3	1.83	1.00	0.681	0.930
4	1.73	0.87	0.762	0.926
5	1.83	0.98	0.788	0.924
6	2.04	0.97	0.715	0.928
7	1.92	0.90	0.721	0.927
8	1.90	0.89	0.793	0.924
9	1.94	0.92	0.716	0.928
10	1.85	0.92	0.781	0.924
Total item score	18.63	7.32		
Total scale	Internal consistency		Cronbach's alpha	0.934
	Test–retest reliability		ICC (95% CI)	0.953 (0.917–0.973)

OSS-TR: Turkish version of the Ottawa Sitting Scale, ICC: Intraclass correlation coefficient, CI: Confidence interval

Table 3 provides the individual statistics, item correlation values, internal consistency and test–retest reliability of the OSS-TR. The corrected total item correlation statistic for all items was 0.68 and above, and the Cronbach's alpha if item deleted statistic was above 0.92. Based on these results, it was observed that it was appropriate not to exclude any item. The results revealed that the scale has an excellent level of internal consistency (Cronbach $\alpha = 0.934$) and the items stand for the similar construct. Furthermore, OSS-TR's the test–retest reliability based on ICC was found to be quite high (ICC = 0.953) (Table 3). To further evaluate measurement reliability, a Bland–Altman plot was constructed to visualize the agreement between test and retest

Table 2 Results of confirmatory factor analysis and model fit indices of the OSS-TR

Item	Factor loadings for CFA	**Model results for EFA**		**Model fit indices for CFA**		
		Examination	Values	Indice	Threshold	Values
1	0.644	KMO measure of sampling adequacy	Overall MSA = 0.878	χ^2/df	< 5	1.225
2	0.637			GFI	> 0.90	0.947
3	0.697			NNFI	> 0.90	0.922
4	0.687	Batlett's test of sphericity	$\chi^2 = 349.884$, $p = 0.006$	CFI	> 0.90	0.980
5	0.785			RMSEA	< 0.080	0.066
6	0.760	Model significance	$\chi^2 = 57.407$, $p = 0.012$	SRMR	< 0.05	0.044
7	0.688					
8	0.730	Ratio of variance explained	0.601			
9	0.649					
10	0.693					

Turkish version of the Ottawa Sitting Scale, EFA: Exploratory factor analysis, CFA: Confirmatory factor analysis, χ^2/df: The ratio of the chi-square statistic to degrees of freedom KMO: Kaiser–Meyer–Olkin, MSA: Measure of sampling adequacy, NNFI: Non-normed fit index, GFI: Goodness of fit index, RMSEA: Root mean square error of approximation, SRMR: Standardized root mean square residual, CFI: Comparative fit index

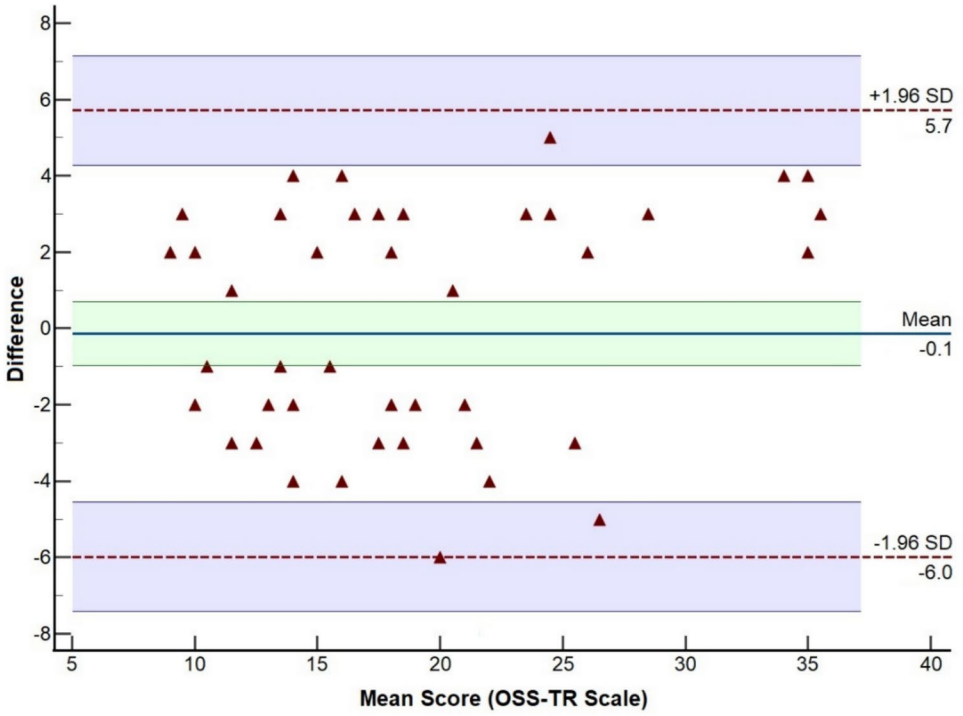

Fig. 1 The Bland–Altman graph representing the agreement between test and retest scores of OSS-TR scale

measurements (Fig. 1). The analysis revealed that the measurement differences were normally distributed around zero, with all data points falling within the 95% confidence intervals (CI). The mean difference between measurements was −0.1346 points (95% CI:−0.9653 to 0.6961), indicating minimal systematic bias. The null hypothesis of zero mean difference was not rejected (p = 0.7463). The limits of agreement ranged from −5.9829 (95% CI:−7.4117 to −4.5541) to 5.7136 (95% CI:4.2848 to 7.1425), suggesting that 95% of the differences between test and retest measurements would fall within these bounds.No outliers or irregular values were observed, indicating strong agreement between the two sets of measurements. These findings, together with the ICC results, demonstrate robust measurement consistency across trials. These results demonstrate good agreement between test and retest measurements of the OSS-TR, with no significant systematic bias and clinically acceptable limits of agreement.

Discussion

This study investigated the psychometric properties of the OSS-TR in MS patients. According to the findings of the study, the OSS-TR was found to be valid and reliable for assessing sitting balance in MS patients.

The original OSS was developed by Thornton et al. [14] to assess sitting balance in populations with stroke, elderly individuals with balance problems, and other neurological disorders. The advantages of the OSS over other balance assessment scales include its specific focus on sitting balance, its detailed examination of postural control and sitting balance even in patients with low physical ability, and its ease of understanding and quick application. A review of the literature revealed that the validity and reliability of the OSS in Turkish have been examined in patients with acute stroke [17] and those discharged from intensive care units [16].

Good sitting balance is essential for successful postural control. Impaired postural control, often resulting from cerebellar lesions, is frequently observed in MS patients compared to healthy individuals. This impairment increases the risk of falls and negatively affects participation in activities of daily living. Sitting balance is one of the subcomponents of postural control [7, 9]. Methods such as the Tinetti Balance Test, BBS, and TUG test are frequently used to evaluate postural control and balance in MS patients [10, 11, 32]. However, none of these methods specifically assess sitting balance. The OSS, developed by Thornton et al. [14] specifically evaluates sitting balance.

Yaşa et al. [17] found items 3, 4, 5, 8, 9, 10 in the 1st factor and items such as 1, 2, 6, 7 in the 2nd factor of the OSS-TR in patients discharged from intensive care. In the other study, Aktaş et al. [16] found that items 3, 4, 5, 8, 9, 10 of the OSS-TR in patients with acute stroke were in the 1st factor and items such as 1, 2, 6, 7 were in the 2nd factor. In the current study, unlike the validity and reliability studies of the OSS-TR in other populations, the scale was found to be single-factor. The fact that the factors of the scale consisted of different items in previous studies and that the OSS-TR consisted of a single factor in the current study may be due

to the differences in patient populations and sitting balance levels.

In the present study, the TIS and BBS, which are frequently used to assess balance and trunk performance in MS patients, were used to investigate the convergent validity of OSS-TR. We expected that better balance and trunk performance would be associated with better sitting balance scores. OSS-TR was highly correlated with both TIS ($r=0.867$, $p<0.001$) and BBS ($r=0.843$, $p<0.001$). These results revealed that the OSS-TR has high convergent validity for use in patients with MS. Thornton et al. [14] examined the concurrent validity of OSS with BBS but did not report any correlation coefficient. Aktaş et al. [16] found a strong correlation between OSS and BBS in patients discharged from the intensive care unit ($r=0.716$, $p<0.001$). In another study, Yaşa et al. [17] found a strong correlation between OSS and both BBS ($r=0.875$, $p<0.001$) and TIS ($r=0.861$, $p<0.001$) in patients with acute stroke.

For newly developed scales, an α value of ≥ 0.70 is generally deemed sufficient, while a threshold of ≥ 0.80 is considered acceptable for scales adapted to different populations [33]. In this study, the Cronbach α coefficient of the total score of the OSS-TR was 0.934, revealing that the OSS-TR has excellent internal consistency. If the items were deleted, it was determined that the Cronbach's α coefficient varied between 0.924–0.930 and there was no need to delete any of the items. Similarly, Yaşa et al. [17] calculated the Cronbach's α coefficient value of the OSS-TR as 0.980, and Aktaş et al. [16] calculated it as 0.889. We found that the current study showed consistent results with versions of the OSS-TR in other populations and had high internal consistency in MS patients.

The most important finding in the examination of scale reliability is that it produces consistent results when applied inter-rater or intra-rater test–retest [34]. Thornton et al. [14] calculated the intra-rater reliability ICC value of the OSS as 0.994 in the original OSS study. Aktas et al. [16] calculated the intra-rater reliability ICC value of OSS as 0.998 in patients discharged from intensive care units, while in another study, Yaşa et al. [17] calculated this value as 0.996 in patients with acute stroke. In summary, these results show that the intra-rater reliability of the OSS is excellent (ICC > 0.80). In this study, we obtained the ICC value for the test–retest reliability of the OSS-TR in MS patients as 0.953. These results are in parallel with the studies examining the reliability of the OSS in the literature and reveal that the OSS-TR has excellent reliability for use in Turkish-speaking MS patients.

This study has some limitations. The patients with MS enrolled for the current study were relatively younger individuals, with a lower EDSS score and mild disability. Functionality levels in MS patients vary with their EDSS scores, suggesting that separate investigations could be conducted for patients with differing scores. Additionally, the study's single-center design resulted in a limited number of participants. In the future, investigating OSS-TR in MS patients with larger patient populations and different EDSS scores in multicenter studies may produce useful results.

Conclusion

The OSS-TR is a reliable instrument with high convergent validity and internal consistency for evaluating sitting balance in Turkish-speaking MS patients. Assessment of sitting balance in MS patients using OSS-TR can assist clinicians in designing and evaluating the effectiveness of rehabilitation programs.

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Declarations

Competing Interest The authors declare no competing interests.

Ethical approval and consent to participate This cross-sectional research obtained approval from the local ethics committee (Number: 2024–12/94). In this study, which was conducted in compliance with the Declaration of Helsinki, written informed consent was also taken from the participants with MS.

Data Availability The datasets generated and/or analysed during the current study are not publicly available due to privacy or ethical restrictions. But are available from the corresponding author on reasonable request.

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