North Clin Istanb
doi: 10.14744/nci.2018.01069

Original Article PT&R
UNCORRECTED PROOF

The validity and reliability of the Turkish version of the trunk impairment scale in stroke patients

Sinem Sag,[1] Raikan Buyukavci,[2] Fusun Sahin,[3]
Mustafa Serdar Sag,[1] Beril Dogu,[4] Banu Kuran[4]

[1]Division of Rheumatology, Department of Physical Medicine and Rehabilitation, Sakarya University Faculty of Medicine, Sakarya, Turkey
[2]Department of Physical Medicine and Rehabilitation, Inonu University Faculty of Medicine, Malatya, Turkey
[3]Department of Physical Medicine and Rehabilitation, Pamukkale University Faculty of Medicine, Denizli, Turkey
[4]Department of Physical Medicine and Rehabilitation, Sisli Hamidiye Etfal Training and Research Hospital, Istanbul, Turkey

ABSTRACT

OBJECTIVE: To determine the validity and reliability of the Turkish version of the Trunk impairment scale (TIS), which is used in the evaluation of somatic motor and coordination disturbances in stroke patients, and provide a culturally adapted version for use in the Turkish population.

METHODS: A total of 80 patients hospitalized at our clinic and rehabilitated for stroke or admitted at our outpatient clinics were included in this study. Reliability was evaluated by the internal consistency (Cronbach α) and test reproducibility (intra-class correlation coefficient [ICCC]) methods, and validity was evaluated by the correlation between subgroups and the total scores of the TIS and Berg Balance Scale, Brunnstrom phases, Barthel index (BI), Rivermead mobility index (RMI) and Short Form -36 (SF-36) scores.

RESULTS: The mean age of the patients was 63,00±12,1 years, and of the patients, 34 were females, and 46 were males. The reliability of the scale was evaluated by the internal consistency, inter- and intra-observer reliability and test-reproducibility, and the findings have shown that the Turkish form of the scale was reliable at a good level. The Cronbach α values were >0,70, ICCC 0,969- 1,0 for all subgroups and total scores. The correlation between the TIS and BBS scales was considerably high in the validity analysis (p<0,001). Also, significant associations between the Barthel index, Rivermead mobility index, KF-36, Brunnstrom and TIS scale scores were found (p<0,001), which have shown the structural validity of this scale.

CONCLUSION: The TIS is a scale for measuring the motor derangement that develops after stroke. It has sufficient reliability, internal consistency and validity for use in clinical practice and stroke investigations. Our study has shown that TIS use for the evaluation of body balance is valid and reliable for the Turkish population.

Keywords: Reliability and validity; stroke; trunk impairment scale.

Cite this article as: *Sag S., Buyukavci R., Sahin F., Sag M. S., Dogu B., Kuran B. The validity and reliability of the Turkish version of the trunk impairment scale in stroke patients. North Clin Istanb*

Stroke, which is an important health issue, is the third most frequent cause of death, after heart disease and cancer, according to European and American statistics. Every year, millions of individuals are disabled globally due to this disorder. Stroke causes medical, economical and social problems every day.

Changes in posture and balance are frequently seen in hemiparesis caused by stroke. Derangements in balance in both sitting and standing are frequent after stroke. Many studies have shown that static sitting balance is an early predictor of functioning in stroke patients [1, 2]. Various questionnaires were used to measure trunk

Received: November 09, 2017 *Accepted:* March 07, 2018 *Online:* August 14, 2018

Correspondence: Dr. Sinem SAG. Sakarya Universitesi Tip Fakultesi, Fiziksel Tedavi ve Rehabilitasyon Anabilim Dali, Romatoloji Bilimdali, Sakarya, Turkey.
Tel: +90 506 536 03 55 e-mail: drsinemyamac@yahoo.com

performance and balance in stroke patients. These scales should be adapted to the language and culture of countries and different cultures where different languages are spoken [3].

The Trunk Impairment Scale (TIS) was developed by Geert Verheyden in 2003 for the evaluation of motor derangements that occur after stroke. It aims to measure the quality of trunk movements and provide guidance for treatment. It was also used in the evaluation of trunk balance in disorders such as Parkinson's disease, multiple sclerosis and cerebral palsy, in addition to stroke patients, and its validity and reliability was shown [4–6].

The validity and reliability of the Turkish version of the TIS , which is used in the evaluation of somatic motor and coordination disturbances in stroke patients and provides a culturally adapted version for use in the Turkish population, was aimed for in this study.

MATERIALS AND METHODS

This study was approved by the Ethics Committee of Şişli Etfal Hospital for Training and Research (Approval number: 71). Written informed consents were obtained from all patients included in the study.

Patient selection

A total of 80 patients, hospitalized for stroke rehabilitation in our clinic or admitted at our outpatient clinics, were included in this study. The exclusion criteria were as follows: the presence of major sensory or cognitive derangement (Mini mental state examination score < 16), the absence of the ability to understand instructions, the presence of serious vision problems, the presence of orthopaedic problems that may preclude exercises which the patient should do while lying down and a mother language other than Turkish.

Evaluation measures

The demographic data of included patients, such as the age, gender, educational status and occupation, and clinical data, such as the duration of illness, type of lesion, location of lesion, involved side and co-morbidities were recorded.

Cognitive Functions: Cognitive functions of the patients were evaluated with the Mini Mental State Examination (MMSE). The MMSE was first developed by Folstein in 1975 for the evaluation of cognitive functions [7]. It was revised, and the validity of its Turkish version was shown before [8]. Patients with a MMSE score < 16 were excluded from the study.

Activities of Daily Living: The daily living activity levels and physical independence of the patients were evaluated by the Barthel Index (BI). BI, which has proven its validity and reliability in various patient groups and populations, mainly evaluates mobility and self-care activities. It includes 10 sections, which are about nourishment, transfer, self-care, use of WC, bathing, movement, use of wheelchair (if relevant), climbing up/down the stairs, putting on clothes and bowel/bladder control. The total score is between 0–100. Its validity and reliability in our society was shown before [9].

Evaluation of General Quality of Life: Short form-36 (SF-36) was used in order to evaluate the quality of life. This was developed by Ware in 1987. SF-36 is a form that consisted of eight subscales with 36 items (physical functioning, physical role limitation, emotional role limitation, social functioning, pain, vitality, mental health and general health), aiming to determine health status in clinical investigations, monitor the outcomes of medical care and evaluate the quality of life [10]. SF-36 uses a score of 100 points, and the scores are between 0–10 for each subscale. Higher scores in this scale reflect a better health level, while lower scores show deterioration in health. The validity and reliability of the Turkish version was shown before [11].

Evaluation of Motor Functions: Neurophysiologic evaluation was done according to Brunnstrom improvement stages. The Brunnstrom Approach was used in order to assess motor improvement in the upper extremity, hand and lower extremity, and at the same time, to determine the current motor stage of the patient. The Brunnstrom approach is a scale of six stages, which includes movement patterns where improvement progressively increases for each region. Higher scores reflect better motor improvement [12].

Evaluation of Mobility: The Rivermead Mobility Index (RMI) was used in order to measure the mobility of patients. This is an index with one dimension, focused on measuring the mobility status, and includes activities of basic mobility [13]. It includes 14 questions from the Guttman Scale, one observation and a hierarchic series of activities from "turning in bed" to "running." Fifteen activities are used in evaluation, and each "yes" answer yields one point. Fifteen points indicates an absence of mobility problems, while 14 or less means that there is a mobility problem. As the RMI is a hierarchic structure (from simple to complex), a smaller score means a more severe problem [14].

Evaluation of Balance: The Berg Balance Scale (BBS) was used in the evaluation of the balance of patients. The test evaluates the ability of persons in maintaining their balance during functional activities. It consists of 14 items, and each item is scored between 0 (bad) and 4 (best) points, assessing dependence and/or independence levels at sitting, standing up, standing with feet together, standing at tandem position, balancing on one foot and the ability of an individual to change positions. The highest score at the BBS reflects better balance. Cases are classified into groups having a "high risk of falling (a score of 0–20 points), "medium risk of falling (21–40 points) or "low risk of falling (41–56 points)", according to the scores of this test [15, 16]. The Turkish version of the BBS was shown to be reliable, valid and sensitive to change in Turkey [17].

Evaluation of Motor Disturbances: The TIS was developed by Geert Verheyden in 2003 for the evaluation of motor disturbances that occur after stroke. It also measures the quality of trunk movement and aims to guide treatment. In addition to patients with stroke, it was used in patients with Parkinson's Disease, multiple sclerosis and young patients with cerebral palsy to evaluate trunk balance, and its validity and reliability was shown [3, 4, 6]. The translation of the TIS , which is used in the evaluation of trunk motor and coordination disturbances in stroke patients, determines the validity and reliability of the Turkish version and provides its cultural adaptation for use in the Turkish population, which were aims of this study.

TIS Translation and adaptation

The suggestions of Guillemin et al., Beaton et al. and the EORTC Quality of Life Group were used in the creation of the Turkish version of the scale, before translation and cultural adaptation [18–20].

In the first step, two individuals whose mother language was Turkish and who knew English at a good level independently translated the TIS from English to Turkish. The differences between the two Turkish translations were evaluated and corrected by a physical therapy specialist whose mother language was Turkish and who knew English at an advanced level, and a common Turkish form was created. In the second step, this Turkish form was translated to English again and re-translated to Turkish by two persons who knew English at an advanced level. The differences were corrected, and a satisfactory harmony with the original scale was obtained.

At the cultural adaptation level, the translations of two individuals with a good knowledge of English were evaluated by an experienced physiotherapist. The differences were corrected, and the resulting Turkish version was evaluated by eight physiotherapists. Unable to see another item that could be misunderstood, the last version of the Turkish translation was created.

Validity and reliability examination

In order to test the validity and reliability of the Turkish version of the TIS, the Turkish Scale was applied to 80 participants two times in a week. Reliability is the precision and reproducibility of a scale [21]. In order to determine the intra-observer reliability, 20 participants were selected among the 80 participants. In order to determine the inter-observer reliability, 20 participants randomly selected among the 80 participants were examined by two different observers at an interval of approximately 15–30 minutes. For intra-observer reliability, 20 participants randomly selected among the 80 participants were evaluated by the same observer two times, both in the morning and in the evening. Validity is the degree that a scale can measure its aim [21]. The validity of the TIS was evaluated by its structural validity. In order to evaluate structural validity, the correlations between sub-sections and the total scores of TIS and Brunnstrom stages, BI, BBS, RMI and SF-36 scores were evaluated.

Statistical evaluation

The data obtained in this study was transferred to SPSS 13.0 software, and statistical analysis was done with this program. Descriptive methods (mean, standard deviation) were used in the evaluation of demographic characteristics of the participants. The internal consistency of the scale was evaluated with the Cronbach alpha (α) coefficient, and the intra- and inter-observer reliability was evaluated with the Cronbach α coefficient and intra-class correlation coefficient (ICCC). The test-repeat test reliability of the scale was evaluated with the Cronbach α coefficient, intra-class correlation coefficient and Spearman correlation. The criteria validity of the scale was evaluated with the Pearson correlation according to the Berg Balance Scale. Its structural validity was evaluated with the Barthel index, Rivermead mobility index,

Table 1. Demographic characteristics of patients

	n	%
Gender		
Female	34	42.5
Male	46	57.5
Total	80	100.0
Age	63.00±12.10	
Time since stroke (months)	1.94±1.72	
Occupation		
House wife	34	42.5
Civil servant	7	8.8
Worker	2	2.5
Freelance	37	46.3
Total	80	100.0
Educational status		
Left primary school	19	23.8
Primary school	46	57.5
Junior high school	8	10.0
High school	6	7.5
University	1	1.3
Total	80	100.0
Lesion location		
MCA	26	32.5
PCA	8	10.0
ACA	3	3.8
LCA	11	13.8
Pons	7	8.8
Thalamus	13	16.3
Other	5	6.3
Lesion type		
Thromboembolic	73	89.8
Haemorrhagic	7	11.2
Total	80	100.0
Involved side		
Right	38	47.5
Left	42	52.5
Total	80	100.0
Co-morbidity		
None	12	15.0
Hypertension (HT)	48	60.0
Diabetes Mellitus (DM)	24	30.0
Cardiac disease	18	22.5
Other	13	16.3

ACA: Anterior cerebral artery; MCA: Middle cerebral artery PCA: Potsrior cerebral artery; LCA: Lentrıculostriat artery.

SF-36, Brunnstrom stages and Pearson correlation. The correlation coefficient (r) was considered very weak if between 0,00–0,25, weak if between 0,26–0,49, medium if between 0,50–0,69, high if between 0,70–0,89 and very high if between 0,90–1,00. The results were evaluated according to p<0,05 significance level at 95% confidence intervals.

RESULT

Eighty patients (34 female, 46 male) who were interned for hemiplegia rehabilitation were included in our study. The age, gender, occupation, educational status, additional diseases and other demographic characteristics of the patients are summarized in Table 1.

Of the patients included in the study, 73% had cerebrovascular thromboembolism and 7% had cerebrovascular bleeding. 26% of the patients had MCA, 13% had thalamus, 11% had LCA, 8% had PCA, and 3% had ACA infarction.

38 patients were right hemiplegia and 42 patients were left hemiplegia. 60% of the patients had hypertension as an additional disease, 30% had diabetes mellitus and 22% had ischemic heart disease.

The results of the patients' brunstrom staging, minimental, rivermead, barthel and berg balance tests are summarized in Table 2.

The Cronbach α values used to evaluate the internal consistency were over 0,70 for all parameters and total scores of TIS (Table 3). This value was 0,77 for the Static Sitting Balance, 0,90 for the Dynamic Sitting Balance, 0.85 for Coordination and 0,93 for the TIS total score. These values show that the TIS has a high internal consistency.

Table 2. Mean scores of patients' Mini Mental test, Brunnstrom staging, Rivermead, Barthel and Berg Balance tests

	Mean±SD
Mini mental test	20.19±3.772
Brunnstrom upper extremity	3.60±1.514
Brunnstrom hand	3.35±1.677
Rivermead index	6.5±3.82
Barthel index	60.81±24.88
Berg Balance Scale	33.93±19.73

SD: Standard deviation

TABLE 3. Trunk Instability Scale – Internal Consistency

	Internal consistency	Inter-observer reliability	Inter-observer reliability	Intra-observer reliability	Intra-observer reliability
	Cronbach alpha	Intra-class correlation coefficient (95% CI)	Cronbach alpha	Intra-class correlation coefficient (95% CI)	Cronbach alpha
Static sitting balance	0.775	1.000 (1.00–1.00)	1.000	0.985 (0.96–0.99)	0.992
Dynamic sitting balance	0.907	0.991 (0.97–0.99)	0.996	0.982 (0.95–0.99)	0.991
Coordination	0.854	0.969 (0.93–0.98)	0.984	0.975 (0.94–0.99)	0.988
Total score	0.931	0.992 (0.98–0.99)	0.996	0.990 (0.97–0.99)	0.995

CI: Confidence interval.

TABLE 4. Trunk Impairment Scale – Test-repeat Test Reliability

	Intra-class correlation coefficient (ICCC)	Spearman correlation*	Internal consistency (Cronbach alpha)
Static sitting balance total	**0.995 (0.99–1.00)**	**0.995**	**0.997**
Static sitting balance 1	1.000 (1.0–1.0)	1.000	1.000
Static sitting balance 2	0.980 (0.96–0.98)	0.981	0.990
Static sitting balance 3	0.991 (0.98–0.99)	0.991	0.996
Dynamic sitting balance total	**0.907 (0.86–0.94)**	**0.914**	**0.951**
Dynamic sitting balance 1	0.563 (0.39–0.70)	0.565	0.720
Dynamic sitting balance 2	0.636 (0.49–0.75)	0.636	0.777
Dynamic sitting balance 3	0.687 (0.55–0.78)	0.687	0.814
Dynamic sitting balance 4	1.000 (1.0–1.0)	1.000	1.000
Dynamic sitting balance 5	0.757 (0.64–0.83)	0.775	0.862
Dynamic sitting balance 6	0.849 (0.77–0.90)	0.849	0.918
Dynamic sitting balance 7	0.890 (0.83–0.92)	0.890	0.942
Dynamic sitting balance 8	1.000 (1.0–1.0)	1.000	1.000
Dynamic sitting balance 9	0.687 (0.55–0.79)	0.696	0.815
Dynamic sitting balance 10	0.904 (0.85–0.93)	0.904	0.949
Coordination total	**0.961 (0.94–0.97)**	**0.962**	**0.980**
Coordination 1	0.874 (0.81–0.92)	0.881	0.933
Coordination 2	0.951 (0.93–0.97)	0.951	0.975
Coordination 3	0.960 (0.94–0.97)	0.961	0.980
Coordination 4	0.924 (0.88–0.95)	0.925	0.960
TIS total score	**0.964 (0.94–0.98)**	**0.970**	**0.982**

ICCC: Intra-class correlation coefficient; TIS: Trunk impairment scale; *p<0.001.

The ICCC for subgroups used in the test-repeat test reliability was between 0,907–0,995, and the TIS total score was 0,964 (Table 4). The intra-observer reliability, which we have calculated as ICCC, was 0,98 for Static Sitting Balance, 0,98 for Dynamic Sitting Balance, 0,97 for Coordination and 0,99 for total TIS score. The in-

Table 5. Correlation between TIS scale and BBS, RMI and BI scales

TIS	BBS	RMI	BI
Static sitting balance			
r value	0.560	0.507	0.420
p value	<0.0001	<0.0001	<0.00011
Dynamic sitting balance			
r value	0.901	0.784	0.812
p value	<0.0001	<0.0001	<0.0001
Coordination			
r value	0.806	0.713	0.730
p value	<0.0001	<0.0001	<0.0001
Total score			
r value	0.887	0.783	0.780
p value	<0.0001	<0.0001	<0.0001

r: Pearson correlation coefficient; TIS: Trunk impairment scale; BBS: Berg balance scale RMI: Rivermead mobility index BI: Barthel index.

ter-observer reliability coefficient was 1,0 for the Static Sitting Balance, 0,99 for the Dynamic Sitting Balance, 0,98 for Coordination and 0,99 for the total TIS score. These results show that inter-observer consistency is at a significant level.

A strong, positive association was found between the TIS and the BBS, BI and RMI sub scores and total score (p<0,001) (Table 5). the relationship between the BBS and Static Sitting Balance was positive and significant at a medium level of significance (r=0,56), while with the Dynamic Sitting Balance (r=0,90), Coordination (r=0,80) and the total TIS score (r=0,88), it was positive. When we looked at the TIS and RMI correlation, we found a positive association of medium significance between the Static Sitting Balance and RMI (r= 0,50) and a very significant association between the Dynamic Sitting Balance (r=0,78), Coordination (r=0,71) and the TIS total score (r=0,78) with RMI (p<0,001).

While an association was not found between the physical and emotional role limitations in SF-36 sub-sections and TIS sub and total scores (p>0,05), a significant association was shown between other SF-36 subsections and TIS total scores (p<0,05) (Table 6). A parallel increase in the TIS total score was detected, increasing the Brunnstrom upper extremity, hand and lower extremity stage values (p<0,01).

DISCUSSION

This study has shown that the Turkish version of the TIS , which is used in the assessment of trunk balance in stroke patients, is valid and reliable in the Turkish population.

Stroke is a medico-social problem which threatens life and is most frequently encountered among neurologic disorders as the third cause of death after heart disease and cancer, according to data from developed countries, and the first cause of morbidity, whose importance progressively increases with age. As the disorder that most frequently causes disability, its rehabilitation is very important [22].

Stroke patients generally present with difficulty in maintaining balance, postural disturbance, inability to hold the head and trunk at the same plane and disruption of weight distribution. Many physical functions require sufficient balance. Trunk control is necessary for maintaining body position, remaining stable after position changes, the ability to accomplish daily activities and mobility [23]. Sitting balance was shown to be a marker of motor and functional improvement after stroke [24, 25]. Trunk control was found to be decreased in stroke patients in comparison to age and gender-matched healthy control groups, and 45–70% of trunk control was shown to be lost in the acute stages of stroke [26].

The ability to control trunk balance in sitting and daily living activities is important for a successful rehabilitation [27]. Scales that aim to determine trunk balance do not reflect improvement by themselves. We have to evaluate functions of trunk muscles not only in terms of disability but also in terms of impairment in order to better understand improvement in trunk balance after stroke and develop more active treatment programs in patients with poor trunk balance.

The TIS , which was developed by Verheyden et al., is a scale that evaluates the functions of trunk muscles at impairment level. In a study aiming to determine the discriminatory ability of the TIS, healthy individuals were compared with stroke patients. A prominent difference was found between the two groups in terms of the TIS total and subscales. Higher scores were found in healthy individuals in comparison with patients. In conclusion, it was found to be a scale with an ability to discriminate between stroke patients and the healthy group [28]. Thirty-two articles were included in an interview investigating clinical scales measuring trunk

TABLE 6. Correlation between TIS scale and SF-36 scale

SF-36	TIS			
	Static sitting balance	Dynamic sitting balance	Coordination	Total score
Physical functioning				
r value	0.250	0.565	0.558	0.595
p value	0.026*	0.0001**	0.0001**	0.0001**
Physical role limitation				
r value	0.116	-0.134	0.035	-0.027
p value	0.305	0.235	0.759	0.813
Pain				
r value	0.277	0.325	0.278	0.331
p value	0.013*	0.003**	0.012*	0.003**
General Health				
r value	0.106	0.365	0.387	0.376
p value	0.349	0.001**	0.0001**	0.001**
Vitality				
r value	0.116	0.210	0.243	0.221
p value	0.305	0.062	0.0001**	0.049*
Social functioning				
r value	0.287	0.307	0.341	0.352
p value	0.010*	0.006**	0.002**	0.001**
Emotional role				
r value	0.116	-0.134	0.035	-0.027
p value	0.305	0.235	0.759	0.813
Mental health				
r value	0.115	0.272	0.228	0.252
p value	0.308	0.015*	0.042*	0.024*
Total score				
r value	0.081	0.611	0.588	0.603
p value	0.001**	0.001**	0.001**	0.001**

TIS: Trunk impairment scale; r: Spearman's Correlation coefficient *p<0.05; **p<0.001.

performance after stroke. In this comparative study evaluating the psychometric features of scales, the TIS was found to be a very good scale for measurement in the evaluation of trunk performance after stroke [3]. There are studies in which the TIS was used as an outcome criteria. In a randomized controlled study investigating the effect of exercises on trunk performance after stroke, trunk exercises were used in addition to conventional treatment in stroke patients. In this study, where the TIS was used as an evaluation measure, a significant improvement was observed in the Dynamic Sitting Balance sub-scale of the TIS, which measures selective trunk lateral flexion [29].

Validity and reliability analyses are done in order to examine the accuracy and appropriateness of data obtained by scales used in the field of rehabilitation. There are also analysis methods to show reliability such as internal consistency, test-repeat test reliability and inter-observer reliability. The items the make up the scale measure the same structures in relation with each other, each item representing the conceptual structure to be measured to show the internal consistency of the scale. The internal consistency of a scale shows the degree that the items reflect the concept that is aimed to be measured and the relationship between the items that make up the scale. This is determined as a Cronbach-α value. In this instance, the α value is between 0 and 1, and its closeness to 1 reflects a stronger internal consistency. A high internal consistency supports the reliability of a scale. We investigated the internal consistency of the subscales of the TIS by calculating the Cronbach α values of Static, Dynamic Sitting Balance and Coordination sub scales of the TIS. This value was 0,77 for the Static Sitting Balance, 0,90 for the Dynamic Sitting Balance, 0.85 for Coordination and 0,93 for the TIS total score. These values show that the TIS has a high internal consistency. In the original study for the TIS, the internal consistency Cronbach α values were 0,79 for the Static Sitting Balance, 0,86 for the Dynamic Sitting Balance, 0,65 for Coordination and 0,89 for the total TIS [30]. Our results were consistent with the original study.

As the patients may be followed up by the same or different physicians at different times during the follow-up period of the disease, the inter-observer and intra-observer reliability of the scales should also be determined. In the study by Verheyden in 2003, where the TIS was first developed, the test was administered by two different observers to 28 stroke patients, and inter-observer reliability was assessed. The inter-observer reliability coefficient was 0,99 for the Static Sitting Balance, 0,98 for the Dynamic Sitting Balance, 0,85 for Coordination and 0,99 for total TIS score [30]. In our study, the inter-observer reliability coefficient was 1,0 for the Static Sitting Balance, 0,99 for the Dynamic Sitting Balance, 0,98 for Coordination and 0,99 for the total TIS score; these are consistent with the original study.

In the study examining the validity and reliability of the TIS in patients with multiple sclerosis, the inter-observer reliability coefficient was 0,95 (total TIS) [5]. In the study investigating the validity and reliability of the TIS in patients with Parkinson's disease, the inter-observer reliability coefficient was 0,97 (total TIS) [4]. In the study where the validity and reliability of the TIS was examined in patients with traumatic brain damage, the inter-observer reliability coefficient was 0,95 (total TIS) [31].

The intra-observer reliability is one of the methods that test the reliability of the scale. In validity and reliability studies with the TIS, there were no studies where the intra-observer reliability was examined, including the original study. The intra-observer reliability results of our study are satisfactory. The intra-observer reliability, which we have calculated as ICCC, was 0,98 for Static Sitting Balance, 0,98 for Dynamic Sitting Balance, 0,97 for Coordination and 0,99 for total TIS score.

In our study, SİKK was 0,99 for Static Sitting Balance for the test-repeat test reliability of the TIS, 0,90 for the Dynamic Sitting Balance, 0,96 for Coordination and 0,96 for the total TIS score. In the original study, these values were 0,91 for the Static Sitting Balance, 0,94 for the Dynamic Sitting Balance, 0,87 for Coordination and 0,96 for the total TIS score [30]. Our results are consistent with the original study.

In the validity and reliability studies of the TIS in patients with multiple sclerosis for test-repeat test reliability ICCC for TIS, the total score was calculated as 0,95 [5]. In the validity and reliability studies of the TIS in patients with Parkinson's disease for test-repeat test reliability ICCC for TIS, the total score was 0,95 [4]. In the study of the validity and reliability of the TIS in patients with traumatic brain damage for test-repeat test reliability ICCC for TIS, the total score was 0,88 [31].

The correlation between the TIS and the BBS was investigated with the Pearson correlation. The Static Sitting Balance is a sub-scale of the TIS which only measures the independent sitting ability of the patient and does not evaluate other movements such as lateral flexion and rotation of the trunk, which includes three items. For this reason, in the acute phase, even patients with a very limited ability of movement may obtain high scores. Even if they obtain high scores from the Static Sitting Balance sub-scale, they may not obtain adequate scores from the Dynamic Sitting Balance, Coordination scales and BDO. This may explain the relationship of the medium significance level between the static sitting balance and BDO, in spite of the highly significant relationship between the Dynamic Sitting Balance and Coordination with the BBS.

In order to show the structural validity of the TIS, we also examined correlations between the RMI, SF-36, BG, Brunnstrom staging and TIS in our study. Trunk balance is one of the main factors for mobility. For this reason, when we looked at the TIS and RMI correlation, we found a positive association of medium significance between the Static Sitting Balance and RMI ($r=0,50$) and a very significant association between the Dynamic Sitting Balance ($r=0,78$), Coordination ($r=0,71$) and the TIS total score ($r=0,78$) with RMI ($p<0,001$). We can explain these results with our evaluations of BBS-TIS correlations.

As we feel that the trunk balance of patients may be associated with mobilization, ambulation and, hence, quality of life, we evaluated the correlation between the TIS and SF-36 in our study. Statistically significant positive correlations were found between the TIS total score and six of the eight sub-groups of SF-36 (excluding role difficulty and emotional role strength). The positive correlation between physical functioning and the TIS total score was stronger than other sub-groups (r=0,595, p=0,0001). Statistically significant positive correlations were found between the Dynamic Sitting Balance and coordination among TIS sub parameters with the other sub-groups (excluding role difficulty and emotional role strength). In addition to these, a statistically significant correlation was not found between the Dynamic Sitting Balance and the vitality sub-group of SF-36 (r=0,210, p=0,062). When we looked at the Static Sitting balance, we found statistically significant positive correlations with only physical functioning, pain and social functioning sub-groups (r=0,250, r=0,277, r=0,287, respectively), without significant positive correlations with other sub-groups.

We evaluated the correlation between the Barthel index and the TIS for the validity of the TIS in our study. We found a very significant correlation between the Barthel Index and the TIS (r=0,78). In Verheyden's study, a very significant correlation was found between the Barthel index and the TIS (r=0,86) [30]. Our result is sufficient. In a multicentre study, the TIS, in the sixth month after stroke, and the Static Sitting Balance subscale were found to be important predictors of the Barthel index [32].

The Brunnstrom is a scale evaluating the developmental stages of movements of functional aim after patients experience a stroke. As it is a scale coordinating the muscle strength of the extremities and trunk, there may be an association between the TIS and Brunnstrom scales. For this reason, we evaluated the correlation between the TIS and Brunnstrom scales in our study. We found associations of medium significance between the TIS and three Brunnstrom parameters (p<0,01).

In conclusion, the TIS is a new scale measuring the motor derangements of the trunk after a stroke. It has sufficient reliability, internal consistency and validity for use in clinical practice and stroke investigations. Our study has shown that the Trunk Impairment Scale, used in the assessment of trunk balance in stroke patients, is valid and reliable in the Turkish population.

Conflict of Interest: The authors declare no conflict of interest.

Financial Disclosure: The authors declared that this study has received no financial support.

REFERENCES

1. Wade DT, Skilbeck CE, Langton Hewer R. PredictingBarthel ADL score at 6 months after an acute stroke. Arch Phys Med Rehabil 1983;64:24-8.
2. Loewen SC, Anderson BA. Predictors of stroke outcome using objective measurement scales. Stroke 1990;21:78-81.
3. Verheyden, G., Nieuwboer, A., Winckel, A., Weerdt, W. Clinical Tools to Measure Trunk Performance After Stroke: A Systematic Review of the Literature. Clin Rehabil 2007; 21: 387-394.
4. Verheyden G, Willems A-M, Ooms L, NieuwboerA. Validity of the Trunk Impairment Scale as a measure of trunk performance in people with Parkinson's disease. Arch Phys Med Rehabil 2007;88:1304-8.
5. Verheyden G, Nuyens G, Nieuwboer A, et al. Reliability and validity of trunk assessment for people with multiple sclerosis. Phys Ther 2006;86:66 –76.
6. Pham HP, Eidem A, Hansen G, Nyquist A, Vik T, Sæther R. Validity and Responsiveness of the Trunk Impairment Scale and Trunk Control Measurement Scale in Young Individuals with Cerebral Palsy. Phys Occup Ther Pediatr 2016;18:1-13.
7. Folstein MF, Folstein SE, McHugh PR. Mini-Mental State: a practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12:189-98.
8. Güngen C, Ertan T, Eker E, Yaşar R, Engin F. Standardize Mini Mental Test'in Türk Toplumunda Hafif Demans Tanısında Geçerlik ve Güvenilirliği. Türk Psikiyatri Derg 2002;13:273-281.
9. Küçükdeveci AA, Yavuzer G, Tennant A, Süldür N, Sonel B, Arasıl T. Adaptation of modified Barthel Index for use in physical medicine and rehabilitation in Turkey. Scand J Rehabil Med 2000; 29:87–92.
10. Ware JE. SF-36 Health Survey Update. In: Maruish ME, ed. The Use of Psychological Testing for Treatment Planning and Outcomes Assessment. 3rd ed. USA: Lawrence Erlbaum Associates 2004; 693-718.
11. Demirsoy C. The MOS-SF 36 health survey: A validation studt with a Turkish sample. Master Tezi. Boğaziçi Üniversitesi, İstanbul, 1999.
12. Ohene Frempong K, Weiner SJ, Sleeper LA et al. Cerebrovascular accidents in sicle cell disease; rates and riskfactors. Blood 1998; 91:288-294.
13. Wade DT. Personal physical disability. In: Wade DT (Ed), Measurement in Neurological Rehabilitation, Oxford University Pres. Oxford 1992;71-82.
14. Collen FM, Wade DT, Robb GF, Bradshaw CM. The Rivermead Mobility Index: A further development of Rivermead Motor Assessment. Int Disabil Studies 1991;13: 50-54.
15. Berg KO, Wood-Dauphinee SL, Williams JI, Maki B. Measuring balance in the elderly: validation of an instrument. Can J Public Health, 1992;83:7-11.
16. Berg K, Wood-Dauphinee S, Williams JI. The balance scale:reliability assessment with elderly residents and patients with an acute stroke. Scand J Rehabil Med 1995;27:27-36.
17. Şahin F, Büyükavcı R, Sağ S, Doğu B, Kuran B. Reliability and Validity of the Turkish Version of the Berg Balance Scale in Patients With Stroke. Turk Phys Med and Rehab 2013;59:170-5
18. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine 2000;25:3186-91.
19. Guillemin F. Cross-cultural adaptation and validation of health status measures. Scand Rheumatol 1995:24:64-8.
20. Petersen MA1, Groenvold M, Bjorner JB, Aaronson N, Conroy T, Cull A. European Organisation for Research and Treatment of Cancer

Quality of Life Group Use of differential item functioning analysis to assess the equivalence of translations of a questionnaire. Qual Life Res. 2003;12:373-85.

21. Küçükdeveci AA. Osteoartritte işlevsel değerlendirme ölçütleri. Turk J Geriatrics 2011;14:37-44.
22. Aboderin I. Venables G. Stroke management in Europen Consensus meeting on stroke management. J Intern med 1996;240:173-80.
23. Bohannon RW: Lateral trunk flexion strength: Impairment, measurement, reliability, and implications following unilateral brain lesion. Int J Rehabil Res 1992;15:249–51
24. Brinkman J, Kuypers HGJM: Splitbrain monkeys: Cerebral control of ipsilateral arm, hand, and finger movements. Science 1972;176:536–9
25. Taoka M, Takashi T, Iwamura Y: Representation of the midline trunk, bilateral arms, and shoulders in the monkey postcentral somatosensory cortex. Exp Brain Res 1998;123:315–22
26. Cote R, Hachinski VC, Schurvell BL, et al: The Canadian neurological scale: A preliminary study in acute stroke. Stroke 1986;17:731–7
27. Kottke FJ: Neurophysiologic therapy for stroke, in Licht S (ed): Stroke and Its Rehabilitation. Baltimore, Waverly Press, 1975:256–324
28. Verheyden G, Nieuwboer A, Feys H, Thijs V, Vaes K, De Weerdt W. Discriminant ability of the Trunk Impairment Scale: A comparison between stroke patients and healthy individuals. Disable Rehabil 2005 2;27:1023-8.
29. Verheyden G, Vereeck L, Truijen S, Troch M, Lafosse C, Saeys W, Leenaerts E, Palinckx A, De Weerdt W. Additional exercises improve trunk performance after stroke: a pilot randomized controlled trial. Neurorehabil Neural Repair 2009;23:281-6.
30. Verheyden G, Nieuwboer A, Mertin J, Preger R, Kiekens C, De Weerdt W. The Trunk Impairment Scale: a new tool to measure motor impairment of the trunk after stroke. Clin Rehabil 2004;18:326-34.
31. Verheyden G, Hughes J, Jelsma J, Nieuwboer A, De Weerdt W.Assessing motor impairment of the trunk in patients with traumaticbrain injury: reliability and validity of the Trunk Impairment Scale. S Afr J Physiother 2006;62:23-8.
32. Verheyden G, Nieuwboer A, De Wit L, Feys H, Schuback B, Baert I, Jenni W, Schupp W, Thijs V, De Weerdt W. Trunk performance after stroke: an eye catching predictor of functional outcome. J Neurol Neurosurg Psychiatry 2007;78:694-8.