Turkish Journal of Geriatrics
2025; 28(3):298–311

DOI: 10.29400/tjgeri.2025.446

Şedef ERSOY[1]
Büşra Şirin AHISHA[2]
Nurdan PAKER[1]
Feride SABIRLI[1]
Nur KESİKTAŞ[1]
Derya BUĞDAYCI[1]
Hüseyin Berkay KARAHACİOĞLU[3]

[1] University of Health Sciences, Istanbul Physical Medicine and Rehabilitation Education and Research Hospital, Istanbul, PMR, Istanbul, Türkiye

[2] Beylikduzu State Hospital, PMR, Istanbul, Türkiye

[3] University College London Hospitals Nhs Foundation Trust, NHS, London, İngiltere

Correspondence

Sedef ERSOY
Phone : +905339532025
e-mail : sedef_ersoy@yahoo.com

Received : May 13, 2025
Accepted : Jul 06, 2025

Cite this article as:
Ersoy S, Ahısha BŞ, Paker N. et al. Turkish Adaptation of the Rehabilitation Complexity Scale-Extended: Validity and Reliability Study in Stroke Patients. Turkish Journal of Geriatrics 2025; 28(3):298–311. doi: 10.29400/tjgeri.2025.446

ORIGINAL ARTICLE

TURKISH ADAPTATION OF THE REHABILITATION COMPLEXITY SCALE-EXTENDED: VALIDITY AND RELIABILITY STUDY IN STROKE PATIENTS

Abstract

This study aimed to adapt the Rehabilitation Complexity Scale-Extended (RCS-E) for use in Turkish and assess its validity and reliability in patients with hemiplegia due to vascular stroke. We reviewed the medical records of 102 patients hospitalized for rehabilitation following ischemic or hemorrhagic stroke. The complexity of rehabilitation needs was assessed using the RCS-E. Validity was determined by analyzing correlations between RCS-E scores and the mBarthel Index, mRankin Scale, and Functional Independence Measure (FIM) scores. Intrarater and interrater reliability were evaluated using the intraclass correlation coefficient (ICC) and Cronbach's alpha. Two experienced rehabilitation specialists performed assessments one week apart. The ICC values for the RCS-E subscales ranged from 0.960 to 0.985, with a total score ICC of 0.987, indicating excellent intra-rater reliability. The inter-rater reliability ICCfor the total score was 0.858, reflecting high reliability. The Cronbach's alpha value for the total score was 0.870, signifying high internal consistency. Significant positive correlations were found between the RCS-E scores and mBarthel Index (r = -0.611), motor FIM (r = 0.659), cognitive FIM (r =-0.481), and total FIM (r =-0.661) scores, while a negative correlation was observed with the mRankin Scale (r = 0.647; p < 0.001 for all).The Turkish version of the RCS-E is a valid and reliable tool for assessing rehabilitation needs in stroke patients with hemiplegia. It effectively guides rehabilitation planning and improves service quality.

Keywords: Rehabilitation; Stroke; Hemiplegia;Validation Study.

INTRODUCTION

Stroke is a significant disease that causes disability worldwide. In 2019, the prevalence of stroke in Turkey was reported as 1.3%. Of those who experienced a stroke, 58.5% were under the age of 70, and 54.3% were women. The rate of ischemic stroke was 65.1%, while 24% were intracerebral hemorrhages, and 10.9% were subarachnoid hemorrhages. In the same year, stroke-related deaths ranked second after cardiovascular system diseases (1).

Stroke patients experience motor and sensory losses, as well as cognitive and emotional changes, as a result of cerebral damage. Therefore, stroke rehabilitation is a highly complex process. The severity of the disease varies depending on the location and size of the lesion in the brain (2). Some individuals may experience severe impairments. In addition, the clinical presentation can be influenced by whether the right or left side of the brain is affected. Left hemisphere lesions can lead to aphasia (3),while right hemisphere lesions may result in issues such as neglect and cognitive impairments (4). There are modifiable risk factors associated with stroke, such as diabetes mellitus, hypertension, ischemic heart disease, and smoking, as well as non-modifiable factors such as age, gender, race, and the side of the lesion. A previous study reported that having more than two comorbidities in stroke patients negatively affects rehabilitation outcomes (5).

The severity of hemiplegia due to stroke may vary among patients. Some individuals may experience severe motor loss on one side of the body, along with complications such as aphasia, dysphagia, neglect, spasticity, pain, urinary and fecal incontinence, cognitive impairments, heterotopic ossification, and pressure ulcers, leading to a more severe clinical presentation (4). These individuals require increased care and rehabilitation. A study conducted in Japan involved 50 patients with vascular stroke (26 women [52%], 24 men [48%]; median age, 70.5 years; IQR, 60.8–78.0 years) with Brunnstrom motor stages I/II. The study suggested that good prognostic indicators included hemorrhagic stroke, age under 70 years, absence of cortical lesions, and early and intensive inpatient rehabilitation (6).

The rehabilitation program for a hemiplegic patient varies depending on the severity of the disease and accompanying problems. It is crucial to identifythe initial functional level and rehabilitation needs during the treatment to observe progress in later stages and manage the treatment effectively (7).In hemiplegic patient groups, scales such as the modified Barthel Index (mBI) (8),the modified Rankin Scale (mRS) (9),and the Functional Independence Measure (FIM)(10) are frequently used to assess disability levels and functional status. Another important factor in this process is the complexity of rehabilitation needs. The assessment of complexity is generally based on physical factors and functional status, often overlooking the patient's therapy needs, nursing care requirements, cognitive and psychological aspects. To address these factors, the Rehabilitation Complexity Scale (RCS) was developed in 2007, and its extended version (RCS-E) was created in 2012(11, 12).

The RCS is valuable for documenting the services provided to patients undergoing inpatient neurological rehabilitation in specialized and complex units. It also aids in documenting rehabilitation interventions. Assessing the complexity of healthcare services required during a patient's inpatient stay at the rehabilitation hospital and after discharge when home healthcare services are required is essential for maintaining rehabilitation continuity. This method helps reduce the financial burden on healthcare services and ensures that qualified healthcare personnel are allocated effectively to where they are most needed. Consequently, it supports the efficient use of resources, allowing patients to receive timely and appropriate levels of healthcare. Moreover, by planning and monitoring rehabilitation processes in a more systematic manner, patients' functional recovery is optimized, and overall efficiency in healthcare services is improved. It has been observed that RCS scores are ≥9 in half of the patients receiving inpatient treatment in complex specialized services (12).The extended version of the RCS (RCS-E) was published in 2012 (11).

The RCS-Eis a valuable tool that offers an easy and practical assessment to assist in determining a patient's rehabilitation needs. Identifying the necessary rehabilitative interventions also guides the development of a suitable treatment program for the patient. To the best of our knowledge, no similar study has been conducted in Turkey. The aim of this study is to adapt the RCS-E for use in Turkish (RCS-ET) and to assess the validity of the RCS-ET in patients with hemiplegia caused by a vascular stroke.

MATERIALS AND METHOD

The study was conducted at the Health Science University,Istanbul Physical Therapy and Rehabilitation Training and Research Hospital between 10/08/2024 and 31/12/2024.Ethical approval was obtained from the Ethics Committee of Istanbul Physical Therapy and Rehabilitation Training and Research Hospital(protocol no.:2024-51).

The medical records of 102 patients hospitalized in the palliative care unit and stroke unit of our tertiary rehabilitation hospital for rehabilitation due to ischemic or hemorrhagic vascular stroke-related hemiplegia were reviewed. Both female and male patients with hemiplegia due to vascular lesionswere included in the study. Exclusion criteria were hemiplegia due to tumors or traumatic lesions.

Demographic data of the patients were obtained from patient records. Brunnstrom motor staging was used to determine the patients' motor status, while the mBI was used for activities of daily living. In addition, the mRS and FIM were utilized for functional status assessment. The RCS-E v13 was used to assess the complexity of patients' rehabilitation needs. Test applications were performed by two independent specialists experienced in rehabilitation, with each practitioner conducting two evaluations at one-week intervals. During the inter-rater reliability assessment, the two evaluators performed their ratings independently and in a blinded manner, without access to each other's scores, in order to minimize observer bias.

Rehabilitation Complexity Scale

The first version of the RCSconsists of four subscales and is a 15-point scale (12). These subscales include basic care and support needs (range 0–3), nursing interventions (range 0–3), intensity of total therapy intervention (range 0–6), and medical intervention (range 0–3). In a study involving 179 individuals with complex neurological diseases, the test–retest reliability of the RCS revealed a kappa value ranging from 0.93 to 0.96, indicating the test's repeatability. In addition, the coefficient alpha was found to be 0.76 in the same study, with reported inter-item correlations of >0.50. A strong relationship was demonstrated between the RCS basic care and nursing subparameter scores (Spearman rho -0.65 to -0.79) and motor FIM and mBIscores. However, a weaker relationship was found between the RCS therapy (rho -0.26) and medical (rho -0.28 to -0.33) sections and the motor FIM and Barthel scores (13). The RCSv2 was expanded in 2012 to create the RCS-E for patients requiring complex rehabilitation.[11] It consists of five domains: basic care or risk (0–4 points), special nursing needs (0–4 points), medical needs (0–4 points), therapy needs (number of required disciplines and intensity; 0–8 points), and equipment/facilities (0–2 points). The total score is 22, with higher scores indicating a greater need for intervention.

With the RCS-Ev13, it is possible to assess an individual's basic care and support needs, cognitive/behavioral needs, skilled nursing needs, medical needs, therapy disciplines, therapy intensity, and equipment needs. In a prospective study conducted on 331 patients hospitalized in a tertiary neurorehabilitation unit, the RCS-E was reported to demonstrate complex treatment needs more effectively than the RCSv2. However, the same study suggested that the RCS-E did not demonstrate superiority over the RCSv2 in identifying complex care and nursing needs. As a result, it was concluded that the RCS-E is comparable to the RCSv2 in representing rehabilitation complexity, but may be more beneficial in determining complex treatment and equipment needs. The RCS-E features a two-factor structure, encompassing nursing/medical care and equipment/therapy (11).

Preparation of RCS-ET

The RCS-Ev13 was translated into Turkish by an individual with strong English proficiency, whose native language is Turkish, and who has experience in the field of rehabilitation. Permission was obtained from the developer of the scale before the translation process began. Following this, a doctor, whose native language is English, conducted a back-translation. Cultural and linguistic variances were carefully considered throughout the translation process. After being reviewed by four senior rehabilitation specialists, the final version of the RCS-ET was created.

Translation and Cross-Cultural Adaptation

During the Turkish translation and cross-cultural adaptation of the RCS-E, certain modifications were made to account for variations in culture, language, and rehabilitation practices.

Adjustments were necessary in the "skilled nursing needs" section. The term "rehab-trained nurse"was changed to "experienced rehabilitation nurse" since there is no specific nurse with that title in Turkey. Similarly, "specialist neurology nurse" was changed to "experienced neurology nurse."In the mental health category, instead of a nurse specifically assigned to this area, the term was altered to "psychologist," as psychologists are typically involved in rehabilitation units in Turkey. In addition, a "wound care nurse"was included in the relevant section, recognizing their important role in patient care in Turkish rehabilitation units. Since no Turkish translation of the Northwick Park Therapy Dependency Assessment (NPTDA) has been undertaken, this reference was omitted from the therapy section. In the therapy disciplines section, the term "rehabilitation engineer" was removed because there is no equivalent profession in Turkey.

Statistical Method

Descriptive statistics were used to analyze the data, including mean, standard deviation, median, minimum, maximum, frequency, and percentage values. The distribution of variables was assessed using the Kolmogorov–Smirnov test. The Wilcoxon test was used to analyze non-normally distributed dependent quantitative data. To evaluate the convergent validity of the RCS-ET scale, Spearman correlation coefficients were calculated between the RCS-ET total and subparameter scores and the scores of established functional outcome measures, including the FIM, mBI, and mRS.

Inter-observer correlation and test–retest reliability were analyzed. Intraclass correlation coefficient (ICC) and Cronbach's alpha values with 95% confidence intervals were reported. Due to differences in the scoring ranges of the items, z-score transformation was applied prior to the Cronbach's alpha calculation.Cronbach's alpha values between 0.6 and 0.7 were considered acceptable, while values ≥0.7 were regarded as satisfactory (14). ICCvalues were interpreted based on widely accepted criteria: values below 0.40 indicated poor reliability, values between 0.40 and 0.74 reflected moderate reliability, values between 0.75 and 0.90 demonstrated high reliability, and values above 0.90 indicated excellent reliability (15).To evaluate the construct validity of the Turkish version of the RCS-E, both exploratory and confirmatory factor analyses (CFA) were performed. Prior to factor analysis, the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were conducted to assess the suitability of the data. Exploratory factor analysis (EFA) was conducted using principal component extraction and Varimax rotation. CFA was conducted to test the model fit of the factor structure derived from the EFA. Model fit was evaluated using the chi-square test (χ^2), degrees of freedom (df), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA). A p-value <0.05 was considered statistically significant. All analyses were performed using the SPSS 28.0 and Jamovi 2.6.44 program.

RESULTS

The demographic and clinical characteristics of the patients are presented in Table 1. Nearly half of the patients were female, with a mean age of 68.31±7.38. While 77.5% of the patients had an ischemic etiology, 30.4% had a hemorrhagic etiology. The etiology was unknown in one patient. Polypharmacy was present in 87 patients (85.3%). Aphasia was observed in 27.5%, pressure ulcers in 10.8%, dementia in 3.9%, and dysphagia in 16.7% (Table 1).

The RCS-ET subscale scores are presented in Table 2. In terms of nursing disciplines, 62.7% of patients required general registered nursing, 77.5% required rehabilitation nursing, 8.8% required psychological support (provided by psychologists in the local setting), 17.6% required palliative care nursing, 25.5% needed assistance from a specialist neurology nurse, and 3.9% had other specialized nursing needs. Regarding medical needs, nearly half of the patients (49.0%) required care from a specialist physician and/or psychiatric treatment. Additionally, 10.8% of patients required no active medical intervention, while 37.3% needed basic investigation, monitoring, or treatment. More than 90% of the patients required blood tests, 81.4% required medication adjustment or monitoring, and 53.9% were referred to a specialist physician. Other medical procedures were needed in 20.6% of cases, and 20.6% of patients had medico-legal or capacity-related issues.

In terms of therapy needs, more than half of the patients (51.0%) required two to three different therapy disciplines, 25.5% required four to five, and 7.8% required six or more. The most commonly needed discipline was physiotherapy (95.1%), followed by orthotics/prosthetics (54.9%), psychology (44.1%), social work (33.3%), and dietetics (20.6%). Speech and swallowing therapy was required in 19.6% of patients, counseling in 7.8%, and alternative therapies such as music or art therapy in 1.0%. In terms of therapy intensity, 48.0% of patients received low-intensity therapy, 37.3% moderate intensity, and 8.8% high intensity. Very high-intensity therapy was required by only one patient (1.0%). Regarding equipment needs, 89.2% of patients required basic special equipment, while 1.0% needed highly specialist equipment. The most frequently used devices were off-the-shelf orthotics (53.9%), wheelchairs or specialized seating systems (24.5%), special mattresses (22.5%), pressure cushions (13.7%), and standing frames (12.7%). Other equipment needs were present in 35.3% of the patients (Table 2).

The results regarding the intra-rater reliability of the RCS subscales, performed one week apart, are presented in Table 3. The *r* values ranged between 0.960 and 0.985 (p=0.001). The ICC value representing the test–retest reliability for the total scores was found to be 0.987, evaluated as excellent. Internal consistency of the Turkish version of the RCS-E was assessed using Cronbach's alpha. Since the items had different scoring ranges, all items were transformed into standardized z-scores prior to analysis. The standardized Cronbach's alpha was 0.870, indicating satisfactory internal consistency according to the ≥0.70 threshold. When individual items were removed, alpha values ranged from 0.825

Table 1. Descriptive statistics

Age	68.31±7.38		
Gender	Female	43	42.2%
	Male	59	57.8%
Marital status	Married	68	66.7%
	Single	31	30.4%
	Unknown	3	2.9%
Paralytic side	Right	53	52.0%
	Left	44	43.1%
	Bilateral	4	3.9%
	Unknown	1	1.0%
Number of CVA	I	85	83.3%
	II	14	13.7%
	III	1	1.0%
	Unknown	2	2.0%
CVA duration (months)	152.0 (30.0-732.0)		
Etiology	Ischemic	79	77.5%
	Hemorrhagic	31	30.4%
	Unknown	1	1.0%
Modified Rankin Scale	No significant disability	1	1.0%
	Slight disability	2	2.0%
	Moderate disability	27	26.5%
	Moderately severe disability	45	44.1%
	Severe disability	27	26.5%
Brunnstrom Upper Extremity Stages	Stage I	27	26.5%
	Stage II	27	26.5%
	Stage III	11	10.8%
	Stage IV	9	8.8%
	Stage V	14	13.7%
	Stage VI	14	13.7%
Brunnstrom Lower Extremity Stages	Stage I	18	17.6%
	Stage II	27	26.5%
	Stage III	16	15.7%
	Stage IV	15	14.7%
	Stage V	17	16.7%
	Stage VI	9	8.8%
Ambulation	Wheelchair	34	33.3%
	Therapeutic Ambulation	27	26.5%
	Indoor Ambulation	26	25.5%
	Community Ambulation	10	9.8%
	Unknown	5	4.9%

Table 1. Continued...			
Device Used for Ambulation	AFO	23	22.5%
	Ambulatory	2	2.0%
	Cane	5	4.9%
	Non-ambulatory	22	21.6%
	Other	49	48.0%
	Unknown	1	1.0%
Spasticity	None	69	67.6%
	Upper extremity	15	14.7%
	Lower extremity	9	8.8%
	Unknown	9	8.8%
Spasticity severity	I	6	18.2%
	II	19	57.6%
	III	8	24.2%
Aphasia		28	27.5%
Pressure Ulcer		11	10.8%
Neglect		0	0%
Dementia		4	3.9%
Dysphagia		17	16.7%
Comorbidities	(-)	4	3.9%
	HT	65	63.7%
	CAD	42	41.2%
	DM	34	33.3%
	AF	2	2.0%
	Other	67	65.7%
Polypharmacy	(+)	87	85.3%
	(-)	13	12.7%
	Unknown	2	2.0%
Modified Barthel Index Score	35.0 (0-100)		
Modified Rankin Scale	4.0(1.0-5.0)		
Motor FIM Score	41.5(0.0-97.0)		
Cognitive FIM Score	26.0(5.0-35.0)		
Total FIM Score	66.0(18.0-130.0)		

SD: Standard deviation, CVA: Cerebrovascular accident, HT: Hypertension, DM: Diabetes mellitus, CAD: Coronary artery disease, AF: Atrial fibrillation, AFO: Ankle-Foot Orthosis, FIM: Functional Independent Measure. Quantitative variables with normal distribution are presented as mean ± standard deviation, while non-normally distributed variables are presented as median (minimum–maximum). Categorical variables are presented as number (percentage). For the etiology variable, more than one etiology could be marked per patient; therefore, the total frequency may exceed the number of participants.

to 0.891, demonstrating that each item contributed meaningfully to the reliability of the scale.

The relationship between RCS subscales and mBI, mRS, and FIM scores is presented in Table 4. The RCS total scores were significantly positively correlated with mBI (*r*=-0.611, *p*=<0.001), motor FIM (*r*=-0.659, *p*=<0.001), cognitive FIM (*r*=-0.481, *p*=<0.001), and total FIM (*r*=-0.661, *p*=<0.001)

Table 2. RCS-E Subparameters and Distribution of Patient Needs

	n	%
Basic care and support needs		
Largely independent	5	4.9%
Requires help from 1 person	49	48.0%
Requires help from 2 people	23	22.5%
Requires help from ≥3 people	23	22.5%
Requires constant 1:1 supervision	2	2.0%
Risk-Cognitive/Behavioural Needs		
No risk	2	2.0%
Low risk	50	49.0%
Medium risk	27	26.5%
High risk	20	19.6%
Very high risk	3	2.9%
Skilled nursing needs		
No needs for skilled nursing	14	13.7%
Requires intervention from a qualified nurse	23	22.5%
Requires intervention from nursing staff who are trained and experienced in rehabilitation	44	43.1%
Requires highly specialist nursing care	21	20.6%
Medical needs		
No active medical intervention	11	10.8%
Basic investigation / monitoring / treatment	38	37.3%
Specialist medical / psychiatric intervention	50	49.0%
Potentially unstable medical /psychiatric condition	3	2.9%
Therapy Disciplines		
No therapist involvement	5	4.9%
1 discipline only	11	10.8%
2-3 discipline	52	51.0%
4-5 discipline	26	25.5%
≥ 6 discipline	8	7.8%
Therapy Intensity		
No therapy intervention	5	4.9%
Low level	49	48.0%
Moderate level	38	37.3%
High level	9	8.8%
Very high level	1	1.0%
Equipment needs		
No needs for special equipment	10	9.8%
Basic special equipment	91	89.2%
Highly specialist equipment	1	1.0%

Table 3. Test-Retest Reliability and Intra-Class Correlation of RCS-ET Subscales

	Test 1	Test 2	p [1]	ICC (%95 CI)	p
	Median	Median			
Basic care and support needs	1.00	1.00	0.655 W	0.985(0.978-0.990)	**<0.001**
Risk-Cognitive/Behavioural Needs	1.00	1.00	0.655 W	0.984(0.977-0.990)	**<0.001**
Skilled nursing needs	2.00	2.00	0.429 W	0.963(0.945-0.975)	**<0.001**
Medical needs	2.00	2.00	0.480 W	0.960(0.940-0.973)	**<0.001**
Therapy disciplines	2.00	2.00	0.763 W	0.967(0.951-0.978)	**<0.001**
Therapy intensity	1.00	1.00	1.000 W	0.974(0.961-0.982)	**<0.001**
Equipment needs	1.00	1.00	1.000 W	0.948(0.924-0.965)	**<0.001**
Total scores	11.00	11.00	0.824 W	0.987(0.981-0.991)	**<0.001**

p[1 w] Wilcoxon test / p[ICC] (Intra Class Correlation) CI: Confidence Interval

Table 4. Relationship of RCS-E Subscales with Barthel, Rankin, and FIM Scores

		Basic care and support needs	Risk-Cognitive/ Behavioural Needs	Skilled nursing needs	Medical needs	Therapy disciplines	Therapy intensity	Equipment needs	Total scores
Modified Barthel Index Score	rs	-0.632	-0.615	-0.626	-0.423	-0.476	-0.245	-0.173	-0.611
	p	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**0.013**	0.082	***<0.001***
Modified Rankin Scale	rs	0.669	0.654	0.634	0.476	0.475	0.266	0.257	0.647
	p	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**0.007**	**0.010**	**<0.001**
Motor FIM Score	rs	-0.680	-0.645	-0.621	-0.499	-0.537	-0.291	-0.189	-0.659
	p	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**0.003**	0.057	**<0.001**
Cognitive FIM Score	rs	-0.458	-0.479	-0.505	-0.385	-0.443	-0.130	-0.208	-0.481
	p	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	0.193	**0.036**	**<0.001**
Total FIM Score	rs	-0.672	-0.652	-0.645	-0.502	-0.545	-0.260	-0.215	-0.661
	p	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**0.008**	**0.030**	**<0.001**

rs: Spearman's rank correlation coefficient.

scores, and negatively correlated with mRS (*r*=0.647, *p*=<0.001) scores.

Inter-rater reliability results are presented in Table 5. The *r* values ranged between 0.364 and 0.853 for the seven subscales (*p*=0.001). The ICC value evaluating the inter-rater reliability for the RCS total scores was found to be 0.858.

To evaluate the construct validity of the Turkish version of the RCS-E, both exploratory and confirmatory factor analyses were performed. Before the exploratory factor analyses, the Kaiser–Meyer–Olkin (KMO) test and Bartlett's test of sphericity were conducted to evaluate sampling adequacy and factorability. The KMO value was 0.836,

Table 5. Inter-rater reliability of RCS-E Subparameters

	Observer 1	Observer 2	p^1	ICC	
	Median	Median		r (%95 CI)	p^{ICC}
Basic care and support needs	1.00	1.50	0.054^W	0.809(0.718-0.871)	**<0.001**
Risk-Cognitive/Behavioural Needs	1.00	2.00	0.068^W	0.853(0.782-0.900)	**<0.001**
Skilled nursing needs	2.00	2.00	0.304^W	0.829(0.746-0.884)	**<0.001**
Medical needs	2.00	2.00	0.061^W	0.743(0.619-0.826)	**<0.001**
Therapy disciplines	2.00	2.00	0.051^W	0.756(0.638-0.835)	**<0.001**
Therapy intensity	1.00	1.00	0.356^W	0.364(0.059-0.570)	**0.012**
Equipment needs	1.00	1.00	0.782^W	0.692(0.544-0.792)	**<0.001**
Total scores	11.00	11.00	0.783^W	0.858(0.789-0.904)	**<0.001**

$p^{1\,W}$ Wilcoxon test / p^{ICC} (Intra Class Correlation) CI: Confidence Interval

Table 6. Exploratory Factor Analysis Results Showing Unrotated and Varimax-Rotated Loadings for Each Domain of the Turkish RCS-E

	Unrotated principal component loading		Varimax rotation orthogonal factor loading	
Domains	**Principal component 1**	**Principal component 2**	**Rotated component 1**	**Rotated component 2**
Basic care and support needs	0.795	−0.223	0.824	0.054
Skilled nursing needs	0.850	−0.197	0.867	0.096
Medical needs	0.907	0.069	0.833	0.366
Therapy disciplines	0.821	-0.129	0.817	0.150
Therapy intensity	0.762	-0.030	0.729	0.225
Equipment needs	0.474	0.868	0.159	0.976

Eigenvalues of principal component 1 and principal component 2 were 3.657 and 0.864, respectively. The percentage of total variance explained by principal component 1 and component 2 was 60.95% and 14.39%, respectively. The total variance explained by the two-component structure was 75.35%.

indicating a meritorious level of sampling adequacy. Bartlett's test was statistically significant (χ^2=302.03, $p < .001$), supporting the suitability of the data for factor analysis. Exploratory factor analysis revealed two components that together explained 75.35% of the total variance. Although the eigenvalue of the second component (0.864) was slightly below the Kaiser criterion of 1, the rotated factor matrix demonstrated a clear and interpretable structure, with the "Equipment Needs" item loading exclusively onto the second factor. Considering the high cumulative variance explained, the conceptual clarity of the factor structure, and consistency with previous adaptation studies, a two-factor solution was retained for interpretation (Table 6).

Confirmatory factor analysis (CFA) was conducted to evaluate the two-factor model derived from the exploratory factor analysis. The model demonstrated an acceptable level of fit based on selected indices: $\chi^2(9)$=84.3, $p < 0.001$, CFI=0.827,

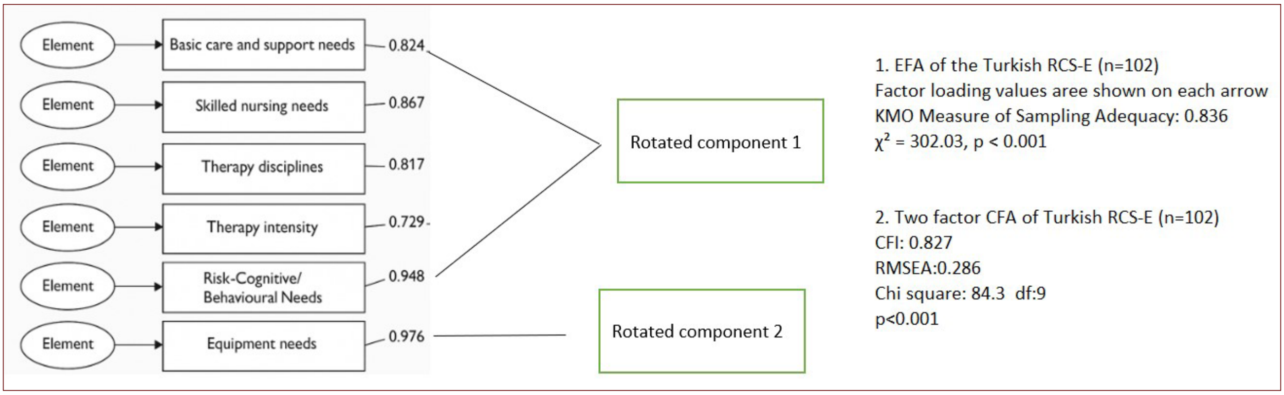

Figure 1. Exploratory and Confirmatory Factor Analysis Results for the Turkish Version of the Rehabilitation Complexity Scale–Extended (RCS-E)

The diagram illustrates the two-factor structure derived from exploratory factor analysis (EFA) using principal component extraction and Varimax rotation. Factor loading values are displayed on the arrows. Rotated Component 1 includes basic care and support needs, skilled nursing needs, therapy disciplines, therapy intensity, and cognitive/behavioral risk. Equipment needs loaded strongly on Rotated Component 2. Confirmatory factor analysis (CFA) was conducted to verify the structure, with model fit indices indicating moderate fit (CFI = 0.827, RMSEA = 0.286, χ^2 = 84.3, df = 9, p < 0.001).

RMSEA=0.286. While some fit indices did not meet ideal thresholds, the overall model supported the proposed two-factor structure of the Turkish RCS-E, reflecting the conceptual distinction between clinical/therapeutic complexity and equipment-related needs (Fig 1).

DISCUSSION

In this study, the Turkish adaptation of the RCS-E was conducted, and its validity and reliability were assessed. The ICC values for the subscales ranged between 0.960 and 0.985, while the RCS-ET total score had an ICC value of 0.987, indicating excellent intra-rater reliability. The ICC value calculated for inter-rater reliability of the total RCS-ET score was 0.858, which was considered highly reliable. The Cronbach's alpha value for the RCS-ET was 0.870, indicating satisfactory internal consistency.

During the preparation of the Turkish adaptation of the RCS-E, the subscales were successfully translated into Turkish and re-evaluated through back-translation, following international guidelines (16).Since the Northwick Park Therapy Dependency Assessment (NPTDA) had not been translated into Turkish, it was not included in the Turkish adaptation of the scale. In addition, the nursing definitions in the nursing subscale were revised to better align with the rehabilitation units in Turkey. Moreover, the term "rehabilitation engineer" was omitted, as there is no equivalent profession in Turkey.

In a previous study, Turner-Stokes et al. applied the RCSv2 to patients with complex neurological disabilities and found the internal consistency of the scale to be moderate (Cronbach's alpha: 0.76). In the test–retest evaluation conducted two hours apart, the kappa values ranged between 0.93 and 0.96, indicating excellent agreement (13). Lee et al. conducted an adaptation and validity study of the Korean version of the RCS-Ev13 in various neurological diagnostic groups, reporting test–retest reliability ICC values for the RCS-E subparameters between 0.69 and 0.84. For total RCS-E scores, the ICC was reported as 0.86, with a Cronbach's alpha value of 0.63. The test–retest interval was determined to be between three and four weeks (17). In a separate study involving patients with brain injury due to traumatic and vascular causes, the Danish version of the RCS-Ev13 was assessed by experts and found to have excellent face validity (18).Roda et al. developed the Italian version of the RCS-E and reported an ICC value of 0.903 for test–retest reliability (indicating good reliability) and a Cronbach's alpha value of 0.702 for internal consistency. In this study, assessments were conducted by the same observer with a one-week interval. In addition, the face validity assessment yielded generally positive feedback (19). In another study involving the Italian adaptation of the RCS-Ev12, the ICC value demonstrating inter-rater reproducibility for total scores was found to be 0.882. The intra-rater reliability for two different raters was reported as 0.93 and 0.77, respectively. Test–retest reliability was determined through measurements taken three months apart (20).Consistent with the literature, the test–retest reliability of the RCS-ET in stroke patients in our study was found to be excellent for the subscales (ICC: 0.960–0.985) and the total score (ICC: 0.987). The Cronbach's alpha value was calculated as 0.870. In addition, the study demonstrated a high level of inter-rater reliability (ICC: 0.858).

During the rehabilitation of individuals with hemiplegia, it is necessary to conduct a clinical evaluation of motor losses, cognitive status, and activities of daily living. For this purpose, scales such as Brunnstrom, motor and cognitive FIM, Rankin, and Barthel are frequently utilized. The inclusion of these scales is particularly important for managing the rehabilitation process and monitoring progress in patients with complicated strokes. In a study by Turner-Stokes et al., the total scores of RCSv2 in patients with neurological disabilities indicated a significant negative correlation with the Barthel Index scores (r=-0.67), FIM motor scores (r=-0.72), and FIM cognitive scores (r=-0.47) (13). In a separate study by Lee et al. on the Korean version of the RCS-E, a significant negative correlation was found between mBI and RCS-E scores in patient groups with cerebrovascular accident, traumatic brain injuries, and other acquired brain injuries (r=-0.53). However, this relationship was not observed in patient groups with lower extremity amputation and arthroplasty (17).In a study conducted on patients with stroke and total hip replacement, the Italian version (12th version) of the RCS-E demonstrated a significant negative correlation between total RCS-E scores and both FIM motor (r=-0.75) and FIM cognitive (r=-0.65) scores (20).In our study, the validation of RCS-ET scores was assessed by examining their correlation with the FIM, mBI, and mRS. The RCS-ET scores indicated a significant positive correlation with the mBI (r=-0.611), motor FIM (r=-0.659), cognitive FIM (r=-0.481), and total FIM (r=-0.661) scores, and a negative correlation with the mRS (r=0.647) scores. In this regard, our results are consistent with the literature.

This study has both limitations and strengths. The RCS-E is a simple and practical assessment tool that helps determine the clinical complexity of rehabilitation and guide the treatment process. In this study, we conducted the Turkish adaptation of the RCS-E, which had not been previously applied in the literature, along with its validity and reliability assessment. Unlike many studies that include patients from various diagnostic groups, only patients with ischemic or hemorrhagic stroke were included in this research. This approach allowed for a more homogeneous and precise analysis. For the test–retest reliability assessment, the interval between the two assessments was set at one week. This duration was chosen to be long enough to reduce the likelihood of the evaluator recalling previous responses, but short enough to avoid significant changes in the patient's functional status during the rehabilitation process. In addition, both evaluators were experienced specialists in stroke rehabilitation and performed the assessments independently in a blinded manner, without access to each other's scores, which supports the objectivity of the reliability analysis.

One limitation of this study is the relatively small sample size and the single-center design, which may limit the generalizability of the findings. Including researchers and participants from different rehabilitation centers could have increased sample diversity and external validity. Another limitation is that the evaluations were based on patient files. Face-to-face assessments could have provided a more comprehensive understanding of the patients' actual rehabilitation needs. In addition, due to the retrospective nature of the study and the use of pre-existing medical records, there is a potential for selection bias in the sample. Finally, the study did not include longitudinal follow-up data, which prevents the evaluation of the scale's responsiveness to clinical change over time. Nevertheless, the results of our study demonstrated satisfactory correlations between the RCS-ET and established functional assessment tools, supporting the relevance and clinical applicability of the scale.

In conclusion, this study demonstrated that the Turkish translation of the RCS-E is a valid, reliable, and practical tool for determining the complexity of rehabilitation needs in hemiplegic patients. The scale's high test–retest and inter-observer agreement values support its reliability as an assessment tool in clinical practice. It can serve as a significant guide in objectively identifying patient needs in all kind of rehabilitation units, not only in stroke units, optimizing treatment plans, and planning post-discharge rehabilitation.

This scale can greatly assist clinicians in various areas such as determining the need for home physiotherapy, conducting cost-effectiveness analyses, utilizing resources more efficiently, deciding which patients should receive home healthcare services, and directing rehabilitation services to appropriate patients. Furthermore, it provides decision-makers with valuable information for reducing healthcare costs and effectively allocating qualified healthcare personnel. Consequently, it enables more effective management of patients' functional recovery processes, as well as an improvement in the quality and continuity of rehabilitation services.As the population ages and the number of geriatric patients increases, the demand for rehabilitation services also rises. In this context, RCS-E emerges as a valuable tool in geriatric rehabilitation. In particular, the RCS-ET is an important tool for developing rehabilitation service delivery models and making decisions regarding resource allocation, thereby supporting the principle of providing the right patient with the right treatment at the right time in healthcare services.

Acknowledgments

Statistical analyses were performed by the professional institution "Istatistik Akademi," and we thank them for their valuable contributions. We would like to thank Prof. Lynne Turner-Stokes Sokes for granting the necessary permission and providing invaluable assistance for the Turkish validation ans reliabilityvstudy of the RCS-E v13 tool.

The authors declare no conflict of interest .This research received no external funding.Written Informed consent was obtained from all subjects involved in the study.

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