

## Turkish version of the Motor Function Measure Scale (MFM-32) for neuromuscular diseases: a cross-cultural adaptation, reliability, and validity study

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**Background/aim:** The Motor Function Measure (MFM-32) is a classification system for ambulant and nonambulant patients with neuromuscular diseases (NMDs). We aimed to translate it into Turkish, culturally adapt it, and test its reliability and validity for Turkish patients with NMDs.

**Materials and methods:** The translation of the 32 items assessing three functional areas: standing position and transfers (D1: 13), axial/proximal (D2: 12), and distal (D3: 7) motor functions was performed according to the established guidelines for cross-cultural adaptation. Totally 51 patients (12.56 ± 8.84 years; F/M 12/39) were tested. Vignos and Brooke scores for the lower and upper extremities, respectively, were used for the validity of the MFM-32-TR items, which were rated on a 4-point Likert scale.

**Results:** The agreement coefficients for interrater reliability were excellent (0.72–0.93) for 10 items, good (0.58–0.77) for 16 items, and moderate (0.42–0.56) for 6 items of the MFM-32-TR. The intertester reliability varied from good to excellent and the intraclass correlation coefficient was 0.76–0.93. The MFM-32-TR positively correlated with Vignos and Brooke scores with coefficients 0.47 to 0.75, indicating concurrent validity.

**Conclusion:** The MFM-32-TR is a reliable and valid outcome measure for the assessment of motor function of people with NMDs in our sociocultural context.

**Key words:** Neuromuscular diseases, motor functions, cultural adaptation, validity, reliability

### 1. Introduction

Neuromuscular diseases (NMDs) as a heterogenic group of diseases affecting the muscle and nerve tissues at different levels are clinically progressive and characterized by a variety of clinical features. Although there are different types of diseases, which are seen due to hereditary or acquired reasons, diseases of the anterior horn motor cells, peripheral nerves, neuromuscular conjunction, or muscle are the most common ones (1). Unfortunately, most of them are still incurable and involve severe impairment and progressive decline of motor function (2). Therefore, physical therapy and rehabilitation interventions and assessment techniques of the functional performance of the patients are still noteworthy for prognosis of the diseases. This is especially important for patients in clinical trials in order to detect their expected

functional capacity. There is a variety of test materials to evaluate the functional level of the patients. Some are disease specific assessment techniques such as the Hammersmith Motor Ability Score (3,4), which is more suitable in strong non-ambulant patients (5), and the North Star Ambulatory Assessment (6), which is specifically designed for ambulant DMD boys to address the functional changes (7). Some are designed for all types of NMDs regardless of the ambulatory levels of the patients, such as the Brooke Upper Extremity Functional Rating Scale (8) and the Vignos Functional Rating Scale (9), to assess the functional level of upper extremity and the ambulation level of subjects with NMDs, respectively. However, those all focus on different aspects of the functional level of the patients and are not efficient to follow the functional changes in patients with NMDs (10).

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The Motor Function Measure (MFM) aims at measuring the motor function of the whole body of children and adults with NMDs for a wide spectrum of these diseases, ranging from those with limb girdle predominance to those with distal impairments (10). It is a reliable and objective test and easy to apply (10,11). The test was developed in the L'Escafe Service of Paediatric Re-education in Lyon, France, between 2000 and 2005, and it is available in several languages (French, Dutch, English, German, Portuguese, and Spanish). This scale has been adapted to patients who can walk as well as those with partial or total gait impairments (12). Therefore, it allows the monitoring of patients' activity level and helps to assess the impact of treatments (10), and to predict the loss of walk for patients with DMD (11). MFM-20 is used for children under 6 years of age, while the MFM-32 is used for evaluating a wide range of patients between the ages of 6 and 60 years.

The scale includes 32 items for adults and 20 items for children in three motor function domains: D1 standing position and transfers, D2 axial and proximal motor function, and D3 distal motor function (10,13). In these dimensions, a unique approach to the functional level of the patients with NMDs is followed, which may be the main cause of the interest from researchers and clinicians in the MFM. It is aimed to search what the patients with NMDs can do, instead of what they cannot do. That provides an inclusive assessment of body functions and gives a taste of success even though they might have very limited joint movements due to the severity of the prognosis. A simple or easy motion such as turning the head to the right or left may be the only motion that the patient can do successfully, or a complicated and functional movement such as collecting the coins on a table may be among the motions that the patient can perform successfully even if she/he cannot walk or stand independently. Therefore, as Vuillerot et al. (14) stated, MFM defines the functional level of the patients with NMDs, regardless of the level of disease severity. It provides information on the motor function of the lower extremity, trunk, and upper extremity, and especially on proximal control (pelvis and shoulder) and distal control (hands and feet) of the extremities. We think that a Turkish translation and cultural adaptation of the MFM will meet the requirements of a detailed and accurate assessment technique for professionals dealing with NMDs, as well as contribute to the subject-related literature in Turkish.

Therefore, the aim of this study was to translate and culturally adapt the MFM-32 into Turkish, and to investigate its test/retest reliability, intertester reliability, and construct validity in patients with NMDs.

## 2. Materials and methods

### 2.1. Participants

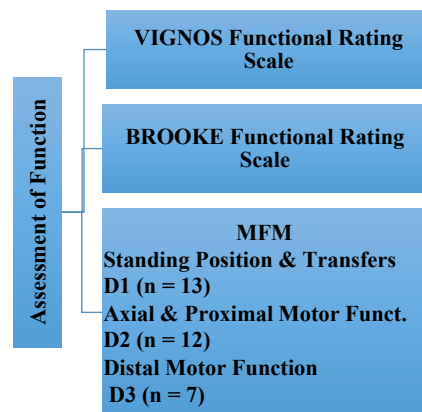
A total of 51 (12 F/39 M) patients aged  $12.56 \pm 8.84$  years (6–21 years; median 10 years), and diagnosed with a NMD (Duchene muscular dystrophy ( $n = 25$ ), myopathy ( $n = 9$ ), spinal muscular atrophy ( $n = 5$ ), Becker muscular dystrophy ( $n=5$ ), polyneuropathy ( $n = 5$ ), Friedreich ataxia ( $n = 2$ )) were included in this study. They were diagnosed in a neurology department by neurologists, based on the clinical criteria of NMDs. Participants with any history of orthopedic, rheumatologic, or vascular problems were excluded from the study.

Before participating, all patients and the parents of the pediatric patients read and signed the informed consent forms. The study was approved by the Review Board of İstanbul Faculty of Medicine, İstanbul University (22/04/2009) and conducted in accordance with the Helsinki Declaration.

Since the age range and median of the participants were 6–21 years and 10 years, respectively, the MFM-32 was used to perform this cross-cultural adaptation, reliability, and validity study. The total scores and subscores of the MFM test were determined in three motor function domains: D1, D2, and D3 (Figure 1). The dimension of each item was scored on a 4-point scale and noted on the scoring sheet.

Generic scoring was defined as follows:

- 0: Cannot initiate the task, or cannot maintain the starting position
- 1: Partially performs the task
- 2: Performs the movement incompletely, or completely but imperfectly (compensatory movements, position maintained for an insufficient duration of time, slowness, uncontrolled movement)
- 3: Performs the task fully and “normally”; the movement is controlled, mastered, directed, and performed at constant speed.



**Figure 1.** The motor function assessment tests applied to the participants.

The scores were expressed as percentages in relation to the maximum score. The total score was the sum of the scores of 32 items ranging from 0 to 96. The total loss of function and the loss of function in each dimension were calculated as percent values as described in Berard et al. (13).

We assessed the functional level of the lower extremities by the Vignos Functional Rating Scale (9) and the functional level of the upper extremities by the Brooke Functional Rating Scale (8).

**2.2. Translation and cross-cultural adaptation procedure**

Initially, permission was obtained from the L'Escale group to validate the Turkish version of the MFM-32. The English version of the MFM-32 (15) was adapted for Turkish use according to the established guidelines for cross-cultural adaptation of self-report measures (Figure 2). In the first stage, two Turkish native speakers who

are fluent in English translated the English version of the MFM into Turkish, independently. In the second stage, the two translators and a team of experts combined both translations, and formed a common draft. In the third stage, two persons independently translated this common draft back into English. Both translators were bilingual native English speakers. Neither translator received any background information on the study or on the MFM. In the fourth stage, an expert committee consisting of the forward and back translators and two physiotherapists reviewed all the translations. They reached semantic, idiomatic, experiential, and conceptual consensus on all discrepancies. Thus, the prefinal version of the Turkish MFM was consolidated. In the fifth stage, the prefinal version of the Turkish MFM was tested in a group of 10 patients with NMDs for the accuracy and the explicitness of the terminology. One of the assessors (physiotherapist)

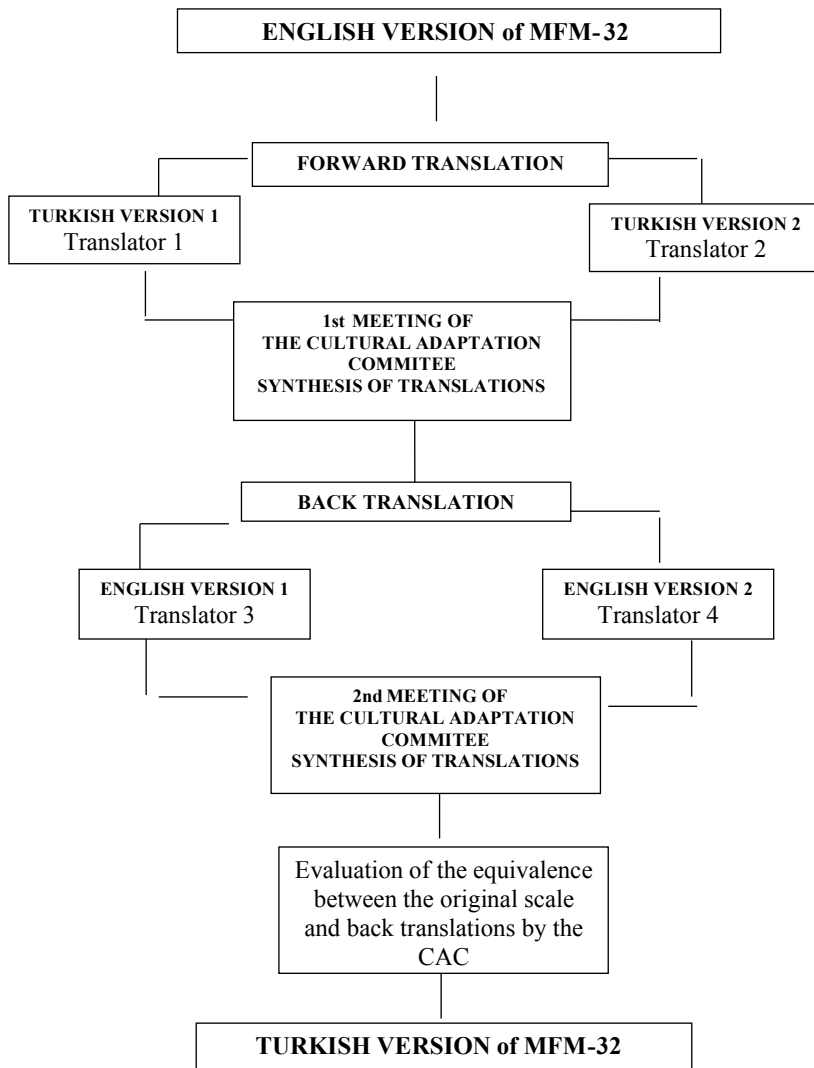


Figure 2. Flowchart of the cultural adaptation phase.

documented the existing problems during the pilot study. Considering these issues, the final Turkish MFM was established.

The reliability and validity of the final Turkish version of MFM were tested in 51 patients with a NMD. All patients were tested with the Turkish version of the MFM by the same assessor. All examinations were recorded on video and each item of the scale was rated twice as test and retests with a 5-day interval by Assessor I and Assessor II also rated the same patient group independently from Assessor I.

### 2.3. Statistical analysis

The data were analyzed using SPSS version 21.0 (SPSS Inc., Chicago, IL, USA). The Kolmogorov-Smirnov test was used to assess the distribution of all scores of Assessors I and II. It was found that the data were normally distributed. Descriptive statistics for continuous variables were reported as mean, median, and standard deviation and for categorical variables were reported as frequency and percentage. Intraclass correlation coefficients (ICCs) were calculated to determine test/retest reliability, ICCs were calculated to determine intertester reliability, Cronbach's alpha coefficient was used to assess the internal consistency of the MFM, and Pearson's correlation coefficient was used to assess the validity of the Turkish version of the MFM-32. Statistical significance was considered as  $P \leq 0.05$ .

### 2.4. Reliability

The reliability of the MFM was evaluated by analyzing test/retest reliability and interrater reliability. Test/retest reliability was determined by using the assessments completed by the physiotherapist (Assessor I) at a 5-day interval as test and retest, and by comparing the achieved test and retest scores. The first and second assessments were completed in the outpatient neurology department. Test/retest reliability was assessed using ICCs, and the paired t-test used for reliability of the two administrations of the questionnaire by Assessor I and Assessor II. Assessor

1 and Assessor 2 completed the evaluation on successive days. One of the assessors had 9 years and the other had 4 years of experience in neurologic rehabilitation. The ICC value of  $>0.70$  indicated that the instrument was reliable (16).

### 2.5. Validity

The validity of the construct was assessed by examining correlations between the scores of the MFM-32 and the Vignos and Brooke Functional Rating Scales. Pearson's correlation coefficients were used to examine the construct validity since the MFM-32 and the Vignos and Brooke Functional Rating Scale scores were continuous variables and normally distributed. Correlation coefficients were rated as follows:  $\leq 0.40$  poor,  $\leq 0.40$  to  $0.75$  intermediate to good, and  $\leq 0.75$  excellent (17).

## 3. Results

### 3.1. Characteristics of the participants

The demographic and physical characteristics of the participating patients are given in Table 1. The total scores of patients from motor function assessments are shown in Table 2.

### 3.2. Test/retest reliability and intertester reliability

The difference between test and retest measurements was not statistically significant ( $P > 0.05$ ). In other words, the outcomes of the tests done by Assessor I 5 days apart were similar to each other and they were reliable. The results of reliability analyses and the mean scores of subscales are presented in Table 3. The test/retest reliability (ICC ranged from 0.76 to 0.90, Cronbach's alpha ranged from 0.84 to 0.93) was excellent (18).

Interrater reliability was also excellent (0.78–0.93) for 10 items (D1: 11, 12, 30, 32; D2: 1, 2, 5, 9, 13; D3: 20), good (0.58–0.77) for 16 items (D1: 6, 24, 25, 26, 27, 28, 29, 31; D2: 3, 7, 14, 16, 23; D3: 4, 21, 22) and moderate (0.42–0.57) for 6 items (D1: 8; D2: 10, 15; D3: 17, 18, 19). The interrater reliability between the outcomes of Assessor

**Table 1.** Sociodemographic and physical characteristics of the patients.

Characteristics n = 51	Mean $\pm$ SD (Median)	%
Age (years)	12.56 $\pm$ 8.84 (10)	n/a
Sex (female/male)	12/39	23.52–76.48
Weight (kg)	33.35 $\pm$ 14.17	n/a
Height (cm)	151.29 $\pm$ 105.63	n/a
Age of ambulant subjects (n = 36)	12.69 $\pm$ 10.44	70.6
Age of nonambulant subjects (n = 15)	12.26 $\pm$ 2.57	29.4

**Table 2.** The total grades achieved from the tests assessing the motor function of the patients (n = 51).

Motor function assessment tests	Total grade	Total loss function
	Mean ± SD (min-max)	%
Vignos Functional Rating Scale	5.03 ± 3.32 (1-9)	n/a
Brooke Functional Rating Scale	2.58 ± 1.79 (1-6)	n/a
MFM-32 TR	59.30 ± 22.96 (0-96)	61.77
Dimensions		
D1 (min-max: 0-39)	12.47 ± 11.2	29.24
D2 (min-max: 0-36)	28.77 ± .97	20.01
D3 (min-max: 0-21)	17.06 ± 3.20	18.78

MFM: Motor Function Measure, D1: standing position and transfers, D2: axial and proximal motor function, D3: distal motor function

**Table 3.** Test/retest reliability and intertester reliability of the Turkish MFM-32.

Self-reports	Outcomes of Assessor I		Outcomes of Assessor II	Intrarater observation		Interrater observation	
	First assessment Mean ± SD	Second assessment Mean ± SD		First-second assessments of Assessor I		Outcomes of Assessors I and II	
			Mean ± SD	ICC	Cronbach's alpha	ICC	Cronbach's alpha
MFM total	59.30 ± 22.96	56.47 ± 31.03	54.27 ± 23.62	0.76	0.84	0.82	0.74
MFM D1	12.47 ± 11.2	12.34 ± 10.41	11.51 ± 9.24	0.77	0.87	0.93	0.96
MFM D2	28.77 ± 0.97	29.07 ± 9.31	25.56 ± 12.35	0.86	0.92	0.83	0.91
MFM D3	17.06 ± 3.20	15.06 ± 11.31	16.10 ± 2.36	0.79	0.88	0.84	0.91

MFM: Motor Function Measure, D1: standing position and transfers, D2: axial and proximal motor function, D3: distal motor function

I (first assessment) and Assessor II varied from good to excellent and the ICC was between 0.76 and 0.93. This outcome shows that the tests done by two independent assessors are also reliable (Table 4).

### 3.3. Concurrent validity

To assess the validity of the MFM-32, we compared it with the outcomes of the Vignos and Brooke Functional Rating Scales. The MFM-32 and the Vignos and Brooke Functional Rating Scale tests were positively correlated with each other with coefficients ranging from 0.43 to 0.75. A moderate correlation was determined between the MFM-32 (D1) and the Vignos Functional Rating Scale ( $r = 0.47$ ;  $P = 0.001$ ), and a strong correlation was determined between the MFM-32 (D2; D3) and the Brooke Functional Rating Scale ( $r = 0.75$ ,  $P = 0.001$ ;  $r = 0.72$ ,  $P = 0.001$ , respectively), indicating the concurrent validity of the Turkish version of the MFM-32.

### 4. Discussion

Patient-administered and disease-related assessment scales examining physical function are increasingly used in international research. As Beaton et al. (15) stated, those instruments should be translated and cross-culturally adapted before their use in different language speaking populations. Therefore, the aim of the present study was to develop a Turkish version of the MFM-32 and to verify its inter- and intrarater reliability. As the first study to validate the MFM-32 in a Turkish population with NMDs, the three phases of the validation process, i.e. translation, cultural adaptation, and reliability and validity analysis, were fulfilled in this study.

The results of this study revealed that the reliability and validity of the Turkish MFM-32 were satisfactory for patients with NMD. The psychometric properties of the Turkish MFM-32 were generally similar to those of the

**Table 4.** For each item of the MFM Cronbach's alpha ( $\alpha$ ) and intertester reliability coefficient (ICC).

Items	D1		D2		D3	
	$\alpha$	ICC	$\alpha$	ICC	$\alpha$	ICC
1	-	-	0.93	0.92	-	-
2	-	-	0.91	0.93	-	-
3	-	-	0.76	0.88	-	-
4	-	-			0.77	0.88
5	-	-	0.77	0.89	-	-
6	0.68	0.78	-	-	-	-
7	-	-	0.67	0.77	-	-
8	0.55	0.76			-	-
9	-	-	0.72	0.81	-	-
10	-	-	0.42	0.76	-	-
11	0.82	0.89	-	-	-	-
12	0.85	0.90	-	-	-	-
13	-	-	0.91	0.89	-	-
14	-	-	0.61	0.78	-	-
15	-	-	0.56	0.76	-	-
16	-	-	0.60	0.79	-	-
17	-	-	-	-	0.56	0.76
18	-	-	-	-	0.55	0.78
19	-	-	-	-	0.42	0.76
20	-	-	-	-	0.88	0.86
21	-	-	-	-	0.76	0.89
22	-	-	-	-	0.77	0.91
23	-	-	0.73	0.84	-	-
24	0.58	0.77	-	-	-	-
25	0.66	0.82	-	-	-	-
26	0.69	0.88	-	-	-	-
27	0.71	0.90	-	-	-	-
28	0.60	0.81	-	-	-	-
29	0.66	0.87	-	-	-	-
30	0.87	0.90	-	-	-	-
31	0.76	0.88	-	-	-	-
32	0.89	0.91	-	-	-	-

D1: standing position and transfers, D2: axial and proximal motor function, D3: distal motor function

original MFM-32, which was validated by Berard et al. (10) to measure the motor function of patients (n = 303) with NMDs. These patients were 6–62 years old and had Duchenne muscular dystrophy (n = 72), Becker muscular dystrophy (n = 32), limb-girdle dystrophy (n = 30), facio-scapula-humeral dystrophy (n = 39), myotonic dystrophy (n = 29), congenital myopathy (n = 21), congenital muscular dystrophy (n = 10), spinal muscular atrophy (n =

35), or hereditary neuropathy (n = 35). Actually, although our sample size was smaller (n = 51) and the patients were younger (7–21 years) than those of Berard et al.'s study (10), the variety of the NMDs was similar as they consisted of DMD (n = 25), myopathy (n = 9), SMA (n = 5), BMD (n = 5), polyneuropathy (n = 5), and Friedreich ataxia (n = 5) patients. They found that “agreement coefficients for inter-rater reliability were excellent for nine items, good for 20

items and moderate for three items". They also reported high correlations between the total scores and the scores of the Vignos and Brooke Functional Rating Scales. Similarly, in our study agreement coefficients for interrater reliability were excellent (0.75–0.93) for 9 items, good (0.58–0.77) for 17 items, and moderate (0.42–0.56) for 6 items and intertester reliability varied from good to excellent, since the ICCs were strong (0.76–0.93). Therefore, we may state that the MFM-32 was positively correlated with the Vignos and Brooke Functional Rating Scale grades from moderate to high with coefficients from 0.47 to 0.75, indicating concurrent validity.

Vuillerot et al. (19) have also reported in a study in 448 patients with genetic neuromuscular diseases that the MFM-32 was a reliable, reproducible, and valuable outcome measure for clinical practice and research, since it was able to describe the physical status of patients and formulate the uniform patient groups according to motor function.

Iwabe et al. (12) published the Portuguese translation of the MFM-32 and they have identified its intra and inter-examiner reliability in patients with clinical and laboratory diagnosis of various types of muscular dystrophy and congenital myopathy. They reported a high reliability and minimal variability as an outcome of their study, which was similar to our intrarater outcomes.

In the light of these outcomes, we conclude that the MFM appeared to be sensitive to capture activities and

possible changes in very weak patients. This was mainly due to the items capturing axial and upper limb activities in the MFM-32. According to our clinical experience, the D2, which aims to assess the proximal control of upper extremity with its 5 items (5 - 9 - 10 - 16 - 23) and D3, which aims to assess fine motor function of hands with its 4 items (1 - 18 - 19 - 20) provide detailed information to assess proximal control with its first 3 items and hand function with its last 3 items. Therefore, we suggest the MFM-32 for clinicians especially those aiming to determine upper extremity function in patients with NMDs.

We may consider the wide spectrum of ages of the patients as a limitation of this study. We could search for the motivation of the patients and the satisfaction level of the patients as well as the parents, which may be recommended for future studies.

In conclusion, we may state that the Turkish version of the MFM-32 can be used effectively as a reliable and valid outcome measure for assessment of motor function in patients with NMDs.

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