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Motor function measure: portuguese version and reliability analysis

Medida da função motora: versão da escala para o português e estudo de confiabilidade

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Abstract

Background: Functional evaluation instruments for patients with neuromuscular disorders are rare. The Motor Function Measure (MFM) scale is available in the original French and in English and Spanish translations. **Objective:** To make a Portuguese translation of the MFM and to identify its intra and inter-examiner reliability. **Methods:** Two translations of the 2004 MFM were produced separately by neurologists who were proficient in French. This procedure resulted in a consensual text after evaluation by the authors. The MFM in Portuguese was applied to 58 patients aged six to 61 years, with clinical and laboratory diagnoses of various types of muscular dystrophy and congenital myopathy that were documented on video. The first author performed the test and retest and another three physical therapists analyzed the same videos to assess the inter-examiner reliability. Statistical analyses were performed using the Kendall, kappa and Pearson coefficients. **Results:** The scale is presented with its 32 items and three dimensions. The Kendall concordance coefficients for inter-examiner analysis and the kappa and Pearson coefficients for the test-retest comparison were statistically significant (p-value<0.0001) for the 32 items on the scale and for the total score. **Conclusions:** The Portuguese version of the MFM showed high reliability and minimal variability when it was applied. It can be used as an instrument for clinical diagnosis and follow-up of neuromuscular disorders. The high reliability in applying the MFM will allow Brazilian patients to be included in international clinical trials that use this scale.

Key words: neuromuscular disorders; motor activity; scales; reliability study.

Resumo

Contextualização: Instrumentos de avaliação funcional de pacientes com doenças neuromusculares são escassos. A escala Medida da Função Motora (MFM) está disponível no original francês e nas versões inglesa e espanhola. **Objetivos:** Realizar a versão da escala para o português e identificar a confiabilidade de sua aplicação intra e interexaminador. **Materiais e métodos:** Duas traduções da MFM de 2004 foram realizadas em separado, por neurologistas proficientes na língua francesa, resultando em texto consensual, após avaliação dos autores. A escala em português foi aplicada em 58 pacientes de seis a 61 anos, com diagnósticos clínico-laboratoriais de variados tipos de distrofias musculares e miopatias congênitas, documentados em vídeo. O primeiro autor realizou o teste e reteste e outros três fisioterapeutas analisaram os mesmos vídeos para confiabilidade interexaminador. Para análises estatísticas foram utilizados os coeficientes de Kendall, Kappa e Pearson. **Resultados:** Apresenta-se a escala em seus 32 itens e três dimensões. Os coeficientes de concordância de Kendall para a análise interexaminador e os coeficientes Kappa e de Pearson para o teste e reteste foram estatisticamente significativos (p-valor<0,0001) nos 32 itens da escala e no escore total. **Conclusões:** A versão portuguesa da MFM mostrou confiabilidade e mínima variabilidade na sua aplicação, podendo ser utilizada como instrumento de diagnóstico clínico e seguimento das doenças neuromusculares. A alta confiabilidade na aplicação da MFM permitirá incluir pacientes brasileiros em ensaios clínicos internacionais que utilizarão a escala.

Palavras-chave: doenças neuromusculares; atividade motora; escalas; estudo de confiabilidade.

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Introduction

Hypotonia, reduction of anti-gravitational movements and the presence of contractures are clinical indicators of neuromuscular disease in newborns[1]. In older patients, the measurement of the degree of muscle strength can be added to these indicators[2], however, it may have some limitations influenced by patient collaboration, rater interpretation of the test, and low inter-rater reliability[3].

In patients with neuromuscular disease, the true functional capacity, especially in complex activities, depends on muscle strength, muscular compensation and possible joint limitations[4]. The scarcity of specific functional instruments for neuromuscular diseases, in general motivated a group of researchers from the L'Escale Service of Pediatric Reeducation in Lyon, France, to develop the Motor Function Measure (MFM)[4]. The objective of MFM was the quantitative assessment of motor function in patients with neuromuscular disease.

The first MFM consisted of 51 items and was validated between 2000 and 2001 in French and Swiss centers. Patients aged six to 60 with diagnosed neuromuscular disease (except severe myasthenia and myositis) and hereditary neuropathies took part in this project. After statistical analyses, the second version of MFM was developed. The items were reduced from 51 to 32, and this version was validated between 2002 and 2003 for the same age group[5]. The exclusion of age groups beyond those limits was justified, on one hand, to avoid considerations on the developmental stages, and on the other, because of the peculiarities of the aging process[4].

The average time for completion of the MFM scale is 36 minutes and the necessary materials are low-cost and easily acquired[4]. The ratings of the scale are accurately detailed in the instruction manual, and the authors[4,5] suggest prior supervised training with at least two patients.

Considering the abovementioned advantages of the MFM, the availability of a version in Portuguese will allow not only the measurement of motor impairment in the diagnostic phase of neuromuscular disease, but also the follow-up and objective measurement of the efficacy of therapy.

The aim of this study was to develop a Portuguese version of the MFM and to verify its inter and intra-rater reliability.

Methods

Initially, permission was obtained from the L'Escale group to validate the Portuguese version of the MFM. The translation was based on the French scale of 2004. Two independent translations were made by neurologists proficient in the French language. The translations were then compared and discussed, and a single consensus version was developed and submitted to a back translation.

The subjects of this study were patients at the Unicamp Neuromuscular Disease Clinic diagnosed with muscular dystrophy (limb-girdle, facioscapulohumeral, Duchenne, Becker, myotonic), myopathy (mitochondrial, centronuclear, minicore, distal), and congenital fiber-type disproportion. All subjects signed an informed consent.

All exams were recorded on video, and each item of the scale was rated at different times by the same rater (test and re-test) and other physical therapists. Three of them were previously trained and instructed on the application of the scale. They rated the same items, independently, after watching the videos.

Statistical analyses

Kendall's coefficient of concordance was used to analyze inter-rater consistency, and the weighted kappa coefficient was used to analyze intra-rater consistency, in order to verify the agreement for each item of the instrument. Pearson's correlation coefficient was used to verify the association between total scores of the first (test) and second evaluation (re-test). The study was approved by the Ethics in Research Committee of the School of Medical Sciences of Unicamp, under approval no. 637/2004.

Summarized Portuguese Version of the MFM

The MFM contains 32 items which include static and dynamic evaluations, divided into three dimensions:

- Dimension 1 (D1): standing position and transfers with 13 items;
- Dimension 2 (D2): axial and proximal motor function with 12 items;
- Dimension 3 (D3): distal motor function with seven items, six of which refer to upper limbs.

Table 1 shows the items, the respective dimension, the initial test position and the exercises requested for patients, thus providing a global vision of the scale. Items are arranged in logical sequence, in the order of the exam, regardless of the dimension.

Each item is rated on a four-point scale (ratings from 0 to 3) and detailed scoring instructions for each item are given in the instruction manual. To acquaint the reader

with the general rules and scoring criteria, the ratings are described as follows: 0 – subject unable to begin the requested task or maintain the initial position; 1 – subject partially accomplishes the item; 2 – subject partially accomplishes the requested movement or accomplishes it completely, but with imperfections; 3 – subject accomplishes the item completely, with controlled movement (normal). In the presence of joint limitation or tendon retraction, subjects were rated as though they did not have enough strength to accomplish the movement and could not receive the maximum rating. The total and partial scores for each dimension were expressed in percentages of the maximum score (96 points). The full Portuguese version of the MFM can be accessed at http://www.mfm-nmd.org. Figures 1 to 3 illustrate dimensions D1, D2 and D3 of the scale.

Results

The Portuguese MFM was administered to 58 patients, 35 men and 23 women, between six and 61 years of age with mean age of 30.39 and median of 29.57 years. The patients' demographic data and their diagnoses are summarized in Table 2.

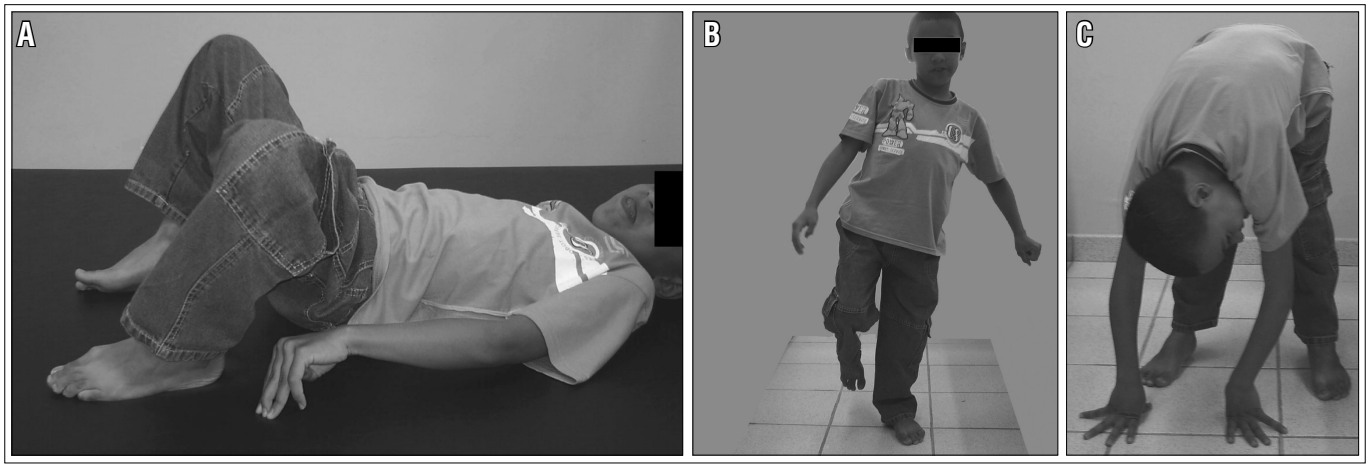
The test and re-test for each of the 32 items of the MFM had weighted Kappa coefficients varying from 0.93 to 1.00. Values closer to 1.00 represent stronger correlation between variables. The MFM total scores in the first and second evaluations demonstrated a Pearson's correlation of r=0.99 and p<0.0001, i.e., high intra-rater correlation, with statistically significant values. The maximum variability for each item was 0.1 (Table 3).

In the inter-rater consistency analysis, all items of the scale and the total score had Kendall concordance coefficients between 0.96 and 1.00 and p<0.0001 (Table 4), i.e. high inter-rater correlation with statistically significant values.

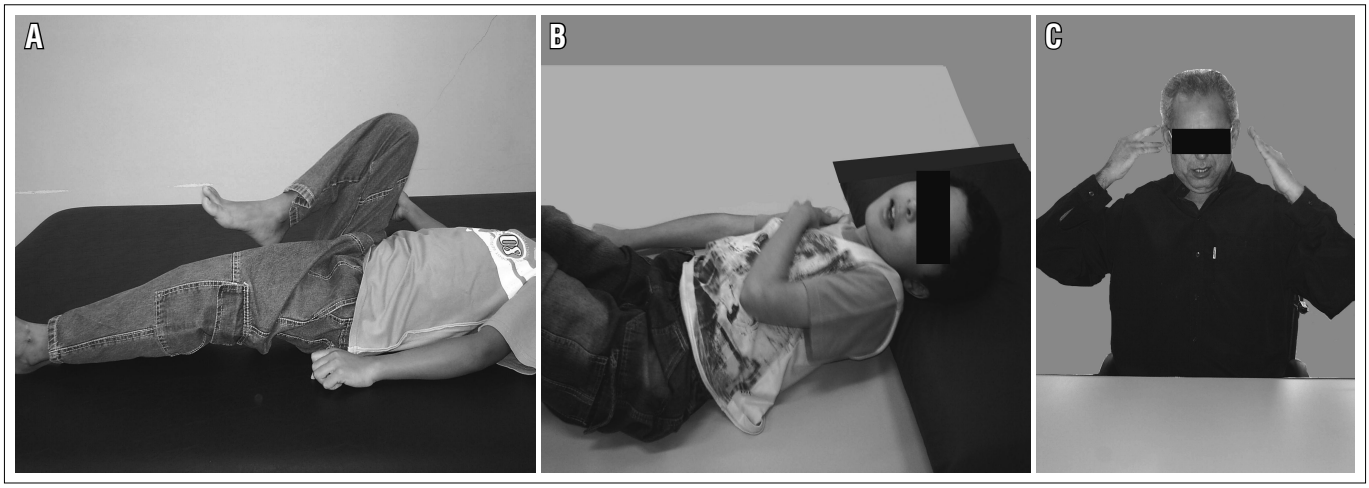
Discussion

The methods of clinical evaluation in the diagnosis phase of the various neuromuscular diseases encompass simple observation of the pacient[1] in search of indicative phenotypes, qualitative exam of muscle tonus[6,7], quantitative study of muscle strength[8], motor skills in activities of daily living (Barthel Index)[9], use of functional scales[10,11] and quality of life[12]. Functional scales have been designed for some of the most prevalent neuromuscular diseases. The scales by Russman et al.[13] and Main et al.[14] refer to spinal amyotrophy types II and III. In a similar group of patients, Merlini et al.[15] observed the relationship between the time required to accomplish certain motor activities and muscle strength. The Vignos scale and Brooke scale evaluate upper and lower limbs respectively in Duchenne muscular dystrophy[16], while the Vignos, Spencer and Archibald scale[17] has been proposed for the measurement of progressive incapacity of the same disease[18].

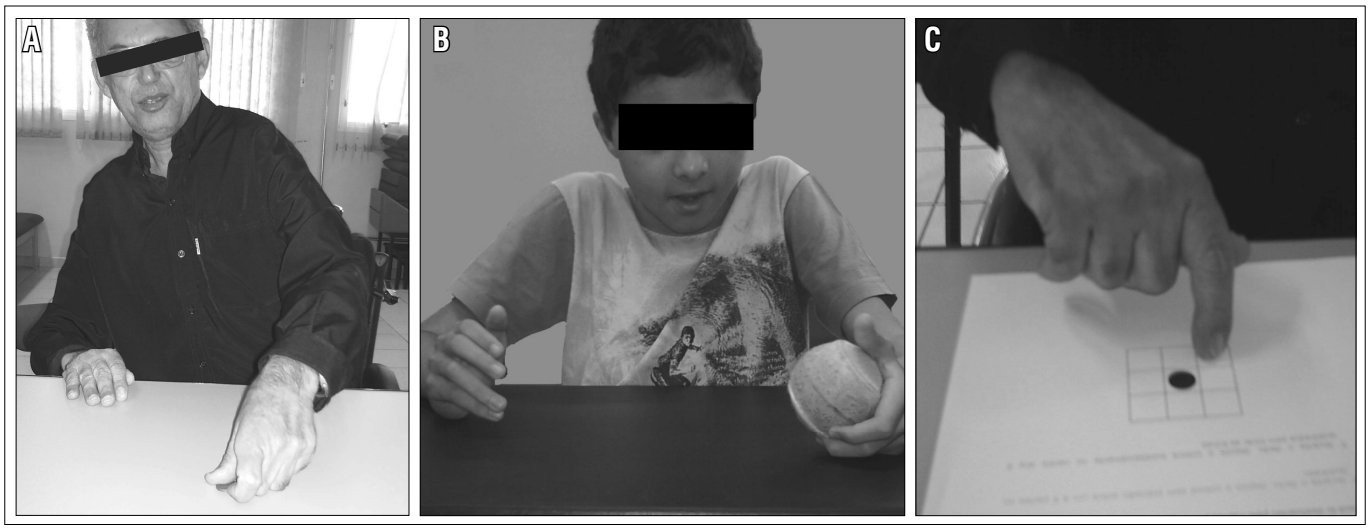
The lack of a specific scale for certain diseases drives the researcher to develop a protocol of exams. Rocco et al.[19] used the Russman scale, the Barthel Index, the muscle strength test and goniometry to characterize the motor limitations of patients. Recently, Lue et al.[9] measured functionality in patients with muscular dystrophy through the examination of four dimensions (mobility, activities of daily living, upper limb function and main difficulties). This scale was



Figures 1A. D1, item 6, supine position: raise pelvis. Patient partially raises pelvis; rating: 2. **1B.** D1, item 26, standing: raise one foot for ten seconds. Patient performs the task for ten seconds; rating: 3. **1C.** D1, item 27, standing: bend forward and touch the floor with one hand and stand up again. The patient touches the floor with one hand and stands up again with compensatory movements; rating 2.



Figures 2A. D2, item 3, supine position: bring one knee to chest. Patient shows hip flexion and knee flexion beyond 90° and raises foot off the mat; rating: 3. **2B.** D2, item 5, supine position: bring one hand to the opposite shoulder. Patient raises hand and moves it to opposite shoulder with compensatory movements; rating 2. **2C.** D2, item 15, seated on a chair: place both hands on the top of head, at the same time. Patient brings head down and raises hands partially; rating 2.



Figures 3A. D3, item 17, seated on a chair; pick up ten coins with one hand in 20 seconds. Patient picks up all the coins in less than 20 s; rating: 3. **3B.** D3, item 21, seated on a chair; hold a tennis ball with one hand and turn hand over completely. Patient picks up the ball, turns hand over incompletely; rating: 2. **3C.** D3, item 22, seated on a chair: place finger in the center of each square of the diagram, successively, without touching the lines. The patient performs the task fully; rating 3.

validated for dystrophy, which most often exhibits proximal motor deficits, and does not evaluate lower limb movement or distal motor function.

The MFM scale allows a comprehensive evaluation of proximal, distal and axial motor impairments with the use of tasks classified into three dimensions[4]. Therefore, it is a useful instrument for a wide spectrum of neuromuscular diseases, ranging from those with limb girdle predominance to those with distal impairments. This scale has been adapted to patients who can walk as well as those with partial or total gait impairments.

The development of Brazilian functional scales for neurological patients is rare in comparison with the large number of versions of scales developed in other countries. In the case of available scales, we could cite as an example the Evaluation Scale of Dynamic and Static Functional Activities in Cerebral Palsy[20]. In the case of versions of scales, there are the Portuguese versions of the Fugl-Meyer scale by Maki et al.[21], the EK[22] scale and the generic questionnaire of quality of life SF-36 (Brazil SF-36)[23].

Developing versions saves time and money, unlike the costly work of developing a new scale which demands the creation of pertinent items, the selection of the most appropriate ones, interpretation and validation[24]. Another advantage of versions is that the specificity of the instrument has been previously defined, and there is relative certainty

Table 1. Motor Function Measure – each of the 32 items of the scale with the initial position and the respective tasks to reach the maximum score (3 points).

Item	Dimensão	Posição inicial	Exercícios
1	D2	Supino	Mantenha a cabeça no eixo e faça a rotação completa para cada um dos lados
2	D2		Levante a cabeça e a mantenha elevada
3	D2		Flexione o quadril e o joelho além de 90º, deslocando o pé do tapete
4	D3		Perna sustentada pelo examinador: realize a flexão dorsal do pé em 90º em relação à perna
5	D2		Eleve uma das mãos do tapete e toque o ombro oposto
6	D1		Membros inferiores semi-fletidos, patelas para cima, pés apoiados sobre o tapete. Eleve a pelve, coluna lombar, bacia e coxas, mantendo-as alinhadas e com os pés próximos
7	D2		Passe para decúbito ventral e libere os membros superiores debaixo do corpo
8	D1		Sente-se sobre o tapete, sem apoio dos membros superiores
9	D2	Sentado na maca	Sem apoio dos membros superiores, mantenha a posição sentada e coloque as mãos em contato entre si
10	D2		Bola de tênis em frente ao sujeito, sem apoio dos membros superiores. Incline-se para frente, toque a bola e depois volte à posição ereta
11	D1		Fique em pé, sem apoio dos membros superiores
12	D1	Em pé	Sem apoio dos membros superiores, sente-se na cadeira, mantendo os pés ligeiramente afastados
13	D2	Sentado na cadeira	Sem apoio dos membros superiores e sem apoio do encosto da cadeira, mantenha a posição sentada, com a cabeça e o tronco alinhados
14	D2	Sentado na cadeira	Com a cabeça posicionada em flexão: levante a cabeça e a mantenha elevada. O movimento e a manutenção devem ser feitos com a cabeça no eixo
15	D2		Antebraços apoiados sobre a mesa e cotovelos para fora: coloque ao mesmo tempo as duas mãos sobre a cabeça, com a cabeça e o tronco alinhados
16	D2		Lápis sobre a mesa: toque o lápis com uma das mãos, com o cotovelo em extensão completa no final do movimento
17	D3		Dez moedas sobre a mesa: pegue sucessivamente e armazene dez moedas de dez centavos em uma das mãos, no tempo de 20 segundos
18	D3		Dedo colocado no centro de um CD-Rom fixo: realize a volta completa do CD-Rom com o dedo, sem apoio da mão
19	D3		Lápis sobre a mesa: pegue o lápis com uma das mãos; desenhe uma série contínua de voltas de 1cm de altura, dentro de um retângulo de 4cm de comprimento
20	D3		Folha de papel entre as mãos: rasgue a folha dobrada em quatro começando pela dobra
21	D3		Bola de tênis sobre a mesa: pegue a bola e depois vire a mão completamente para cima segurando a bola
22	D3		Dedo no centro de um quadrado fixo: levante o dedo e depois o coloque sucessivamente no centro das oito casas do quadrado, sem tocar as linhas
23	D2		Membros superiores ao lado do corpo: ao mesmo tempo coloque os dois antebraços e/ou as mãos sobre a mesa
24	D1	Sentado na cadeira	Levante-se, sem apoio dos membros superiores, com os pés próximos
25	D1	Em pé; apoio dos membros superiores	Solte-se e mantenha-se em pé, com os pés próximos; cabeça, tronco e membros alinhados
26	D1		Sem apoio dos membros superiores, levante um pé, por dez segundos
27	D1	Em pé	Sem apoio, incline-se, toque o solo com uma das mãos e depois se levante
28	D1	Em pé sem apoio	Ande dez passos à frente, sobre ambos os calcanhares
29	D1		Ande dez passos à frente, sobre uma linha reta
30	D1		Corra dez metros
31	D1		Salte no mesmo lugar, com um pé, dez vezes seguidas
32	D1		Sem apoio dos membros superiores, agache-se e levante-se duas vezes em seguida

Fonte: adaptação/versão Bérard C, et al.[4]

Table 2. Demographic data and diagnoses.

Case	Gender	Age	Diag	Case	Gender	Age	Diag
01	M	10	DMD	30	F	22	MD
02	F	14	MD	31	F	22	CNM
03	F	15	LGMD	32	F	52	CNM
04	M	12	CMD	33	F	25	CNM
05	M	15	DMD	34	M	24	MCM
06	M	25	CFTD	35	M	56	DM
07	F	27	LGMD	36	M	51	DM
08	M	32	DM	37	F	39	DM
09	M	33	FSHD	38	F	38	DM
10	M	41	MD	39	F	53	MD-1
11	M	43	DM	40	F	47	MD-1
12	M	35	DM	41	M	7	DMD
13	M	43	MD-1	42	M	19	BMD
14	M	45	FSHD	43	M	31	BMD
15	M	33	MM	44	M	53	FSHD
16	F	34	LGMD	45	M	37	FSHD
17	M	6	CMD	46	F	23	MD-1
18	F	15	CMD	47	M	17	BMD
19	M	32	MD	48	M	56	FSHD
20	M	18	BMD	49	M	16	DMD
21	F	26	FSHD	50	M	41	MD-1
22	F	13	CFTD	51	F	11	FSHD
23	M	10	CFTD	52	F	44	MD-1
24	M	8	DMD	53	M	44	MD-1
25	F	34	MD-1	54	F	25	MD-1
26	M	61	FSHD	55	M	42	MD-1
27	F	30	FSHD	56	F	32	MD
28	F	53	CNM	57	M	24	FSHD
29	M	24	BMD	58	M	25	FSHD

Diag=diagnosis; MD=Muscular dystrophy, without specification; BMD=Becker muscular dystrophy; LGMD=Limb girdle muscular dystrophy; CMD=Congenital muscular dystrophy; CFTD=Congenital fiber type disproportion; DMD=Duchenne muscular dystrophy; FSHD=Facioscapulohumeral muscular dystrophy; MD-1=Myotonic dystrophy, type 1; CNM=Centronuclear myopathy; DM=Distal myopathy; MM=Mitochondrial myopathy; MCM=Minicore myopathy.

Table 3. Intra-rater reliability of the MFM scale.

Item	Kappa coefficient	Item	Kappa coefficient
1	1.00	17	1.00
2	1.00	18	1.00
3	1.00	19	1.00
4	0.97	20	1.00
5	1.00	21	1.00
6	0.97	22	1.00
7	0.98	23	1.00
8	1.00	24	1.00
9	1.00	25	1.00
10	1.00	26	1.00
11	1.00	27	1.00
12	1.00	28	1.00
13	0.93	29	1.00
14	1.00	30	1.00
15	1.00	31	1.00
16	1.00	32	0.96

Table 4. Inter-rater reliability of the MFM scale.

Item	W (p-value)	Item	W (p-value)
1	1.00	18	0.98 (<0.0001)
2	1.00	19	1.00
3	1.00	20	1.00
4	0.99 (<0.0001)	21	1.00
5	1.00	22	1.00
6	1.00	23	0.99 (<0.0001)
7	0.98 (<0.0001)	24	1.00
8	0.99 (<0.0001)	25	1.00
9	0.97 (<0.0001)	26	0.98 (<0.0001)
10	0.98 (<0.0001)	27	0.99 (<0.0001)
11	0.99 (<0.0001)	28	1.00
12	1.00	29	1.00
13	1.00	30	0.96 (<0.0001)
14	1.00	31	0.97 (<0.0001)
15	0.97 (<0.0001)	32	0.98 (<0.0001)
16	0.98 (<0.0001)	Total	0.99 (<0.0001)
17	1.00		

W=Kendall coefficient of concordance.

in regard to the efficiency of the original, which has been used repeatedly[11]. These general benefits were a motivation for the development of a Portuguese version of the MFM scale.

Guillemin, Bombardier, and Beaton[24] suggested the need for the adaptation of subjective and personal scales and questionnaires within the Brazilian cultural context, with semantic validation, as was accomplished with other scales[25,26]. The 32 items of the MFM deal with objective commands of positioning, movements and transfers, hence actions that do not entail difficult interpretation or semantic variations. Therefore, this stage of the study was not necessary.

Safety and reliability in the application of a new scale[27] or version[10] presupposes the validation of the instrument, so that it can be used by other professionals. The application of the Portuguese version of the MFM scale yielded absolutely reproducible results, with appropriate inter and intra-rater coefficients of agreement for the 32 items, which demonstrate similar properties to the original French version[5]. The reproducible results indicate appropriate reliability levels[23].

The use of an instruction manual with previous training ensures the evaluation is learned correctly and minimizes errors during application of the instrument[28]. The raters in the MFM study had no difficulty understanding the Portuguese version of the scale or the instruction manual, demonstrating that this scale is easy to learn. Inter and intra-rater agreement of the Portuguese version of the MFM can be attributed, in part, to the rater's experience and performance due to previous training and also to the clarity of the instructions contained in the manual.

The Portuguese version of the MFM demonstrated good reliability and homogeneity in its application and can be considered a scale with high reproducibility which allows its

use as a measure of motor function in neuromuscular diseases. Furthermore, a scale which has been validated in several countries can promote collaborative clinical and therapeutic studies, having this as a common instrument.

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