

ORIGINAL ARTICLE

## Reliability and validity of milliken activities of daily living scale (MAS) in measuring activity limitations of a turkish population

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### Abstract

**Aim:** The Milliken Activities of Daily Living Scale (MAS) is a self-report scale to address limitation of ability to perform daily tasks in upper extremity injuries. It can address the necessity of each task, which makes MAS useful while planning individual treatment. The objective of this study was to perform cross-cultural adaptation of the MAS TURKISH and to evaluate its reliability and validity for Turkish-speaking patients with upper extremity conditions. **Method:** A total of 99 patients were asked to complete the adapted MAS and DASH at baseline and one week after the initial assessment. Also grip strength was evaluated with an interval of one week. **Results:** The reliability of the adapted version was good, with high internal consistency (Cronbach's alpha = 0.964) and test–retest reliability (interclass correlation coefficient (ICC) = 0.772) for the total score. A statistically significant correlation between MAS and DASH scores and grip strength scores of the injured side was obtained. **Conclusion:** The results of the study have shown that the Turkish version of MAS has excellent test–retest reliability and validity. It is a suitable assessment for evaluating function and giving an overview of activity limitations in many performance areas in a Turkish population.

**Key words:** Activity limitation, cross-cultural adaptation, hand function, Milliken Activities of Daily Living Scale, Turkish version

### Introduction

The gold standard of evidence-based practice is creating a growing push for higher quality evidence, which goes beyond simple objective measurements and reflects an individual's ability to participate in life (1). Therefore, evidence-based clinical decision-making requires measurement tools with good clinometric properties covering all domains of the International Classification of Functioning, Disability and Health (ICF) (2). Studies investigate such tools especially to understand the components, activity limitations, and participation according to ICF (1,2).

Upper extremity injuries commonly affect the ability to engage successfully in daily activities (1). However, it is necessary to know body limitations such as range of motion and muscle strength, and it is important to evaluate a person's activity limitations in order to be aware of a patient's participation in activities (3,4). A thorough evaluation of the functional status of patients with hand impairment consists of looking at the patient's performance areas within the context of his or her life roles (5).

Assessments focusing on activity limitations are also fundamental for decision-making, determination of patient progress, and evaluation of the effectiveness of treatment in hand therapy (1,4). This requires the

use of reliable and validated instruments to evaluate changes and, if possible, to predict the outcomes of different interventions (6). Traditional physical measures are less sensitive to clinical changes following upper extremity disorders than fully validated designed outcome questionnaires (4).

Although the upper extremity is very important in performing activities of daily living (ADL) there is very little information available regarding patient outcomes, although much has been published detailing the outcomes following lower extremity orthopaedic trauma (7). Frequently used ADL scales such as the Functional Independence Measure, Katz ADL scale, Lawton ADL scale, and Barthel ADL Index were developed for neurological conditions which were not sensitive to determine difficulties in orthopaedic injuries (8).

There are numerous measures that address upper extremity function, but only at the impairment level, not measuring pure activity limitations (4,9). The Milliken Activities of Daily Living Scale (MAS) was developed to capture the person's individualized lifestyle and perspective by including a self-report scale to address the necessity of each task, to assist the person to analyze his or her own abilities, and to provide a self-report scale to address limitation of ability to perform daily tasks in upper extremity injuries (10).

With the increase in the number of multinational and multicultural research projects, it would seem more appropriate to evaluate and adapt existing tools instead of designing new ones. As most questionnaires were developed in English-speaking countries, cross-cultural adaptation of validated outcome instruments has been advocated in order to facilitate their use in international multicentre clinical trials (11).

The objective of our study was to perform cross-cultural adaptation of the MAS TURKISH and to evaluate its reliability and validity for Turkish-speaking patients with upper extremity conditions. The process of translation and adaptation will be explained in detail to guide other researchers who are interested in doing version studies.

## Materials and method

### *Translation and cross-cultural adaptation*

A cross-cultural adaptation process was performed by following the guidelines provided by Ruberto et al. and Beaton et al. (11,12). The original version of the MAS was adapted into Turkish via the following five steps: (1) forward translations into Turkish, (2) a synthesis of the translations, (3) back translations into English, (4) revision by a committee of experts, and (5) test of the pre-final version (11). These guidelines are based on a review of cross-cultural

adaptation in the medical, sociological, and psychological literature as well as on the experience acquired through the years by different research groups (11).

The MAS questionnaire was translated into Turkish by two different and independent native Turkish speakers, who were both unaware of the purpose of the translation. Both Turkish translations were compared for inconsistencies. The questionnaire was retranslated, also blindly and independently, into English by two native English speakers. Each of the English translations was compared with the original English MAS questionnaire and checked for inconsistencies. The Turkish version was then jointly reviewed by a bilingual team to assess the necessity of performing a cultural adaptation and to fine-tune it in order to use among Turkish patients. They again compared the Turkish version with the original English version to detect errors of interpretation and nuances that might have been missed. A pre-final version was created and subjected to field-testing on 30 patients with different upper extremity problems. This version was finalized after slight changes were made through a consensus.

### *Questionnaires*

All the subjects filled the MAS and Disabilities of Arm, Shoulder and Hand-Turkish (DASH-T). They were also evaluated with the J-Tech Tracker Functional Capacity Evaluation System to measure grip strength.

The MAS (10) was developed with the goal of incorporating perceived task necessity into a client self-report measure in 2005. It is a client-centred measure that aims to capture information regarding bilateral and unilateral tasks, gross and fine motor skills, and a variety of prehensile patterns and resistance levels in any impairment that results in upper extremity activity limitations. It is composed of 47 tasks in the areas of meal preparation and eating (8 items), personal hygiene (9 items), dressing (8 items), object manipulation (8 items), housecleaning and laundry (7 items), and other activities (6 items) (10).

The DASH (13) is an upper-extremity specific outcome measure that was introduced by the American Academy of Orthopedic Surgeons in collaboration with a number of other organizations. DASH is a self-administered questionnaire with high validity to measure patients' perception of disabilities and symptoms and symptoms associated with any condition affecting the upper limb. It contains 30 items; 21 of them evaluate difficulty with specific tasks, five evaluate symptoms, and each of the remaining evaluates social function, work function, sleep, and confidence. DASH produce scores between 0 and 100 for each

module, in which a high DASH score indicates severe disability (13). The DASH has been shown to be reliable and valid in patient population with various upper-extremity disorders and has been translated into different languages (13,14). DASH cross-cultural adaptation into Turkish, and the validity and reliability study was performed by Duger et al. (14,15).

The DASH and the MAS both address limitations of upper extremity but DASH focuses more on physical health and pain symptoms. A notable advantage of the MAS is that functioning and pure activity limitations are taken into consideration with regard to personal factors as it includes a self-report scale to address the necessity of each task. The MAS also recognizes performance areas that DASH does not cover. It has potential in the development of patient-centred treatment programmes which are tailored to individual patients' requirements and have relevance to their daily activities. Therefore, it was considered for adaptation for a Turkish population.

### Subjects

A total of 99 patients with different upper extremity problems referred to the outpatient department of physical therapy or occupational therapy at Hacettepe University Faculty of Health Sciences from December 2009 to September 2010 were included to the study. The diagnoses were confirmed by the department of orthopaedics and an appropriate diagnostic work-up, including radiological and neurophysiologic investigations, was done by an orthopaedist at Hacettepe University.

Inclusion criteria for the patients were having an upper extremity problem of at least four weeks' duration, able to read or write in Turkish, and able to complete the questionnaire independently. Patients who had undergone a hand operation were included in the study at least four weeks after the surgery. Patients were excluded from the study if they had neurological disease, if they did not complete the entire questionnaire, if their symptoms had changed between the first and second measurements, and if they had any open wound or skin lesion.

Written informed consent was obtained from all participating patients at their first visit. Hacettepe University Ethical Committee approved the study (reference number HEK 09/122-21).

### Procedure

After the translation and adaptation process, subjects were asked to complete the MAS by rating their current ability level on a Likert scale ranging from

1 (unable to do) to 5 (able to do as before injury). In addition, level of necessity for each item is considered on a Likert scale ranging from 1 (not necessary) to 3 (necessary). Scores were summed for each section, and a global activity score is attained by summing scores for all sections. An integrated scoring procedure that uses the product of each ability score multiplied by each necessity score is also available.

Subjects had also completed the DASH questionnaire on the same day. The scoring of the DASH was done according to its original scoring system. The disability/symptom section was scored (30 items, scored 1–5) by simply summing and averaging the assigned values for all completed responses. This value was then transformed to a score out of 100 by subtracting one and multiplying by 25 (14).

Grip strength was measured with the Grip Track Module of the J-Tech Tracker Functional Capacity Evaluation System. Patients sat on a chair with shoulders and wrist in neutral position and the elbow in 90° of flexion. They were asked to squeeze the device as hard as possible and were encouraged vocally. In convenient with the recommendations of the American Society of Hand Therapy, three attempts were made and an average score was calculated for the affected hand. If both hands were affected, the dominant side was accepted as the affected side (16).

Subjects were asked to fill in the questionnaires twice with a one-week interval to assess the test–retest reliability of the MAS. It was assumed that the clinical situation did not change during this period. However, in total 74 of the subjects came for the second assessment or completed the entire questionnaires. Fifteen of the patients returned to their home town, three of the patients did not complete the entire questionnaire correctly, and seven of them did not want to complete the questionnaires again.

### Analyses

*Reliability.* Two types of reliability (test–retest and internal consistency) were assessed. Instrument test–retest reliability was assessed with the interclass correlation coefficient (ICC). ICCs can vary from 0.000 to 1.00 where values of 0.60 to 0.80 are regarded as evidence of good reliability, those above 0.80 indicating excellent reliability. Cronbach's alpha coefficient was used to determine internal consistency. A Cronbach's alpha value equal or greater than 0.7 is generally regarded as satisfactory.

*Validity.* Validation studies were assessed by construct validity, which means that the scales in the questionnaire behave as expected. The construct validity was assessed by comparing the results of the MAS with the

Turkish versions of the DASH and grip strength of the injured hand. To assess the association between domains, Pearson's product moment correlation coefficient was used if normal distribution was provided. If the data did not show normal distribution, Spearman's rank correlation coefficient was used.

Only test-retest reliability has been calculated with the 74 subjects; other reliability and validity studies have been undertaken for the entire 99 subjects who participated in the study.

## Results

### Adaptation

The MAS's translation was realized with minimal difficulties. The forward and backward translations had some discrepancies reflecting language specific/cultural differences in a few items. These were able to be resolved satisfactorily and gave the best conceptual equivalence.

In the eating/meal preparation section, the item "open a cereal box" needed to be explained further with other examples suitable for a Turkish population as occasionally "cereal" is not packaged in boxes. Also cereals like cornflakes are not a common food consumed by the population. The examples were therefore widened and the item changed to "open a box of cereals, juice, or milk".

In the hygiene section, back translation of "toileting" was "going to the toilet". The tasks involved in toileting have different words/phrases in Turkish. As the translation meaning only going to the toilet does not cover the hygiene part of toileting, this item's translation involved two phrases covering going to the toilet and cleaning oneself.

In the section on object manipulation the word "manipulation" needed to be discussed to find a word covering the same meaning in Turkish. Manipulation involves different handling activities and all of these activities have different words in Turkish. Instead of manipulation a word which has a quite similar meaning, "use", was used. The title and item 2 were translated with the agreed word for manipulation. In the same section item 9, writing a cheque, is not an activity that Turkish people do. Our population does not use cheques very often. The item was changed to signing as this task is thought to be an important task while writing a cheque.

In the other activities section "mow lawn" is also not a common activity. In the pilot study no one answered this item as many of the people who came to our department were living in cities and they do not have a lawn to mow. The item was changed into leading equipment with two arms such as a lawnmower, buggy, or trolley.

The pre-final version was judged and performed well in field testing. No patients had a problem completing the scale. The patients considered most of the MAS items to be clear and relevant to the condition of their activity limitations.

### Patient characteristics

Ninety-nine patients (59 women, 40 men) with a mean age of  $41.21 \pm 12.08$  years, range 20–59 years, were included in the study. Ninety-four patients were right-side dominant, and 41 patients' affected hand was the right. The diagnoses of the patients were categorized as nerve entrapments, fractures, and soft tissue injuries. The patients' diagnoses are presented in Table I.

During the first visit 99 patients completed the MAS and DASH. Grip strength was also assessed. The mean total score for MAS was  $428.5 \pm 132.7$  (range 128–690) and for DASH was  $40.2 \pm 22.9$  (range 0–90). Descriptive statistics for the MAS, DASH, and grip strength scores obtained are summarized in Table II.

### Reliability

Seventy-four patients completed the MAS questionnaire twice, with an interval of seven days (retest). To minimize the risk of short-term clinical change, no treatment was provided to these patients over the retest interval.

Internal consistency was calculated with Cronbach's alpha. According to the results, values ranged from 0.96 to 0.81, which means the consistency between items was excellent (Table III). The intraclass correlation coefficient (ICC) was used for test-retest reliability. The test-retest correlation showed excellent reliability in dressing, object manipulation, housecleaning, and other activities. The correlation was 0.76–0.79 for other domains, which also shows good reliability (Table III).

Table I. Categories of major diagnoses.

Major diagnoses	Number of patients (%)
Nerve entrapment	30(30.3%)
Fracture	28(28.2%)
Soft tissue injury	36(36.3%)
Cut tendon	10 (8.5%)
Ligament injury	3 (5.2%)
Tendinitis	20 (16.8%)
Trigger finger	3 (4.3%)
Other	5 (5.0%)

Table II. Descriptive statistics for the MAS, DASH, and grip strength scores.

	Mean ± SD	Median	Minimum	Maximum
<b>MAS</b>				
Total	428.5 ± 132.7	415	128	690
Meal preparation and eating	90.0 ± 25.5	91	36	120
Personal hygiene	80.1 ± 27.2	81	20	135
Dressing	89.2 ± 28.4	85	22	120
Object manipulation	55.8 ± 29.4	52	0	105
Housecleaning and laundry	37.0 ± 23.6	33	0	90
Other activities	76.5 ± 25.0	75	16	90
<b>DASH</b>	40.2 ± 22.9	36.7	0	90
Grip affected side	15.1 ± 11.1	11	1	47
Grip non-affected side	24.9 ± 10.2	23	5	46

Table III. Reliability testing of MAS.

	Internal consistency (Cronbach's alpha)	Test-retest correlation (intra-class correlation)	
		r	p
<b>MAS</b>			
Total	0.964	0.772	<0.001
Meal preparation and eating	0.871	0.761	<0.001
Personal hygiene	0.812	0.797	<0.001
Dressing	0.898	0.837	<0.001
Object manipulation	0.881	0.817	<0.001
Housecleaning and laundry	0.946	0.841	<0.001
Other activities	0.842	0.821	<0.001

*Construct validity*

DASH is used as a gold standard to assess the construct validity of MAS. The correlation between the MAS scores and grip strength scores for the affected side was also analysed. The correlation coefficients of the MAS scores to the DASH scores and grip strength scores are shown in Table IV.

There were strong to moderate correlations between the MAS subscale scores and DASH scores. The best correlation was found between the total MAS score and DASH score. Weak to moderate correlations were found between MAS and grip strength. The lowest correlation was found between MAS's personal hygiene, dressing, and housecleaning/laundry domains and grip strength.

**Discussion**

Generic outcome measures developed for upper extremity disorders such as DASH or the Michigan Hand Outcome Questionnaire address problems in

stated activities but they do not specifically develop knowledge on which performance areas the people have difficulty in (2,17). Although all these measures are standardized, valid, and reliable methods and give valuable information on the functional status of the patient, we were seeking a standardized, easy to complete, self-reported tool giving more information on activities that reflects the limitations of the population.

The MAS was found to be a suitable assessment for evaluating function and giving an overview of activity limitations in many performance areas. It also offers the ability to capture the person's individualized lifestyle and perspective by including a self-report scale addressing the necessity of each task, and assists the person concerned to analyse his or her own abilities and the therapist in treatment planning and to measure treatment outcomes (10). MAS's items were assumed to be appropriate for a Turkish population as it evaluates many of the performance areas in daily living.

It is also thought that it would be an advantage for the questionnaire to have the necessity section. Within

Table IV. Correlation of the MAS with DASH and grip strength.

	DASH		Grip strength affected	
	r	p	r	p
MAS				
Total	-0.641	<0.001	0.439	<0.001
Meal preparation and eating	-0.534	<0.001	0.391	<0.001
Personal hygiene	-0.588	<0.001	0.384	0.001
Dressing	-0.609	<0.001	0.318	0.005
Object manipulation	-0.636	<0.001	0.505	<0.001
Housecleaning and laundry	-0.351	<0.001	0.258	0.024
Other activities	-0.503	<0.001	0.410	<0.001

this section, the possibility of influence of patient priorities on arm-specific disability can be shown. Also, as MAS takes features such as age, sex, and lifestyle into account, it can give us some information on the characteristics of the patients involved. The items and necessity section make MAS useful while planning treatment. MAS has potential in the development of patient-centred treatment programmes that are tailored to individual patients' requirements and have relevance to their daily activities.

In this study, cross-cultural adaptation of the MAS for a Turkish population was performed and the test-retest reliability and construct validity of MAS Turkish were stated by following the systemic standardized approach.

General outcome results of MAS pointed to the lowest scores being in the sections "house cleaning/laundry", "object manipulation", and "other activities". The biggest activity limitation was found in the cleaning section. This reflects the importance of taking care of the house for a Turkish population. Women normally start doing housework even if they are not well enough to do so. The items object manipulation and other activities are commonly addressed by both men and women. Meal preparation and eating, personal hygiene, and dressing also gave valuable results by showing in which activities of these sections people have a problem. However, as they were not the most limited activities, we can say that outcome questionnaires providing examples only of self-care may not reflect the affected areas of performance for the population. Therefore we thought that the MAS questionnaire itself captured many of the problems in daily living.

In the adaptation process, conceptual equivalence was achieved with minor changes. Subjects found the language to be clear and understandable. While completing the questionnaire, they did not seek help to clarify the meaning of any of the items. After filling in the questionnaire, patients stated that the questions

reflected all of the problems they are faced with, that they had realized some of their problems in some areas, and that they found MAS easy and useful.

The reliability and construct validity results indicated that MAS is a reliable and valid assessment for individuals who sustain hand injury in a Turkish population. To establish reliability, internal consistency and test-retest correlation were stated. The internal consistency of the new version was high for all domains. This indicates conceptual equivalence of the Turkish version of MAS and comparability of interpretation across countries. Test-retest was done with a one-week interval to minimize the possible memory effect and provide a more realistic view of the degree of score change that may occur for non-specific reasons. The ICC was between 0.76 and 0.80 only for meal preparation/eating, personal hygiene, and total score; the other domains achieved values greater than 0.80. This may reflect the natural improvement and need of people to start activities related to eating and hygiene. This reasoning may be exclusive to a Turkish population but these activities are probably the most necessary ones as people first try to eat or go to the toilet by themselves.

In the determination of construct validity, the DASH questionnaire was selected to be a gold standard measure as it is accepted to be an often used, qualified, reliable, validated, standardized instrument. There were high to moderate correlations between the MAS subscale scores and DASH scores. The DASH was found to be best correlated with the total MAS score and MAS object manipulation score. One reason that assessments are similar in measuring change may be because of the similarity of the items making up these assessments (18). The DASH has items for eating, dressing, cleaning, and manipulation whereas the MAS contain broader items for these domains. For example while DASH has an item "prepare a meal", MAS has eight items related to preparing and eating a meal and while DASH asks

“wash or blow-dry your hair”, MAS has nine items related to personal hygiene. However, DASH includes four of the items included in the object manipulation section of MAS. This may be the reason for good correlation between this section and DASH. In general these two assessments have the same domains and correlated well, therefore they can be expected to discriminate between people of different abilities in a similar way.

There were also moderate correlation between the MAS and grip strength. As strength is not needed for all of the activities, it may not reflect a strong correlation. In fact, given the International Classification of Functioning, Disability and Health model of disability, variances between disability experienced and performance-based measures are to be anticipated (19). The lowest correlation was found in the dressing and housecleaning/laundry domains. These activities may be affected by not only strength but also limitations in range of motion.

This study has several limitations. Although the sample size is statistically sound for hand and wrist patients in the aggregate, it does not permit analyses of each major diagnostic group. The construct validity was tested only by comparing with DASH and grip strength measurement. But there is a need for studies that investigate the correlation of MAS with pain, hand function, psychological status, and quality of life as it does not directly ask but may indirectly assess these parameters that affect healing. Participation in meaningful activities has been associated with improved physical and mental health (20). The effect of these symptoms on psychological health and activity participation should be explored.

The MAS TURKISH proved to be a reliable and valid measure and may better discriminate in terms of activity limitation than DASH, which focuses on an assessment of disability. This new instrument was found to be feasible for implementation in clinical practice and may be particularly useful when examining intervention or disease processes of wrist and hand pathology and their impact on activity.

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