

Validity and Reliability of Arabic Version of Michigan Hand Outcomes Questionnaire in Assessment of Hand Function Post Burn

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ABSTRACT

Background: Burns on the hands are prevalent as a result of their exposed position. Hand burns can have a significant influence on both the physical and psychological well-being. The Michigan Hand Outcomes Questionnaire (MHQ) is commonly used to evaluate the hand and wrist problems. **Objectives:** To evaluate the validity and reliability of Arabic version of MHQ in assessment of hand function post burn. **Subjects and Methods:** 100 patients started to participate in the current study 1 month after burn injury, aged from (20-35) years, who suffered from second degree thermal burn injury with total body surface area (TBSA) ranged from (20-30%) involving mostly the dominant hand. The procedure of the study started by translation of the English version of MHQ into Arabic (forward and backward translation process). The pre-final version of MHQ was reviewed and analysed by 10 experts for validation process. Patients were asked to fill all items of the final version of MHQ to be tested and retested after 1 week for reliability assessment. **Results:** The mean index of clarity was 94.86%. The scale content validity index (S-CVI) was 0.94 and item content validity index (I-CVI) ranged from 0.8 to 1. The mean expert proportion of relevance was 94.59%. The r value was 0.667 and the p value was 0.001. Cronbach's alpha was 0.835. ICC of total score was 0.974 with 95% CI 0.930-0.987. Completing the scale took an average of 12.46 ± 3.86 minutes, with a maximum of 20 minutes and a minimum of 7 minutes. **Conclusion:** The Arabic version of MHQ proved to be a valid, reliable and feasible tool for assessing hand function in burned patients.

Keywords: Arabic language, Hand function, Burn, Michigan Hand Outcomes Questionnaire.

INTRODUCTION

Hand burns are considered challenging situations in burn therapy. Even though human hands make up approximately 2.5%-3% of the TBSA, they account for eighty percent of all body burns. In order to prevent upcoming impairment of hand functions and to achieve cosmetics and functional outcomes adequate for the activities of daily living (ADLs), burns of this type should receive more attention than burns of a similar size elsewhere on the body, as they significantly affect patient outcomes [1].

The hand performs a variety of vital tasks, including sensing, manipulating, gripping, and touching. Thus, burn damage to the hand might result in significant limits that impact an individual's involvement and activities [2].

Physical and social functioning has taken precedence above mortality rate avoidance in outcome evaluations for burn patients; thus, there is a perceived lack of burn-specific functional metrics, particularly for hand function. The impact of a burn damage must be documented, and appropriate hand function measurements are a critical first step in organizing, carrying out, and evaluating the results of hand function interventions and burn patients' rehabilitation programs [2,3].

The MHQ was developed in 1998 by Chung *et al.* [4] in order to assess patients' health state objectively for both acute and chronic hand illnesses.

It has now been translated and verified into several languages, comprising Dutch, German, Japanese, Korean, Polish, Brazilian Portuguese,

Turkish, and others, and has been used extensively across the world. The MHQ is the only available questionnaire that can differentiate between the two hands. It is more perceptive to functional alterations in the affected hand, and offers a more thorough evaluation [5].

So, we aimed to assess the validity and reliability of the translated Arabic version of MHQ in patients after burn as a tool to assess hand function.

SUBJECTS AND METHODS

Study design: This study was cross sectional study, which was performed at Department of Burn and Plastic Surgery, Assiut University and Otiefy Hospital, Assuit, Ministry of Health, Egypt from February 2023 to March 2024.

Sample size calculation:

To avoid type II error, the sample size was computed. Sample size for ICCs was calculated utilizing the formula conducted by Walter *et al.* [6]. Using the minimum acceptable ICC of 0.8, expected ICC of 0.9, significance level of 0.05, statistical power of 80% and number of repetitions of 2 and the required sample size was about 100 subjects.

SUBJECTS

Participants in this study included one hundred patients with dorsal surface burns on their dominant hands.

Inclusion criteria of the studied cases:

1) Patients of both genders with ages ranged from 20 to 35 years. (2) All patients suffering from second degree thermal burn injury with TBSA ranged from 20 to 30% with burn involving the dorsal surface of the dominant hand. (3) All patients were asked to fill the questionnaire after 1 month from burn injury and they were asked to refill the questionnaire with average time of 1 week. (4) All participants abled to read and write in Arabic. (5) All participants abled to understand items of the questionnaire easily.

Those who met any of the following criteria were not allowed to participate:

(1) Patients with cognitive and psychiatric disorders. (2) Patients with communication, vision and hearing disorders. (3) Patient who didn't fill the questionnaire till the end. (4) Patient who wasn't cooperative in filling the questionnaire. (5) Suicidal burn.

METHODS

• **Assessment Scale:** A self-administered questionnaire called MHQ. 37 key questions are used to evaluate the left and right hands' respective functionalities. The MHQ has six separate scales: (1) overall hand function (5 questions); (2) ADLs (5 with an extra 7 questions); (3) work performance (5 questions); (4) pain (5 questions); (5) aesthetics (4 questions); and (6) patient satisfaction with hand function (6 questions). Every inquiry is represented by a whole integer between 1 and 5. Each of the six scales' results is scored, and the scores are translated into numbers between 0 and 100. Better outcomes are indicated by greater numerical scores, with the exception of the pain scale, where greater scores are linked to more severe pain^[7,8].

• **Translation Procedures:**

The MHQ was translated and converted into Arabic using the following steps^[9].

• **Step 1: Forward translation (Initial translation):** Bilingual translators with Arabic as their native language translated MHQ's English content into Arabic using the forward translation method.

They provided the researcher with an overview of each item that was simple to understand for a candidate who was around 15 years old. The backgrounds and profiles of the two translators were dissimilar. Two translators worked on the questionnaire; one knew the ideas being translated from the researcher version, known as T1, and the other translator, known as T2, didn't know the concepts and didn't have any experience in medicine or clinical settings.

• **Step 2: Synthesis of translation:** The original questionnaire was translated into one common form (T12), and T1 and T2 versions, by the researcher.

• **Step 3: Backward translation:** Two more

bilingual translators, whose first language is English, translated this Arabic version T12 back into English without ever seeing the original English version (the reverse translation procedure). Both had no medical training and were multilingual in Arabic and English. They created two back translations, BT1 and BT2.

• **Step 4: Expert review:** To ensure conceptual meaning for the Egyptian people, the researcher ensured conceptual equivalency by bringing together all translated versions of the questionnaire, developing the pre-final questionnaire for field testing, and reviewing and modifying the translated instrument T12.

• **Step 5: Test of pre final testing:** A pre-final version of MHQ was given one-on-one to ten volunteers who were burn specialists in the field of physiotherapy and were reared in Egypt. Every participant was questioned on their thoughts on every topic on the survey. Their viewpoints and ideas were noted. An item was updated in consultation with linguistics specialists if two or more respondents had difficulties answering it.

• **Step 6: Authentication:** The final version of Arabic MHQ was administrated to an authentic office for translation.

Validation process: A panel of 10 experts with expertise in the topic studied was formed to review the final version of MHQ. Before giving a score on every single item in the given Content Validation Form, the experts were asked to critically analyze the domain and all of its components. To make the items more relevant to the topic in question, we asked the experts for comments, either orally or in writing. The item specific Index of Content Validity was determined by dividing the total expert scores by the total number of experts.

Reliability process: The researcher explained the items of the questionnaire to the participants, who were asked to answer the questionnaire with number from 1 to 5 for each item. Each survey question was allocated a score based on the response, with the exception of a pain scale, where a higher score is linked to more severe pain, a higher numerical score indicates better outcomes. The participants were invited to re-complete the questionnaire for test-retest reliability (TRR) analysis after a week had passed.

Ethical approval:

The study was authorized by the Ethical Committee of Faculty of Physical Therapy, Cairo University (No. P.T.REC/012/003621). Each participant in the study gave his consent before taking part in the study. The Helsinki Declaration was adhered to throughout the investigation.

Statistical analysis

SPSS version 25.0 for Windows was utilized to conduct all statistical analyses. Mean \pm SD were

used in the sample's descriptive statistical analysis for the quantitative data. Frequency and percentage were utilized for qualitative data. To test face validity, the Clarity Index was employed. To evaluate the content validity, the expert proportion of relevance, S-CVI, and I-CVI were employed. Pearson correlation coefficients were used to examine concurrent validity by examining the relationship between the MHQ scale and DASH. The internal consistency reliability was assessed using Cronbach's alpha. Utilizing the two-way mixed ICC with 95% CI, TRR was assessed. Every statistical test had a significance threshold of $p < 0.05$.

RESULTS

Subject demographic data

This study was conducted on a total of 100 patients with hand burns. Their mean \pm SD age was 27.90 ± 5.04 . The mean \pm SD TBSA was $25.56 \pm 3.74\%$. 71% of subjects were females. 86% of subjects were right-handed. 71% of subjects had the dominant hand affected (Table 1).

Table (1): General demographic data of the subjects (N=100).

	Mean \pm SD	Minimum	Maximum
Age (years)	27.90 ± 5.04	20	35
TBSA (%)	25.56 ± 3.74	20	30
	N	%	
Sex			
Females	71	71	
Males	29	29	
Dominant hand			
Right	86	86	
Left	14	14	
Affected hand			
Dominant	71	71	
Non dominant	1	1	
Both	28	28	

SD: Standard deviation.

Face validity

Expert panel for face validity:

10 experts participated in this study to investigate the validity of Arabic version of MHQ scale. There were 5 experts holding PhD, 3 consultants and 2 experts had master's degrees. The expert panel's mean \pm SD experience years for validity were 13.33 ± 4.43 years, ranging from 10 to 20 years.

Index of clarity of Arabic version of MHQ scale:

94.86% is an excellent mean index of clarity for the Arabic version of the MHQ scale. The Arabic version of the MHQ scale's measure of clarity varied from 80% to 100%.

The mean index of clarity of overall hand function was 94%, ADLs was 94.17 %, work performance was 94%, pain was 96%, aesthetics was 95% and the index of clarity of satisfaction was 96.67%.

Table (2): Item index of clarity of the Arabic version of MHQ scale:

	No. of experts that agree (Clear responses)	Item index of clarity (%)
Overall hand function		
Q1	10	100
Q2	9	90
Q3	9	90
Q4	10	100
Q5	9	90
ADL – one hand		
Q1	9	90
Q2	9	90
Q3	9	90
Q4	9	90
Q5	10	100
ADL – both hands		
Q1	10	100
Q2	9	90
Q3	9	90
Q4	10	100
Q5	9	90
Q6	10	100
Q7	10	100
Work performance		
Q1	10	100
Q2	8	80
Q3	9	90
Q4	10	100
Q5	10	100
Pain		
Q1	10	100
Q2	10	100
Q3	9	90
Q4	9	90
Q5	10	100
Aesthetics		
Q1	9	90
Q2	9	90
Q3	10	100
Q4	10	100
Satisfaction		
Q1	10	100
Q2	10	100
Q3	10	100
Q4	9	90
Q5	9	90
Q6	10	100
Mean	9.49	94.86

Content validity:

- CVI

The Arabic version of MHQ demonstrated excellent content validity, the scale CVI (S-CVI) was 0.94. The I-CVI ranged from 0.8 to 1. 19 items had 1 I-CVI, 15 items had 0.9 I-CVI and 3 items had 0.8 I-CVI.

Table (3): I-CVI of the final Arabic version of MHQ:

	No. of experts that agree (relevant responses)	I-CVI
Overall hand function		
Q1	10	1
Q2	8	0.8
Q3	9	0.9
Q4	10	1
Q5	9	0.9
ADL		
Q1	10	1
Q2	8	0.8
Q3	9	0.9
Q4	10	1
Q5	10	1
Q6	10	1
Q7	10	1
Q8	9	0.9
Q9	9	0.9
Q10	10	1
Q11	9	0.9
Q12	9	0.9
Work performance		
Q1	10	1
Q2	8	0.8
Q3	9	0.9
Q4	10	1
Q5	10	1
Pain		
Q1	10	1
Q2	10	1
Q3	9	0.9
Q4	9	0.9
Q5	10	1
Aesthetics		
Q1	9	0.9
Q2	9	0.9
Q3	10	1
Q4	10	1
Satisfaction		
Q1	10	1
Q2	9	0.9
Q3	10	1
Q4	9	0.9
Q5	9	0.9
Q6	10	1
	S-CVI	0.94

• Expert proportion of relevance

The mean expert proportion of relevance was 94.59%, which is excellent. One expert had 100% proportion of relevance, eight experts had 90 to 98% and one expert had 89.19% proportion of relevance.

• Concurrent validity

The correlations between total score of MHQ scale and each of disability score and work score of DASH was moderately positive significant correlation. The correlations between work score of MHQ scale and work score of DASH was moderately positive significant correlation. The correlations of disability score of DASH were moderately positive significant correlation with overall hand function, ADL, work performance, pain, aesthetics, and satisfaction. The correlations of work score of DASH were moderately positive significant correlation with overall hand function, ADL, pain, aesthetics, and satisfaction (Table 4).

Table (4): Correlation between MHQ and DASH questionnaires:

	DASH			
	Disability		Work	
	r value	p value	r value	p value
MHQ	0.667	0.001	0.580	0.001
Overall hand function	0.337	0.001	0.340	0.001
ADL	0.453	0.001	0.474	0.001
Work performance	0.348	0.001	0.638	0.001
Pain	0.365	0.001	0.439	0.001
Aesthetics	0.344	0.001	0.319	0.001
Satisfaction	0.470	0.001	0.413	0.001

r value: Pearson correlation coefficient. p value: Probability value
S: Significant

Reliability

-Internal consistency of Arabic version of MHQ scale:

Cronbach's alpha was used to assess the internal consistency of the MHQ. Cronbach's alpha for the Arabic version of MHQ was 0.835, indicating strong internal consistency. Cronbach's alpha for MHQ subscales was excellent for overall hand function and work performance, good for ADL and satisfaction, and acceptable for pain and aesthetics subscales (Table 5).

Table (5): Cronbach’s Alpha for Arabic version of MHQ:

	Number of items	Cronbach’s Alpha	95% CI	Degree
MHQ	37	0.835	0.874-0.788	Good
Overall hand function	5	0.929	0.905-0.949	Excellent
ADL	12	0.819	0.762-0.868	Good
Work performance	5	0.955	0.875-0.937	Excellent
Pain	5	0.723	0.627-0.801	Acceptable
Aesthetics	4	0.732	0.635-0.809	Acceptable
Satisfaction	6	0.874	0.832-0.909	Good

CI: Confidence interval.

- Test-retest reliability of the Arabic version of MHQ:

The Arabic version of MHOQ scale showed excellent test-retest reliability in all items. ICC of total score was 0.974. ICC of overall hand function, ADL, work, pain, aesthetics, and satisfaction subscales was 0.947 and above.

Table (6): Test-retest reliability of Arabic version of MHQ:

	ICC	(95% CI)		P value
		Lower bound	Upper bound	
MHQ	0.974	0.930	0.987	0.001
Overall hand function	0.949	0.680	0.982	0.001
ADL	0.972	0.918	0.987	0.001
Work performance	0.978	0.938	0.989	0.001
Pain	0.967	0.948	0.979	0.001
Aesthetics	0.947	0.921	0.964	0.001
Satisfaction	0.986	0.965	0.993	0.001

ICC: Intraclass correlation coefficient value;

CI: Confidence Interval. P value, Probability value

Feasibility:

The MHQ questionnaire took an average of 12.46 ± 3.86 min to complete, with a maximum time of 20 minutes and a minimum of 7 minutes. There were no missing items. 44% of participants needed 7-10 minutes to complete the questionnaire (Table 7).

Table (7): Frequency distribution of time needed to complete the MHQ scale in minutes:

Time (min)	Frequency	Percent
7-10	44	44
11-15	33	33
16-20	23	23
Average ± SD	12.46 ± 3.86	

DISCUSSION

One of the most often burned parts of the body is thought to be the hand. Even though hand burns only make about 5% of the TBSA, they are considered serious damage and need lengthy care in a burn center. Although hand burns don’t usually result in significant death rates, they could cause deformities and disabilities that could firmly restrict the patient's ability to conduct ADLs and fine motor skills. These limitations can lead to significant functional limitations as well as impairments in the patient's physical and psychological state as well as their overall quality of life [10].

One of the most popular standardized tools for evaluating hand functioning in both acute and chronic hand and wrist illnesses is the MHQ, developed in 1998 at Michigan University in the United States. Investigators can evaluate the hand and wrist both generally and specifically on one side thanks to MHQ. The 37 questions (items) on it evaluate hand function in six categories (domains): general function, ADLs, work, pain, aesthetic appearance, and personal satisfaction. It is typically self-assessed in around ten min [11].

This study was carried-out for translation and validation the Arabic version of MHQ questionnaire to aid in the evaluation of hand functions post burn. This study was performed on 100 patients of both gender who had second degree thermal burn injury, TBSA ranged from (20 to 30 %) with burn injury involving the dorsal surface of the dominant hand. Their ages ranged from 20 to 35 years. This study was conducted in Department of Burn and Plastic Surgery, Assuit University Hospital and Otiefy Hospital, Assuit, Ministry of Health, Egypt.

Getting a questionnaire translated into another language remains a challenging task. Once the original questionnaire has been translated, it must be tested for reliability and validity in a sufficient sample and evaluated for psychometric features in the population of interest. The face validity, content validity, concurrent validity, internal consistency, TRR, and viability of the Arabic version of MHQ have all been proven in our study.

Ten experts evaluated the face validity of the Arabic-language version of the MHQ questionnaire using the clarity index. To ensure that the Arabic version of MHQ is clear and simple for patients to understand, the clarity index was checked and the pre-final version was adjusted. 94.86% is an excellent mean index of clarity for the Arabic version

of the MHQ scale. This indicates that the content is concise, easy to understand, and clear. This was in line with **Passiatore et al.**'s findings^[11] who discovered that the Italian translation of MHQ was prepared using a straightforward vocabulary and everyday terminology to make it as easy to understand as possible and to allow for maximum completion. Consequently, the questionnaire has shown to be clear and easy to understand.

Examining content validity involves determining how well the questionnaire's items capture the topics of interest^[12]. The S-CVI was 0.94 which demonstrated an excellent content validity. The mean expert proportion of relevance was 94.59%, which is excellent. One expert had 100% proportion of relevance, eight experts had 90 to 98% and one expert had 89.19% proportion of relevance. The I-CVI ranged from 0.8 to 1. 19 items had 1 I-CVI, 15 items had 0.9 I-CVI and 3 items had 0.8 I-CVI. So, experts believe that the Arabic version of MHQ has excellent content validity. This was in accordance with **Shi et al.**^[12], who suggested that, I-CVIs of 0.78 or more and S-CVI/UA and S-CVI/Ave 0.8 and 0.9 or higher should make up a scale with outstanding content validity.

In our study, evidence for concurrent validity was established by assessing the link between the MHQ and DASH questionnaire. The correlations between total score of MHQ scale, disability score and work score of DASH were moderately positive significant correlation ($r=0.667$, $p=0.0001$) and ($r=0.580$, $p=0.0001$) respectively. The correlations between work score of MHQ scale and work score of DASH was moderately positive significant correlation ($r=0.638$, $p=0.001$). The correlations of disability score of DASH were moderately positive significant correlation with overall hand function ($r=0.337$, $p=0.001$), ADL ($r=0.453$, $p=0.001$), work performance ($r=0.348$, $p=0.001$), pain ($r=0.365$, $p=0.001$), aesthetics ($r=0.344$, $p=0.001$) and satisfaction ($r=0.470$, $p=0.001$). The correlations of work score of DASH were moderately positive significant correlation with overall hand function ($r=0.340$, $p=0.001$), ADL ($r=0.474$, $p=0.001$), pain ($r=0.439$, $p=0.01$), aesthetics ($r=0.319$, $p=0.001$) and satisfaction ($r=0.413$, $p=0.001$).

Our results came in agreement with **Passiatore et al.**^[11] who showed excellent correlation between Italian version of MHQ and DASH questionnaires in every subscale.

For a measurement to be considered reliable, it must agree with the measured value when taken at different times using the same or comparable procedures. When evaluating a construct of interest, internal consistency shows how well-related the items are. The number of items in the questionnaire and their variation determine Cronbach's α , which is used for estimation^[13].

Our research revealed that all of the Arabic MHQ questionnaire's items showed strong

correlations, indicating strong internal consistency. TRR and good internal consistency were seen in all Arabic MHQ subscales. The Arabic translation was precise and internally consistent across the full questionnaire and subclass areas.

Internal consistency evaluates how consistently respondents answer different questionnaire items. To assess the MHQ subscales, we used a Cronbach's alpha. Cronbach's alpha is generally considered to be perfect when it is ≥ 0.9 , satisfactory when it is $0.7 \leq \alpha < 0.9$, acceptable when it is $0.6 \leq \alpha < 0.7$, bad when it is $0.5 \leq \alpha < 0.6$, and undesirable when it is < 0.5 . However, in terms of question redundancy, we have to exercise caution for > 0.9 ^[14]. The value of α that we obtained was 0.835, which demonstrated sufficient variation among the items and was deemed good internal consistency in our target group. In agreement, **Öksüz et al.**^[15] who discovered that for all subscale scores, the internal consistency coefficient of the Turkish version of MHQ, as determined by Cronbach's alpha, varied from 0.85 to 0.96. A threshold value of 0.80 was considered accepted results. In addition to the finding of **Hulkkonen et al.**^[16] who found that all of the MHQ subscales in the Finnish version have Cronbach's alpha values between 0.90 and 0.97, suggesting great internal consistency in the subscales, and **Lye et al.**^[5] found that since all of the ICC values for the Malay version of MHQ were greater than 0.9, the level of ICC was excellent. Also, the finding of **Dhippayom et al.**^[17] who found that the Thai version of MHQ had a satisfactory internal consistency, as determined by the Cronbach's alpha coefficient, which varied from 0.7 to 0.95.

To ensure that respondents' responses were consistent, the TRR was tested by giving the same questionnaire to the same group of individuals twice^[14]. For such questionnaires, the test-retest was administered at 1 week interval to allow the memory to fade when recalling the previous answer; however, the gap should not be so extensive that other circumstances could influence the last response.

The Arabic version of MHQ showed excellent test-re test reliability in all items. ICC of total score was 0.974 with 95% CI 0.930-0.987, 0.949 for overall hand function, 0.972 for ADL, 0.978 for work, 0.967 for pain, 0.947 for aesthetics and 0.986 for satisfaction. This is consistent with **Öksüz et al.**^[15] who found that ICC values ranged from 0.000 to 1.00; values above 0.80 are considered to indicate exceptional reliability, and values between 0.60 and 0.80 are considered to be evidence of good reliability. Also, with **Passiatore et al.**^[11] who found that the Italian version of MHQ included ICC values ranging from 0 to 1, where 1 denoted perfect reliability. These values were assessed as follows: Low reliability is indicated by values less than 0.50, moderate reliability is shown by values between 0.50 and 0.75, high reliability is indicated by values between 0.75 and 0.90, and excellent reliability is

demonstrated by values more than 0.90. Furthermore, **Hulkkonen et al.** [16] reported that all of the Finnish version of the MHQ subscales had high to outstanding TRR, with ICC values ranging from 0.66 to 0.91.

The research instrument checks the feasibility of the translated construct. The MHQ needed an average of 12.46 ± 3.86 min to be completed with maximum of 20 min and minimum of 7 min. It needed 7 to 10 min to be completed in 44% of all patients, 11 to 15 min in 33% of all patients and 16 to 20 min in 23% of all patients There were no missing items. Our findings corroborated those of **Ilhanli et al.** [18], who discovered that patients finished the Turkish version of MHQ in nine minutes, and that the duration was deemed appropriate by the patients, in line with findings published in other studies. The patients found it easy to complete the questionnaire.

The current study is considered one of the studies in validity and reliability of MHQ on Egyptian patients (Arabic mother tongue). The completed version is thought to serve as the foundation for the upcoming studies that will be carried out to determine the complete psychometric qualities of the MHQ Arabic language version.

Limitations:

This study was limited by individual difference between the patients, and the experts were so busy.

CONCLUSION

The Arabic version of MHQ was established to be a valid, reliable, and feasible approach to be used with Arabic speaking patients with post hand burn to aid in assessing hand function.

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