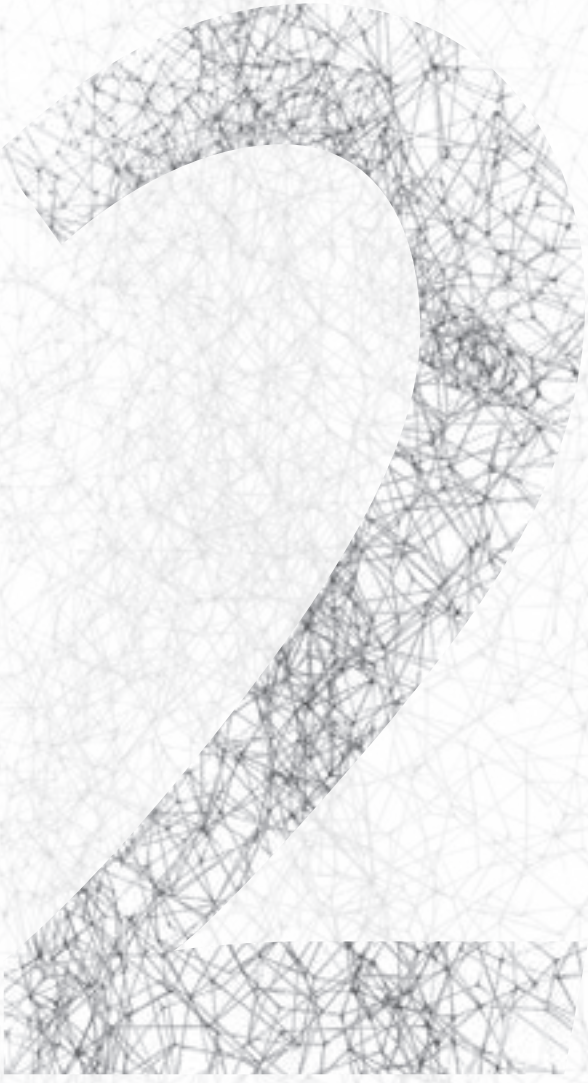
The long term consequences of stroke

Arwert, H.J.



Chapter 2

Validity of the Michigan Hand Outcomes Questionnaire in Patients With Stroke

Arwert HJ, Keizer S, Kromme CH, Vliet Vlieland TP, Meesters JJ
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List of abbreviations:

ARAT Action Research Arm Test
ICF International Classification of Functioning, Disability and Health
FAT Frenchay Arm Test
MCS mental component summary
MHQ Michigan Hand Outcomes Questionnaire MI Motricity Index
NHPT Nine Hole Peg Test
PCS physical component summary
SF-36 Medical Outcomes Study 36-Item Short-Form Health Survey

Abstract

Objective: To investigate the measurement properties of the Dutch version of the Michigan Hand Outcomes Questionnaire (MHQ) in patients with stroke.

Design: Validation study.

Setting: Outpatient rehabilitation clinic.

Participants: Consecutive patients with stroke (N=51; mean age, 60±11y; 16 women (31%)).

Interventions: Patients were asked to complete the MHQ (57 items) and Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36). Additional assessments included the Barthel Index and performance tests for hand function (Action Research Arm Test, Nine Hole Peg Test, Frenchay Arm Test, Motricity Index).

Main Outcome Measures: Associations between the MHQ and other outcome measures were determined using Spearman correlation coefficients and the internal consistency of the MHQ using Cronbach a. Floor or ceiling effects were present if >15% of the patients scored minimal or maximal scores, respectively. Test-retest reliability was established by the intraclass correlation coefficient.

Results: The mean MHQ total score was 70.0±22.4, with Cronbach α being .97. The MHQ total score correlated significantly with the physical component summary of the SF-36, the Barthel Index, and all hand function performance tests (P<.01). The MHQ total score showed no floor or ceiling effects. The test-retest intraclass correlation coefficient was .97.

Conclusions: This study provides preliminary evidence that the MHQ is an internally consistent, valid, and reliable hand function questionnaire in outpatients after stroke, although these results need to be further confirmed.

Introduction

Despite important advances in acute medical care, stroke accounts for >6 million deaths per year worldwide and has a major impact on multiple areas of life in many of the survivors.[1] Regarding the consequences for upper extremity function, it was found that 69% of the patients experience hand function problems directly after stroke, leading to permanent limited function in half of them.[2] Moreover, the initial impairment of the upper extremity was found to be the strongest prognostic factor for the outcome of stroke.[3] The comprehensive International Classification of Functioning, Disability and Health (ICF) core set for patients with stroke comprises all aspects of health status that are important for patients with this condition,[4] including fine hand use as well as hand and arm use.

Until now, hand function problems in patients with stroke are usually identified and monitored by means of instrumented performance tests, such as the Nine Hole Peg Test (NHPT),[5] the Frenchay Arm Test (FAT),[6] or the Action Research Arm Test (ARAT).[7] Such instrumented tests are, however, time-consuming in terms of administration, preparation, and travel time for patients to attend face-to-face sessions and require specific equipment as well as trained clinicians. These requirements can form a barrier to assess poststroke hand function in a proper and timely manner in daily practice. Self-administered questionnaires have an important advantage in this respect, although questionnaires are subjective in their nature and some patients might not be able to complete a questionnaire without assistance. Self-reported outcome measures may cover information that is not obtained from the capacity outcome measures of upper limb function and vice versa.[8] In general, the aim and nature of a study will determine the type of the outcome measure to be chosen.

Ideally, a hand function questionnaire should include aspects of hand function not only in the ICF domains body functions and body structures but also in the domains activities and participation. Currently, there is no single valid and reliable outcome measure available to capture the full range of daily function in the hemiparetic upper limb.[9] This observation is in accordance with a systematic review on the topic of instruments for arm/ hand assessment,[10] concluding that there is a need for instruments to measure hand function that are easy to administer, covering aspects of body functions as well as daily activities. The Stroke Impact Scale[11] and the ABILHAND[12] are outcome questionnaires that comprise hand-related questions, but only with respect to some aspects of the ICF. The Stroke Impact Scale focuses on strength and daily activities and the ABILHAND on daily activities. The Michigan Hand

Outcomes Questionnaire (MHQ) covers the ICF core sets for stroke to a much larger extent than do the aforementioned questionnaires.

The MHQ[13] is a patient-reported outcome measure focusing on hand performance in daily life, but also takes such aspects into account as underlying impairments, work, and satisfaction. Apart from bimanual tasks, it includes an assessment of each hand separately. Its validity and responsiveness have been proven for various hand conditions, for example, in patients with rheumatoid arthritis, metacarpal phalangeal joint arthroplasty, carpal tunnel syndrome, hand injury, and distal radius fracture.[14-19] The MHQ was recently used in a study on the effect of botulinum toxin on spasticity in patients after acquired brain injury,[20] but is not validated for this patient group to date. Therefore, the present study aimed to investigate the measurement properties of the MHQ in patients with stroke receiving outpatient rehabilitation care.

Methods

Study design

This cross-sectional study was conducted from May 1, 2013 to February 1, 2014 in the Sophia Rehabilitation Center, The Hague. The study was judged to be nonmedical research by the Medical Ethics Review Committee of the Leiden University Medical Center. All participants gave written informed consent, and the study was conducted according to the Declaration of Helsinki.[21]

Patients

Consecutive adult patients with stroke who received multidisciplinary rehabilitation treatment in the Sophia Rehabilitation Center were selected using the following inclusion criteria: first stroke no longer than 5 years ago; 18 years or older; participating in an outpatient multidisciplinary rehabilitation program; being able to read and comprehend the Dutch language; being in a sufficient physical and emotional status to take part in assessments and to complete questionnaires. Potentially eligible patients were invited by their treating physician to participate.

Rehabilitation treatment

All patients received a regular stroke rehabilitation treatment, not necessarily focused on hand problems. This comprises a multidisciplinary, goal-oriented, individualized treatment program. National evidence-based guidelines were followed with respect to the type and intensity of individual treatment modalities.[22]

Assessment methods

Procedure

Stroke characteristics were collected from the medical record, including the nature of stroke (hemorrhagic/ischemic), time since stroke, and type of paresis (left/right).

Patients were invited to a 1-hour assessment on a regular treatment day. The assessment comprised the Barthel Index, a set of questionnaires (sociodemographic characteristics and the MHQ), and 4 instrumented tests. In case of bilateral involvement, the most affected site was tested. Patients whose treatment schedule allowed a retest 2 weeks after the first administration of the MHQ were asked to complete the MHQ for a second time (21 patients); they all complied. The clinical assessments and data extraction from the medical records were executed by a trained and experienced health professional (S.K.), who was not involved in the treatment of the patients.

Sociodemographic characteristics

Sociodemographic characteristics included age, sex, educational level (low: up to and including lower technical and vocational training; medium: up to and including secondary technical and vocational training; and high: up to and including higher technical and vocational training and university), and employment status (in patients younger than 65y).

The MHQ

The MHQ is a self-administered, 57-item questionnaire covering 6 domains: overall hand function, activities of daily living, pain, work performance, aesthetics, and patients' satisfaction with hand function.[13,23] It covers the relevant ICF categories to describe the effect of stroke on hand function.[4] The function of the left and right hand is recorded separately (except for the domains pain and work performance). Each item is scored on a 1 to 5 scale, with the domain scores ranging from 0 to 100. For every domain, a higher score indicates

better hand function. The pain scale is reversed (100 - pain score) to obtain a range from worst (0) to best (100). The total score (the average of all domains) ranges from 0 to 100, with higher scores indicating better hand function.[13,23] This total score is obtained by summing the scores for all 6 scales and then dividing by 6. For scales with <50% missing items, the average of the existing scale items was imputed for the missing items. If 50% of the items are missing, the scale was not scored. The MHQ total score was not computed if scores for >2 scales were missing. The Dutch version of the MHQ was developed and validated in patients with rheumatoid arthritis.[24] Patients filled in the MHQ without further assistance. It takes 15 minutes to complete the questionnaire.[23]

Physical functioning

The Barthel Index is a structured interview to estimate a patient's performance in terms of activities of daily living. Scores range from 0 to 20, with 20 points indicating full independence in activities of daily living.[25]

Health-Related Quality of Life

The Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) is a generic instrument with 36 items covering 8 domains: physical function, role physical, bodily pain, general health, vitality, social function, role emotional, and mental health. From these, physical and mental component summary (PCS and MCS) of the SF36 can be computed, with both scales ranging from 0 to 100, with higher scores indicating better health status. Translation and validation of the Dutch version of the SF-36 was done by Aaronson et al.[26]

Instrumented tests

Hand function was measured using the following 4 instrumented tests, which were validated for patients with stroke:

The FAT assesses the functional capacity of the paretic upperextremity.[6] The test consists of 5 instrumented tasks, each scored binomially (0 or 1 point), with the maximum score being 5 points, with higher scores indicating better function.

The ARAT is an instrumented test to evaluate arm/hand function poststroke.[7] In this test, patients have to perform standardized tasks using 19 tools from a testing box. Dexterity and speed are scored on a 4-point scale (0-3). The maximum score is 57 points, with higher scores indicating good hand function.

The NHPT is an instrumented test specifically for hand function.[5] In this test, patients are asked to take 9 pegs from a box, stick them on a board, take them out again, and put them back in the box. Scores range from 0 to 18 points, with higher scores indicating better performance. Time is recorded, and the time limit is 50 seconds.

The Motricity Index (MI) measures muscle strength of the hemiplegic side in patients with stroke, arm and leg separately.[27] It takes into account the ability to perform voluntary movements and the maximal voluntary contraction. The score ranges from 0 to 100, with higher scores indicating more strength. In this study, the MI Arm was used.

Analysis

Descriptive analyses were used for disease characteristics, sociodemographic characteristics, instrumented tests, and outcomes on the questionnaires of patients participating in the study.

Then, the following measurement properties of the MHQ were determined.

Validity

In this study, the convergent validity, a subtype of construct validity, was used (how strongly a measure correlates with other related measures).[28] For this purpose, correlations between the MHQ total score and subscales on the one side and measures of physical and psychological functioning and overall quality of life on the other side were determined using Spearman correlation coefficients. We hypothesized that lower MHQ total scores would be associated with worse physical functioning and a lower quality of life. Furthermore, because the MHQ total score is a measure of hand function, we hypothesized that correlations with measures of mental functioning (MCS of the SF-36) would be the weakest whereas correlations with measures addressing hand function (instrumented tests) would be stronger.

Internal consistency

The internal consistency is related to the degree of interrelatedness of the MHQ total score and the 6 MHQ subscale scores. It was determined by calculating Cronbach α. The internal consistency is considered to be good when Cronbach α is between .70 and .95.[28]

Floor or ceiling effects

Possible floor or ceiling effects of the MHQ were determined by using the frequency

distributions of the MHQ total and subscale scores at admission. Floor or ceiling effects were considered to be present if >15% of the respondents achieved the lowest or highest possible score, respectively.[28]

Test-retest reliability

Test-retest reliability was studied by computing the intraclass correlation of the total and subscale scores obtained at the assessment in the hospital and 2 weeks later in a subsample of 21 patients. Hand function was assumed to be stable in our population in a 2-week period, and exact recollection of the initial answers was not to be expected.

The validity and floor or ceiling effects were analyzed similarly in a subgroup of patients with limited hand function (MI Arm<100) to account for the fact that the patients in this study were not primarily included because of hand function problems.

All statistical analyses were performed using SPSS 22.0 for Windows.[a] A P value of <.05 was considered statistically significant. Tests were all 2-sided.

Results

In total, 51 patients agreed to participate in the study. Table 1 lists the sociodemographic and clinical characteristics of these patients.

Age, sex, and educational level were not significantly correlated to MHQ total scores (age: r=.02, P=.92; sex: r=.13, P=.39; educational level: r=.27, P=.06). The mean MHQ score was 70.0±22.4, with the best subscore for the domain pain (79.3±24.4) (table 2). The relatively high scores on the MHQ and instrumented tests were an indication for an overall mild impairment. A subgroup of patients with impaired hand function was identified using the MI Arm as a criterion; 37 patients scored <100 points. This subgroup had lower results on all outcome measures.

The ARAT and MHQ outcome scores of the patients with an MI Arm of 100 points were 56.4±1.3 and 92.1±9.1, respectively.

Table 3 presents the correlations between the MHQ scores of the affected hand and measures of physical functioning and quality of life. Significant correlations (2-tailed, P<.01)

were found between the MHQ total score and outcome scores of the PCS of the SF-36, FAT, NHPT, MI Arm, and ARAT. The correlations indicated that lower MHQ scores were associated with worse physical functioning and lower quality of life. No significant correlation was found between the MHQ total score and score of the MCS of the SF-36. The subgroup of patients with impaired hand function (MI Arm score<100) yielded similar results. Table 4 presents the correlations between the MHQ subscales (all patients) and other outcome measures. The MHQ work subscale was significantly associated with the MCS of the SF-36, and the MHQ pain subscale was significantly associated with the PCS of the SF-36, NHPT time, and MI Arm.

With respect to the internal consistency of the MHQ, Cronbach α was .97 for the total score, .95 for the domain overall hand function, .97 for activities of daily living, .86 for pain, .97 for work performance, .90 for aesthetics, and .92 for patients' satisfaction with hand function.

Table 5 presents the number of patients with minimum and maximum scores (floor and ceiling effects). The MHQ total score showed no floor or ceiling effects. The MHQ subscores, however, did show ceiling effects. Floor or ceiling effects were also observed in the Barthel Index, FAT, ARAT, NHPT, and MI Arm. In the subgroup of patients with problems of arm/hand function (MI Arm<100), only the MHQ pain and aesthetics subscales showed a ceiling effect; the other MHQ subscales no longer showed it. The Barthel Index, FAT, ARAT, and NHPT still had large percentages in the minimum or maximum scores. The MI Arm no longer showed a ceiling effect because of the selection criterion of this subgroup (MI Arm<100).

Test-retest reliability was determined by means of the intraclass correlation coefficient computed in the 21 patients who filled in the MHQ twice. The intraclass correlation coefficient was .97 for the total score, .89 for the domain overall hand function, .84 for activities of daily living, .96 for pain, .90 for work performance, .78 for aesthetics, and .94 for patients' satisfaction with hand function.

Discussion

This study gives preliminary evidence that the MHQ is a consistent, valid, and reliable questionnaire to assess hand function in a population of 51 patients with stroke who were treated at an outpatient rehabilitation clinic. The MHQ comprises elements of the ICF domains body functions and structures, activities, and participation.

Our study population was not selected for problems in hand function specifically. This resulted in a relatively high MHQ total score compared with other studies. In previous studies of patients with rheumatic conditions and hand function problems, patients had average scores of 38.3[29] and 48.3[24] before treatment and 62.7 and 54.7 after treatment, respectively. In addition, patients with carpal tunnel syndrome had scores ranging from 47.6 to 52.9 before surgery and from 59.3 to 67.7 after surgery.[19] After selection of a subgroup of patients with hand function problems (MI Arm<100; n=37), the MHQ total score was 61.5 in our study, which is in line with other study populations.

The validity of the MHQ was accounted for by the significant correlations with the instrumented tests and PCS of the SF-36. As expected, lower MHQ total scores were related to unfavorable outcome scores, except for the MCS of the SF-36. We concluded that as far as emotional well-being is part of the MHQ construct, it does not correlate to mental aspects in general. In other populations such as those with rheumatoid arthritis, carpal tunnel syndrome, and distal radial fracture, the validity of the MHQ was established by relating the MHQ to instrumented hand tests or patient-reported improvement.[13,14,30]

The internal consistency of the MHQ was excellent for all subscales. In the study of Chung et al,[13] comparable values varying from .86 to .97 were found.

Floor or ceiling effects were prominent in the instrumented hand function tests and in the MHQ subscales. In the selected group of patients with hand function problems (MI Arm<100), the MHQ and 4 of the MHQ subscales showed no floor or ceiling effects; the MHQ subscales showed a ceiling effect for domains aesthetics and pain, as did the instrumented tests. The ceiling effect of the ARAT is a common problem, as demonstrated in another hospital-based population with stroke.[31] In the study of Shauver and Chung,[32] a ceiling effect was observed in the MHQ in patients with distal radial fracture 3 months postoperatively, in contrast to patients with rheumatoid arthritis or carpal tunnel syndrome. In our population with stroke, the MHQ can deal relatively well with floor and ceiling effects in the population with stroke, specifically in the subgroup with impaired hand function. Considering this, the MHQ is probably most suited for patients with stroke who actually experience hand function limitations.

The excellent reliability is in concordance with other studies of orthopedic patient groups such as those with rheumatoid arthritis and osteoarthritis; the intraclass correlation coefficient ranges from .85 to .96 for the total scores in these studies.[14]

Study limitations

This study is related to a population of patients with stroke taking part in an outpatient rehabilitation program in a specialized rehabilitation center. This population did not include the frail older population of patients with stroke who are referred to a nursing home after initial hospital admission, nor do the patients with very mild consequences who are directly discharged to their homes to receive treatment in primary care; therefore, the outcomes of this study cannot be applied to the population with stroke as a whole. Owing to the nature of a patient-reported outcome measure, patients with stroke and impaired cognitive functions may experience difficulties using the questionnaire. Another limitation of this study is the relatively small sample size, which prevented additional statistical analyses, such as confirmatory factor analysis. In contrast, the small sample size enabled the use of comprehensive hand function testing.

Conclusions

This study provides preliminary evidence that the MHQ is an internally consistent, valid, and reliable questionnaire with the ability to assess and describe hand function in patients with stroke admitted for outpatient rehabilitation; however, the results need to be confirmed in other populations with stroke. It may satisfy the need for a stroke-specific hand outcome measure that is easy to administer and covers the body functions and structures as well as the activities and participation domains of the ICF. Further research is needed to confirm responsiveness to treatment and to establish the minimal clinically important difference.

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Table 1. Baseline clinical and sociodemographic characteristics of 51 stroke patients receiving outpatient rehabilitation treatment.

Mean (min-max)	
Age, years	60 (39-87)
Time since stroke, months	8 (3-27)
Barthel Index	19 (12-20)
Number of patients; n (%)	
Female	16 (31)
Ischaemic stroke	39 (76)
Affected hand at time of study	
• Left	20 (39)
• Right	20 (39)
• Both	6 (12)
• None	5 (10)
Paid job before stroke [a]	
Education level [b]	30 (88)
• Low	14 (28)
• Medium	22 (44)
• High	14 (28)

[a] 30 out of 34 patients who had the workable age (≤65years before stroke)

[b] Low: up to and including lower technical and vocational training; medium: up to and including secondary technical and vocational training; and high: up to and including higher technical and vocational training and university.

Table 2. MHQ scores of the affected hand and measures of physical functioning and QoL of 51 stroke patients admitted for a general rehabilitation treatment, and in subgroup of 37 patients with hand function problems (Motricity Index Arm <100).

Hand Function Measure	N	Mean (SD) all patients	N	Mean (SD) subgroup MI<100
MHQ total score (worst-best; 0-100)	50	70.0 (22.4)	36	61.5 (20.1)
Subscales MHQ (worst-best; 0-100)				
Overall hand function	51	58.0 (27.3)	37	47.6 (22.2)
Activities of daily living	50	73.3 (26.6)	36	65.6 (27.1)
Pain	49	79.3 (24.4)	36	74.1 (25.9)
Work performance	45	63.4 (32.3)	33	53.3 (31.0)
Aesthetics	51	78.5 (29.4)	37	70.8 (31.2)
Satisfaction	51	63.7 (29.7)	37	53.9 (28.4)
Barthel index (worst-best, 0-20)	51	19.4 (1.4)	37	19.3 (1.6)
SF-36 PCS (worst-best; 0-100)	44	39.9 (11.2)	32	37.9 (10.7)
SF-36 MCS (worst-best; 0-100)	44	42.0 (13.8)	32	41.8 (13.5)
FAT (worst-best; 0-5)	51	4.2 (1.4)	37	3.7 (1.5)
ARAT (worst-best; 0-57)	51	49.0 (15.9)	37	46.2 (17.9)
NHPT performance (worst-best, 0-18)	51	14.5 (6.5)	37	13.2 (7.2)
NHPT time (best-worst, 0-50)	51	34.9 (10.6)	37	37.7 (10.7)
MI arm (worst-best, 0-100)	51	81.2 (18.4)	37	74.0 (16.7)

Table 3. Spearman rank correlation coefficients between the MHQ scores of the affected hand and measures of physical functioning and QoL of 51 stroke patients admitted for a general rehabilitation treatment, and in the subgroup of 37 patients with hand function problems (Motricity Index Arm <100).

Functional status	N	All patients		N	Subgroup	MI<100
		Spearman	sign		Spearman	sign
Barthel index (worst-best, 0-20)	50	0.41	0.004	36	0.49	0.002
SF-36 PCS (worst-best; 0-100)	44	0.49	0.001	32	0.46	0.007
SF-36 MCS (worst-best; 0-100)	44	0.22	0.145	32	0.27	0.136
FAT (worst-best; 0-5)	50	0.45	0.001	36	0.39	0.020
ARAT (worst-best; 0-57)	50	0.64	0.000	36	0.60	0.000
NHPT performance (worst-best, 0-18)	50	0.56	0.000	36	0.52	0.001
NHPT time (best-worst, 0-50)	50	-0.64	0.000	36	-0.54	0.001
MI arm (worst-best, 0-100)	50	0.78	0.000	36	0.65	0.000

Table 4. Floor and ceiling effect of the MHQ scores of the affected hand and measures of physical functioning and QoL of 51 stroke patients admitted for a general rehabilitation treatment, and in the subgroup of 37 patients with hand function problems (Motricity Index Arm <100).

	Overall hand function	Activities of daily living	Pain	Work performance	Aesthetics	Satisfaction	MHQ total
Barthel index	.385**	.404**	.090	.162	.535**	.298*	.405**
SF-36 PCS	.404**	.492**	.354*	.407**	.487**	.435**	.493**
SF-36 MCS	.097	.224	.114	.338*	.220	.159	.223
FAT	.538**	.488**	.218	.206	.330*	.490**	.447**
ARAT	.715**	.624**	.242	.453**	.486**	.621**	.639**
NHPT perf	.598**	.631**	.145	.385**	.451**	.509**	.559**
NHPT time	-.696**	-.712**	-.303*	-.473**	-.421**	-.646**	-.640**
MI arm	.797**	.669**	.431**	.590**	.674**	.715**	.780**

***. Correlation is significant at the 0.01 level (2-tailed).*

**. Correlation is significant at the 0.05 level (2-tailed).*