# Clinimetrics in Hand Therapy:

## Hand Assessment Recommendations for Therapy (HandART)

Lucelle van de Ven-Stevens

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*Voor mijn ouders*

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# 1

# Introduction and outline of the thesis

*Mr. K.'s thumb, index finger and middle finger of the left hand were amputated as a result of a firework injury. Several months after the injury, a toe-to-thumb transplantation was one of the options that were proposed by a hand surgeon. Before the final decision and planning of the operation, Mr. K. was referred to a hand therapist for functional assessment. Besides measuring impairments, the hand therapist assessed the patient's functional capacities and activity limitations as well as esthetical aspects and his personal wishes and needs. This functional assessment made clear that Mr. K hardly experienced any activity limitations or participation restrictions. For example, he was able to use his affected hand for writing, playing basketball and for technical drawing. More than that, he felt his hand was very functional, because at home he was able to clean drinking glasses and reach for defective parts of his car more easily than before the injury. Together with his therapist, he decided that a toe-to-thumb transplantation was not indicated.*

With regard to the case report above, an important question is whether Mr. K. would have drawn the same conclusion when he had been assessed by a different hand therapist? And would this therapist have performed the same functional assessment? Until now, no standardized core set for the assessment of patients with injury or disease of the hand(s) ('hand conditions') exists, so the likelihood that the functional assessments and subsequent clinical decisions made by different hand therapists would be the same is low. Although many instruments have been described in the literature for the assessment of hand impairments and related activity limitations and participation restrictions, a standardized core set is still lacking. Despite several important initiatives[1-8] to determine a (diagnosis-specific) core set of instruments, no consensus was reached even though the need for a consensus is strongly felt particularly among hand therapists. This lack of standardization causes undesirable variation in clinical practice and probably also results in a higher risk of ineffective or cost-inefficient interventions in patients with hand conditions. Against this background, this thesis addresses the requirements for hand function assessment. In other words, which instruments are relevant for the assessment of impairments, activity limitations and participation restrictions in patients with hand conditions and which instruments should be used to evaluate the effect of interventions?

The prevalence of hand conditions is estimated to be more than 10% of the population in the Netherlands.[9] Especially hand injuries are common[10] and account for nearly 20% of all visits to emergency departments of hospitals.[11] In addition, people with hand diseases such as Dupuytren's disease, osteoarthritis, or tendinitis are frequently seen by physicians and hand therapists. More importantly, hand conditions may have a large impact on the performance of people's daily life activities in the areas of self-care, occupational and household activities, and leisure. They may also have impact on the physical, functional and mental health of individuals and, thus, lead to high healthcare costs and costs associated with loss of productivity.[10-16] Therefore, it is stated that people with hand conditions require specialized medical treatment and allied health care.

## Treatment of hand conditions: 'bottom-up' versus 'top-down' approach

In the assessment and treatment of patients with hand conditions, a 'bottom-up' approach can be distinguished from a 'top-down' approach.[17] While a bottom-up approach focuses on the impairments, a top-down approach[18] starts with the assessment of activity limitations and participation restrictions, also taking into account the environmental context. A bottom-up approach, using a biomechanical frame of reference, is preferably applied in the first weeks after a hand trauma or surgical intervention. Its primary focus is to reduce deficits in hand functions and structures. The hand surgeon, hand therapist and the patient try to reconstruct, maintain and improve hand structures, such as tendons and nerves, and hand functions, such as active and passive range of joint motion. In this phase, a biomechanical frame of reference is most applicable to preserve range of motion (ROM) and muscle or grip strength, and to prevent the formation of scar tissue.[17] Interventions are focused on improving hand functions and basic skills by protecting the operated or injured structures, facilitating tissue repair. In this 'acute' period, existing treatment protocols and guidelines for several hand conditions, such as tendon injuries or nerve injuries, are particularly important. When using the bottom-up approach, it is often assumed that, by eliminating or reducing hand impairments, activity limitations will automatically diminish. However, although hand impairments can certainly cause activity limitations and participation restrictions, their inter-relationship is not linear.[7,19-25] Thus, even in the 'acute' phase, it is important to be aware of individual patients' needs and to tailor interventions to their personal needs.

In the 'post-acute' phase, usually several weeks after a hand injury or surgery, a top-down or 'occupation-based' approach is preferred to support person-centered assessments and interventions. In this approach, the therapist and the patient together determine what aspects of occupational (or vocational) performance require attention. After assessing participation restrictions and activity limitations, hand impairments are evaluated[26,27] according to the Taxonomic Code of Occupational Performance (TCOP).[28] In this period, when the person is allowed to use his hand(s) actively and functionally, he learns to cope with his impairments and disabilities. Depending on the severity of the injury or disease and on the phase of rehabilitation, different interventions can be considered such as (continuing) active and passive ROM exercises, splinting, training of strength and coordination, functional exercises using activities, and training of compensatory strategies with the aim to improve dexterity, and overall functioning (activities and participation). In this perspective, also secondary surgical interventions such as tenolysis, neurolysis, arthrodesis, and even transfers of tendons and digits can be performed. To determine optimal treatment, it is important to discuss whether and how it is possible to improve the functional capacity and performance of the hand(s) of the individual patient. Most of all, it is necessary to know individual patients' *wishes and needs* with regard to hand structure, function and dexterity. For example, is it desirable to apply a splint to improve the

extension of a finger with limited ROM, if a person does not experience any functional problems and is not motivated to wear a splint? Or is it advisable to perform tendon transfers to improve wrist and finger extension in a person with a radial nerve injury ('dropping hand'), if he/she experiences pain as the most important problem and needs a good grip strength to perform activities at work? By assessing activity limitations and participation restrictions next to hand impairments, both the patient and the therapist obtain optimal insight in the individual complaints, disabilities, needs and expectations. Such an integral functional assessment, taking into account both personal and environmental factors, greatly supports clinicians to inform their patients and next of kin about the best treatment options. This 'top-down' approach also greatly facilitates person-centered practice.

## Person-centered practice

In the last decade, healthcare has focused more and more on the individual patient characteristics, both from a genetic, biological and psychological perspective ('personalized medicine') and from a social and societal perspective ('participatory healthcare'). This has resulted in various concepts of person-centered practice, in which people are encouraged to manage their own health (self-empowerment). This is expected to increase their participation and life satisfaction both in the short and in the long term.[29] Person-centered practice implies that the patient is involved in the decision-making process and includes the following elements: 1) healthcare providers share the management of health issues with their patients, and 2) healthcare providers focus on patients as individuals rather than on their underlying health conditions.[30] In person-centered practice, the therapist and patient work together to define the occupational (and vocational) problems, the need for and focus of intervention, and the preferred outcomes. To this end, patients require information that enables them to make decisions about the use of healthcare and health services that will meet their needs most effectively and conveniently. Thus, person-centered instruments assess meaningful outcomes from the individual's perspective. These outcomes are needed in the shared decision-making process to choose the appropriate intervention(s). Person-centered instruments are also necessary to evaluate the effects of interventions. One of these person-centered instrument, which is widely used in occupational therapy, is the Canadian Occupational Performance Measure (COPM). Because of its wide acceptance and use, the construct validity of the COPM for patients with hand conditions will be addressed in this thesis.

## International Classification of Functioning, Disability and Health (ICF)

To be able to structure and standardize person-centered assessment in patients with hand conditions, it is important to first reach interdisciplinary consensus about which domains of the International Classification of Functioning, Disability and Health (ICF) are relevant for these patients. The ICF provides a standard language and conceptual basis for

the definition and measurement of human health and disability, comprising more than 1400 category-codes. The ICF is a classification of health and health-related domains and is aimed to be used by healthcare workers all over the world.[31] It conceptualizes human functioning as a 'dynamic interaction between a person's health condition, environmental factors and personal factors'.[31]

Part I of the ICF comprises the components 'Body Functions and Structures (impairments)' and 'Activities (limitations) and Participation (restrictions)', while part II covers the 'Environmental Factors' and 'Personal Factors' that can influence the interactions between impairments, activity limitations and participation restrictions. In a person-centered approach, attention must be paid to all components of ICF part I, including 'Activities and Participation'. Moreover, one should distinguish between the two qualifiers of this latter component, namely 'Capacity' and 'Performance'. While the Capacity qualifier describes an individual's ability to execute a task or an action in a standardized environment, the Performance qualifier describes what an individual actually does in his/her own environment. Still, the personal and environmental factors from ICF part II are equally important in a person-centered approach to really target the individual patient rather than only his/her health condition(s). According to the ICF, 'Activity' is defined as 'the execution of a task or action by an individual'. Therefore, 'Activity' refers to the performance of basic skills such as grasping, manipulating and releasing objects. But at the same time, 'Activity' refers to the performance of more complex tasks such as pouring a glass of water or, even more complex, to total activities, such as preparing a meal. When assessing activity limitations, clinicians should realize that some activity-oriented instruments aim to measure the performance of basic skills, while others aim to assess more complex (total) activities. As a consequence, such instruments differ in the way they should be interpreted.

To determine which domains and categories of the ICF should be addressed when assessing patients with hand conditions, it is necessary to reach consensus on which components of the ICF are relevant for this population. Thereafter, it can be determined by which instruments these ICF components can and should be assessed. The ultimate aim is to reach consensus on the standardization of the functional assessment of patients with hand conditions to support functional diagnostics, clinical decision making, as well as the evaluation of interventions.

## Outline of this thesis

To reach consensus on which instruments should be used for the functional assessments of patients with hand conditions, the project '*HandART: Hand Assessment Recommendations for Therapy*' was designed. This thesis describes the different parts of the HandART project and is divided in three parts. Part 1 consists of two literature reviews on instruments designed to assess activity limitations in patients with hand conditions. Part II contains

three chapters that use the ICF as a backbone and focus on the development of an ICF Core Set for Hand Conditions. Part III consists of a validation study aimed at the construct validity of the COPM for patients with hand conditions and a Delphi study aimed at reaching consensus to compile a HandART core set of assessment tools for these patients directed at impairments and activity limitations.

## Part I Literature review

**Chapter 2** describes a literature review that aimed to identify instruments to assess activity limitations in persons with hand conditions. Subsequently, instruments were selected according to predefined criteria.

**Chapter 3** reports a systematic review of the literature on the clinimetric properties of these selected instruments. The instruments were categorized into 1) pegboard tests measuring fine hand use, 2) instruments measuring fine hand use by picking up, manipulating, and placing different objects, 3) instruments measuring fine hand use by scoring single task performance, and 4) questionnaires. To evaluate the available information about the clinimetric properties, the quality criteria as proposed by Terwee and co-workers (2007) were used.

## Part II ICF Core Set

**Chapter 4** highlights the most common aspects of human functioning as well as those aspects that deserve more consideration in research on hand conditions based on literature review. The ICF was used as a reference to analyze the content of published studies on hand conditions.

**Chapter 5** reports the results of an international consensus conference that was organized to develop a Brief and a Comprehensive ICF Core Set for Hand Conditions.

**Chapter 6** provides an overview of the item content of 46 instruments in the area of hand surgery and hand rehabilitation in relation to the 23 categories of the Brief ICF Core Set for Hand Conditions.

## Part III COPM validation study and HandART Delphi study

**Chapter 7** aims to establish the construct validity of the COPM in relation to the Disabilities of Arm, Shoulder and Hand questionnaire (DASH) and the Michigan Hand Outcomes Questionnaire (MHQ) for patients with hand conditions.

**Chapter 8** presents the results of the international HandART Delphi study. The goal of this study was to reach European consensus among hand surgeons, hand therapists and

rehabilitation physicians on a core set of assessment tools to be used in patients with hand conditions. The ultimate aim was to include as few instruments as possible, but as many as necessary to assess hand impairments and related activity limitations.

**Summary and general discussion**

The thesis ends with **Chapter 9** providing a summary and general discussion of all previous chapters. The discussion will focus on methodological limitations as well as on suggestions for clinical practice and directions for future research.

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# PART I

## Literature Review

# 2

# Assessment of activities in patients with hand injury: A review of instruments in use


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## ABSTRACT

**Background:** Physical impairments are not necessarily coupled with functional limitations. For this reason, it is important to assess not only body functions and structures, but also activities and/or participation to decide which intervention is indicated and to evaluate the effect of the intervention in a valid way.

**Objective:** The purpose of this review was to examine available instruments for assessing the limitations in activity and their application within the clinical reasoning process in patients with hand injuries.

**Method:** A literature search identified instruments that met four selection criteria: quality of information, target population, percentage items related to hand function, and a focus on activities. The selected instruments were categorised according to three items: the specific components, the aspects of activity that could be assessed with it and how activity was assessed (questionnaire or otherwise).

**Results:** Seventy two instruments were identifi ed, of which 23 met the selection criteria. These selected instruments showed important differences in the constructs they assessed and in the manner of assessment.

**Conclusion:** Instruments to assess limitations of activity as a result of hand injury should be evaluated further in terms of reliability and validity, before their use within the clinical reasoning process can be standardised.

## INTRODUCTION

Hand injuries may affect the patient's abilities to successfully engage in his day-to-day self-care, work, and leisure activities. When deciding on appropriate treatment, physicians and hand therapists can be guided by evaluation of body functions and structures or by evaluation of activities and participation, two components described in the International Classification of Functioning, Disability and Health, (ICF).[1] According to the ICF, 'activity' is defined as 'the execution of a task or action by an individual', and 'participation' is defined as 'the person's involvement in a life situation'.

The two types of evaluation do not necessarily lead to the same treatment decision. Body functions and structures are not necessarily coupled with activity limitations or participation restrictions. Sometimes minor impairments can lead to substantial activity limitations or participation restrictions. On the other hand, major impairment of body function does not always lead to limitations in activities or participation. For this reason, it is important to assess not only body functions and structures, but also activities and participation. Instruments to assess body functions and body structures, such as the goniometer or dynamometer, have been extensively studied for psychometric properties and are widely used in clinical practice.[2;3] However, there appears to be no consensus on appropriate instruments to assess activity limitations and participation restrictions in patients with hand injuries.[4] We made an inventory of the instruments in use in patients with hand injuries to assess activity limitations and their application within the clinical reasoning process.

## METHOD

To identify relevant instruments, we searched without date limitations the databases Medline and Cinahl, the internet, and publications such as 'Clinical Assessment Recommendations of the American Society of Hand Therapists (ASHT) for relevant articles, using combinations of the following keywords:

i. assessment, measure, measurement, test, questionnaire, evaluation, or meetinstrument [Dutch for instrument];
ii. function, activity, dexterity, performance, skill, or disability;
iii. hand, upper extremity, or arm; and
iv. injury, trauma or letsel [Dutch for injury].

The references of relevant publications were also studied. The search was restricted to the English and Dutch language publications. Information about the target population, type of tasks, and the proportion of tasks of arm and hand function, was collected. Two reviewers independently selected appropriate instruments on the basis of the following criteria:

i. there was sufficient information to describe the target population, the type of tasks and type of results to decide if the instrument could be selected;
ii. the target population was adults with a hand injury or hand disorder (rheumatoid arthritis included);
iii. the instrument contained sufficient items ( >50%) on tasks and activities involving arm and hand function; and
iv. the instrument focused on activities (rather than body functions and structures or on participation).

If no specific target population was described, the instrument was also included. Instruments describing a specific target population such as patients with a central neurological disorder (e.g. stroke or Parkinson's disease), mental disorder, or upper extremity amputation were excluded. The reason for inclusion activity limitations due to impairments of hand functions caused by rheumatoid arthritis is that these are similar to those in hand injury, in contrast to those in central neurological disorders for example. The selected instruments were then classified according to:

i. the specific components according to the ICF;
ii. the aspects of activity that could be assessed with it; and
iii. the way it is performed (questionnaire or otherwise).

The different aspects of activity used were

a) (fine) hand and arm use (skills such as reaching, grasping, picking up, handling, dexterity, manipulating, moving and releasing);
b) single tasks (such as writing a sentence, pouring a glass of water, fasten shoe laces), and
c) (total) activities of daily living (ADL, such as sending a letter, preparing breakfast, dressing).

## RESULTS

Of the 72 instruments identified in the literature search 23 met our selection criteria. Instruments that were not selected and the main reasons for this are mentioned in Table 1.

The 23 selected instruments were grouped as described under Method, according to the specific components of the instrument, the aspects of activity that could be assessed, and its performance (see Table 2).

About half of the instruments (11 of 23) assessed only one aspect of activity. Twelve evaluated more than one component of the ICF or aspect of activity. The majority of the instruments (18 of 23) assessed fine hand use. Fourteen instruments evaluated single tasks. Only four instruments assessed (total) activities. Besides assessing one or more aspects of activity, seven instruments also assessed body functions, whereas three instruments also assessed participation.

Fifteen instruments assessed only aspects of activity. Of these instruments, nine assessed only fine hand use. The Functional Dexterity Test[5;6], Grooved Pegboard test[7;8], Nine-Hole Peg Test[2;9-14], and the Purdue Pegboard Test[2;6;15-18] are pegboard tests. The Box and Block Test[2;19;20], Minnesota Manual Dexterity Test[21;22], Moberg Pick Up test[2;23-25], O'Neill Hand Function Assessment[26], and the Rosenbusch Test of finger dexterity[27] include picking up, manipulating and placing different objects, without using a pegboard. Of the other six instruments, the Jebsen-Taylor Test of Hand Function[2;28-32], Sollerman Hand Function Test[33-36], Southampton Hand Assessment Procedure[37;38], Test d'Evaluation des Membres Supérieurs de Personnes Agées[30;39-41], and the Upper Extremity Function Test[30;42] assessed fine hand use and single tasks. The Subjective Hand Function Scoring system[36] assessed single tasks only. Of the four instruments assessing (total) activities, three questionnaires -the self-administered questionnaire for the assessment of Severity of Symptoms and Functional status in carpal tunnel syndrome (Boston Questionnaire)[43], the Disabilities of the Arm, Shoulder and Hand (DASH)[44-50], and the Michigan Hand Outcomes Questionnaire (MHQ)[51;52] also included questions about body functions (pain and sensibility). In addition to information about (total) activities, the Canadian Occupational Performance Measure (COPM)[53-56], the DASH[44-50], and the MHQ[51;52], also gathered information about participation.

**Table 1** Not selected instruments and the main reason for not selecting

| INSTRUMENT | MAIN REASON PER INSTRUMENT FOR *NOT* SELECTING THE INSTRUMENT | | | |
|---|---|---|---|---|
| | NOT ENOUGH INFORMATION FOUND | INAPPROPRIATE TARGET POPULATION | <50% RELATED TO ARM AND HAND FUNCTION | MAINLY FOCUSED ON BODY FUNCTIONS & STRUCTURES OR PARTICIPATION |
| A 12 item short form health survey (SF-12)[61;62] | | | X | |
| Action Research Arm test (ARA)[63-65] | | X | | |
| Apfel 19 item Pick up test[2] | X | | | |
| Arthritis Impact Measurement Scales (AIMS)[61;66;67] | | | X | |
| Assessment of living Skills and Resources (ALSAR)[68] | | X | | |
| Assessment of Motor and Process Skills (AMPS)[69-71] | | | X | |
| Baltimore quantitative upper extremity function test[72] | X | | | |
| Barthel Index (BI)[61;73;74] | | X | | |
| Benneth Hand Tool Dexterity Test[2] | X | | | |
| Brunnstrom Fugl Meyer Test (B-FM)[65] | | X | | |
| Capabilities of Upper Extremity Instrument (CUE)[75] | | X | | |
| Computer Abilities Scanning and Training Test (CASTT) (www.nici.kun.nl) | X | | | |
| Crawford Small Parts test[2;76] | X | | | |
| Evaluation of daily Activity Questionnaire (EDAQ)[77] | | | X | |
| Extended Activities of Daily Living Scale (Extended ADL)[78;79] | | X | | |
| Frenchay Activities Index[80;81] | | X | | |
| Frenchay Arm Test[11] | | X | | |
| Functional Autonomy Measurement System (SMAF)[82;83] | | | X | |
| Functional Independence Measure (FIM)[61;84-87] | | | | X |
| General Wellbeing Schedule (GWBS)[61;88] | | | X | |
| Hand Assessment[89] | X | | | |

| | | | | |
|---|---|---|---|---|
| Hand Injury Severity Scoring System (HISS)[90;91] | | | | X |
| Hand mobility in Scleroderma test (HAMIS)[92;93] | | | | X |
| Handicap Assessment and Resource Tool (HART)[94] | X | | | |
| Health Assessment Questionnaire (HAQ)[61;95-97] | | | X | |
| Impact on Participation and Autonomy (IPA)[98-101] | | | | X |
| Impact of Rheumatic siseases on General Health and Lifestyle (IRGL)[102-104] | | | X | |
| Juvenile Arthritis Functional Status Index (JASI)[105] | | X | | |
| Klein-Bell ADL scale[106;107] | | | X | |
| Life Habits (LIFE-H)[108-110] | | | | X |
| Manual Ability Scanning Test (MAST)[111-113] | | X | | |
| McMaster-Toronto Arthritis Patient Preference Disability Questionnaire (MACTAR)[114-116] | | | X | |
| Minnesota Leisure Time Physical Activity Questionnaire (LTPA)[117] | | | X | |
| Modified Health Assessment Questionnaire (MHAQ)[61;97;118;119] | | | X | |
| Modified Motor Assessment Chart (MMAC)[120;121] | | X | | |
| MOS 36 item short form health survey (SF-36)[61;62;122;123] | | | X | |
| Motor Assessment Scale (MAS)[124;125] | | X | | |
| O'Connor Finger Dexterity Test (www.licmef.com/evaldexterity.) | X | | | |
| Physical Capacity Evaluation[126] | | X | | |
| Psychosocial Adjustment to Illnes Scale (PAIS)[127;128] | | | | X |
| Quality of Life Index[61] | | X | | |
| Quality of Well being Scale (QWB)[61;129-131] | | | X | |
| Sickness Impact Profile (SIP)[61;132;133] | | | | X |
| Simulated Activities of Daily Living Examination (SADLE)[134] | | X | | |
| Standaard Observatie Ergotherapie Schrijven en Sensomotorische Schrijfvoorwaarden (SOESSS)[135] | | X | | |
| The Prosthetic Upper Extremity Functional Index (PUFI)[136] | | X | | |
| Tufts Assessment of Motor performance (TAMP)[137-139] | X | | | |
| Wilson's Functional Test[140] | X | | | |
| Workerrole-interview[141] | | | X | |

**Table 2** Description of selected instruments

| INSTRUMENT | TARGET POPULATION | TYPE OF TASKS |
|---|---|---|
| Severity of Symptoms and Functional status of the Boston Carpal Tunnel Questionnaire (CTQ)[43] | Carpal tunnel syndrome | questionnaire, (6 clinical areas (11 q) and 8 functional activities (8q)) |
| Arthritis Hand Function Test (AHFT)[2;19;20;142] | Rheumatoid arthritis | grip strength (grip and pinch), 9-hole pegboard, applied dexterity (5 tasks: lacing shoes, (un)fasten buttons, (un)fasten safety pins, cutting putty with knife and fork, manipulating four coins in a slot) and applied strength (2 tasks: lifting a tray of cans, pouring a glass of water). |
| Box and Block Test (BBT)[2;19;20] | Handicapped | transporting blocks, one block at a time, from one compartment to the other, as quickly as possible, during one minute . |
| Canadian Occupational Performance Measure (COPM)[53;54;56;58] | No specific | semi-structured interview, to asses client outcomes in the area of self-care, productivity and leisure. |
| Disabilities of the Arm, Shoulder and Hand (DASH)[44-50] | Upper extremity musculoskeletal conditions | questionnaire, part A 30 items (21 physical function items, 6 symptom items and 3 social or role function items), and optional part B 4 questions (about difficulties (impact of arm/hand problem) in playing instrument or sport or performing work) All items refer to the situation in the past week. |
| Functional Dexterity Test (FDT)[5;6] | Hand injury | FDT was designed to combine 3 components of dexterity: manipulation, time and accuracy, and 3-jaw chuck prehension pattern (tripod grip). Task: turning 16 pegs (diameter 2,2 cm, length 4cm) as quickly as possible in a pegboard. |
| Grooved Pegboard test[7;8] | No specific | consisting of 25 holes with randomly positioned slots. Pegs with a key along one side must be rotated to match the hole before they can be inserted. This test requires more complex visual-motor coordination than most pegboard tests. The subject has to place pegs into holes on a board. The holes are angled at various directions. |
| Jebsen-Taylor Test of Hand Function (JTHF)[2;28-32] | Broad categories of patients with disabilities of hand function | 7 hand activities, like writing, turning over cards, picking up small objects, simulate eating, stacking checkers, picking up large light objects, picking up large heavy objects. |
| Michigan Hand Outcomes Questionnaire (MHQ)[51;52] | Patients with all types of hand disorders | questionnaire of 37 items, which contains 6 scales: 1) overall hand function, 2) activities of daily living, 3) work performance, 4) pain, 5) aesthetics, 6) satisfaction with hand function |

| TYPE OF RESULTS | Q or T | B* | ACTIVITY | | | P* |
|---|---|---|---|---|---|---|
| | | | 1* | 2* | 3* | |
| score 1-5 per item, calculate mean of all items | Q | X | X | X | X | |
| mm HG, kg, time number of lifted cans, ml poured water | T | X | X | X | | |
| number of transported blocks | T | | X | | | |
| score1: rating on 1-10 scale (for importance, perception of performance and satisfaction with performance) | Q | | | X | X | X |
| 5-point Likert scale | Q | X | | X | X | X |
| using a stopwatch, recording the time in seconds, that it takes for the patient to turn over all 16 pegs on the board with one hand. A 5-or 10-second penalty may be added. | T | | X | | | |
| time in seconds | T | | X | | | |
| time, using a stopwatch | T | | X | X | | |
| 5 point score. A total is counted and can vary from 0 to 100. | Q | X | | X | X | X |

**Table 2** Continued

| INSTRUMENT | TARGET POPULATION | TYPE OF TASKS |
|---|---|---|
| Minnesota Manual Dexterity Test, 1991 edition (MMDT)[21;22] | No specific | incorporate 5 subtests: Placing test, Turning test, Displacing test, One-hand Turning and Placing test, and the Two-hand Turning and Placing test |
| Moberg Pick Up test (MPUT)[2;23-25] | Injured hand | pick up a number of small objects and place them in a small container. The same procedure is repeated with the patient blindfolded. |
| Nine-Hole Peg Test (NHPT)[2;9-14] | No specific | Pick up nine pegs (3,2 cm long and .64 cm in diameter) one at a time, and put them into the holes as quickly as possible. Then remove the pegs and return them to the container. |
| O'Neill Hand Function Assessment[26] | Irish adult population, hand disorders, >16 year and intact central nervous system | based on a commonly used grip classification of the hand and it also contains a non-prehensive section. There are eight tasks in the final version of the assessment: 1.Picking up coins, 2.picking up pins, 3.lifting up plates, picking up and turning piping, picking up tennis balls, lifting blocks with handles, bringing hand to mouth, tapping keyboard. |
| Purdue Pegboard Test (PPT)[2;6;15-18] | Various populations (industrial population, Cerebral lesions, patients with impairments of the upper limb) | four subtests: right hand (RH), left hand (LH), both hands(BH), and assembly. Placing with right and then with left hand as many pins as possible down the row within 30 seconds, Placing, with right and left hand simultaneously, as many pins as possible down the row within 30 seconds. The assembly subtest requires that both hands work simultaneously while performing different tasks for 60 seconds. |
| Radboud Skills Test (RST)[143-145] | CRPS-I | 10 tasks, two handed, (walking, paper in envelop, pillow in slip, putting on shirt, closing buttons, put on sock, tiding laces, washing hands , drying hands, folding towel) |
| Rosenbusch Test of finger dexterity[27] | Patients with hand function problems | manipulating objects: holding 6 objects in the hand and the rolling out of the objects from the tips of the thumb and index and long finger into six depressions in the testing board. This manipulation is tested for four subtests: marbles, jacks, wooden cubes, and flat round stones |
| Sequential Occupational Dexterity Assessment (SODA)[146-148] | RA | 12 tasks (6 bilateral, 6 unilateral): writing a sentence, picking up an envelope, picking up coins, holding receiver of a telephone, unscrewing toothpaste, squeeze toothpaste on a toothbrush, handling a spoon and knife, buttoning a shirt, unscrewing a thermos, pouring water into a glass, washing hands, drying hands. |

| TYPE OF RESULTS | Q or T | B* | ACTIVITY | | | P* |
|---|---|---|---|---|---|---|
| | | | 1* | 2* | 3* | |
| number of seconds to complete each task, timed with a stopwatch | T | | X | | | |
| time to accomplish the task | T | | X | | | |
| time, using a stopwatch | T | | X | | | |
| norm-referenced: speed (time in seconds), and criterion-referenced: manner (scored each task out of five points: the type of grip demanded, the accuracy of the task, and the positioning of the upper extremity. | T | | X | | | |
| 5 separate scores: total number of pins placed by each hand, total number of pairs of pins placed, The R+L+B-subtest is a computation of the scores of the first three subtests, The assembly score is the total number of objects placed in 60 sec.. | T | | X | | | |
| 5-point score (0=normal, 4=affected hand is not moving or task is not possible),<br>3-point score for effort (0=no effort, 2=much effort) and a VAS-score for pain | T | X | | X | | |
| time using a stopwatch, accuracy: the time-scores are weighted for accuracy (performance) | T | | X | | | |
| 3-point score ability, 3-point score effort, VAS-score | T | X | X | X | | |

**Table 2** Continued

| INSTRUMENT | TARGET POPULATION | TYPE OF TASKS |
|---|---|---|
| Smith Hand Function Evaluation (SHFE)[149;150] | Hand function disorders | A. unilateral grasp-release tasks (blocks, nails, coins and pegs), B. bilateral eye-hand coordination activities of ADL (safety pin, buckle, buttons, zipper, tying knot, tying bow, lacing shoes), C. write with pen, D. grip strength |
| Sollerman Hand Function Test (SHFT)[33-36] | No specific | 20 tasks, each comprising a task considered to be an activity of daily living (put key into lock, pick up coins from surface or purses, open/close zip, lift wooden cubes, lift iron, turn screw, pick up nuts, unscrew jar, pressing buttons, cut with knife and fork, put on stocking on hand, write, fold and put paper in envelope, put paper-clip on envelope, hold telephone receiver to ear, turn door-handle, pour water from pure-pack/ and jug/ and cup. |
| Southampton Hand Assessment Procedure (SHAP)[37;38] | Pathologic and prosthetic hand function | The test consists of a series of 12 abstract tasks and 14 day-to-day activities with grips like lateral, power, tripod, extension and spherical |
| Subjective Hand function Scoring system (HFS)[36] | Hand trauma | 25 tasks of daily living, like handling buttons, shoelaces, using the toilet, cleaning teeth, unscrewing lids, cutting, pouring kettle, using key, driving, etc., are discussed with the patient and scored |
| Test d'Evaluation des Membres Supérieurs de Personnes Agées / Upper Extremity Performance Test for the elderly (TEMPA)[30;39-41] | Elderly | 9 tasks representing daily activities (5 bilateral and 4 unilateral), for a total of 13 different items (like pick up a jar, open a jar, pour water, open a lock, write, tia a scarf, shuffle and deal cards, handle coins, pick up objects) |
| Upper Extremity Function Test (UEFT)[30;42] | Various populations | 33 subtests, unilateral, somewhat representative of ADL |

Legend: Q = questionnaire; T = test; B = instrument measures body functions and body structure;
Activity: 1: instrument measures (fine) hand and arm use; 2: instrument measures (single) tasks;
3: instrument measures (total) Activities of daily living
P: instrument measures participation (restrictions)

| TYPE OF RESULTS | Q or T | B* | ACTIVITY | | | P* |
|---|---|---|---|---|---|---|
| | | | 1* | 2* | 3* | |
| A. time, B. time, C. time, D. kg | T | X | X | X | | |
| 5-point score (0=task cannot be performed, 4=task is completed without difficulty within 20 seconds and with the prescribed hand-grip of normal quality) | T | | X | X | | |
| The score given by the SHAP test is a functional score, 100% being normal hand function, made up of five sub-scores for each of the different hand grips. Each activity is measured against time | T | | X | X | | |
| 4-pointscore, (score 1 =easy or not relevant, 4=impossible) Total hand function score between 25 and 100 | Q | | | X | | |
| length of execution (time in sec), functional rating (4-point scale), task analysis | T | | X | X | | |
| quantitative: 4-point ordinale scale (normal-impossible) | T | | X | X | | |

## DISCUSSION

The purpose of this study was to review available instruments for assessing the limitations in activities and their application within the clinical reasoning process in patients with hand injuries. Twenty-three of the 72 instruments identified met our four selection criteria with regard to

i. quality of information;
ii. target population;
iii. percentage items related to hand function; and
iv. focus on activities.

The 23 instruments selected differed in the constructs they assessed and in the way in which the assessment was performed. Firstly, some instruments combined the assessment of activity with the assessment of body functions and body structures. For example, the MHQ included questions to assess pain and the Arthritis Hand Function Test (AHFT) included tests to assess grip strength. It is efficient to use combined instruments, but if information of the components is needed separately, combined instruments may not be suitable.

Secondly, activity could refer to specific skills like placing pegs into holes and pouring a glass of water, or activity could refer to general performance skills or (total) activities like preparing a meal. For example the Box and Block Test included transporting blocks, whereas the DASH contained questions about gardening and recreational activities. In other words, instruments assessed different aspects of activities. It was not possible to indicate these differences using only the terms of the component activities and participation of the ICF. The ICF was introduced in 2001 by the World Health Organization and has two parts.[1] The first part of the ICF consist of two components, namely i) body functions and structures, and ii) activities and participation. The component 'activities and participation' from the ICF includes (fine) hand and arm use. Self-care, domestic life, major life areas (including work) etc. are also described in the component 'activities and participation'[1], but too general to be usable to describe and distinguish between the selected instruments. Although the overall aim of the ICF is to provide a unified and standard language and framework for the description of health and health-related states, we did not find it completely adequate to describe the different construct or aspects of activity that are measured by instruments. Therefore, to describe and/or distinguish between the different instruments, in this review the different aspects of activity used were:

i. (fine) hand and arm use (skills such as reaching, grasping, picking up,etc. );
ii. single tasks (for example writing a sentence, pouring a glass of water, fasten shoe laces); and
iii. (total) activities of daily living (ADL, such as sending a letter, preparing breakfast, toileting and dressing ).

A third difference is the way in which the assessment was performed. Some instruments used a questionnaire, and other instruments such as the Jebsen-Taylor Test of Hand Function included tests with a scoring system. Within a questionnaire, scoring is more dependant of subjective experiences of the patient, whereas testing is more objective. The patient's subjectieve view of his activity limitations is influenced by many immeasurable factors, including the level of motivation, intelligence and expectations. Within the clinical reasoning process it is important to take patient's wishes and needs into account. In the ICF, the two qualifiers (or constructs) for the component 'activities and participation' are 'capacity' and 'performance'.[1] The capacity qualifier describes an individual's ability to execute a task or an action in a standardized environment, and the performance qualifier describes what an individual does in his or her current environment. The ICF describes in the first part only two components, namely

i. body functions and body structures and
ii. activities and participation.

However, it is important within the clinical reasoning process to make a distinction between the two qualifiers capacity and performance of the second component. Although interventions can be used to improve body functions and structures, the therapist and surgeon need to know if the individual patient wishes or needs to improve the functional abilities of the hand, and if so, in what way. We need to know which types of tasks and their performance are relevant the patient's daily life. Measures of *capacity* might be suitable for evaluating the patient's current situation or the effect of an intervention, and instruments that measure (fine) hand and arm use, single tasks, or (total) ADL can be used for this purpose. In contrast, when making decisions about appropriate treatment, we need information about performance and, for this purpose, instruments that measure patient's experience of (total) ADL, possibly combined with some measurement of participation, might be more useful. At the moment, the use of an instrument that measures the patient's experienced problems, combined with instruments that measure capacity might be appropriate. The COPM, combined with measures of (fine) hand and arm use, (single) tasks or (total) Activities of daily living might be most suitable. The COPM measures a patient's self-perception of occupational performance in self-care, productivity, and leisure and its use increases the patient's involvement with the therapeutic process. The COPM is designed to be used in client-centred therapy practice.[53;54;56-59] To measure (fine) hand and arm use the O'Neill Hand Function Assessment might be used because it measures the performance of the hand in a wide range of tasks that represent everyday activities. To measure (single) tasks or (total) activities of daily living, the DASH or the MHQ might be most appropriate instruments. The DASH is a region-specific tool that measures disability and symptom experience in terms of clinical input rather than patient priorities.[44-50] The MHQ is also a region-specific questionnaire and measures six health state domains considered important to patients, hand therapists, and hand surgeons.[51;52]

In accordance with research methodology, the way in which an instrument can be evaluated and selected has been described.[30;60] Important aspects are clinical utility (availability and the usefulness of the test results); standardization; purpose; psychometric properties (reliability and validity); and the perspective of the patient. We evaluated instruments for their clinical utility and are in the process of evaluating their psychometric properties to make a further selection. This selection of instruments will be presented to experts using a consensus procedure, to make a final selection of instruments in use to measure activity limitations and their application within the clinical reasoning process in patients with hand injury.

## CONCLUSION

The purpose of this study was to identify relevant instruments to assess activity limitations in patients with hand injuries. Of 72 instruments that assess activity limitations, 23 met our inclusion criteria. The 23 instruments selected differed in the constructs they assessed and in the way in which the assessment was performed. Their validity and reliability remain to be explored in the context of the ICF and that will be the focus of the next stage of the study.

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# 3

# Clinimetric properties of instruments to assess activities in patients with hand injury: A systematic review of the literature


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## ABSTRACT

**Objective:** To perform a systematic review of the literature to assess the clinimetric properties of instruments measuring limitations of activity

**Data sources:** The Medline, Cochrane Library, Picarta, Occupational Therapy-seeker, and CINAHL databases were searched for English or Dutch language articles published between 2001 and 2006.

**Study selection:** Two reviewers independently reviewed the identified publications for eligibility (based on the title and abstract), methodologic criteria, and clinimetric properties. To evaluate the available information of the clinimetric properties the quality criteria for instrument properties were used.

**Data synthesis:** In total 103 publications were retrieved, 79 of which were eligible for inclusion. Of these, 54 met the methodologic quality criteria. Twenty-three instruments were reviewed, divided into 1) Pegboard tests measuring fine hand use only; 2) instruments measuring fine hand use only, by picking up, manipulating, and placing different objects; 3) instruments measuring single tasks (and fine hand use) by scoring task performance; and 4) questionnaires. The reliability, validity, and responsiveness of only 5 instruments were adequately described in the literature; the description of the clinimetric properties of the other instruments was inadequate.

**Conclusion:** None of the instruments had a positive rating for all the clinimetric properties.

## INTRODUCTION

Evaluation of the activity limitations of patients with hand injury is complex. Many methods have been developed to determine general hand function, defined as the nature and extent of daily activities that individuals perform with the hands.[1-3] According to the International Classification of Functioning, Disability and Health (ICF), two components are described: 'body functions and structures' and 'activities and participation'. *Activity* is defined as "the execution of a task or action by an individual", and *participation* is defined as "the person's involvement in a life situation". Activities include fine hand use–for example, "performing the coordinated actions of handling objects, picking up, manipulating and releasing them using one's hand, fingers, and thumb, such as required to lift coins off a table or turn a dial or knob".[4] Injuries of the hand are the most common injuries[5] and account for about 20% of all presentations at hospital emergency departments.[6] The introduction of new technologies has been accompanied by an increase in the costs of treating these common injuries. The costs of hand injuries include those of the actual medical treatment and indirect costs to the patient,[6] and these costs increase with the complexity of the hand injury.[7] For example, tendon injuries are expensive, especially if they are complicated by rupture, stiffness, or adhesion.[8] Indirect costs include the cost of the time off work, lost earnings, the cost of visiting the doctor or health worker, and the cost to the employer for lost productivity.[6] Outcomes research and measurement have become the preferred approach for linking costs, quality, and efficiency in order to achieve cost-effective treatments. Nowadays, it is not only patients and health professionals who are interested in outcomes, but also hospital managers, lawyers, policy makers, and the media.[9]

Hand injuries may affect a person's ability to successfully engage in day-to-day self-care, work, and leisure activities. For this reason it is important to evaluate a person's activity limitations.[9-11] Such assessments are fundamental to decision making, determination of patient progress, and evaluation of the effectiveness of treatment.[11] Patients usually seek treatment to relieve symptoms and to reduce disability, and there is growing interest in measures that reflect a patient's perceived performance of activities of daily living (ADLs).[1] This requires the use of reliable and validated instruments to evaluate changes and, if possible, to predict the outcomes of different interventions. There is currently no standardized, or universally accepted, evaluation battery for hand therapy.[3-12] While instruments to assess body functions and body structures, such as the goniometer or dynamometer, are widely used in clinical practice,[13-15] there is no consensus on appropriate instruments to assess activity limitations and participation restrictions in patients with hand function problems, and patient-based outcomes such as ADLs have not been thoroughly investigated within the area of hand surgery and hand therapy.[15] Better assessment methods are required to provide the information necessary to assist in clinical decision-making.[9]

At the moment, it would seem more appropriate to evaluate and adapt existing tools instead of designing new ones.[3,9] Some reviews of existing instruments are available[13,16] but these are not peer-reviewed and have methodological flaws. Moreover, recently developed instruments are not mentioned or only a few instruments or only instruments for a specific diagnosis are described.[9,12,17-19] For these reasons, we extensively reviewed instruments to assess activity limitations (according to the definition of the ICF) in persons with hand disorders and their application within the clinical reasoning process, to prepare a preliminary core-set of instruments.[20] We selected 23 instruments. In the current study, we systematically reviewed the literature on the clinimetric properties of these 23 instruments for assessing activity limitations, to evaluate the clinimetric quality of the instruments.

## METHODS

Relevant instruments to assess activity limitations in patients with hand injuries were selected based on four selection criteria: (1) there was adequate description of the target population, the type of tasks, and the type of results; (2) the study population consisted of healthy adults, adults with hand function disorders or not specified; (3) the instrument contained sufficient items (>50%) on tasks and activities involving arm and hand function, based on the definitions of the ICF; and (4), the instrument focused on activities (rather than body functions and structures or on participation). Twenty-three Instruments were selected based on these criteria.[20]

### Search strategy

We reviewed the literature from 2001 to 2006 (first 2 months) and used the Medline, Cochrane Library, Picarta, OT-seeker and CINAHL databases to identify studies of interest. We used combinations of these terms: the name of the instrument, clinimetric properties and year (appendix 1). Dutch and English publications were identified. In addition, references were checked for relevant studies published before 2001.

### Selection procedure and description of the information

Two reviewers independently reviewed the identified publications. In case of disagreement between the 2 reviewers, a third reviewer was involved to reach consensus. The third reviewer was instructed to take part of the discussion in case there was disagreement. The 3 reviewers had to agree whether or not a publication had to be included or whether the quality criteria were met. First, title and abstracts were reviewed for eligibility by 2 independent reviewers. If the article seemed eligible, the full-text publication was reviewed for eligibility by the same 2 independent reviewers. Publications were included if they fulfilled the following criteria: (1) at least 1 of the 23 instruments was included; (2) at

least 1 of the clinimetric properties was assessed; and(3) the study population consisted of healthy adults, adults with hand function disorders, or not specified. In the second step, the methodological quality of the studies was assessed by 2 independent reviewers, using a set of methodological criteria. A pilot had been performed to evaluate whether the reviewers judged the publications in the same way. In the third step all the clinimetric properties of the 23 instruments were described based on the publications that were included.

## Evaluation of the clinimetric quality of the instruments

The quality criteria of Terwee et al.[21] were used to assess the clinimetric properties of the instruments (appendix 2).[21] For each property a sample size of at least 50 patients is considered adequate.



## Clinimetric properties

In this study the following clinimetric properties of an instrument are evaluated:[15,17,19,21-24]
*Internal consistency. Internal consistency* is the extent to which items in a (sub)scale are inter-correlated – that is, they measure the same construct; this is a measure of the homogeneity of a (sub)scale. Internal consistency is an important measurement property for questionnaires that intend to measure a single underlying concept by using multiple items.[17,21] When internal consistency is relevant, principal component analysis or factor analysis should be applied to determine whether the items form only one overall scale (dimension) or more than 1.[21] Internal consistency is often tested by calculating a Cronbach's alpha coefficient and has a value between 0 and 1. A positive rating for internal consistency was given when factor analysis was applied, Cronbach's alpha was calculated per dimension, and the Cronbach's alpha was between .70 and .95.[15,17,21,23]

## Reproducibility

Reproducibility includes the 2 concepts reliability and agreement.[25,26] *Agreement* concerns the absolute measurement error, i.e. how close the scores on repeated measures are, expressed in the unit of the measurement scale at issue.[21,26] *Reliability* concerns the degree to which patients can be distinguished from each other, despite measurement error.[21,24,26]

***Agreement.*** The measurement error can be expressed as the standard error of measurement (SEM) and this means a standard deviation (SD) of repeated measurements in 1 person.[24] The SEM can be calculated either including systematic differences (SEM agreement) or excluding them (SEM consistency).[21] The SEM can be converted into the smallest detectable change (SDC = 1.96 x $\sqrt{2}$ x SEM), which reflects the smallest within-person change in score that (with $p < .05$) can be interpreted as a 'real' change in 1 person.

Another method to determine agreement is described by Bland and Altman.[4] In this method the limits of agreement equal the mean change in scores of repeated measurements

(mean change ± 1.96 x SD of these changes ($SD_{change}$). The absolute measurement error should be smaller than the minimal amount of change in the subscale that is considered to be important (minimal important change: MIC). Therefore, the MIC of a (sub)scale should be defined. A positive rating for agreement is given if the SDC or the limits of agreement are smaller than the MIC. Because this is a relatively new approach, a positive rating is also given if authors provide convincing arguments that the agreement is acceptable.

***Reliability.*** Reliability is defined as the extent to which an instrument is free of a measurement error, such as the extent to which the instrument produces consistent, reproducible results on repeated administration (*test-retest*), when used by the same rater (*intrarater reliability*), or when used by different raters *(interrater reliability)*.[17,19,22,23] To establish reliability, a correlation coefficient is calculated, and an intraclass correlation coefficient (ICC) is the most suitable and most commonly used parameter for continuous measures. Reliability coefficients (ICCs) concern the variation in the population (interindividual variation) divided by the total variation, which is the interindividual variation plus the intra-individual variation (measurement error), expressed as a ratio between 0 and 1 ($ICC = {}^{var(persons)} / {}_{var(persons) + var(error)}$). Because systematic differences are considered to be part of the measurement error, $ICC_{agreement}$ is preferred.[21] The Pearson correlation coefficient is inadequate, because systematic differences are not taken into account.[24] For ordinal measures, the weighted Cohen's Kappa coefficient (***κ***) should be used. When quadratic weights are being used, the weighted ***κ*** coefficient is identical to the $ICC_{agreement}$.[24] A value for weighted Kappa or ICC of .70 or higher was a criteria of acceptability.[15,17]

## Validity

*Validity* is the extent to which an instrument actually measures what it is intended to measure. Several types of validity are distinguished.

***Content validity.*** Content validity refers to the extent to which the instrument covers the scope of the construct that it was designed to measure. It is the extent to which the domain of interest is comprehensively sampled by the items in the questionnaire or test. Content validity depends on the setting and population in which the instrument is going to be used. Content validity is assessed qualitatively during development by pretesting, expert opinion, and literature review.[15,17,19,22,23] A positive rating was given if a clear description was provided of the measurement aim, the target population, the concepts that were measured, and the item selection. Also, the target population should have been involved during item selection.

***Construct validity.*** Construct validity is concerned with the extent to which a particular instrument relates to other measures in a manner that is consistent with theoretically derived hypothesis concerning the domains that are measured. Convergent validity refers to evidence that the scale is correlated with other measures of the same or similar constructs. Divergent or discriminant validity refers to evidence that the scale is not

correlated with measures of different constructs.[15,17,19,22,23] Statistical results relating to validity are often expressed in correlation coefficients. According to the type of validity that is studied, the value can vary to a great extent. Construct validity should be assessed by testing predefined hypotheses (eg, about expected correlations between measures or expected differences in scores between known groups). These hypotheses need to be as specific as possible. A positive rating was given when hypotheses were specified in advance and at least 75% of the results were in accordance with the hypotheses.[5,6]

***Criterion validity.*** Criterion validity is the extent to which the results of an instrument relate to a gold standard or to an external criterion measure.[19,22,23] Construct validity is commonly used instead of criterion validity in studying assessments of activities, because in most cases a criterion standard is lacking. A positive rating is given if convincing arguments are presented that the used standard really is a criterion standard and if the correlation with the criterion standard is at least .70.



## Responsiveness

Responsiveness or sensitivity to change represents the ability of an instrument to detect change, if present, in the construct being measured.[15,17,19,23] Responsiveness is considered to be a measure of longitudinal validity. In analogy to construct validity, longitudinal validity should be assessed by testing predefined hypotheses– for example about expected correlations between changes in measures, or expected differences in changes between known groups. Furthermore, the instrument should be able to distinguish clinically important change from measurement error. Responsiveness should therefore be tested by relating the SDC to the MIC, as described under agreement. A positive rating was given if hypotheses were specified in advance and at least 75% of the results were in accordance with the hypotheses, and if MIC was greater than SDC.[21] Other adequate measures of responsiveness are Guyatt's responsiveness ratio (Guatt RR)[21,28] and the AUC: the Area Under the receiver operating characteristics (ROC) Curve. For acceptability the RR should be at least 1.96 and the AUC should be at least 0.70.[21] Effect Size (ES) and Standardized Response Mean (SRM) are inadequate, because they do not measure the ability of the instrument to distinguish important change from measurement error. The ES is dependent on variability of baseline scores. The SRM is dependent on variability of treatment effect.[24]

## Norm scores

Norm scores may be needed in order to determine if a score reflects "normative" or "activity limitation". Scores may show considerable variation with age or sex. Norm scores for an instrument are meaningful and clinically useful only if the reliability and validity of the measurement instrument have been established. A description of the samples used to produce norms should be provided to allow comparison with a particular clinical population.[23]

## RESULTS

The literature on 23 instruments to assess activity limitations in patients with hand injuries was reviewed to evaluate the clinimetric quality of the instruments. Of 103 publications retrieved, 79 were considered relevant, and of these, 54 were considered to be methodologically sound and were used to evaluate the clinimetric quality of the instruments. The 23 instruments were classified as (1) Pegboard tests measuring only fine hand use; (2) Instruments measuring only fine hand use by picking up, manipulating, and placing different objects; (3) instruments measuring single tasks (and fine hand use) by scoring executed tasks; and (4) Questionnaires (appendix 3).

In appendix 3 the clinimetric properties of the 23 instruments are described based on the systematic review. The clinimetric property of the instrument is mentioned only if information was available. Most information was found on test-retest reliability, inter-rater reliability, and construct validity. The reliability, validity, and responsiveness of 5 instruments were described in the literature, whereas the clinimetric properties of other instruments were only partly described. The reliability and validity of 15 instruments were described.

In appendix 4 a summary of the evaluation of the clinimetric quality of this information is presented. Of the pegboard tests, the intra- reliability /inter-reliability of the FDT was tested adequately with good results, but sample-sizes were too small. For the Nine-Hole Peg Test and the Purdue Pegboard Test, none of the clinimetric properties have a positive rating. Of instruments measuring only fine hand use, the test-retest of the Box and Block Test and the Minnesota Manual Dexterity Test 1991 edition was tested adequately with good results, but here also, sample-sizes are too small. Most clinimetric properties are described of The Rosenbusch Test of Finger Dexterity. Instruments measuring only fine hand use did not have any positive ratings because of doubtful or unknown design or small sample sizes. Also, of instruments measuring single tasks, no adequate information on clinimetric properties was provided, so no positive rating is given. However, some questionnaires received a positive rating for some clinimetric properties. The test-retest reliability, the content validity, the construct validity and the responsiveness of the Disabilities of the Arm Shoulder and Hand (DASH) were studied adequately with good results. The Michigan Hand Outcomes Questionnaire (MHQ) also had a positive rating for content validity and construct validity. The DASH had most positive ratings. None of the instruments had a positive rating for all measurement properties.

## DISCUSSION

The purpose of this study was to review the clinimetric properties of 23 instruments to assess activity limitations. Systematically reviewing the literature and selecting publications according to a three-step review process, we found 54 studies to describe the clinimetric

properties of these 23 instruments. Some publications might have been missed as a result of our search strategy, in which we used clinimetric properties as keywords.

None of the instruments had satisfactory results for all properties, according to the quality criteria recently proposed by Terwee et al.[21] These criteria are mostly opinion based because there is no empirical evidence in this field to support explicit quality criteria yet. In the meantime Mokkink et al.[29] are working on international consensus. They describe the protocol for the COSMIN-study, the objective of which is to develop a checklist that contains *CO*nsensus-based *S*tandards for the selection of health *M*easurement *IN*struments. They focus on evaluative health-related patient-reported outcomes.[29] In many studies the sample size (< 30 subjects) was not adequate for studying the reliability or validity of the instrument. However, we found no information about the minimum number of subjects needed or in what way it could be calculated for clinimetric studies, and it is only recently that clinimetric reviews of studies on the development and evaluation of health measurement are being published. This may explain the small sample sizes that were used in the reported studies. However, when statistical estimates are derived from very small populations, confidence intervals will be wide, reflecting a high degree of uncertainty in the precision of the reliability coefficient.[17,21] A recent study suggested that a sample size of at least 50 subjects should be used.[21]

Different study designs have been used to determine the validity of an instrument. A new instrument is generally not designed to replicate existing instruments, and that is why a criterion standard for measuring activities is often lacking. This is why we reported the information as construct validity, even if authors mentioned criterion validity instead of construct validity. Many authors failed to specify hypotheses for the assessment of construct validity.[21] Without specific hypotheses, the risk of bias is high because retrospectively it is tempting to think up alternative explanations for low correlations instead of concluding that the questionnaire may not be valid.[17,21]

In addition, most instruments were designed to measure activities or some form of dexterity, with scores being correlated with measures of impairment, such as, grip strength, range of motion, pain or sensibility, although it is not clear what correlation can be expected between activity limitations and impairments. In a recent study related to "hand impairments and their relationship with manual ability in children with cerebral palsy", Arnould et al.[30 (p711)] have reported that gross manual dexterity (measured with the Box and Block Test) on the dominant hand and grip strength on the non dominant hand were the best independent predictors of manual ability (activity), but predicted only 58% of its variance. This study showed that fine hand use (gross manual dexterity) and limitation of manual ADLs are not related in a predictable straightforward relationship. It is also important that, besides body functions and structures, activity is measured and treated, because performing an activity is not simply the integration of body functions (grip force, tactile perception, proprioception) in manual ADLs.[30]

This lack of uniform information about the clinimetric properties of instruments means that it is not possible to recommend 1 or 2 instruments for assessing activity

limitations in patients with hand injuries. Moreover, it should be remembered that the clinimetric properties of an instrument vary by study population and setting.[24] Clinimetric properties of all instruments should be evaluated in further studies. Of the pegboard tests, The Functional Dexterity Test, the Nine-hole Peg Test and the Purdue Pegboard test, need further research of all clinimetric properties with sample-sizes of more than 50 patients with a hand injury. Of instruments to measure fine hand use, the Box and Block Test and the Minnesota Manual Dexterity Test 1991 edition were the only instruments with a potentially positive rating if sample-sizes had been larger. When statistical estimates are derived from very small populations, confidence intervals will be wide. This indicates the high degree of uncertainty in the precision of the reliability coefficient.[17,21] Of instruments measuring single tasks there was only one positive rating on the construct validity of the Upper Extremity Performance Test for the Elderly (TEMPA). It is important to formulate hypotheses before validity testing. These hypotheses should specify both magnitude and direction of the expected correlation.[17,21] Also, questionnaires do not have a positive rating for all clinimetric properties. However, the DASH was given a positive rating for four clinimetric properties. The DASH is used very often in clinical practice and this review confirms its quality. However, clinimetric properties of an instrument may vary among different settings and populations.

The purpose for which an instrument is used affects its reproducibility and responsiveness. For example, discriminative questionnaires require a high level of reliability to be able to distinguish between persons, whereas evaluative questionnaires require a high level of agreement to be able to measure important changes. Evaluative questionnaires should be responsive to change, whereas discriminative questionnaires do not necessarily need to be responsive to change.[21,24] It is important that outcome instruments measure the outcomes of interest for patients, especially when the primary purpose of treatment is to relieve symptoms and decrease disability.[11] Hand therapists and hand surgeons are increasingly interested in the problems patients experience in performing daily activities. Especially in a decision-making process, when surgeons and therapists discuss whether an intervention is suitable for the individual patient, it is important to know what the problems and needs are for this patient. The COPM is suitable for this purpose, and further research on clinimetric properties is needed. The DASH or MHQ can be used to measure activity limitations. On the basis of our findings, the COPM might be more adequate for evaluative purposes (agreement) and the DASH or MHQ might be more adequate for discriminative or diagnostic purposes (reliability and validity). Veehof et al.[11] also suggested that the DASH provides a means for group comparisons, with help of a fixed number of items. The COPM allows patients to state their individual concerns and to rate their relative importance; it provides a means for goal attaining in individual patients. According to Veehof et al.[11], the DASH could be used in clinical trials, whereas the COPM might be preferred in clinical practice. Thus the setting and context of the study may help determine whether the DASH or the COPM should be used.

## CONCLUSIONS

On the basis of the quality of various instruments to evaluate physical limitations and the target population, it would be appropriate to select some instruments and to develop and evaluate them further. Of the pegboard tests, the Purdue Pegboard test is recommended over the nine-hole Peg Test because the Purdue Pegboard test involves bilateral and unilateral hand use, and has a broader age range of normative data. For instruments measuring only fine hand use by manipulating objects, the Box and Block Test is recommended, whereas the JTHF should be considered if an instrument measuring the performance of a single task is required. For questionnaires, the COPM is recommended for evaluative purposes and the DASH is recommended for discriminative or diagnostic purposes. However, more research is needed, with samples of more than 50 subjects and appropriate statistical methods, before a core-set of instruments can be established.

# APPENDIX 1

## Terms used in the literature review (2001-2006)

| Instruments to measure activity | Clinimetric properties |
|---|---|
| 1. A Self Administered Questionnaire for the assessment of Severity of Symptoms and Functional status in carpal tunnel syndrome (CTQ)<br>2. Arthritis Hand Function Test (AHFT)<br>3. Box and Block Test (BBT)<br>4. Canadian Occupational Performance Measure (COPM)<br>5. Disabilities of the Arm, Shoulder and Hand (DASH)<br>6. Functional Dexterity Test (FDT)<br>7. Grooved Pegboard Test<br>8. Jebsen-Taylor Test of Hand Function (JTHF)<br>9. Michigan Hand Outcomes Questionnaire (MHQ)<br>10. Minnesota Manual Dexterity Test 1991 edition (MMDT)<br>11. Moberg Pick Up Test (MPUT)<br>12. Nine Hole Peg Test (NHPT)<br>13. O'Neill Hand Function Assessment<br>14. Purdue Pegboard Test (PPT)<br>15. Radboud Skills Test (RST)<br>16. Rosenbusch Test of Finger Dexterity<br>17. Sequential Occupational Dexterity Assessment (SODA)<br>18. Smith Hand Function Evaluation (SHFE)<br>19. Sollerman Hand Function Test (SHFT)<br>20. Southampton Hand Assessment Procedure (SHAP)<br>21. Subjective Hand Function Scoring System (HFS)<br>22. Test d'Evaluation des Membres Supérieurs de Personnes Agées / Upper Extremity Performance Test for the Elderly (TEMPA)<br>23. Upper Extremity Function Test (UEFT) | ▪ Item Construction<br>▪ Reliability/ Reproducibility / Reproduceerbaarheid<br>  ▪ Interrater<br>  ▪ Intrarater<br>  ▪ Test – retest<br>  ▪ Internal consistency<br>▪ Validitity<br>  ▪ Content validity<br>  ▪ Construct validity<br>  ▪ Criterion validity<br>  ▪ Face validity<br>▪ Sensitivity<br>▪ Specificity<br>▪ Responsiveness/ longitudinal validity/ responsiviteit<br>▪ Norms<br>▪ Feasibility, hanteerbaarheid<br>▪ Standardization<br>▪ Scoring norms |

# APPENDIX 2

## Quality criteria for measurement properties

| Property | Definition | Quality criteria[a,b] |
|---|---|---|
| 1 Content validity | The extent to which the domain of interest is comprehensively sampled by the items in the questionnaire | + A clear description is provided of the measurement aim, the target population, the concepts that are being measured, and the item selection AND target population and either investigators OR experts were involved in item selection<br>? A clear description of above mentioned aspects is lacking OR only target population involved OR doubtful design or method<br>- No target population involvement<br>0 No information found on target population involvement. |
| 2 Internal consistency | The extent to which items in a (sub)scale are intercorrelated, thus measuring the same construct | + Factor analyses performed on adequate sample size (7 x number of items and >100) AND Cronbach's alpha(s) calculated per dimension AND Cronbach's alpha values between 0.70-0.95<br>? No factor analysis OR doubtful design or method<br>- Cronbach's alpha(s) less than 0.70 or greater than 0.95, despite adequate design and method<br>0 No information found on internal consistency. |
| 3 Criterion validity | The extent to which scores on a particular questionnaire relate to a criterion standard | + Convincing arguments that criterion standard is "a criterion standard" AND correlation with criterion standard is greater than or equal to 0.70<br>? No convincing arguments that criterion standard is "criterion" OR doubtful design or method<br>- Correlation with criterion standard less than 0.70, despite adequate design and method<br>0 No information found on criterion validity. |
| 4 Construct validity | Tthe extent to which scores on a particular questionnaire relate to other measures in a manner that is consistent with theoretically derived hypotheses concerning the concepts that are being measured | + Specific hypotheses were formulated AND at least 75% of the results are in accordance with these hypotheses<br>? Doubtful design or method (eg, no hypotheses)<br>- less than 75% of hypotheses were confirmed, despite adequate design and methods<br>0 No information found on construct validity. |

| Property | Definition | Quality criteria[a,b] |
|---|---|---|
| 5 Reproducibility | | |
| 5.1 Agreement | The extent to which the scores on repeated measures are close to each other (absolute measurement error) | + SDC less than MIC OR MIC outside the Limits Of Agreement (LOA) OR convincing arguments that agreement is acceptable<br>? Doubtful design or method OR 'MIC not defined and no convincing arguments that agreement is acceptable'<br>- SDC greater than or equal to MIC OR MIC inside LOA, despite adequate design and method<br>0 No information found on agreement. |
| 5.2 Reliability | The extent to which patients can be distinguished from each other, despite measurement errors (relative measurement error) | + ICC or Kappa greater than or equal to 0.70<br>? Doubtful design or method (eg, time interval not mentioned)<br>- ICC or Kappa less than 0.70, despite adequate design and method<br>0 No information found on reliability |
| 6 Responsiveness | The ability of a questionnaire to detect clinically important changes over time | + $SDC_{individual}$ or $SDC_{group}$ less than MIC OR MIC outside the LOA OR RR greater than 1.96 OR AUC greater than or equal to 0.70<br>? Doubtful design or method OR sample size less than 50 OR methodological flaws;<br>- $SDC_{individual}$ or $SDC_{group}$ greater than or equal to MIC OR MIC equals or inside LOA OR RR less than or equal to 1.96 OR AUC less than 0.70, despite adequate design and methods<br>0 No information found on responsiveness. |
| 7 Floor and ceiling effects | The number of respondents who achieved the lowest or highest possible score | + Fifteen percent or less of the respondents achieved the highest or lowest possible scores<br>? Doubtful design or method OR sample size less than 50 OR methodological flaws<br>- More than 15% of the respondents achieved the highest or lowest possible scores, despite adequate design and methods<br>0 No information found on interpretation. |
| 8 Interpretability | The degree to which one can assign qualitative meaning to quantitative scores | + Mean and SD scores presented of at least four relevant subgroups of patients and MIC defined<br>? Doubtful design or method OR less than 4 subgroups OR no MIC defined;<br>0 No information found on interpretation. |

[a] *+ = positive rating;? = indeterminate rating; - = negative rating; 0 = no information available*

[b] *doubtful design or method equals lacking of a clear description of the design or methods of the study, sample size smaller than 50 subjects (should be at least 50 in every (subgroup) analysis), or any important methodological weakness in the design or execution of the study*

*ICC = intraclass correlation coefficient; MIC = minimal important change ; SDC = smallest detectable change ; LOA = limits of agreement ; SD = standard deviation ; AUC = Area Under the receiver operating characteristics Curve (ROC).*

# APPENDIX 3

## Description of clinimetric properties of instruments to measure activities

### 1) Pegboard tests measuring only fine hand use

| **Instrument** | **Functional Dexterity Test (FDT) [31]** |
|---|---|
|  | |
| Purpose | FDT was designed to combine 3 components of dexterity: manipulation, time and accuracy, and 3-jaw chuck prehension pattern (tripod grip). |
| Type of tasks | Turning 16 pegs (diameter 2,2 cm, length 4cm) as quickly as possible in a pegboard. |
| Type of results | Using a stopwatch, recording the time in seconds, that it takes for the patient to turn over all 16 pegs on the board with one hand. A 5-or 10-second penalty may be added. |
| Internal consistency | Not relevant |
| Test-retest reliability | - Aaron and Steginк[31]: Pearson Correlation coefficient r= 0.90, (N=30) |
| Intra-rater reliability | - Aaron and Steginк[31]: ICC > 0.9 for injured and uninjured hand for the timed scores (N=30) |
| Inter-rater reliability | - Aaron and Steginк[31]: ICC > 0.99 for injured and uninjured hand for the timed scores (N=30); For the scores including the penalties, the ICC values varied from 0.73 to 0.88. |
| Content validity | No information available; Aaron and Steginк[31] mentioned that the FDT was designed to combine 3 components of dexterity: manipulation (dynamic, precision handling), time and accuracy (speed), and 3-jaw chuck prehension pattern (also referred to as palmar pinch, pencil pinch, or tripod grip). Based on the literature, the ability to perform tasks with the use of a 3-jaw prehension pattern is a crucial component of normal hand function. It is important to examine the ability of patients and subjects to perform this prehension pattern. |
| Construct validity (concurrent, divergent) | - Aaron and Steginк[31]: biserial correlation between scores on the FDT and 4 functional tasks was -0.64 ($p<0.001$) (N=46)<br>- Aaron and Steginк[31]: Pearson product moment correlation between scores on the FDT and the Jebsen-Taylor Test of Hand Function (N=21) was 0.52 ($p=0.015$) for the dominant hands (injured and uninjured) but was not significant for the non-dominant hands. |
| Norm scores | Aaron and Steginк[31]: executed normative studies are preliminary. |

| **Instrument** | **Grooved Pegboard test [32]** |
|---|---|
|  | |
| Purpose | To assess manipulative dexterity |
| Type of tasks | The subject has to place 25 pegs into holes with randomly positioned slots on a board; Pegs with a key along one side must be rotated to match the hole before they can be inserted. |
| Type of results | Time in seconds |
| Internal consistency | Not relevant |
| Norm scores | Normative data for 2 versions (place tasks and remove tasks); findings also indicated that the remove task was sensitive to sex and handedness effects. |

| **Instrument** | **Nine-Hole Peg Test (NHPT)[33-36]** |
|---|---|
|  | |
| Purpose | A simple, timed test of fine motor coordination; simple, quick assessment for finger dexterity |
| Type of tasks | Pick up nine pegs (3,2 cm long and .64cm in diameter) one at a time, and put them into the holes as quickly as possible. Then remove the pegs and return them to the container. |
| Type of results | Time, using a stopwatch |
| Internal consistency | Not relevant |
| Test-retest reliability | - Oxford Grice et al.[33]: using a commercially available version a Pearson correlation coefficient for both the right and the left hand of r = 0.459 and r = 0.442 respectively (N=25 young healthy adults)<br>- Smith et al.[35]: correlation coefficients for the dominant and non-dominant hands of $r_{503}$ = 0.81 and 0.79, respectively, p <0.001 (N=503 children 5-10 year) It is not described what correlation is calculated.<br>- Mathiowetz et al.[36]: using a self-made version according to specifications a Pearson correlation coefficient of r=0.69 for the right hand and r=0.43 for the left hand (N=26 female Occupational Therapy students, age 20-39) |

| | |
|---|---|
| Inter-rater reliability | - Oxford Grice et al.[33]: using a commercially available version, a Pearson correlation coefficient for both the right and left hands of r = 0.984 and r = 0.993, respectively (N=25 young healthy adults)<br>- Poole et al.[34]: ICC = 0.98 for the dominant hand and 0.96 for the non-dominant hand in testing children (4-19 years, N=20).<br>- Smith et al.[35]: correlation coefficient of r = 0.99 p<0.0005 for both the dominant and non-dominant hand (in children 5-10 year, N=416); again, it is not clear what correlation is calculated.<br>- Mathiowetz et al.[36]: using a self-made version according to specifications a Pearson correlation coefficient for both the right and left hands of r = 0.97 and r = 0.99, respectively (two examiners) |
| Construct validity (concurrent, divergent) | - Mathiowetz et al.[36]: Pearson correlation coefficient was used and a significant inverse relationship between the Nine Hole Peg Test and the Purdue Pegboard Test was obtained for the right hand (r= -0.61) and left hand (r= -0.53) (N=26 female Occupational Therapy students, age 20-39).<br>- Smith et al.[35]: significant inverse correlations were obtained of r = - 0.80 and r = -0.74, for the dominant and non-dominant hands, respectively, between scores of the nine-hole peg test and the Purdue Pegboard Test (in 236 children 6, 8 and 10 year). |
| Norm scores | - Oxford Grice et al.[33]: support the original norms previously published by Mathiowetz et al.[36]<br>- Poole et al.[34] have collected normative data in children aged between 4 and 19 (N=53).<br>- Mathiowetz et al.[36]: using a self-made version according to specifications, collected normative data for adults (N=618 volunteers, aged 20-94) |

| **Instrument** | **Purdue Pegboard Test (PPT) [37-40]** |
|---|---|
|  | |
| Purpose | To measure fine manual dexterity; designed to aid in selecting adults applying for industrial jobs such as assembly, packing and other manual jobs.[40] |
| Type of tasks | Four subtests (five subscores): right hand (RH), left hand (LH), both hands(BH), (right + left+ both (R+L+B)), and assembly; placing with right and then with left hand as many pins as possible down the row within 30 seconds, Placing, with right and left hand simultaneously, as many pins as possible down the row within 30 seconds. The assembly subtest requires that both hands work simultaneously while performing different tasks for 60 seconds. |

| | |
|---|---|
| Type of results | Total number of pins placed by each hand, total number of pairs of pins placed; the right + left + both hands-subtest is a computation of the scores of the first 3 subtests; the assembly score is the total number of objects placed in 60 seconds. |
| Internal consistency | Not relevant |
| Test-retest reliability | - Buddenberg and Davis[37]: 1-trial administration scored lower (ICC ranged 0.37 to 0.70) than the 3-trial administration (all ICC's ≥0.81) (N=47)<br>- Desrosiers et al.[38]: ICC ranged from 0.66 to 0.90 (N=35) |
| Content validity | According to definitions of finger dexterity and manual dexterity the Purdue Pegboard test would be properly called a test of finger dexterity.[40] |
| Construct validity (concurrent, divergent) | - Desrosiers et al.[39]: Pearson correlation coefficients of the Minnesota Manual Dexterity Test (MMDT) with the Purdue Pegboard Test (PP) are -0.64 for the right hand, -0.67 for the left hand, and -0.63 for both hands (N=247) |
| Norm scores | - Desrosiers et al.[38]: normative data for people aged 60 and over have been illustrated for all scores obtained on the Purdue Pegboard Test by women and men according to age groups in 10-year segments (N=360); significant differences were found between the men and women ($p < 0.0001$ for all subtests) and between the right and left hand.<br>- Mathiowetz et al.[40]: for 14-19 year olds, normative data have been established (N=176). An independent *t* -test showed that females did significantly better than males for right hand, left hand and both hands subtests of the Purdue Pegboard.Test; on the assembly subtest, no significant differences between males and females were found; another independent *t* -test showed that there was no significant difference between urban and suburban subjects aged 14 to 17 years for right hand, left hand subtests of the Purdue Pegboard Test; suburban subjects did significantly better than urban subjects. |

### 2) Instruments measuring only fine hand use by picking up, manipulating and placing different objects

| **Instrument** | **Box and Block Test (BBT)** [39,41-43] |
|---|---|
|  | |
| Purpose | To evaluate the gross manual dexterity in handicapped people |
| Type of tasks | Transporting blocks, 1 block at a time, from 1 compartment to the other, as quickly as possible, during 1 minute |

| | |
|---|---|
| Type of results | Number of transported blocks |
| Test-retest reliability | - Desrosiers et al.[42]: ICC for right-handed able-bodied subjects was 0.90, and for left-handed able-bodied subjects it was 0.89 (N=35). The ICC for right-handed subjects with impairment was 0.97 and for left-handed subjects with impairment it was 0.96 (N=34). |
| Inter-rater reliability | - Mathiowetz et al.[43]: Pearson correlation coefficients of r = 1.000 and 0.999 right and left hands, respectively, was found between raters A and B (N=27) |
| Construct validity (concurrent, divergent) | - Desrosiers et al.[39,41,42]: Pearson correlation coefficients between the BBT and the ARA are 0.80 (right hand) and 0.82 (left hand). Correlation between the BBT and independence (SMAF-ADL) are 0.42 (right hand) to 0.54 (left hand);<br>Spearman Correlation coefficient between the functional rating and task analysis components of the TEMPA and the ARA is greater (0.90 to 0.95) than that between the TEMPA and the BBT (0.73 to 0.78);<br>Pearson correlation coefficients of the BBT with the MMDT are -0.63 to -0.67 |
| Norm scores | - Mathiowetz et al.[43]: normative data for adults (N=628); the differences between men and women were relatively small (women scored slightly better than men) In general, the highest scores were achieved by the youngest group (age 20-24y) and the lowest scores were achieved by the oldest group (age ≥75y).<br>- Desrosiers et al.[42]: normative data for each of the age groups for the right and left hand (N=360) |

| **Instrument** | **Minnesota Manual Dexterity Test (MMDT), 1991 edition [39,44]** |
|---|---|
|  | |
| Purpose | To measure manual dexterity |
| Type of tasks | Incorporate 5 subtests: Placing test, Turning test, Displacing test, One-hand Turning and Placing test, and the Two-hand Turning and Placing test |
| Type of results | Number of seconds to complete each task, timed with a stopwatch |
| Test-retest reliability | - Desrosiers et al.[39]: *concluded acceptable to high test-retest reliability (ICC's of 0.79 to 0.88, N=35)* |
| Construct validity (concurrent, divergent) | - Desrosiers et al.[39]: to verify the construct validity of the MMDT, the BBT and the PPT were also administered (N=247). This validity study is based on the hypothesis that because the MMDT is supposed to evaluate both gross and fine manual dexterity, it should be closely correlated with a gross manual test (BBT) and with a fine dexterity test (PPT); they reported that Pearson's correlation coefficients of the MMDT with the BBT and the PPT are moderate (-0.63 to -0.67, and p<.0001). |

| | |
|---|---|
| Norm scores | - Desrosiers et al.[39]: the effects of age, sex, and side (left or right) were studied with Pearson correlation coefficients and $\chi^2$ (chi-square) tests; because of the small number of subjects who were not right-handed, the results were analyzed without considering hand dominance; age was found to be correlated with test performance [r = 0.51 to 0.55 depending on the test (p < .0001)]. For all 3 age groups combined, women obtained better scores (were faster) than the men for the right hand (p = .008). Statistically significant better scores were found for the right hand of the Placing test when compared to the left, for both sexes (p <.001).<br>- Surrey et al.[44]: even though the MMDT and the Minnesota Rate of Manipulation Test (MRMT) are constructed differently and are different versions of the Complete Minnesota Dexterity tests, both tests use the same instruction manual and the same normative data; to determine if normative data of the MRMT could be used for the MMDT, the performance outcomes between the 2 tests of manual dexterity were evaluated. The difference scores for both of the subtests conveyed statistical significance, and the scores showed that the differences were greater for the Placing subtest (T = 13.24, p <.000) than they were for the Turning subtest (T = 4.25, p <.000). |

| **Instrument** | **Moberg Pick Up test (MPUT)[45-49]** |
|---|---|
|  | |
| Purpose | To evaluate the functional sensibility |
| Type of tasks | Pick up a number of small objects and place them in a small container. The same procedure is repeated with the patient blindfolded. |
| Type of results | Time to accomplish the task |
| Inter-rater reliability | - Ng et al.[46]: for 14 subjects, a Pearson correlation coefficient of r = 0.60, p <.01 for group 1 eyes open and for the group eyes closed, the Pearson correlation coefficient was r = 0.801, p <.01. |
| Construct validity (concurrent, divergent) | - Chiari-Grisar et al.[45]: the MPUT scores correlated with the DASH scores of the operated (r = 0.59, p <.01) and non-operated hands (r = 0.60, p < .01) (N=37 patients with RA with finger joint arthroplasty); the correlations between the MPUT and Health Assessment Questionnaire (HAQ) (N=35) were moderate to high (operated hands, r = 0.36, p <.05; non-operated hands, r = 0.48, p <.05); the MPUT scores and the grip strength showed moderate correlations (operated hands, r = 0.29, p <.05; non-operated hands, r = 0.26, p >.05), based on Spearman and Pearson correlation coefficients |

| | |
|---|---|
| | - Stamm et al.[49]: a significant Spearman rank correlation coefficient between MPUT (performed with open eyes only) and Button test (BT) of r = 0.52 (N=100 patients with inflammatory joint disease attending a rheumatology outpatient clinic and who completed both tests) |
| Norm scores | - Ng et al.[46]: normal values for mean (SD) for the Moberg Pickup Test, according to the differences in gender and hand dominance (N=100) |

| **Instrument** | **O'Neill Hand Function Assessment[50]** |
|---|---|
|  | |
| Purpose | To measure the performance of the hand in a wide range of tasks that represent everyday activities |
| Type of tasks | There are 8 tasks in the final version of the assessment: (1) Picking up coins, (2) picking up pins, (3) lifting up plates, (4) picking up and turning piping, (5) picking up tennis balls, (6) lifting blocks with handles, (7) bringing hand to mouth, and (8) tapping keyboard. |
| Type of results | Norm-referenced: speed (time in seconds), and criterion-referenced: manner (scored each task out of five points): the type of grip demanded, the accuracy of the task, and the positioning of the upper extremity |
| Test-retest reliability | - O'Neill[50]: high correlations of 0.82 in non-disabled adults for the total score (N=22); the individual tasks had a more moderate range of 0.54 to 0.79. The second test of the assessment was performed faster than the first. |
| Inter-rater reliability | - O'Neill[50]: Pearson product moment correlations between the scores ranging from 0.96 to 0.99 for all the tasks, in non-disabled adults (N=28) |
| Content validity | - O'Neill[50]: to establish the content validity experts called upon to decide the tasks in the assessment were 55 occupational therapists working throughout Ireland in the area of physical disabilities; through the methodology of a questionnaire, rank ordering of tasks under these 7 grip classifications was performed by the therapists. |
| Construct validity (concurrent, divergent) | O'Neill[50]: the total score on the assessment (population unknown) had predicted correlations with a measure of grip strength (r = -0.37), with pain (r = -0.09) and with range of movement: finger flexion (r = -0.18) finger extension (r=0.38) and thumb flexion (r = 0.58); correlations with another measure of disability, the Nine Hole Peg Test, produced a Pearson product moment correlation of 0.98. In examining in more detail the correlations with the Nine Hole Peg Test, the tasks of palmar, tip, lateral, cylindrical and spherical prehension had high correlations with this peg test, but the hook prehension task (r=0.38) and the two non-prehensive tasks (r=0.04, r=-0.07) had very low correlations. according to O'Neill, this implies that the O'Neill Hand Function Assessment has a value in measuring a broader construct than that measured by the Nine Hole Peg Test. |

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|---|---|
| Norm scores | - O'Neill[50]: normative data have been collected for a non-disabled population on their performance in the speed section only; the results of an analysis of variance demonstrated that there were significant differences between age groups and for hand dominance; however, more data have to be collected. |

| **Instrument** | **Rosenbusch Test of finger dexterity[51]** |
|---|---|
| Purpose | *To assess patients' problems with hand function involving fine dexterity; measures the speed of interdigital manipulation of objects by each hand separately* |
| Type of tasks | Manipulating objects: holding 6 objects in the hand and the rolling out of the objects from the tips of the thumb and index and long finger into six depressions in the testing board; this manipulation is tested for four subtests: marbles, jacks, wooden cubes, and flat round stones |
| Type of results | Time using a stopwatch, accuracy: the time-scores are weighted for accuracy (performance) |
| Internal consistency | - Stein and Yerxa[51]: coefficient alpha of 0.87 for non-dominant normal hands, 0.93 for dominant normal hands, and 0.96 for dysfunctional hands (N=64) |
| Test-retest reliability | - Stein and Yerxa[51]: the correlation for the dominant hands ranged from 0.79 to 0.93, the correlation for the non-dominant hands ranged from 0.73 to 0.88, for the combined hands 0.68 to 0.84; when scores of all subtests were summed to arrive at a total score, the stability correlation was $r = 0.93$. (in N=13 healthy adults); it is not described what correlation is calculated. |
| Inter-rater reliability | - Stein and Yerxa[51]: Pearson product moment correlation to compare combined hands and weighted scores (N=10); inter-rater reliability coefficients ranged from 0.97 to 0.99. |
| Content validity | - Stein and Yerxa[51]: 100% agreement in a panel of experts that the test measures fine dexterity. |
| Construct validity (concurrent, divergent) | - Stein and Yerxa[51]: the construct validity was assessed with the discriminant-groups method and the *t* test showed that the instrument discriminates between persons with normal hand function (N=17) and those with dysfunction involving fine dexterity (N=17). |

### 3) Instruments measuring single tasks (and fine hand use) by scoring executed tasks

| Instrument | Arthritis Hand Function Test (AHFT) [52-55] |
|---|---|
| Purpose | Measure of hand function: hand strength and dexterity in adults with RA |
| Type of tasks | Grip strength (grip and pinch), 9-hole pegboard, applied dexterity (5 tasks: lacing shoes, (un)fasten buttons, (un)fasten safety pins, cutting putty with knife and fork, manipulating four coins in a slot) and applied strength (2 tasks: lifting a tray of cans, pouring a glass of water) |
| Type of results | mm HG, kg, time number of lifted cans, ml poured water |
| Test-retest reliability | - Backman and Mackie[52]: ICC of most items of 0.83 to 0.96 (N=25). Only 3 items were less: left-hand pegboard dexterity (0.76), fastening safety pins (0.78), and cutting with a knife and fork (0.74).<br>- Poole et al.[54]: for most items ICC's = 0.80 – 0.97 and for the others ICC's = 0.57-0.73 (N=20 patients with systemic sclerosis). |
| Inter-rater reliability | - Backman and Mackie[53]: ICCs ranged from 0.45 to 0.99 (N=30). Most exceeded 0.80, suggesting a level of consistency between raters.<br>- Backman and Mackie[52]: ICCs for every item exceeding 0.99 (N = 26, two thoroughly trained raters); the percentage agreement ranged between 90,3% to 100%.<br>- Poole et al.[54]: interrater ICCs of 0.99 to 1.00 (N=20 patients with systemic sclerosis). |
| Construct validity (concurrent, divergent) | - Poole et al.[55]: significant Spearman correlation coefficients between scores on the Duruoz Hand Index (DHI) and scores on the AHFT of $r_s$ =0.36-0.54 (N=40 patients with RA).<br>- Poole et al.[54]: Pearson's *r* correlation coefficients (significant) between some items of the AHFT and HAQ ranged from 0.46 to 0.73 and between some items of the AHFT and AIMS2 ranged from 0.45 to 0.69. (N=20 patients with systemic sclerosis)<br>- Backman and Mackie[52]: Pearson's correlation coefficient ranged from 0.40 to 0.75 for the relationship between every item of the AHFT and the self-reported Physical Activities of Daily Living (PADL) or the self-reported Instrumental Activities of Daily Living (IADL) (N=26 patients with osteoarthritis) |

| Instrument | Jebsen-Taylor Test of Hand Function (JTHF) [2,31,56,57] |
|---|---|
|  | |
| Purpose | Provide objective measurements, evaluate patient's functional capabilities to assess disability and the effectiveness of treatment |
| Type of tasks | Seven hand activities, like writing, turning over cards, picking up small objects, simulate eating, stacking checkers, picking up large light objects, picking up large heavy objects. |
| Type of results | Time, using a stopwatch |

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|---|---|
| Test-retest reliability | - Jebsen et al.[56]: Pearson product-moment correlation coefficients ranging from 0.69 to 0.99 (all p<.01) (N=26, with stable hand function problems) |
| Construct validity (concurrent, divergent) | - MacDermid and Mulè[57]: Pearson *r* correlation coefficients between subtests of the JTHF and the NK Hand Dexterity Test ranged from 0.38 to 0.88 (N=50); furthermore, the JTHF score was moderately correlated with patient-rated function (personal care: -0.42 to -0.61, household -0.41 to -0.61, work –0.45 to –0.67 and recreation –0.34 to –0.57).<br>- Sharma et al.[2]: all subtests but writing a short sentence were correlated with Health Assessment Questionnaire (HAQ) scores ranging 0.49-0.55 in patients with RA (N=25); in the same study the total hand pain score was not significantly related to any JTHF subtest scores.<br>- Aaron and Stegink Jansen[31]: Pearson product moment correlation between the scores on the JHFT, as a whole, and scores on the FDT was statistically significant (r = 0.52, p = .015) for the dominant hands (injured and uninjured included) but was not significant for the non-dominant hands. (N=21) |
| Norm scores | - Jebsen et al.[56] reported normative data |

| **Instrument** | **Radboud Skills Test (RST)** [58,59] |
|---|---|
| Purpose | Register the manner in which an extremity with CRPS-I is used in daily tasks. |
| Type of tasks | Ten tasks, 2 handed, (walking, paper in envelop, pillow in slip, putting on shirt, closing buttons, put on sock, tying laces, washing hands , drying hands, folding towel) |
| Type of results | Five-point score (0=normal, 4=affected hand is not moving or task is not possible), 3-point score for effort (0=no effort, 2=much effort) and a VAS-score for pain |
| Test-retest reliability | - Cup et al.[59]: weighted Kappa's of 0.401 to 0.708 (N=15 patients with CRPS-I) |
| Intra-rater reliability | - de Boer et al.[58]: weighted Cohen's Kappa's of 0.607 to 1 (N=22 patients with CRPS-I) |
| Inter-rater reliability | - de Boer et al.[58]: weighted Cohen's Kappa's varying from 0.468 to 0.955 (N=22 patients with CRPS-I) |

| **Instrument** | **Sequential Occupational Dexterity Assessment (SODA)** [60-63] |
|---|---|
| Purpose | Measure bimanual dexterity in daily life |
| Type of tasks | Twelve tasks (6 bilateral, 6 unilateral): writing a sentence, picking up an envelope, picking up coins, holding receiver of a telephone, unscrewing toothpaste, squeeze toothpaste on a toothbrush, handling a spoon and knife, buttoning a shirt, unscrewing a thermos, pouring water into a glass, washing hands, drying hands. |
| Type of results | Three-point score ability, 3-point score effort, VAS-score |

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|---|---|
| Internal consistency | - Massy Westropp et al.[62]: *α*-value for abilities of 0.91, for physical function 0.9 and for pain 0.8 (N=62).<br>- van Lankveld et al.[61]: Cronbach's alpha was 0.91(N=109). |
| Test-retest reliability | - Massy et al.[62]: ICC for scales is 0.88 – 0.89, overall ICC is 0.89 in patients with Rheumatoid Arthritis affecting both hands (N=17)<br>- van Lankveld et al.[61]: Pearson correlation coefficient between the first and the second score of $r = 0.93$ in RA patients (N=22) |
| Inter-rater reliability | - van Lankveld et al.[61]: Kendall's coefficient of concordance W to express the degree of association between the 3 sets of ranking ($W = 0.78$, $p < .01$) (N=6). |
| Construct validity (concurrent, divergent) | - Massy et al.[62]: the physical function scales of the Australian Canadian Osteoarthritis Hand Index (AUSCAN) and SODA are related (Pearson r = 0.81) (N=62 patients with RA)<br>- van Lankveld et al.[61]: correlating the SODA scores of the validity group (N=109) with demographic variables, disease activity, impairment of the hand, pain, and self-reported dexterity; a significant Pearson's correlation coefficient was found between duration of disease and SODA score ($r = -0.21$, $p < .05$); the general level of disease activity as assessed with DAS correlated significantly with dexterity as assessed with the SODA (-0.34); also correlations between the SODA and grip strength (0.49) and between SODA and the Range of Motion of wrist (0.49) and fingers (0.53) were significant; carefully assessed of impairments in both hands explained 51% of the variation in SODA scores; the correlations between the SODA scores and the three pain measures were all negative (VAS -0.54, IRGL-pain -0.41, and SODA-pain -0.57); the correlation between the SODA and the self-reported IRGL scale "self-care" was 0.65.<br>- O'Conner et al.[63]: a significant association between the SODA and the Sollerman was found ($r = 0.79$, $p < .01$); when the SODA was correlated with demographic variables such as age, gender and duration of disease, only the latter demonstrated weak correlation with the 2 tests ($r = -0.62$). (all in patients with different diagnosis, N=25). |
| Responsiveness | - van Lankveld et al.[61]: the average SODA score ± SD before operation in patients with RA (N=14) was 70.5 ±20.6); six weeks post-operatively the average score had increased to 88.43 ±16.8); this significant increase in the SODA score reflects the sensitivity of the SODA to changes in dexterity.<br>- Effing et al.[60]: sensitivity to change, significant Wilcoxon test (N=17 patients attending hand surgery). |

| **Instrument** | **Smith Hand Function Evaluation (SHFE)[64]** |
|---|---|
| Purpose | Assessment of grip strength and unilateral and bilateral hand dexterity including subjective evaluation of shoulder and elbow range of motion through observation of movements |
| Type of tasks | (1) Unilateral grasp-release tasks (blocks, nails, coins and pegs); (2) bilateral eye-hand coordination activities of ADL (safety pin, buckle, buttons, zipper, tying knot, tying bow, lacing shoes); (3) write with pen; and (4) grip strength |

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| Type of results | (1) Time, (2) time, (3) time, (4) kilograms |
| Norm scores | - Smith[64]: described the test in detail and has established norm scores, namely unilateral and bilateral task norms for male and female subjects (N=91) comparing right with left hand scores, regardless of hand dominance. |

| **Instrument** | **Sollerman Hand Function Test (SHFT)[63]** |
|---|---|
| |  |
| Purpose | Assessment of hand function |
| Type of tasks | Twenty tasks, each task considered to be an ADL (for example, put key into lock, open/close zip, lift iron, cut with knife and fork, hold telephone receiver to ear) |
| Type of results | Five-point score (0=task cannot be performed, 4=task is completed without difficulty within 20 seconds and with the prescribed hand-grip of normal quality) |
| Construct validity (concurrent, divergent) | - O'Conner et al.[63]: examination of the association between the Sollerman test of handgrip and the SODA and their relationship to impairment and subjective disability measures (N=25); Spearman and Pearson correlations were used, and a significant association between the Sollerman and SODA was found ($r = 0.79$, $p < .01$); when the Sollerman was correlated with demographic variables such as age, gender and duration of disease, only the last demonstrated weak correlation with the two tests (Sollerman $r = -0.48$); moderate associations were found between the Sollerman test and range of motion (flexor deficit r= -0,50 and extensor deficit r = -0.71); the association between the Sollerman and VAS for pain was for the dominant hand $r = - 0,39$ and for the non-dominant hand $r = -0,30$; subjective hand function using the VAS was strongly associated with the Sollerman ($r = 0.83$); a moderate association was found with self-reported disability in upper limb activities ($r = -0,61$); only weak associations were found between the Sollerman and disability in global daily life activities (HAQ, r= -0.49) |

| **Instrument** | **Southampton Hand Assessment Procedure (SHAP)[65]** |
|---|---|
| Purpose | Specifically developed to test hand function rather than dexterity |
| Type of tasks | The test consists of a series of 12 abstract tasks and 14 day-to-day activities with grips like lateral, power, tripod, extension and spherical |
| Type of results | The score given by the SHAP test is a functional score, 100% being normal hand function, made up of 5 sub-scores for each of the different hand grips; each activity is measured against time |

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| Internal consistency | - Light et al.[65]: internal consistency measures are inappropriate in this context |
| Test-retest reliability | - Light et al.[65]: the SHAP has been shown to be reliable by statistically insignificant differences between subjects' performance during replicate assessments: the ANOVA test revealed an F value of 0.39 ($F_{crit}$=3.28) and *P* value of .68, thereby indicating there is no statistically difference between two measurements (N=21). |
| Inter-rater reliability | - Light et al.[65]: the SHAP has been shown to be reliable by statistically insignificant differences between subjects' performance with various assessors: the ANOVA test revealed an F value of 2.65 ($F_{crit}$=3.09) and *P* value of .75, thereby indicating there is no statistically difference between the measurements of the raters (N=21). |
| Content validity | - Light et al.[65]: the content validity was demonstrated by peer panel approval. |
| Norm scores | Norm-scores are collected (N=24, 18-25 year with no hand function disorders). |

| **Instrument** | **Test d'Evaluation des Membres Supérieurs de Personnes Agées / Upper Extremity Performance Test for the elderly (TEMPA)** [41,66,67] |
|---|---|
|  | |
| Purpose | Accurate assessment of upper extremity performance is a critical element in determining the potential independence of the physically impaired person. |
| Type of tasks | Nine tasks representing daily activities (5 bilateral and 4 unilateral), for a total of 13 different items (such as pick up a jar, open a jar, pour water, open a lock, write, tia a scarf, shuffle and deal cards, handle coins, pick up objects) |
| Type of results | Length of execution (time in sec), functional rating (4-point scale), task analysis |
| Construct validity | - Desrosiers et al.[41]: the highest correlation was found between the combined functional rating total score on the TEMPA and the Partial functional autonomy measurement system (SMAF) ADL score (Spearman Rho = .71), and demonstrates the presence of a link between independence in personal care and upper extremity performance in accordance with the hypotheses formulated in advance. (N=104 between 60-94 year)<br>- Desrosiers et al.[41]: correlation between the functional rating and task analysis components of the TEMPA and the ARA is greater (Spearman Rho, 0.90 to 0.95) than that between the TEMPA and the BBT (Spearman Rho, 0.73 to 0.78) in elderly subjects with different diagnoses (N=104). |

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| | - Umraw et.al[67]: correlation analyses demonstrated that the total scores for the TEMPA and the MHQ are significantly correlated; Spearman rank correlation r= 0.68 (p = 0.001) (N=20). Because the TEMPA and the MHQ both assessed ADL, a possible correlation between the 2 scores was examined; results indicated a statistically significant correlation between the 2 assessment tools for the non-dominant hand scores (*r* = 0.64; p= .003, bilateral scores (*r* = 0.61; p = .006), and the overall scores (*r* = 0.7; p = .001) for ADLs. |
| Norm scores | - Desrosiers et al.[66]: normative data (N=360); the length for the majority of the tasks increases significantly (p <.0001) with age in a non-linear and exponential way; sex has influence on 7 out of the 13 tasks. |

| **Instrument** | **Upper Extremity Function Test (UEFT)[68]** |
|---|---|
| Purpose | Purpose: to measure arm and hand activities of a general nature used in daily living |
| Type of tasks | Thirty-three subtests, unilateral, somewhat representative of ADLs |
| Type of results | Quantitative: 4-point ordinale scale (normal-impossible) |
| Test-retest reliability | - Carroll[68]: 5 of the 6 scales had intraclass correlation scores over 0.85. (N=22) |
| Inter-rater reliability | - Caroll[68]: 2 experienced observers independently made individual hand evaluations (N=48 nursing home patients) and scored them; there were 22 identical total scores, 10 differed by 1 point, 4 by 2 points, 5 by 3 points, 4 by 4 points and 3 by 5 points; 3 inexperienced observers watched a series of 15 patients perform the UEFT; these inexperienced observers were within 7 points in 29 of 30 tests (97%). |
| Norm scores | - Caroll[68]: norm scores have been established (N=79) |

### 4) Questionnaires

| **Instrument** | **A self Administered Questionnaire for the assessment of Severity of Symptoms and Functional status in CTS / Carpal Tunnel Questionnaire (CTQ)[69]** |
|---|---|
| Purpose | Assessment of severity of symptoms and functional status in patients with CTS |
| Type of tasks | Questionnaire, (6 clinical areas (11 questions) and 8 functional activities (8 questions )) |
| Type of results | Score 1-5 per item, calculate mean of all items |
| Internal consistency | - Levine et al.[69]: Symptom Severity Scale: Cronbach's alpha = 0.89 (N=67) and Functional Status Scale: Cronbach's alpha = 0.91 (N=67) |
| Test-retest reliability | - Levine et al.[69]: Symptom Severity Scale: Pearson correlation coefficient = 0.91; Functional Status Scale: Pearson correlation coefficient = 0.93; test-retest reliability was assessed by administration of the scales to the patients (N=31) on 2 successive days. |

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| Content validity | - Levine et al.[69]: a panel of hand surgeons, rheumatologists and patients was consulted; after pilot testing questions were eliminated |
| Construct validity (concurrent, divergent) | - Levine et al.[69]: construct validity was assessed in patients with CTS (N=43) by comparison of the scores on the scale with several measures of disability and impairments, including grip strength as measured with a dynamometer and pressure sensitivity with the Semmes Weinstein monofilament testing; all Spearman correlation coefficients were in the expected direction: positive, but low; These results indicate that the 2 scales and the other measures of dysfunction of the median nerve capture different, complementary aspects of outcome measure; Levine[69]concluded that severity of symptoms and functional disability cannot be estimated by sensibility or nerve-conduction testing. |
| Responsiveness | - Levine et al.[69]: responsiveness to clinical change was assessed by comparison of the preoperative and postoperative scores in 2 cohorts of patients (retrospectively N=38 and prospectively N=26) who had had carpal tunnel release; in both groups, improvement was associated with an improvement in the scores for both severity of symptoms and functional status. |

| **Instrument** | **Canadian Occupational Performance Measure (COPM)[11,60,70-73]** |
|---|---|
| Purpose | To assess client outcomes in the area of self-care, productivity and leisure |
| Type of tasks | Semi-structured interview |
| Type of results | Score1: rating on 1 to 10 scale (for importance, perception of performance and satisfaction with performance) |
| Agreement | - Eyssen et al.[71]: analyses were complemented by calculation of the Bland – Altman 95% limits of agreement; the limits of agreement for the mean values of performance and satisfaction were in the range of -2.5 to 2.4 (DASH-DLV, – 0.05, ±1.2) and -2.3 to 2.7 (DASH-DLV, -0.01,±1.4), respectively; Ttis indicates that for individuals only large differences (>2.5 – 2.7 points) can be detected. (N=95 newly referred outpatients of occupational therapy departments of two university hospitals) |
| Test-retest reliability | - Eyssen et al.[71]: the ICC for the mean scores for performance and satisfaction were respectively 0.67 (95% CI 0.54-0.78) and 0.69 (95% CI 0.56-0.79); the Cohen's weighted Kappa for each of the 5 problems ranged from 0.37 to 0.49 for performance scores and 0.38 to 0.49 for satisfaction scores (all N=95 newly referred outpatients of occupational therapy departments of 2 university hospitals) |
| Inter-rater reliability | - Eyssen et al.[71]: inter-rater agreement of the prioritized problems was moderate; of the problems that were prioritized at the first assessment, the median percentage that were also prioritized at the second assessment was 66%. If not only the prioritized activities, but all activities identified at the second assessment are taken into account (including problems in activities which do exist but were not prioritized), the inter-rater agreement is 80%. |

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| Content validity | - Law et al.[73]: therapists involved in the development were from Canada and represented all areas of occupational therapy; information from the review of existing measures and from content experts was used; an initial pilot testing with 20 clients has been completed. |
| Construct validity (concurrent, divergent) | - Dedding et al.[70]: supportive evidence for the divergent validity of the COPM (N=99 from which 29 within target population) in accordance with described expectations: the Spearman correlation coefficient between the Sickness Impact Profile (SIP68) and the COPM performance scores was –0.20 (p=.05), and between the SIP68 and the COPM satisfaction scores it was –0.19 (p=.07); the correlations between the performance and satisfaction scores of the COPM and the physical domain of the SIP68 were, respectively –0.21 (p=.04) and –0.19 (p=.06); this study also provided evidence for convergent validity: 63% of the corresponding problems in the Disability and Impact Profile (DIP) were reported to be a disruption of quality of life and 74% of the corresponding problems in the SIP68 were identified as a disability.<br>- McColl et al.[72]: construct validity was supported (N=61disabled individuals living in the community); multivariate analyses showed that scores on the COPM were significantly related to theoretically related constructs: satisfaction with performance, reintegration to normal living, and life satisfaction; most participants (53%), when asked about problems of daily living, spontaneously reported at least 1 of the problems raised on the COPM.<br>- Veehof et al.[11]: the construct validity of the COPM and the DASH-DLV was also assessed by comparison of the outcomes (N=50):t<br>The percentage of problems that corresponded between the COPM and the DASH-DLV, calculated by the 2 independent occupational therapists, was 79% and 83% (kappa coefficient = 0.79, $p < 0.001$) |
| Responsiveness | - Effing et al.[60]: positive regression coefficients (n=17), the COPM seems to be sensitive to change. |

| **Instrument** | **Disabilities of the Arm, Shoulder and Hand Questionnaire (DASH)** [11,45,74-82] |
|---|---|
| Purpose | To quantify disability; measure of symptoms and functional status and reflect the impact of a disorder |
| Type of tasks | Questionnaire, part A 30 items (21 physical function items, 6 symptom items and 3 social or role function items), and optional part B 4 questions (about difficulties [impact of arm/hand problem] in playing instrument or sport or performing work); all items refer to the situation in the past week. |
| Type of results | Five-point Likert scale |
| Internal consistency | - Gummesson et al.[76]: Cronbach's alpha > 0.90 (N=109)<br>- Hobby et al.[77]: Cronbach's alpha = 0.97 (N=32)<br>- Palmen et al.[81]: Cronbach's alpha = 0.97 (N=88).<br>- Veehof et al.[11]: Cronbach's alpha = 0.95 (N = 50) |

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|---|---|
| Agreement | - Palmen et al.[81]: the Bland-Altman method was used for the limits of agreement: -12.1 to 14.9 (SD 6.9). SDC is 13.5% (N=88)<br>- Veehof et al.[11]: the limits of agreement between the 2 assessments ranged from –6.7 to 10.0. (N=50). |
| Test-retest reliability | - Palmen et al.[81]: ICC of 0.95 for the total population (N=88)<br>- Veehof et al.[11]: Pearson correlation coefficient of the total DASH scores of the initial assessment and the reassessment $r$ = 0.98 (p =.001) (N=50).<br>- Beaton et al.[74]: ICC of 0.96. The standard error of measurement (SEM) is 4.6 DASH points, which led to a smallest detectable change ($SDC_{95}$) of 12.75 on a 100-point scale. (N=56 patients with either wrist/hand or shoulder problems) |
| Content validity | - Hudak et al.[78]: 13 outcome measurement scales were identified and reviewed; no single scale met the criteria; the scales were combined to produce an initial pool of 821 potential items, which were reviewed by 3 members of the collaborative group the reduced item list (177 items) was sent to content experts (reduction to 78 items); further item reduction is based on field testing. |
| Construct validity (concurrent, divergent) | - Hobby et al.[77]: Spearman correlation coefficient between the total scores of the DASH and grip strength was -0.48 (p=.006); between Dash and static two-point discrimination 0.12; and between DASH and Nine-Hole Peg Test 0.16. (all N=32 patients with CTS)<br>- Navsarikar et al.[80]: Spearman correlation coefficients between DASH and grip strength $r$ = -0.47, (CI –0.67. –0.21.) and between DASH and number of active joints in the upper limbs $r$ =0.65 (CI 0.46 - 0.79) (N = 50 patients with psoriatic arthritis)<br>- Chiari et al.[45]: Pearson correlation coefficients were calculated to study construct validity: between DASH and Health Assessment Questionnaire (HAQ) ($r$ = 0.72 ; p<.01) and between the DASH and Moberg Pick Up Test ($r$ = 0.6; p<.01) (N=37 patients with RA with finger joint arthroplasty)<br>- Chiari et al.[45]: active ROM of neither the metacarpophalangeal nor the proximal interphalangeal joints correlated with the DASH.<br>- Chiari et al.[45]: the correlation between the DASH and the subscales of the SF-36 varied from -0.31 to 0.73.<br>- Palmen et al.[81]: correlations between the DASH and the subscales of the SF-36 varied from 0.49 to 0.85, in accordance with the hypotheses, formulated in advance (N = 88).<br>- Veehof et al.[11]: the percentage of problems that corresponded between the DASH-DLV and the COPM, calculated by the two independent occupational therapists, was 79% and 83% (kappa coefficient = 0.79, p < 0.001)<br>- Beaton et al.[74]: discriminative validity (sensitive to the range of disability) was verified and confirmed by looking at (1) the distribution of baseline scores, (2) floor or ceiling effects, (3) differences in scores between subgroups. (N=200 patients with either wrist/hand or shoulder problems) |

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| | - Beaton et al.[74]: Pearson Correlation Coefficient between DASH and: Pain severity, 0.72; ability to function 0.79; ability to work 0.76; Shoulder Pain and Disability Index (SPADI) -pain 0.82; SPADI function 0.88; Brigham symptoms 0.71; and Brigham function 0.89 (N=200 patients with either wrist/hand or shoulder problems) |
| Responsiveness | - Gay et al.[75]: after carpal tunnel release the DASH showed moderate sensitivity to change at 6 weeks and good at 12 weeks (effect size 1.01, standardized response mean 1.13; N=34 patients scheduled for carpal tunnel release), but at both times less than the disease specific Carpal Tunnel Questionnaire.<br>- Kotsis and Chung[79]: the score of the function/symptom scale decreased by 17.5 points; SRM 0.7; the DASH was responsive at 6 months after surgery, but the combined function/symptom scale of the DASH limits the measurement of symptom and function improvement after carpal tunnel surgery (N = 50 patients with carpal tunnel release).<br>- Gummesson et al.[76]: the mean score change was 15. the effect size (ES) was 0.7 and the SRM 1.2. (N=109); the DASH can detect changes of disability after surgery in patients with upper extremity musculoskeletal disorders; they suggest a 10-point difference in mean DASH score may be considered as a minimal important change.<br>- Hobby et al.[77]: responsiveness to change: ES 0.49 with SRM 0.43.( N=24 patients with CTS)<br>- Beaton et al.[74]: the DASH demonstrated change in all situations in which change was presumed to have occurred- before and after treatment (ES 0.74-0.80).<br>- MacDermid and Tottenham[82]: the DASH demonstrated responsiveness after 3 months (N=60: 24 wrist problems, 36 hand problems).; SRM of 1.37 and effect size of 1.49 indicated a treatment effect. |

| **Instrument** | **Michigan Hand Outcomes Questionnaire (MHQ)[62,67,79,83,84]** |
|---|---|
| Purpose | To measure outcomes pertinent to patients with hand disorders, to assess outcomes that were considered important by patients with hand disorders, hand therapists, and hand surgeons.[83] |
| Type of tasks | Questionnaire of 37 items, which contains 6 scales: (1) overall hand function, (2) activities of daily living, (3) work performance, (4) pain, (5) aesthetics, (6) satisfaction with hand function |
| Type of results | Five point score; a total is counted and can vary from 0 to 100. |
| Internal consistency | - Chung et al.[83]: all the scales in the MHQ had Cronbach's alphas greater than 0.85. (N=200)<br>- Massy-Westropp et al.[62]: alpha values for 5 of the 6 scales ≥ 0.88 and for 1 scale (pain) 0.75. |

| | |
|---|---|
| Agreement | - Chung et al.[83]: limits of agreement for the mean values of the 6 scales of the MHQ were in the range of –2.75 to 6.03 (N=22 patients with hand disorders) |
| Test-retest reliability | - Chung et al.[83]: ICCs for the 6 scales ranging from 0.81 to 0.97. (N=22 patients with hand disorders)<br>- Massy-Westropp et al.[62]: ICCs for the 6 scales, ranging from 0.58 to 0.97, overall ICC = 0.95; upper confidence limit for the differences between test 1 and 2 = 5 points out of 100 (N=17 patients with RA). |
| Content validity | - Chung et al.[83]: after searching Medline and evaluating existing questionnaires, an initial pool of 100 questions was pilot-tested in 20 patients; after factor analysis, the number of questions was reduced to a 37-item MHQ. |
| Construct validity (concurrent, divergent) | - Chung et al.[83]: Spearman rank correlations between the 6 scales of the MHQ: $r \geq 0.63$ among the 5 scales that measure functional outcomes; the esthetics scale showed weaker correlations with the other scales (N=200).<br>- Chung et al.[83]: compared 3 of the scales in the MHQ (ADLs, work performance, and pain) with similar questions in the Short Form 12 (SF-12), which asked about physical limitations because of health (N=200); they reported (Spearman) correlations ranging from 0.54 – 0.79 for the ADL, work performance and pain scales; pain questions from the MHQ correlated with pain questions of the SF-12 ($r$ =0.79, p<.05, N=62); because questions in the SF-12 inquired about health and not specifically about hand performance, the authors hypothesized that there would only be moderate correlation between similar items in these 2 questionnaires. (N=200 patients with hand disorders).<br>- Massy-Westropp et al.[62]: the AUSCAN and the MHQ pain scales correlated (Pearson $r$ = 0.68, p <.001; N=62 patients with RA).<br>- Umraw et al.[67]: correlation analyses demonstrated that the total scores for the TEMPA and the MHQ are significantly correlated; Spearman rank correlation $r$ = 0.68 (p = .001; N=20); because the TEMPA and the MHQ both assessed ADLs, a possible correlation between the 2 scores was examined; results indicated a statistically significant correlation between the 2 assessment tools for the non-dominant hand scores ($r$ = 0.64; p= .003), bilateral scores ($r$ = 0.61; p = .006), and the overall scores ($r$ = 0.7; p = 0.001) for ADLs. |
| Responsiveness | - Chung et al.[84]: when the scores of self-assessment of change were correlated with the change in scores for the six scales of the MHQ over time, all six Spearman correlations were statistically significant (p <.05, N=92); correlations ranged from 0.25 for the esthetics scale to 0.43 for the pain scale; hereby using the heuristic method of responsiveness testing, comparing the patients' self-reported magnitude of change in health status with the change in MHQ scores at baseline and follow-up. |

| | |
|---|---|
| | - Kotsis and Chung[79]: all domains of the MHQ revealed significant postoperative improvement (all p <.01) in patients with CTS (n=50); SRMs ranged from (0.5 - 0.6) for the ADLs, work, and functional scales, to (0.9 – 1.1) for the pain and satisfaction scales. |

| **Instrument** | **Subjective Hand function Scoring system (HFS)[85]** |
|---|---|
| Purpose | Assessment of hand function in order to plan and monitor progress through rehabilitation. |
| Type of tasks | Twenty-five tasks of daily living, such as handling buttons and shoelaces, using the toilet, cleaning teeth, unscrewing lids, cutting, pouring kettle, using key, and driving, are discussed with the patient and scored. |
| Type of results | Four-pointscore, (score 1 [easy or not relevant], 4[impossible]; total hand function score between 25 and 100 |
| | No article was found that met the criteria during the selection procedure to describe clinimetric properties of the Subjective Hand Function Scoring system |

NOTE. If no information was available on the clinimetric property of an instrument, this property is not mentioned.

# APPENDIX 4

## Summary evaluation of clinimetric quality

### 1) Pegboard tests measuring only fine hand use

| instrument | Internal consistency | Agreement | Test-retest reliability | Intra-rater reliability | Inter-rater reliability | Content validity | Construct validity (concurrent, divergent) | Criterion / concurrent validity (gold standard) | Responsiveness |
|---|---|---|---|---|---|---|---|---|---|
| Functional Dexterity Test (FDT) | ? | 0 | ? | * | * | 0 | ? | 0 | 0 |
| Grooved Pegboard test | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nine-Hole Peg Test (NHPT) | ? | 0 | ? | 0 | ? | 0 | ? | 0 | 0 |
| Purdue Pegboard Test | ? | 0 | ? | 0 | 0 | 0 | ? | 0 | 0 |

### 2) Instruments measuring only fine hand use by picking up, manipulating and placing different objects

| instrument | Internal consistency | Agreement | Test-retest reliability | Intra-rater reliability | Inter-rater reliability | Content validity | Construct validity (concurrent, divergent) | Criterion / concurrent validity (gold standard) | Responsiveness |
|---|---|---|---|---|---|---|---|---|---|
| Box and Block Test (BBT) | 0 | 0 | * | 0 | ? | 0 | ? | 0 | 0 |
| Minnesota Manual Dexterity Test, 1991 edition (MMDT) | 0 | 0 | * | 0 | 0 | 0 | ? | 0 | 0 |
| Moberg Pick Up test (MPUT) | 0 | 0 | 0 | 0 | ? | 0 | ? | 0 | 0 |
| O'Neill Hand Function Assessment | 0 | 0 | ? | 0 | ? | ? | ? | 0 | 0 |
| Rosenbusch Test of finger dexterity | ? | 0 | ? | 0 | ? | ? | ? | 0 | 0 |

### 3) Instruments measuring single tasks (and fine hand use) by scoring executed tasks

| instrument | Internal consistency | Agreement | Test-retest reliability | Intra-rater reliability | Inter-rater reliability | Content validity | Construct validity (concurrent, divergent) | Criterion / concurrent validity (gold standard) | Responsiveness |
|---|---|---|---|---|---|---|---|---|---|
| Arthritis Hand Function Test (AHFT) | 0 | 0 | ? | 0 | * | 0 | ? | 0 | 0 |
| Jebsen-Taylor Test of Hand Function (JTHF) | 0 | 0 | ? | 0 | 0 | 0 | ? | 0 | 0 |
| Radboud Skills Test (RST) | 0 | 0 | ? | ? | ? | 0 | 0 | 0 | 0 |
| Sequential Occupational Dexterity Assessment (SODA) | ? | 0 | ? | 0 | ? | 0 | ? | 0 | ? |
| Smith Hand Function Evaluation (SHFE) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sollerman Hand Function Test (SHFT) | 0 | 0 | 0 | 0 | 0 | 0 | ? | 0 | 0 |
| Southampton Hand Assessment Procedure (SHAP) | 0 | 0 | ? | 0 | ? | ? | 0 | 0 | 0 |
| Test d'Evaluation des Membres Supérieurs de Personnes Agées / Upper Extremity Performance Test for the elderly (TEMPA) | 0 | 0 | ? | 0 | ? | 0 | + | 0 | 0 |
| Upper Extremity Function Test (UEFT) | 0 | 0 | ? | 0 | ? | 0 | 0 | 0 | 0 |

### 4) Questionnaires

| instrument | Internal consistency | Agreement | Test-retest reliability | Intra-rater reliability | Inter-rater reliability | Content validity | Construct validity (concurrent, divergent) | Criterion / concurrent validity (gold standard) | Responsiveness |
|---|---|---|---|---|---|---|---|---|---|
| A self Administered Questionnaire for the assessment of Severity of Symptoms and Functional status in CTS (CTQ) | ? | 0 | ? | 0 | 0 | 0 | ? | 0 | ? |
| Canadian Occupational Performance Measure (COPM) | 0 | ? | - | 0 | ? | ? | ? | 0 | ? |
| Disabilities of the Arm, Shoulder and Hand (DASH) | ? | ? | + | 0 | 0 | + | + | 0 | ? |
| Michigan Hand Outcomes Questionnaire (MHQ) | ? | ? | ? | 0 | 0 | + | + | 0 | ? |
| Subjective Hand function Scoring system (HFS) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

NOTE. In conformity with the quality criteria for measurement properties of Terwee et al.[7]:
Rating: + = positive rating; ? = indeterminate rating (doubtful design); - = negative rating; 0 = no information available.
NB Doubtful design or method = lacking of a clear description of the design or methods of the study, sample size smaller than 50 subjects (should be at least 50 in every (subgroup) analysis), or any important methodological weakness in the design or execution of the study.
* = design and results are adequate, but $30 \leq N \leq 50$

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# APPENDIX

## Results from update of clinimetric review (2011) used in the Delphi study (unpublished)

**Description of clinimetric properties of instruments to measure activities**

Only new information is presented. If no additional information was available on the clinimetric property of an instrument, this instrument or property is not mentioned.

### 1) Pegboard tests measuring only fine hand use

| **Instrument**  | **Functional Dexterity Test (FDT)** |
|---|---|
| Test-retest reliability | - Videler et al.2008[1]: intraclass correlation coefficients between 0.83 and 0.95 (95% CI. 71–0.97) (N=49 HMSN1a) |

| **Instrument**  | **Grooved Pegboard test** |
|---|---|
| Construct validity (concurrent, divergent) | - Ashendorf et al.2009[2]: Significant correlations, with most magnitudes greater than r=.20 and reaching the p<.01 level, were observed between GPT performance and all cognitive tasks explored in the present study.GPT may be more strongly associated with general cognitive functioning in healthy adults (N= 307 community-dwelling Caucasian adults (ages 55–74)). |
| Norm scores | - Ashendorf et al.2009[2]: GPT performance was influenced by age and gender (N= 307 community-dwelling Caucasian adults (ages 55–74)).<br>- Bryden et al.2007[3]: task complexity affects the size of the preferred hand advantage inperformance (N= 30 right-handed individuals (18 to 24 years of age), start and end positions were manipulated). |

| **Instrument** | **Purdue Pegboard Test (PPT)** |
|---|---|
|  | |
| Test-retest reliability | - Amirjani et al. 2011[4]: The interclass correlation was significant (P<0.001), with an intraclass correlation coefficient of 0.97 (N=51 subjects with CTS). |
| Construct validity (concurrent, divergent) | - Amirjani et al. 2011[4]: Pearson's correlation coefficients (r) between the Purdue Pegboard Test and the Levine Self-Assessment Questionnaire scores are substantially higher (and significant) in the elderly group compared with the younger age groups (N= CTS-patients, 34 (20–39 years), 110 (40–59 years) and 56 (60+ years). |
| Norm scores | - Amirjani et al. 2011[4]: As the age of healthy participants increased, their performance on the Purdue Pegboard Test became markedly slower (N=122 healthy subjects, consisting of 91 females and 31males, 20–89 years of age, and N=190 subjects with CTS, including 141 females and 49 males, 20–86 years of age). |



### 2) Instruments measuring only fine hand use by picking up, manipulating and placing different objects

| **Instrument** | **Box and Block Test (BBT)** |
|---|---|
|  | |
| Intra-rater reliability | - Canny et al. 2009[5]: ICC of .90 resp. .98 (N=30 fibromyalgia patients and N=30 controls) |
| Inter-rater reliability | - Canny et al. 2009[5]: ICC of .85 resp. .80 (N=30 fibromyalgia patients and N=30 controls) |
| Norm scores | - Canny et al. 2009[5]: Fibromyalgia patients' B&B Test scores (N=30 ) were significantly lower (more impaired) than those of the control group (N=30) and standardized norms ( unpaired $t = 5.2154$, $df = 58$, $p = .0001$). |

| **Instrument** | **Moberg Pick Up test (MPUT)** |
|---|---|
|  | |
| Construct validity (concurrent, divergent) | - Stamm et al. 2007[6]: Spearman's correlation coefficient between MPUT and JTHF is .69 ($p<0.0001$) if not controlled for age (N= 100 OA-patients). |
| Norm scores | - Amirjani et al. 2007[7]: Hand dexterity of the subjects is significantly affected by age, with young subjects being the fastest and elderly subjects<br>the slowest. Women accomplished the test faster than men, and task performance with the dominant hand is faster than with the non-dominant<br>hand (N=116 healthy subjects). |

### 3) Instruments measuring single tasks (and fine hand use) by scoring executed tasks

| **Instrument** | **Jebsen-Taylor Test of Hand Function (JTHF)** |
|---|---|
|  | |
| Construct validity (concurrent, divergent) | - Davis et al. 2010[8]: Comparison of the change in mean total MHQ and JTT scores postoperatively showed poor correlation between these 2 tests, with a Pearson's correlation coefficient of 0.19 (RA), 0.04 (OA), and 0.36 (distal radius fractures), and moderate correlation with a correlation coefficient of 0.59 (CTS) (N= 37 RA, 10 OA, 18 CTS, 46 distal radius fracture). |
| Responsiveness | Davis et al. 2010[8]: ROC curves that test discriminate ability of the change in JTT total score have AUC values of 0.52 to 0.66 for each of the 4 conditions. ROC analyses showed that the JTT cannot reliably predict positive patient-reported outcome as assessed by the MHQ (N= 37 RA, 10 OA, 18 CTS, 46 distal radius fracture). |

| Instrument | Sollerman Hand Function Test (SHFT) |
|---|---|
|  | |
| Test-retest reliability | Videler et al.2008[1]: intraclass correlation coefficients between 0.98 and 0.99 (95% confidence interval (CI) 0.97–0.99) (N=49 HMSN1a) |
| Responsiveness | Videler et al.2008[1]: The 95% limits of agreement between Sollerman tests showed that differences greater than 3 points can be interpreted as a change in dexterity (N=49 HMSN1a). |



### 4) Questionnaires

| Instrument | A self Administered Questionnaire for the assessment of Severity of Symptoms and Functional status in CTS (Carpal Tunnel Questionnaire (CTQ) |
|---|---|
| Internal consistency | - Katz et al. 1996[9]: Cronbach's alphas were in the range of .88 to .96. (N=CTS; patients with paresthesia involving at least two of the first four fingers and duration of symptoms of at least 1 month and if their physician had a clinical impression of carpal tunnel syndrome: 216 (81%) completed 6-month follow-up forms, including 121 workers' compensation recipients (78% of those contacted) and 95 non recipients (84%)). |
| Test-retest reliability | - Amirfeyz et al.2007[10]: Pearson correlation 0.78 for both symptom and function scale (N=43 CTS)<br>- Greenslade et al. 2004[11]: Pearson's correlation coefficient for CTQ-SS of 0.82 (p=0.084) and for CTQ-F of 0.79 (p=0.564) (N=31 CTS) |
| Construct validity (concurrent, divergent) | - Amirjani et al. 2011[4]: Pearson's correlation coefficients (r) between the Purdue Pegboard Test and the Levine Self-Assessment Questionnaire scores are substantially higher (and significant) in the elderly group compared with the younger age groups.(N= CTS-patients, 34 (20–39 years), 110 (40–59 years) and 56 (60+ years.).<br>- Gay et al. 2003[12]: Spearman correlation coefficient of 0.90 (6 weeks), resp. 0.87 (12 weeks) between CTQ and DASH change scores after Carpal Tunnel Release (N=34 patients scheduled for carpal tunnel release), but at both times less than the disease specific Carpal Tunnel Questionnaire. |
| Responsiveness | - Amirfeyz et al.2007[10]: According to the patient global impression of change score (PGIC), 93% of patients improved. The cut-off values for raw change scores after CTR is 0.47 (N=43 CTS). |

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|---|---|
| | - Chatterjee et al. 2009[13]: all domains of the CTQ showed significant postoperative improvement, with SRM of the CTQ was 1.22. The CTQ demonstrated increased sensitivity to change after CTR compared to the MHQ (N=42 CTS patients (54% of recruited) and scheduled for unilateral open CTR, with adequately completed preoperative and postoperative questionnaires).<br>- Gay et al. 2003[12]: after Carpal Tunnel Release the CTQ showed good sensitivity to change at 6 weeks and best sensitivity at 12 weeks (effect size 1.71, standardized response mean 1.66) compared with DASH and SF-36.(N=34 patients scheduled for carpal tunnel release), but at both times less than the disease specific Carpal Tunnel Questionnaire.<br>- Greenslade et al. 2004[11]: SRM for CTQ-SS of 1.07 and for CTQ-F of 0.62 (both p<0.001) (N=57 CTS) |

| **Instrument** | **Canadian Occupational Performance Measure (COPM)** |
|---|---|
| Construct validity (concurrent, divergent) | - Dekkers, Nielsen, et al. 2010[14]: The participants reported 802 performance problems: 38% within self-care, 52% within productivity, and 10% within leisure. DASH score correlated moderately with the total number of performance problems on the COPM and with the COPM satisfaction score (Spearman's rho: rs –0.53, p = 0.001and rs 0.50, p = 0.001, respectively) (N=41 Danish elderly woman with fracture UE).<br>- Sampaio et al. 2006[15]: Spearman Rank correlation coefficient were calculated: Low correlations between grip strength and COPM scores were found only at admission (r=0.314; p=0.045). When the relationship between gains in strength and COPM scores at discharge were examined, significant low correlations were found with the performance (r=0.324; p=0.039) and satisfaction (r=0.0326; p=0.038) subscales (N=42 hand injured). |

| **Instrument** | **Disabilities of the Arm, Shoulder and Hand Questionnaire (DASH)** |
|---|---|
| Internal consistency | - Dias et al.2008[16] : Cronbach's alpha = 0.98 (N=100 hand and wrist disorders)<br>- Franchignoni et al. 2010[17]: Cronbach's alpha = .95 for DASH-Italian version. All items showed an item-to-total correlation between .53 and .76, except item 26, "Tingling" (*r*_.31). Factor analysis established the presence of 3 underlying constructs related to manual functioning (items 1–5, 7–11, 16–18, 20, 21), shoulder range of motion (items 6, 12–15, 19), and symptoms and consequences (items 22–30) The fit to the Rasch model was good for all items except 4 (items 20, 21, 25, 26) (N=238 upper-extremity disorders). |

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| | - Lehman et al. 2011[18]: Secondary analysis was performed on data collected from outpatient clinics. On the basis of the EFA results, they tested the fit of a three-factor model to the discharge data. Factor 1 included the gross motor items (Items 5–15, 18, and 19). Factor 2 included the fine motor items (Items 1–4, 16, and 17). Factor 3 included the symptoms items (Items 22–30). Items 20 and 21 were excluded from the analysis because of their failure to load on any of the three factors. When divided into the three constructs, only one item misfit (Tingling, MnSq 5 1.67) (N=991 Participants with a wide range of orthopedic and neurological conditions affecting predominantly the shoulder and neck). |
| Test-retest reliability | - Amirfeyz et al.2007[10]: Pearson correlation 0.88 (N=43 CTS)<br>- Greenslade et al. 2004[11]: Pearson's correlation coefficient for DASH of 0.90 (p=0.210) (N=31 CTS) |
| Construct validity (concurrent, divergent) | - MacDermid et al.2007[19]: Hypotheses were formulated, but not all of them are confirmed. Pearson or Spearman correlation between DASH and PRWHE-totalscore of 0.82 (p<0.01) and between DASH and subscales of AUSCAN varied from 0.59 to 0.87 (p<0.01). Correlation between DASH and SF-36 of -0.49 (p<0.01).<br><br>Correlations between DASH and strength varied from -0.44 to -0.37, dexterity from 0.30-0.48 (all p<0.01), and ROM from -0.25 to 0.10 (most not significant) (N=121 OA, tendon interposition arthroplasty of CMC joint).<br>- Dekkers, Nielsen et al. 2010[14]: DASH score correlated moderately with the total number of performance problems on the COPM and with the COPM satisfaction score (Spearman's rho: rs –0.53, p = 0.001and rs 0.50, p = 0.001, respectively) (N=41 Danish elderly woman with fracture UE).<br>- Dias et al. 2008[16]: correlation coefficient of the DASH with the MHQ and PEM was 0.82 (N=100 hand and wrist disorders).<br>- Dias et al. 2008[16]: correlation coefficient between DASH and Levine symptom score was -0.33 (N=26 median nerve disorder).<br>- Dias et al. 2008[16]: correlation coefficient between DASH and Gartland and Werley score was -0.17 (N=27 wrist complaints).<br>- Soohoo et al. 2002[20]: Pearson correlation coefficients of the DASH questionnaire to the SF-36 subscales ranged from -0.36 to -0.62. The DASH questionnaire had fewer ceiling and floor scores than most of the SF-36 subscales (N=90 visiting upper extremity clinic). |
| Responsiveness | - McMillan 2009[21]: SRM was calculated, DASH was responsive for CTS (0.77, N=20), wrist pain (0.61, N=21)) and tumor (0.55, N=6))<br>- Amirfeyz et al.2007[10]: According to the patient global impression of change score (PGIC), 93% of patients improved. The cut-off values for raw change scores after CTR is 20.9 (N=43 CTS).<br>- Horng et al. 2010[22]: the effect size for the DASH questionnaire was 0.67 (CI 0.41, 1.08), the standardized response mean for the DASH questionnaire was 0.86 (CI 0.60, 1.20) (N=105 hand injury, of which 50 responded to follow-up). |

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|---|---|
| | - Greenslade et al. 2004[11]: SRM for DASH of 0.66 (p<0.001)(N=57 CTS)<br>- Adams et al. 2010[23]: SRM of -0.31 [95% confidence interval (95% CI) -0.51, -0.12], and ES of -0.21 [95% CI -0.08, -0.34]) (N= 104 early rheumatoid arthritis population) |

| **Instrument** | **Michigan Hand Outcomes Questionnaire (MHQ)** |
|---|---|
| Construct validity (concurrent, divergent) | - Dias et al. 2008[16]: correlation coefficient of the MHQ and PEM was 0.76 (N=100 hand and wrist disorders).<br>- Dias et al. 2008[16]: correlation coefficient between MHQ and Levine symptom score was -0.31 (N=26 median nerve disorder).<br>- Dias et al. 2008[16]: correlation coefficient between DASH and Gartland and Werley score was -0.03 (N=27 wrist complaints).<br>- Davis et al. 2010[8]: Comparison of the change in mean total MHQ and JTT scores postoperatively showed poor correlation between these 2 tests, with a Pearson's correlation coefficient of 0.19 (RA), 0.04 (OA), and 0.36 (distal radius fractures), and moderate correlation with a correlation coefficient of 0.59 (CTS) (N= 37 RA, 10 OA, 18 CTS, 46 distal radius fracture). |
| Responsiveness | - McMillan2009[21]: SRM was calculated, MHQ was responsive for CTS (1.04, N=20), wrist pain (0.87, N=21)) and finger contracture (0.62, N=34)).<br>- Davis et al. 2010[8]: Reported mean total MHQ scores increased significantly in all 4 patient cohorts after surgery. Greater effect size and standardized response means with MHQ for each condition compared with JTT for all conditions (N= 37 RA, 10 OA, 18 CTS, 46 distal radius fracture).<br>- Horng et al. 2010[22]: the effect size for the MHQ was 0.84 (confidence interval [CI] 0.61, 1.18), the standardized response mean for the MHQ was 1.05 (CI 0.78, 1.42) (N=105 hand injury, of which 50 responded to follow-up).<br>- Chatterjee et al. 2009[13]: all domains of the CTQ showed significant postoperative improvement, with SRM of the MHQ-total was 0.80, with SRM for subscales ranging from 0.79 to 1.30. The CTQ demonstrated increased sensitivity to change after CTR compared to the MHQ (N=42 CTS patients (54% of recruited) and scheduled for unilateral open CTR, with adequately completed preoperative and postoperative questionnaires).<br>- Shauver et al. 2009[24]: For CTS patients, minimal clinically important differences (MCIDs) of 23, 13, and 8 were identified for the pain, function, and work domains, respectively. For RA-patients, pain and function were also identified as having discriminative ability, with MCIDs of 11 and 13, respectively. An MCID of 3 was identified for the activities of daily living domain. For DRF patients, no MHQ domains showed discriminative ability (N=40 RA patients, 53 CTS patients, and 51 DRF patients). |

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| | - Adams et al. 2010[23]: SRM of 0.49 [95% confidence interval (95% CI) 0.27, 0.72], and ES of 0.37 [95% CI 0.21, 0.54]) (N= 80 early rheumatoid arthritis population)<br>- van der Giesen et al. 2008[25]: The mean MHQ total score improved significantly between baseline (mean ± standard deviation, 48.3±12.2) and follow-up (mean, 54.7±16.9) (change score, -7.2; 95% confidence interval, -11.1 to -3.3). Of the MHQ total score, the SRM was -0.72, the effect size<br>-0.52, and responsiveness ratio was -1.99 (N=28 patients with problems in hand function due to RA).<br>- Kotsis et al. 2007[26]: all domains of the MHQ except aesthetics significantly improved in patients with DRF. In period 1, SRMs were large (>0.8) for the overall score and for the work domain; medium (0.5– 0.7) for the pain, function, and ADL domains; and small (0.2–0.4) for the aesthetics and satisfaction domains. In period 2, the SRM for the MHQ pain domain was medium (0.4) (N= patients with DRF, period 1: N=47 and period 2 N=37). |

**Added instruments:**

| **Instrument** | **Australian/Canadian Osteoarthritis Hand Index (AUSCAN)[19,27-29]** |
|---|---|
| Type of tasks | Self-administered questionnaire |
| Type of results | Likert-scaled format (AUSCAN LK3.0) or visual, Analogue-scaled format (AUSCAN VA3.0) scores |
| Internal consistency | - Bellamy et al.2002[28]: Cronbach's alpha was excellent; At assessment one for the AUSCAN LK3.0 pain 0.90 and physical function 0.94, AUSCAN VA3.0 pain 0.94 and physical function 0.94 (N=50 patients with OA). |
| Test-retest reliability | - Bellamy et al.2002[28]: The test–retest intraclass correlation coefficients for the AUSCAN LK3.0 were as follows: pain 0.70, stiffness 0.77, and physical function 0.86; and AUSCAN VA3.0 were pain 0.84, stiffness 0.86, physical function 0.90 (N=50 patients with OA). |
| Content validity | - Bellamy et al. 2002[27]: item generation capitalized on the experience of both clinical investigators and patients with hand OA. Clinical trials in OA from 1968 to 1995 were reviewed. Predefined areas of disability were culled from eight existing questionnaires. Opinions of four rheumatologists, an orthopaedic surgeon, and two physiotherapists were solicited in the generation of closed-ended questions for use in patient interviews to generate the item inventory. Thereafter, patients with hand OA were questioned first with the closed-ended questions, and after that with an open-ended question. The process of item rationalization resulting in item reduction has been described in detail. |

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| Construct validity (concurrent, divergent) | - MacDermid et al.2007[19]: Hypotheses were formulated, but not all of them are confirmed. Pearson or Spearman correlation between AUSCAN-subscales and PRWHE-total-score varied from 0.66-0.86 ($p<0.01$) and between AUSCAN-subscales and DASH varied from 0.59 to 0.87 ($p<0.01$). Correlation between AUSCAN-subscales and SF-36 varied from -0.48 to -0.28 ($p<0.01$). Correlations between AUSCAN-subscales and strength varied from -0.46 to -0.22, dexterity from 0.22-0.43 (all $p<0.01$), and ROM from -0.29 to 0.14 (most not significant) (N=121 OA, tendon interposition arthroplasty of CMC joint).<br>- Bellamy et al.2002[28]: Many Pearson correlation coefficients between AUSCAN subscales and several outcome measures at two assessment moments are presented (N=50 patients with OA). |
| Responsiveness | - Bellamy et al.2002[28]: SRM for the AUSCAN are reported and varied for the subscales between -0.23 and -0.84: values for the AUSCAN pain and function subscales were among the highest, and for the stiffness of the same order as the FIHOA (N=44 patients with OA). |
| Norm scores | - Bellamy et al. 2010[29]: Age- and gender-specific AUSCAN normative values were estimated based on approximately 5,500 subjects. Age-related differences were noted at the subscale level. In general, disability increased with age for all items. |

| **Instrument** | **Patient Evaluation Measure (PEM)[16,30,31]** |
|---|---|
| Purpose | Questionnaire that evaluates the process of treatment, the current state of the hand and provides an overall assessment. |
| Type of tasks | 14 questions, posed simply and with seven possible answers, presented as a categorized visual analogue scale. Six questions relate to symptoms, three to the impact of the disorder on the patient, two to satisfaction and three to general disability and handicap. |
| Type of results | The answers are expressed as a percentage disability ranging from zero to 100. |
| Internal consistency | - Dias et al. 2008[16]: Cronbach's alpha = 0.94 (N=100 hand and wrist disorders)<br>- Hobby et al. 2005[30]: Cronbach's alpha = 0.94 (N=32 CTS) |
| Construct validity (concurrent, divergent) | - Dias et al. 2008[16]: correlation coefficient between PEM and Levine symptom score was -0.37 (N=26 median nerve disorder)<br>- Dias et al. 2008[16]: correlation coefficient between DASH and Gartland and Werley score was -0.14 (N=27 wrist complaints)<br>- Hobby et al. 2005[30]: Spearman rank correlation between PEM and DASH scores was strong (pre-op rs 0.66, $p<0.0001$; post-op rs ) 0.85, $p<0.0001$) (N=32, resp 24 CTS) |
| Responsiveness | - Hobby et al. 2005[30]: responsiveness to change: effect size 0.97 with standardized response means 0.95.( N=24 patients with CTS) |

| Instrument | Patiënt Rated wrist/hand Evaluation (PRWHE)[19,32] |
|---|---|
| Purpose | To evaluate pain and disability related to wrist and hand disorders. |
| Type of tasks | Questionnaire, (15-item scale: 5 pain items and 10 functional items) |
| Type of results | The score ranges from 0 to 100 points; 50 points are allocated to five pain items and 50 points to 10 functional items. |
| Test-retest reliability | - MacDermid rt al. 1998[32]: Test-retest reliability was excellent (ICCs > 0.90). |
| Construct validity (concurrent, divergent) | - MacDermid et al. 2007[19]: Hypotheses were formulated, but not all of them are confirmed. Pearson or Spearman correlation between PRWHE-totalscore and DASH of 0.82 (p<0.01) and between PRWHE-totalscore and subscales of AUSCAN varied from 0.66 to 0.86 (p<0.01). Correlation between PRWHE-totalscore and SF-36 varied from -0.44 to -0.39 (p<0.01). Correlations between PRWHE-totalscore and strength varied from -0.45 to -0.36, dexterity from 0.32-0.44 (all p<0.01), and ROM from -0.34 to 0.12 (most not significant) (N=121 OA, tendon interposition arthroplasty of CMC joint). |

| Instrument | Upper Extremity Functional Scale (UEFS)[33] |
|---|---|
| Purpose | To measure the impacts of Upper Extremity Disorders on function |
| Type of tasks | Questionnaire, 8 questions |
| Type of results | - Pransky et al. 1997[33]: Scale per question ranges from 0-10, UEFS score is the sum of all responses; one missing response is allowed and is interpolated as the average of the other responses. |
| Internal consistency | - Pransky et al. 1997[33]: Cronbach's alpha test was used, ranged from 0.83-0.93 across the study groups (N= 108 patients with work-related UEDs and 165 patients with the carpal tunnel syndrome (CTS)). |
| Content validity | - Pransky et al. 1997[33]: The questions to be included in the UEFS were selected with input from physicians, occupational therapists, and UED patients through a series of informal discussion groups. |
| Construct validity (concurrent, divergent) | Pransky et al. 1997[33]: Pearson Correlation between the UEFS and the AIMS subscales was .81 in the UED patients and .81 in the CTS patients (P < 0.0001) (N= 108 patients UEDs and 165 CTS). |
| Responsiveness | Pransky et al. 1997[33]: Standardized response means (SRM) were calculated. |

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# PART II

## ICF Core Set for Hand Conditions

# 4

# What is our knowledge of functioning and disability in hand conditions based on?


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## ABSTRACT

**Objective:** To analyze the content of published studies on hand conditions, using the *International Classification of Functioning, Disability and Health (ICF)* as a reference, and to highlight the most common aspects of functioning as well as those that deserve more consideration in research on hand conditions.

**Data Sources***:* The MEDLINE, Embase, PsycINFO, CINAHL and PEDro databases were searched for English language studies on hand conditions published between 1998 and 2008.

**Study Selection:** The identified studies were reviewed by 2 persons independently. Studies reporting firsthand data of patients with diseases or injuries of the hand and with a minimum sample size of 10 patients were included. Reviews, overviews, meta-analyzes and psychometric studies were excluded.

**Data Extraction:** Peer review strategy was conducted in the data extraction process. Data from a random sample of 15% of the included studies was extracted by 2 reviewers independently.

**Data Synthesis:** The search identified 18861 citations. A random sample of 2782 (15%) abstracts was reviewed, leading to the inclusion of 471 publications. Preliminary included publications were reviewed in full-text, resulting in the finally inclusion of 188 studies. The information obtained from the included studies was linked to 127 second-level ICF categories. Second-level categories most frequently addressed in the studies were 'Health services, systems and policies'; 'Sensation of pain'; 'Structure of upper extremity'; 'Mobility of joint functions'; and 'Muscle power functions'.

**Conclusion:** The ICF provides a valuable reference to systematically analyze the content of published studies on hand conditions. Research activity needs to widen its focus on mental functions, further mobility functioning, self-care and domestic life aspects as well as environmental factors to encompass the impact of hand conditions on an individual's health. This would increase our knowledge on patients' needs and would help to ensure patient-oriented care.

## INTRODUCTION

Disabilities are core experiences for persons with hand conditions. Suffering from a disease, or injury of the hand can result in a large number of problems in functioning.[1-4] Functioning constitutes a complex and dynamic interaction between a health condition and contextual factors (i.e. personal and environmental factors)[5] the impact of hand conditions on an individual's health can be quite different from patient to patient. The problems patients experience are not only related to functions of body systems, but may also affect a person's ability to successfully carry out daily routine in domestic life, self care, work and leisure activities.[6-9] An in-depth understanding and knowledge of the impact of hand conditions on health and health-related domains is essential to ensure high quality care and patient treatment. Extensive research has been carried out[2,6,9-15] to explore these impacts of hand conditions, yet it has not been summarized to date. The information thereby provided forms the scientific basis to increase our awareness on patients' needs and to guide clinical practice. Thus, it is crucial that research activities capture the entire spectrum of functioning and disability potentially relevant to patients with hand conditions.

Published studies on hand conditions need to be reviewed in order to identify what aspects of health are already addressed, and to highlight potential gaps in the literature. However, to systematically group and compare the information derived from the published literature, an etiologically neutral reference of health and health-related components is required.

The *International Classification of Functioning, Disability and Health* (ICF), adopted in 2001 by the World Health Organization (WHO), offers an etiologically neutral framework and classification,[16] describing the different determinants of health and health-related domains. Based on the biopsychosocial view of functioning, disability, and health, the classification comprises the components body functions (b), body structures (s), and activities and participation (d). In the ICF, functioning and disability are understood as an interaction with the environment and the characteristics of the person. Therefore, contextual personal and environmental factors (e) are also included in the ICF approach, whereas the personal factors have not been classified yet (figure 1).

With more than 1400 ICF categories, the classification offers a universal frame, valuable to perform structured content evaluation of published studies[17] or to analyze content validity of assessment instruments.[18,19] An overview of components of health and related domains frequently addressed in a determined field of research[20,21] as well as areas where further research may be required can be provided using such a review.

The objective of our study was to analyze the content of published studies on hand conditions, based on the biopsychosocial view of functioning, disability and health.

The specific aims were to: (1) identify studies on patients with conditions or injuries of the hand; (2) identify the outcome measures reported in these studies; (3) analyze the content of the identified outcome measures, using the ICF as a reference; and (4) report the aspects of functioning addressed in the included studies.

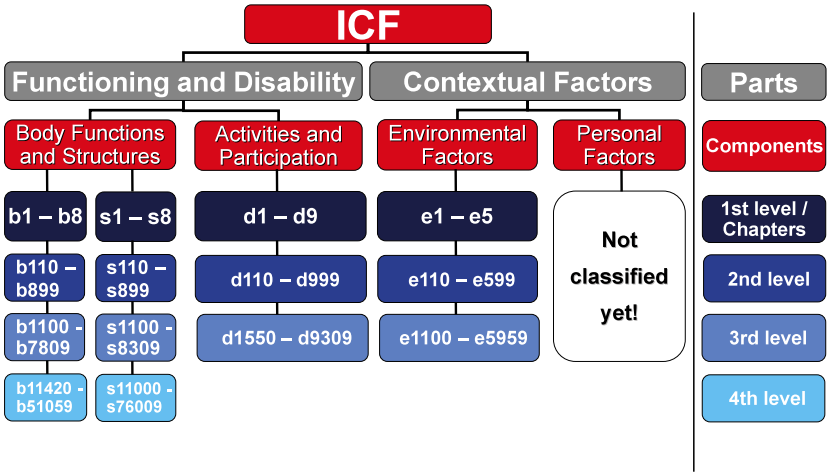


**Figure 1** The structure of the ICF

## METHODS

### Study design

A systematic review was performed with three steps: Step 1, selection of studies, Step 2, data extraction, and Step 3, linking to the ICF. All steps were conducted by at least two reviewers independently (SK, BK, SB or MC).

*Step 1: Selection of studies.* We searched the electronic literature databases Medline, Embase, PsycINFO, CINAHL, and PEDro for articles in English and published between 1998 and 2008. The search strategy comprised search terms referring to (1) anatomic structures (eg, 'ulna'), or parts of the hand (eg, 'finger'), combined with the Boolean OR; (2) injuries or diseases (eg, 'fracture') , combined with the Boolean OR; (3) interventions (eg, 'surgery'), combined with the Boolean andalso MeSH terms (eg, 'hand injuries') related to the hand. We used Boolean and adjacency operators to limit our search.

A screen applying the inclusion criteria was performed on the retrieved abstracts. We included studies if they (1) reported firsthand data of patients either with conditions (such as Dupuytren's disease) or injuries located at the hand, wrist or forearm. Studies on patients with conditions not localized or originating in the hand but affecting the hand, such as stroke, were excluded; (2) reported a sample size equal to or higher than 10; and (3) included persons aged 18 years or older. We included randomized and clinical controlled trials, observational studies (cross-sectional or longitudinal), qualitative studies and chart reviews. Reviews, overviews, meta-analyses, and psychometric studies were excluded. A final decision on the included or excluded articles was made when the full-text was accessed and reviewed.

*Step 2: Data extraction.* We extracted all outcome measures that were reported from the included studies. Outcome measures were categorized as follows: (1) standardized patient self-reported measures, in which patients respond to a number of standardized questions; (2) standardized health professional-reported measures in which the health professionals report the patient's performance or status; (3) standardized performance tests of the patient's performed tasks; and (4) clinical assessments which comprise technical measures (eg, imaging), as well as physical examinations (eg, goniometry). Additionally, we extracted all further reported outcomes such as 'nerve growth'. Sample size, sex, socio-demographic parameters, in addition to diagnosis, and intervention type were also extracted.

*Step 3: Linking to the ICF.* Each item from the patient self-reported and the health professional-reported outcome measures were linked to the ICF by 2 researchers based on established linking rules.[22,23] Additionally, we linked the aim of every single task within a certain standardized performance test, as well as the aim of each clinical assessment, for which it was assessed. All further reported outcomes were also linked to the ICF. During the whole linking process, the researches were advised to link the content of the outcome measures to the ICF category representing it most precisely. Two researchers independently decided which ICF category should be linked. In case of disagreement, a third researcher was involved to reach consensus. The application of the predefined linking rules has been shown to yield high overall agreement between raters (91% at the second-level of the classification).[22]



## Analyses

We used descriptive statistics to report the most frequently used outcome measures. To describe the aspects of functioning found, we calculated the frequency of studies addressing a determined ICF category. If an ICF category was addressed more than once in the same study, we counted that ICF category only once. Therefore, the maximum number does not exceed the number of identified studies. The results are presented by type of study design.

The total frequency of ICF categories is presented on the second level of the classification. If third or fourth level ICF categories were used in the linking process, the overlying second level category was reported. Because the ICF is organized in a hierarchical scheme, more specific third or fourth level categories share the attributes of less specific second level categories[24] (table 1).

ICF categories addressed in 3% or more the studies are shown.

## RESULTS

In Step 1, the searches identified a total of 18861 citations. Out of these, a computer-generated random sample of 2782 (15%) studies was drawn. Abstract review led to the retrieval of 471 full-text articles, of which 188 studies were finally included. These studies included a total study sample of 11814 participants, with study size ranging from 10 to 985. The total sample across studies comprised 6097 (52%) women (24 studies did not provide information on sex). Mean age ranged from 23.8 to 82.0. Ninety-nine (53%) studies described interventions on patients with hand conditions in the framework of randomized or clinical controlled trials. Main diagnosis of the patients were: fractures of forearm (29%) and carpal tunnel syndrome (10%) (Table 2).

**Table 1** Hierarchical structure of the ICF with further specification in the higher levels

| ICF Code | Title | ICF Level |
|---|---|---|
| s7 | Structures related to movement | (first/chapter-level) |
| s730 | Structure of upper extremity | (second-level) |
| s7302 | Structure of hand | (third-level) |
| s73020 | Bones of hand | (fourth-level) |
| s73021 | Joints of hand and fingers | (fourth-level) |
| s73022 | Muscles of hand | (fourth-level) |
| s73023 | Ligaments and fasciae of hand | (fourth-level) |
| s73028 | Structure of the hand, other specified | (fourth-level) |

In Step 2, we identified 66 different standardized outcome measures: 34 patient self-reported measures, 19 health-professional reported measures and 13 standardized performance tests. The clinical assessments recorded from the included studies most frequently aimed to assess: range of motion or mobility in joints of hand and fingers, pain, and pinch or grip strength, which were addressed in 92 (49%), 88 (47%) and 85 (45%) of the studies, respectively. In addition, we extracted 1814 further reported outcomes such as 'nerve growth', 'thenar atrophy', 'prothesis stability', 'tenderness' or 'existence of blisters'. Table 3 presents the frequency of the outcome measures and the main clinical assessments.

The content of the outcome measures and the further reported outcomes extracted in step 2 comprised a total of 5844 concepts. Of these, 4882 (84%) were linked to 127 different second-level categories of the ICF in Step 3. Fifty-four ICF categories reached a frequency of at least 3% (Table 4). The most frequently identified category in the component Body Functions was b280 'Sensation of pain'. From Body Structures, s730 'Structure of upper extremity' and in Activities and Participation, d440 'Fine hand use' showed the highest frequencies. The category e580 'Health services, systems and policies' was most frequent among Environmental Factors.

**Table 2** Most frequent main diagnoses included in all 188 studies on hand conditions

| Diagnosis | Number of diagnosis | % of 188 studies |
|---|---|---|
| Fracture of forearm | 55 | 29.3 |
| Carpal tunnel syndrome | 19 | 10.1 |
| Fracture at wrist and hand level | 15 | 8.0 |
| Other arthrosis | 15 | 8.0 |
| Arthrosis of first carpometacarpal joint | 11 | 5.9 |
| Algoneurodystrophy | 10 | 5.3 |
| Dislocation, sprain and strain of joints and ligaments at wrist and hand level | 6 | 3.2 |
| Other and unspecified injuries of wrist and hand | 6 | 3.2 |
| Burn and corrosion of wrist and hand | 5 | 2.7 |
| Open wound of wrist and hand | 4 | 2.1 |
| Injury of nerves at wrist and hand level | 4 | 2.1 |

Note: Only diagnoses with a frequency >3 are reported.



**Table 3** Frequency of standardized outcome measures and clinical assessments reported in all 188 studies

| Standardized outcome measures* | frequency of instrument | % of 188 studies |
|---|---|---|
| ***Health-professional reported measures*** | | |
| Gartland and Werley Score | 16 | 8.5 |
| MAYO Wrist Score | 8 | 4.3 |
| ***Patient reported measures*** | | |
| Disabilities of the Arm, Shoulder and Hand (DASH) | 22 | 11.7 |
| Severity of Symptoms and Functional Status of the Boston Carpal Tunnel Questionnaire | 10 | 5.3 |
| MOS 36 item short form health survey (SF-36) | 6 | 3.2 |
| Patient-Rated Wrist Evaluation (PRWE) | 4 | 2.1 |
| ***Performance tests*** | | |
| Jebsen-Taylor Test of Hand Function (JTHF) | 7 | 3.7 |

**Table 3** Continued

| Clinical assessments† | frequency of instrument | % of 188 studies |
|---|---|---|
| Range of motion / mobility in joints of hand and fingers (Goniometric assessment or physical examination) | 92 | 48.9 |
| Pain (Visual Analogue Scale) | 88 | 46.8 |
| Pinch and/or grip strength (Hand dynamometers) | 85 | 45.2 |
| Bone position, fracture displacement, carpal changes (Medical imaging technique) | 61 | 32.4 |
| Nerve damage, nerve function, sensory assessment (Neurological examination, Two-Point-Discrimination, Tinel's sign, Phalen's test, Semmes-Weinstein Monofilament Test) | 21 | 11.1 |

* Of all 66 different standardized outcome measures, only those with a frequency > 3 are presented (n=7).
† Of all clinical assessments, only those reported in >10% of the studies are presented. Whenever a clinical assessment was reported more than once in a determined study, it was counted only one time.

**Table 4** Frequency of second-level icf categories considered in all 188 studies including patients with hand conditions, by study type

| ICF Code | Title | Intervention study (n=99) | | Observational study (n=89) | | Total number of studies (n=188) | |
|---|---|---|---|---|---|---|---|
| | | frequency of category | % of 99 studies | frequency of category | % of 89 studies | frequency of category | % of 188 studies |
| ***Body Functions*** | | | | | | | |
| b126 | Temperament and personality functions | 14 | 14.14 | 15 | 16.85 | 29 | 15.43 |
| b130 | Energy and drive functions | 11 | 11.11 | 5 | 5.62 | 16 | 8.51 |
| b134 | Sleep functions | 9 | 9.09 | 7 | 7.87 | 16 | 8.51 |
| b152 | Emotional functions | 10 | 10.10 | 10 | 11.24 | 20 | 10.64 |
| **b265** | **Touch function** | **32** | **32.32** | **26** | **29.21** | **58** | **30.85** |
| **b270** | **Sensory functions related to temperature and other stimuli** | **34** | **34.34** | **28** | **31.46** | **62** | **32.98** |
| **b280** | **Sensation of pain** | **74** | **74.75** | **57** | **64.04** | **131** | **69.68** |
| b415 | Blood vessel functions | 4 | 4.04 | 2 | 2.25 | 6 | 3.19 |
| b430 | Haematological system functions | 3 | 3.03 | 3 | 3.37 | 6 | 3.19 |
| b435 | Immunological system functions | 26 | 26.26 | 10 | 11.24 | 36 | 19.15 |
| **b710** | **Mobility of joint functions** | **70** | **70.71** | **54** | **60.67** | **124** | **65.96** |
| **b715** | **Stability of joint functions** | **37** | **37.37** | **22** | **24.72** | **59** | **31.38** |
| b720 | Mobility of bone functions | 2 | 2.02 | 8 | 8.99 | 10 | 5.32 |
| **b730** | **Muscle power functions** | **66** | **66.67** | **46** | **51.69** | **112** | **59.57** |
| b810 | Protective functions of the skin | 6 | 6.06 | 3 | 3.37 | 9 | 4.79 |
| b820 | Repair functions of the skin | 10 | 10.10 | 5 | 5.62 | 15 | 7.98 |
| b830 | Other functions of the skin | 5 | 5.05 | 4 | 4.49 | 9 | 4.79 |
| b840 | Sensation related to the skin | 21 | 21.21 | 14 | 15.73 | 35 | 18.62 |

**Table 4** Continued

| ICF Code | Title | Intervention study (n=99) | | Observational study (n=89) | | Total number of studies (n=188) | |
|---|---|---|---|---|---|---|---|
| | | frequency of category | % of 99 studies | frequency of category | % of 89 studies | frequency of category | % of 188 studies |
| ***Body Structures*** | | | | | | | |
| s120 | Spinal cord and related structures | 28 | 28.28 | 18 | 20.22 | 46 | 24.47 |
| s410 | Structure of cardiovascular system | 5 | 5.05 | 8 | 8.99 | 13 | 6.91 |
| s720 | Structure of shoulder region | 11 | 11.11 | 11 | 12.36 | 22 | 11.70 |
| **s730** | **Structure of upper extremity** | **68** | **68.69** | **60** | **67.42** | **128** | **68.09** |
| s810 | Structure of areas of skin | 9 | 9.09 | 11 | 12.36 | 20 | 10.64 |
| ***Activities and Participati***on | | | | | | | |
| d166 | Reading | 7 | 7.07 | 2 | 2.25 | 9 | 4.79 |
| d170 | Writing | 21 | 21.21 | 16 | 17.98 | 37 | 19.68 |
| d230 | Carrying out daily routine | 16 | 16.16 | 13 | 14.61 | 29 | 15.43 |
| d410 | Changing basic body position | 6 | 6.06 | 4 | 4.49 | 10 | 5.32 |
| **d430** | **Lifting and carrying objects** | **29** | **29.29** | **20** | **22.47** | **49** | **26.06** |
| **d440** | **Fine hand use** | **32** | **32.32** | **23** | **25.84** | **55** | **29.26** |
| **d445** | **Hand and arm use** | **32** | **32.32** | **20** | **22.47** | **52** | **27.66** |
| d450 | Walking | 6 | 6.06 | 4 | 4.49 | 10 | 5.32 |
| d455 | Moving around | 6 | 6.06 | 4 | 4.49 | 10 | 5.32 |
| d470 | Using transportation | 12 | 12.12 | 11 | 12.36 | 23 | 12.23 |
| d475 | Driving | 11 | 11.11 | 14 | 15.73 | 25 | 13.30 |
| d510 | Washing oneself | 23 | 23.23 | 18 | 20.22 | 41 | 21.81 |
| d530 | Toileting | 2 | 2.02 | 5 | 5.62 | 7 | 3.72 |
| **d540** | **Dressing** | **27** | **27.27** | **20** | **22.47** | **47** | **25.00** |
| d550 | Eating | 16 | 16.16 | 17 | 19.10 | 33 | 17.55 |
| d560 | Drinking | 4 | 4.04 | 4 | 4.49 | 8 | 4.26 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| d620 | Acquisition of goods and services | 2 | 2.02 | 4 | 4.49 | 6 | 3.19 |
| d630 | Preparing meals | 15 | 15.15 | 13 | 14.61 | 28 | 14.89 |
| d640 | Doing housework | 19 | 19.19 | 17 | 19.10 | 36 | 19.15 |
| d650 | Caring for household objects | 13 | 13.13 | 13 | 14.61 | 26 | 13.83 |
| d750 | Informal social relationships | 15 | 15.15 | 13 | 14.61 | 28 | 14.89 |
| d760 | Family relationships | 17 | 17.17 | 15 | 16.85 | 32 | 17.02 |
| d770 | Intimate relationships | 13 | 13.13 | 15 | 16.85 | 28 | 14.89 |
| d845 | Acquiring. keeping and terminating a job | 3 | 3.03 | 9 | 10.11 | 12 | 6.38 |
| d850 | Remunerative employment | 19 | 19.19 | 24 | 26.97 | 43 | 22.87 |
| d855 | Non-remunerative employment | 9 | 9.09 | 13 | 14.61 | 22 | 11.70 |
| d920 | Recreation and leisure | 24 | 24.24 | 21 | 23.60 | 45 | 23.94 |
| ***Environmental Factors*** | | | | | | | |
| e110 | Products or substances for personal consumption | 23 | 23.23 | 11 | 12.36 | 34 | 18.09 |
| **e115** | **Products and technology for personal use in daily living** | **52** | **52.53** | **28** | **31.46** | **80** | **42.55** |
| e165 | Assets | 2 | 2.02 | 6 | 6.74 | 8 | 4.26 |
| **e580** | **Health services. systems and policies** | **82** | **82.83** | **61** | **68.54** | **143** | **76.06** |

Note: Of all 127 identified ICF categories, only ICF categories considered in ≥ 3% of the total study number are presented (n=54); ICF categories considered in ≥25% of the total study number are printed in bold (n=13).

## DISCUSSION

This systematic review presents an overview of the content of published studies on hand conditions, based on the biopsychosocial view of functioning, disability and health. Analyzing the outcome measures reported in studies on hand conditions, by using the ICF as a reference, highlights the most common aspects of functioning as well as those that deserve more consideration in research on hand conditions. The impact of hand conditions on patients health[4,7,13,14] is reflected in the large number of different ICF categories (n=127) identified in this review.

Pain, mobility of joints and muscle power are the aspects of functioning most frequently addressed in Body Functions, which is in line with studies on conditions such as hand osteoarthritis,[4] scleroderma,[8] Dupuytren's contracture,[6] systemic lupus erythematosus [7] or digit amputations.[25] Our results show however, that mental functions such as emotional functions (eg, anxiety) or sleep functions (eg, maintenance of sleep) are only rarely considered. Considering that these aspects of functioning are important to health from the patient perspective,[26-32] it would be worthwhile to increase research focus on the impact of hand conditions on mental functions.

Mobility related to hands and arms, such as 'fine hand use' or 'hand and arm use' were the dominant aspects of functioning among Activities and Participation due to their presence in the standardized outcome measures and performance tests.[33,34] Notably, 48 different ICF categories (i.e. 38% of 127) refer to the Activities and Participation domain. This emphasizes that the impact of hand conditions on a broad range of activities of daily living is well addressed in the literature. Activities and Participation was, however, reported less frequently than the main body functions. Our results also indicated that, activity limitations and participation restrictions are not yet systematically considered in research on hand conditions. For example, further mobility functions such as d475 'Driving' and d470 'Using transportation' are only rarely addressed, even though these aspects have been stated as important from the patient perspective[26,29,30] and might restrict patients with hand conditions in, for example, returning to work or being able to socialize with friends and family. Instrumental day to day self-care functions or domestic life functions were also overlooked. For example, studies failed to address functioning aspects such as d530 'toileting' or d620 'acquisition of goods and services'. To widen our knowledge in terms of what impacts health in patients with a hand condition, and as a consequence to further develop patient-oriented care,[35] we need to be aware if and to what extent patients experience limitations in certain functioning aspects.

Our review additionally highlights that Environmental Factors in general are infrequently addressed. Environmental Factors must be seen in close interaction with the components of functioning and disability. They can have a facilitating or restricting impact on a person's performance. For example, using splints can facilitate the performance of activities of daily living, but might also be experienced as a barrier causing

inconvenience or discomfort.[25,27,36,37] Further, attitudes and support of family, friends, colleagues or health professionals, are essential to a person's ability to cope with the consequences of the disease.[15,38-40] Considering this, one has to bear in mind that decrements in certain aspects of functioning (ie, the amount of disability) depends on the circumstances in which the patient lives or actually is situated and also on the activities someone needs or wants to perform. Results of an assessment in a created setting might differ from the results of an assessment in the patient's natural environment and therefore might lead to a biased perception of patient's disability. It is therefore important that clinicians and researchers take into account the different impacts of environmental factors when planning patient's rehabilitation or when designing tools for daily living assessment.

This review also provides an overview of the most frequently used standardized outcome measures and clinical assessments. The decision to use a certain outcome measure often depends on its psychometric properties and on existing reference data. However, widely used instruments may not always be the best to address the aim of a study. For example the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36), a questionnaire used in hand conditions does not address sleep functions which is an impairment in these patients.[19] Outcome measures frequently used in a certain field of research can be analyzed by linking its content to the corresponding component or category of the ICF. As a consequence, different outcome measures become comparable regarding its content.[18,41] This facilitates the decision on the adequate outcome measure to choose regarding the study aim and informs about contents not yet captured in the different outcome measures.[26]

Moreover, indexing publications by using the ICF (in addition to the standard MeSH terms) would enable researchers to cross-classify publications to more precisely direct a literature search on a certain subject of interest and to identify gaps of research.

However, it must also be recognized that the use of the ICF for analyzing study contents indicates possible weak areas of the classification system. For example, in the components Body Functions and Structures, the ICF does not provide sufficiently specific codes to describe in detail the problems of persons suffering from hand conditions. The assessment of impairment in nerves of the arm or the hand is frequently addressed in research, as it can have a tremendous effect on hand function.[10,42] However, the most specific code provided by the ICF to capture this information is s120 'Spinal cord and related structures' which might not be sufficiently detailed for clinical purpose. The same applies for body structures such as arteries or veins of the arm and hand, as well as strength in muscles of the hand or mobility in joints of fingers. The studies reported more precise information that could not be provided by the selected ICF category. These findings underline the need for more specific ICF categories addressing the upper extremity and hand in future versions of this classification. Having more specific ICF categories about the hand would

enable clinicians to more precisely describe patients' functioning after experiencing a certain condition or injury of the hand.

However, to keep the system practical for clinicians, a tool including a pre-selection of hand relevant ICF categories would be necessary.[43] Therefore the ICF Core Sets for Hand Conditions have been adopted at the International ICF Consensus Conference, which convened in Switzerland in May 2009.[44] They represent a list of ICF categories, taken from the entire classification that can serve as the international standard for reporting of functioning of persons with hand conditions. Using ICF Core Sets for Hand Conditions can be valuable to guide clinicians working in multidisciplinary teams[45] as well as researchers focusing on a certain research question.[46]

## Study Limitations

Some study limitations have to be mentioned. This review solely includes English language studies published over a limited period of time (1998–2008). Consequently, it systematically omits some publications. Furthermore, we only analyzed a random sample of 15 %of the retrieved studies for practical reasons.

We excluded conditions not originated at the hand but affecting the hand such as stroke or Parkinson's disease. Including these conditions would have revealed instruments (eg, the Unified Parkinson's Disease Rating Scale) not typically used in the type of hand patient we were focused on. To avoid skewed results, we excluded these conditions (eg, neurologic diseases).

We solely analyzed the contents of the outcome measures and did not evaluate its psychometric properties as this, has already been described in previously published articles such those as by Schoneveld,[47] and van de Ven-Stevens,[34] and colleagues.
Further, it is important to mention that the objectives of this review directed us to the descriptive content of the ICF codes, and we did not enter into the area of the qualifiers in which it would be possible to designate the extent of the impairment and, for example, to identify left and right hands separately.

It was not feasible to link all information obtained from the studies to the ICF. Some concepts refer to health conditions or personal factors, which are not coded or classified. Others were not specified in sufficient detail to allow linking. However, the small portion of concepts that had to be considered as 'not covered' by the ICF (3.4%) is in line with other linking experiences that also show a percentage of about 3%of concepts to be 'not covered'.[21,48,49]

# CONCLUSIONS

This review gives an overview of the content of published studies on hand conditions based on the biopsychosocial view of functioning, disability and health. It reports the

most common aspects of functioning and disability being addressed in the published literature and highlights those that deserve more consideration in research on hand conditions. The ICF could be used as a valuable etiologically neutral frame to identify, group and quantify the information retrieved from the included studies. The findings from our study show that research activity needs to widen its focus on mental functions, further mobility functioning, self-care and domestic life aspects to encompass the impact of hand conditions, potentially experienced by patients affected. Furthermore, the influence of environmental factors on patient's health status should be considered more systematically. This would increase our knowledge on patients' needs and would help to ensure patient-oriented care.

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# 5

# Report on the International ICF Consensus Conference on the ICF Core Sets for Hand Conditions


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## ABSTRACT

**Objective:** The aim of the conference was to derive the Brief and the Comprehensive International Classification of Functioning, Disability and Health (ICF) Core Set for Hand Conditions from the subset of ICF categories selected on the basis of the preparatory phase research.

**Methods:** Following a multistage decision process, the experts agreed on the ICF categories to be included in the ICF Core Sets for Hand Conditions.The development of the ICF Core Sets for Hand Conditions involved a formal decision-making and consensus process, integrating evidence gathered from preparatory studies including a qualitative study, a systematic literature review, an expert survey and an empirical multicentre study.

**Results:** Twenty-three experts selected a total of 117 categories for the Comprehensive Core Set and 23 categories for the Brief Core Set. The largest number of categories was selected from the ICF component 'Activities and Participation'.

**Conclusion:** The ICF Core Sets for Hand Conditions serve a clinical framework to comprehensively assess patients in acute care hospitals and early post-acute rehabilitation facilities. The first versions of the ICF Core Sets will be further tested and validated through empirical studies.

## INTRODUCTION

The World Health Organisation (WHO) developed the International Classification of Functioning Disability and Health (ICF) as a means to address the consequences of the health conditions from a comprehensive perspective.[1] With the ICF we can now rely on a globally accepted language to communicate about functioning in individuals with Hand Conditions (HC). The ICF is based on the integrative model of functioning. The model illustrates an individual's functioning as a complex relationship between the health condition and contextual factors (i.e. environmental and personal factors) with dynamic and bidirectional interactions among the entities (figure 1). The whole classification comprises the components 'Body Functions and Structures', 'Activities and Participation', and 'Environmental Factors'. The component 'Personal Factors' has not yet been classified. (figure 1 and Box 1).[8] The ICF provides more than 1400 ICF categories, thus enhancing its applicability in clinical practice and research, tools, such as ICF Core Sets, are needed. ICF Core Sets are lists of ICF categories relevant for the description of functioning of individuals with a specific health problem or being treated in specific settings.

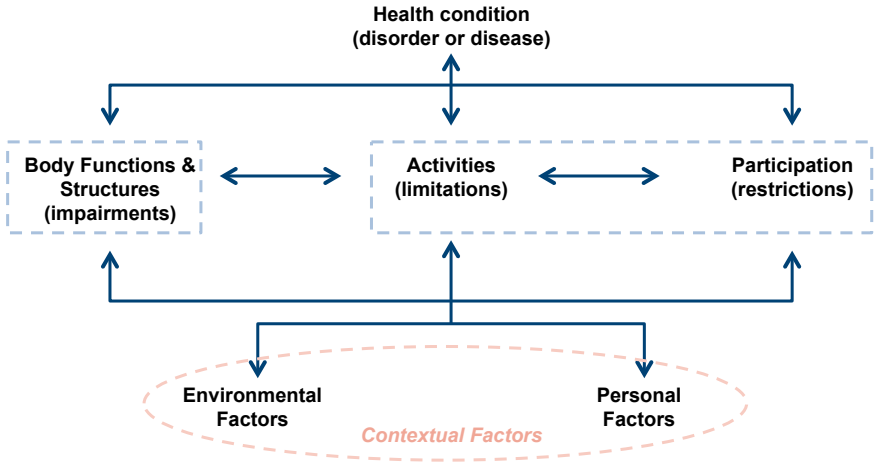


**Figure 1** The integrative model of functioning, World Health Organization, Geneva, 2001[2]

In May 2009 an International ICF Consensus Conference on 'ICF Core Sets for Hand Conditions' in collaboration with WHO, took place at Nottwil, Switzerland. The aim of the conference was to decide on the first version of ICF Core Sets for Hand Conditions. It is envisioned that *ICF Core Sets for Hand Conditions* will stimulate research leading to improved understanding of functioning, disability and health in individuals with HC.

**Box 1** International Classification of Functioning, Disability and Health (ICF)2

The ICF is a comprehensive classification with 1424 ICF categories. In the International Classification of Functioning, Disability and Health (ICF), two parts, each with two components are described.
Part I, Functioning and Disability,

a. Body Functions and Structures
b. Activities and Participation'.

'Activity' is defined as "the execution of a task or action by an individual", and 'participation' is defined as "the person's involvement in a life situation".

Part II, Contextual Factors

c. Environmental Factors
d. Personal Factors

Within each component , domains are further grouped according to their common characteristics in several categories. These categories contain 1 to 4 levels.[1]

Additionally, the *ICF Core Sets for Hand Conditions* may form the basis for studying the content validity of already existing instruments or for the development of new instruments to quantify the severity of hand conditions, to measure change over time and the effectiveness of interventions.[4]

The development of *ICF Core Sets for Hand Conditions* started in February 2008 and is a cooperative effort of the German Social Accident Insurance (DGUV), the Institution for Statutory Accident Insurance and Prevention in the Health and Welfare Services (BGW) (Germany) and the ICF Research Branch of the Collaborating Centre of the Family of International Classifications (DIMDI, Köln, Germany) at the Institute for Health and Rehabilitation Sciences at Ludwig-Maximilian University in Munich (Germany).

The aim of the project was to develop the *ICF Core Sets for Hand conditions* to specify functioning and disability of individuals with HC. In this context hand conditions include conditions of the hand (considered as conditions / health problems located directly at the hand such as carpal tunnel syndrome, injuries of the hand, osteoarthritis of finger joints, amputations or Dupuytren's disease,etc.), and conditions involving the hand (considered as conditions / health problems originating external to the hand but affecting the hand such as rheumatoid arthritis, stroke, Parkinson's disease or multiple sclerosis etc.).[4]

There were three phases in the project "Development of the *ICF Core Sets for Hand Conditions"*. Within the first phase four preparatory studies were conducted to address adequately different perspectives:[4]

- *Systematic literature review*: A systematic literature review was performed[2] (1) to identify parameters and outcomes reported in studies involving patients with HC and published within the years 2003 to 2008 and (2) to identify and quantify the concepts contained in

these parameters and outcomes using the ICF as a reference. The systematic review was performed, followed by a selection procedure with three steps: step 1, selection of studies; step 2, outcome measures and parameters extraction; and step 3, linkage of the concepts contained within the outcome measures and parameters to the corresponding categories of the ICF. All steps were conducted by two independent reviewers. More information will be published in the future.

- *Qualitative study*: Ten focus groups including 59 individuals with different types of hand conditions were performed at five different study centres in Germany.
- *Expert survey:* An Internet based expert survey was undertaken to gather the opinion of an international pool of 162 experts from 55 countries and of six different health professions (physicians, nurses, physiotherapists, occupational therapists, psychologists, and social workers) regarding the most relevant and typical areas to be considered in individuals with HC.
- *Empirical study*: A cross-sectional multicentre study with 210 patients was conducted at five study centres to describe functioning and health of individuals with HC and to identify the most common problems using the classification system of the ICF.

The aim of the conference was to derive the Brief and the Comprehensive ICF Core Sets for Hand Conditions from the subset of ICF categories selected on the basis of the Preparatory Phase research.

- A Brief ICF Core Set for Hand Conditions is defined as a list of ICF categories that serves as minimal international standard for the reporting of functioning in persons with HC along the continuum of care (ranging from the acute hospital to rehabilitation facilities and community) and across sectors (health, education, labour and social affairs)
- A Comprehensive ICF Core Set for Hand Conditions is defined as a list of ICF categories that includes as few categories as possible to be practical, but as many as necessary to describe the aspects of functioning relevant to persons with HC in a comprehensive, multi-disciplinary assessment



## METHOD

A formal decision-making and consensus process was used, integrating evidence gathered from preparatory studies including a qualitative study, a systematic literature review, an expert survey and an empirical multicentre study. The different steps and phases during the consensus conference were defined and described in advance.[5]

At the ICF Consensus Conference the results of the preparatory studies were presented by researchers from the Institute for Health and Rehabilitation Sciences. On the basis of this information, three working groups, each of which consisted of participants from different health professions, discussed and determined through a voting mechanism the selection of ICF categories.

Observers were present and they were instructed not to be involved in discussions.

The group decisions were presented and discussed at several plenary sessions. The plenary sessions were led by the group leader. (Institute for Health and Rehabilitation Sciences).

**Box 2** Consensus Procedure[4,5]

The ICF Consensus Conference on 'ICF Core Sets for Hand Conditions' involved health professionals from different parts of the world. Twenty-three experts were invited to attend the conference and were divided into three different working groups. Each group consisted of different health professionals from different countries who worked actively together for 3 days in a teamwork technique called the "Nominal Group Technique." The language at the conference was English.

At the beginning of the conference, participants were trained on (1) the structure, principles, and nomenclature of the ICF in general and; (2) the results from the preparatory studies; and (3) the principles of the consensus process applied during the conference.

The categories to be included in the ICF Core Sets were chosen in 2 different types of sessions: in working groups and in the plenary. The decision-making process included 3 consecutive steps: (1) selection of ICF categories for the Comprehensive ICF Core Set on second level; (2) selection of categories that require to be described in more detail at higher ICF-levels, i.e, third and fourth level; and (3) selection of categories out of the Comprehensive ICF Core Set that should be included in the Brief ICF Core Set for HC.

The categories for the Brief ICF Core Set for HC were chosen out of the Comprehensive ICF Core Set by means of a ranking exercise. The cut-off line for the ranking was determined in a separate vote after the ranking.

## RESULTS

Twenty-three experts in the field of HC (physicians, physiotherapists, occupational therapists, nurses, psychologists, and social workers) from 22 different countries were involved in the formal decision-making and consensus process, which resulted in the selection of ICF categories for the *ICF Core Sets for Hand Conditions*. Representatives of the World Confederation for Physical Therapy (WCPT), the World Federation of Occupational Therapists (WFOT) and the International Federation of Societies for Hand Therapy (IFSHT) were also present.

As a result of the ICF Consensus Conference two *ICF Core Sets for Hand Conditions* were developed as follows:

- A *Comprehensive ICF Core Set for Hand Conditions* including a selection of 117 ICF categories to be taken into account in a comprehensive, multi-disciplinary assessment

- A *Brief ICF Core Set for Hand Conditions* including a selection of 23 ICF categories out of the *Comprehensive ICF Core Set for Hand Conditions* to be taken into account in any patient with HC irrespective of the health care setting in which they are treated and when single health care professionals and not a multidisciplinary team is involved, respectively.

The development of the *ICF Core Sets for Hand Conditions* within two and a half days was associated with an enormous workload for the participants and a very tight time schedule. The ICF Core Sets for Hand Conditions are presented on the ICF Research Branch website: http://www.icf-research-branch.org/research/Hand.htm

## DISCUSSION

The aim of the ICF Consensus Conference on 'ICF Core Sets for Hand Conditions' was to derive the Brief and the Comprehensive ICF Core Set for Hand Conditions from the subset of ICF categories selected on the basis of the preparatory phase research. A lot of discussions took place in the working groups and during the plenary sessions. Consensus was achieved by a structured voting procedure.

As in any decision making and consensus process involving experts, the process has limitations and the results of the voting may have been influenced by several aspects, such as the knowledge of the participants regarding the ICF or decision process itself. This emphasizes the need for testing the first version of ICF Core Sets as well as the need to link this first proposal to assessment instruments and clinical assessment guidelines that are already in use.



## Acknowledgement

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## APPENDIX

Brief ICF Core Set for Hand Conditions
(ICF Research Branch in cooperation with WHO, 2009)

### Brief ICF Core Set for Hand Conditions

| ICF code | Title |
|---|---|
| b152 | Emotional functions |
| b265 | Touch function |
| b270 | Sensory functions related to temperature and other stimuli |
| b280 | Sensation of pain |
| b710 | Mobility of joint functions |
| b715 | Stability of joint functions |
| b730 | Muscle power functions |
| b760 | Control of voluntary movement functions |
| b810 | Protective functions of the skin |
| s120 | Spinal cord and related structures |
| s720 | Structure of shoulder region |
| s730 | Structure of upper extremity |
| d230 | Carrying out daily routine |
| d430 | Lifting and carrying objects |
| d440 | Fine hand use |
| d445 | Hand and arm use |
| d5 | Self-care |
| d6 | Domestic life |
| d7 | Interpersonal interactions and relationships |
| d840 - d859 | Work and employment |
| e1 | Products and technology |
| e3 | Support and relationships |
| e5 | Services, systems and policies |

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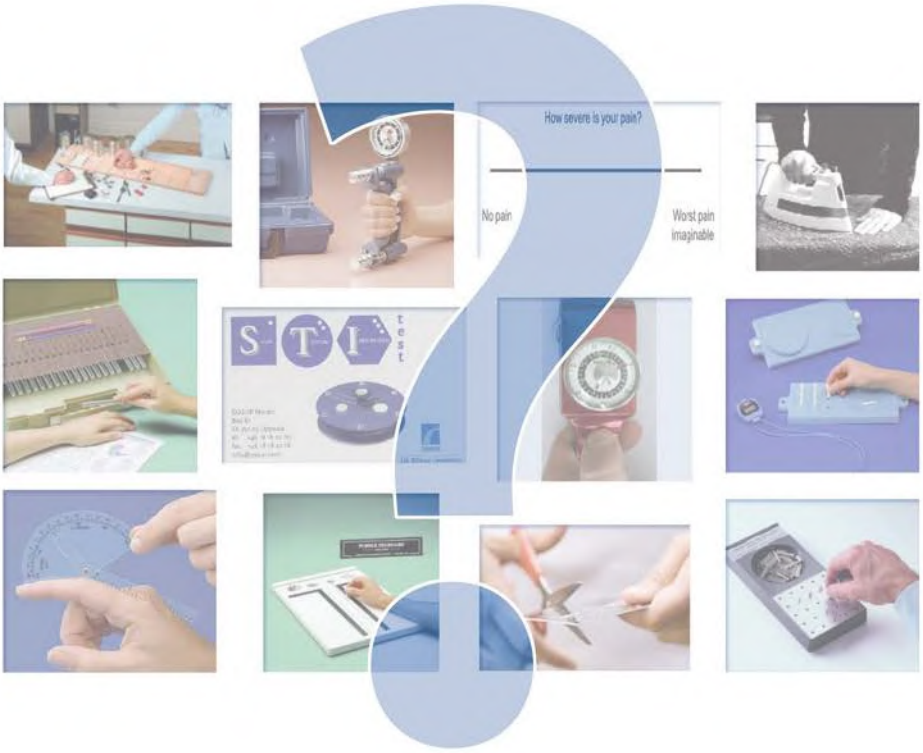
# 6

# Which assessment tools address the categories of the Brief ICF Core Set for Hand Conditions?

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van de Ven-Stevens LAW, Kus S, Graff MJ, and Geurts ACH. Which assessment tools address the categories of the Brief ICF Core Set for Hand Conditions? *Hand Therapy, 2015;20:75-87.*

## ABSTRACT

**Introduction:** The purpose of this study was to explore whether assessment tools address aspects that are relevant according to the Brief ICF Core Set for Hand Conditions (BICF-CS).

**Methods:** Assessment tools meant to assess functioning and/or environmental factors in adults with hand conditions were reviewed. MEDLINE and CINAHL databases, previously published reviews, the book "Clinical Assessment Recommendations of the ASHT", and websites of assessment tools were used for the content comparison and linking to the 23 categories of the BICF-CS. The updated version of the linking rules was applied by two reviewers.

**Results:** Forty-six assessment tools, known within the areas of hand therapy and hand surgery, were linked to the 23 categories of the BICF-CS. Regarding *Body functions and body structures*, the categories that were most frequently addressed were *b730 'Muscle power functions'*, *b280 'Sensation of pain'*, *b710 'Mobility of joint functions'*, and *s730 'Structure of upper extremity'*. Regarding *Activities and Participation, d440 'Fine hand use'* was addressed mostly and 25 assessment tools (with a total of 146 items) were linked to this category. Regarding *Environmental Factors,* only one assessment tool was identified that could be linked to two categories. Fifteen points of discussion were encountered in the linking process.

**Conclusion:** Content comparison of 46 assessment tools revealed that 19 of the 23 categories of the BICF-CS were addressed. The environmental factors were hardly addressed.

## INTRODUCTION

Persons with a hand injury or hand disorder (i.e., hand condition) may experience impairments, activity limitations and participation restrictions. A variety of day-to-day activities may be limited, such as self-care and domestic life. In clinical practice, assessment tools are increasingly used to evaluate, for instance, a person's body functions, self-care abilities, and environmental factors, domains that are described in the International Classification of Functioning, Disability and Health (ICF).

The ICF was introduced in 2001 by the World Health Organization as a means to address human functioning from a bio-psychosocial perspective.[1] It provides a common language for members from various healthcare professions to describe individual functioning, disability and health.[1] According to the ICF, functioning comprises the components "Body Functions" and "Body Structures" as well as "Activities and Participation". The contextual Environmental and Personal Factors are also considered within the bio-psychosocial perspective, although the "Personal Factors" have not yet been classified. Each component is composed of categories and subcategories providing more than 1400 ICF (sub)categories altogether.[1] To enhance its applicability in clinical practice and research, ICF Core Sets are needed.[2] ICF Core Sets list certain aspects taken from the entire classification that are relevant for the description of functioning of individuals being treated in specific settings or with specific health problems, such as hand conditions.[2,3] The Brief and Comprehensive ICF Core Sets for Hand Conditions[4] have been adopted at the international ICF consensus conference in May 2009.[5,6] During this conference, from a subset of ICF categories based on preparatory studies, 23 experts selected a total of 117 categories for a Comprehensive Core Set and 23 categories for a Brief Core Set: the Comprehensive (CICF-CS) and Brief (BICF-CS) Core Set for Hand Conditions, respectively. These core sets can serve as a useful tool to guide hand therapists, hand surgeons, rehabilitation physicians and researchers in the assessment of a patient's functioning and health in both clinical practice and scientific studies.

The BICF-CS and CICF-CS provide an evidence-based selection of functional aspects and environmental factors that should be considered among patients with hand injuries or hand disorders. Thus, these core sets can be used to determine how well available assessment tools address all relevant aspects of human functioning in individuals with hand conditions. The aim of this study was, therefore, to provide content comparison of assessment tools, known within the area of hand surgery and hand rehabilitation, with the 23 categories of the Brief ICF Core Set for Hand Conditions (BICF-CS).

# METHODS

## Literature review

For instruments that assess body functions and structures (impairments), activity (limitations) and/or participation (restrictions) information was gathered. The literature concerning assessment tools that address activity (limitations) and participation (restrictions) in patients with hand conditions was systematically reviewed as was reported in previous publications.[7,8] The Medline and CINAHL databases, the book "Clinical Assessment Recommendations of the American Society of Hand Therapists",[9] and (if existent) websites of assessment tools were used to collect more detailed information about the assessment tools such as content descriptions, administration manuals, and scoring forms. Publications already reporting about a particular assessment tool with respect to the ICF were also reviewed.[10-16]

## Assessment tools

Assessment tools included were either observational instruments or questionnaires meant to assess functioning and/or environmental factors in adults with hand conditions. The definitive list consisted of assessment tools that are commonly used in hand conditions and that are sufficiently described in literature.[8,9] Observational instruments are performance tests and include (1) pegboard tests measuring only fine hand use; (2) instruments measuring only fine hand use by picking up, manipulating, and placing different objects; and (3) instruments measuring single tasks (and fine hand use) by scoring executed tasks. Questionnaires include Patient Reported Outcome Measures and questionnaires that can be completed by hand therapist and patient together. Biomedical and laboratory tests, such as x-rays or electromyography, were not considered.

## Linking Process

Two independent reviewers (physical therapy students (StW and CG) who had been trained for this study) applied the updated version of the linking rules to map the content of the included assessment tools to the 23 BICF-CS categories[17] (table 1) . The decision on the ICF categories to be linked to the items of a certain instrument was based on the description, scoring form and test manual as well as on the definitions of the ICF categories.[1] In the first step of the linking process, the content of each item and, if applicable, its response options (response scale) were determined using the standardized linking rules. Item content was referred to as the meaningful concept(s) addressed by a particular item of an assessment tool.[17] The meaningful concept within each item of every single instrument was then, in the second step, linked to the most specific BICF-CS category. If an item was considered to address more than one meaningful concept or if it was specified by examples, each concept was separately linked to a BICF-CS category. For example, "Button a shirt or blouse" was linked to *d440 Fine Hand Use* as well as to *d5 Self-Care*.

**Table 1** Linking rules

| | |
|---|---|
| Specific rules for the linking of health-status | |
| a. | Identify all meaningful concepts within each item |
| b. | Link all response options if they contain meaningful concepts |
| c. | Interval of time (during the last week) is not linked to the ICF |
| d. | Meaningful items explained by examples, both item and examples are linked. The linked examples will be put within parentheses |
| Updated linking rules, to be applied after having used the four specific rules | |
| 1. | Before one links meaningful concepts, one should acquire knowledge of the conceptual and taxonomical fundaments of the ICF, chapters, domains and categories of the classification |
| 2. | Each meaningful concepts is linked to the most precise ICF category |
| 3. | Do not use the so-called "other specified" ICF categories. If the content of a meaningful concept is not named in the corresponding ICF category, the additional information is documented |
| 4. | Do not use the so-called "unspecified" ICF categories, but to the lower level category |
| 5. | If the information provided by the meaningful concept is not sufficient for making a decision about the most precise ICF category it should be linked to, the meaningful concept is assigned nd (not definable)<br>Special cases of this rule:<br>- meaningful concepts referring to health in general, physical health or mental health, are assigned: nd-gh, nd-ph or nd-mh (not definable - general health, not definable – physical health, not definable – mental health)<br>- Meaningful concepts referring to quality of life in general are assigned nd-qol (not definable – quality of life) |
| 6. | If the meaningful concept is not contained in the ICF, but it is clearly a personal factor, it will be assigned as pf (personal factor) |
| 7. | If the meaningful concept is not contained in the ICF and it is clearly not a personal factor, it will be assigned as nc (not covered) |
| 8. | If the meaningful concept refer to a diagnosis or a health condition, it will be assigned hc (health condition) |

The ICF has a hierarchical structure. Each chapter of the classification consists of first-, second- and third-level categories – in some chapters even of fourth-level categories – which represent the single units of the classification system. A lower level category provides information in a more precise way, thus, shares the attributes of its higher level category but not vice versa. For example, the category *b2 Sensory functions and pain* reflects the first (highest) level, *b280 Sensation of pain* represents the second level, *b2801 Pain in body part* corresponds with the third level, and *b28014 Pain in upper limb* corresponds with the fourth level. The CICF-CS consists of more third- and fourth-level categories than the BICF-CS. Thus, it was helpful to use the CICF-CS as a reference in the linking process.

If needed, a particular assessment tool was first linked to the third- or fourth-level category of the CICF-CS. Then, it was decided whether this tool could be linked to a first- or second-level category of the BICF-CS. In the case of disagreement between the two reviewers, a third reviewer (LvdV-S) was involved to reach consensus. Whenever the reviewers agreed that they were not able to link an item to a BICF-CS category, or whenever their linking differed from that of previous studies, discussion points were noted.

## RESULTS

Regarding all assessment tools, the available information (such as publications, manuals, scoring forms) was sufficient and could be used in the linking process. Table 2 shows the results of this process. Forty-six assessment tools known within the areas of hand surgery and hand rehabilitation could be linked to 19 categories of the BICF-CS. As can be concluded from this table, only 4 of the 23 BICF-CS categories remained unaddressed. These were: *b810 "Protective functions of the skin", s120 "Spinal cord and related structures",*

**Table 2** Results of the linking process:
An overview of the item content of assessment tools, related to the 23 categories of the Brief ICF Core Set for Hand Conditions (BICF-CS)

***Table 2a. Overview results all instruments***

| Instruments | Total number of items | Number of different concepts | Total Number of linked categories | Categories of the Brief ICF Core Set for Hand Conditions and items per category | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | b152 | b265 | b270 | b280 | b710 | b715 | b730 |
| | | | | Emotional Functions | Touch functions | Sensory Functions related to temperature and other stimuli | Sensation of pain | Mobility of joint functions | Stability of joint functions | Muscle power functions |
| | | | | b152 | b265 | b270 | b280 | b710 | b715 | b730 |
| Total number of instruments linked to this category | | | | 5 | 7 | 7 | 9 | 9 | 1 | 13 |
| Total number of items linked to this category | | | | 12 | 13 | 26 | 81 (49 +32) | 20 | 3 | 25 |

*s720 "Structure of shoulder region"*, and the environmental factor *e1 "Products and technology"*. Body Functions most frequently addressed were *b730 "Muscle power functions", b280 "Sensation of pain"* and *b710 "Mobility of joint functions"*. Of the Body Structures, only *s730 "Structure of upper extremity"* was covered. With regard to the component Activities and Participation, *d440 "Fine hand use"* was addressed mostly and 25 assessment tools (with a total of 146 items) were linked to this category. The Michigan Hand Outcomes Questionnaire (MHQ) and the Disabilities of the Arm, Shoulder and Hand questionnaire (DASH) covered most of the functional aspects of the BICF-CS (n=14) with an almost complete overlap. The only exception was that the MHQ included "*Structure of upper extremity" (s730),* whereas the DASH included "*Carrying out daily routine" (d230).* The categories of the BICF-CS that were not addressed by the DASH or the MHQ (i.e. b715, b760, b810, s120, s720, e1, e3, e5) were covered only by one (a different instrument per category as can be seen in table 2) or by no instrument at all. Regarding Environmental Factors, only the Patient Evaluation Measure (PEM) could be linked to the categories *e3 "Support and relationships"* and *e5 "Services, systems and policies"*. Fifteen discussion topics were encountered in the linking process (table 3).



| | b760 | b810 | s120 | s720 | s730 | d230 | d430 | d440 | d445 | d5 | d6 | d7 | d840-d859 | e1 | e3 | e5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Control of voluntary movement functions | Protective functions of the skin | Spinal cord and related structures | Structure of shoulder region | Structure of Upper Extremity | Carrying out daily routine | Lifting and carrying objects | Fine hand use | Hand and arm use | Self-care | Domestic life | Interpersonal interactions and relationships | Work and employment | Products and technology | Support ad relationships | Services, systems and policies |
| | b760 | b810 | s120 | s720 | s730 | d230 | d430 | d440 | d445 | d5 | d6 | d7 | d840-d859 | e1 | e3 | e5 |
| | 1 | 0 | 0 | 0 | 5 | 1 | 11 | 25 | 15 | 16 | 9 | 4 | 7 | 0 | 1 | 1 |
| | 1 | 0 | 0 | 0 | 10 | 1 | 20 | 146 | 76 | 59 | 29 | 6 | 20 | 0 | 5 | 2 |

**Table 2** Continued

***Table 2b. Instruments mainly measuring body functions and structures***

| Instruments | Total number of items | Number of different concepts | Total Number of linked categories | b152 | b265 | b270 | b280 | b710 | b715 | b730 |
|---|---|---|---|---|---|---|---|---|---|---|
| Ab-Adductometer | 2 | 1 | 1 | | | | | | | 2 |
| Blood-pressure cuff | 2 | 2 | 1 | | | | | | | 1 |
| Circumference measure (Finger) | 4 | 1 | 1 | | | | | | | |
| Goniometer | 1 | 1 | 1 | | | | | 1 | | |
| Jamar Dynamometer | 1 | 1 | 1 | | | | | | | 1 |
| Kapandji 1-10 | 3 | 1 | 1 | | | | | 3 | | |
| Manual muscle testing (MMT) | 1 | 1 | 1 | | | | | | | 1 |
| McGill Pain Questionnaire (MPQ) | 49 | 6 | 5 | 1 | | x12 | 49 | | | |
| Moberg Pick Up Test (MPUT) | 3 | 2 | 2 | | 3 | | | | | |
| Pinch Gauge | 3 | 1 | 1 | | | | | | | 3 |
| Pollexograph | 1 | 1 | 1 | | | | | 1 | | |
| Rotterdam Intrinsic Hand Myometer (RIHM) | 1 | 1 | 1 | | | | | | | 1 |
| Semmes Weinstein Monofilament Test (SWMT) | 1 | 1 | 2 | | 1 | 1 | | | | |
| Shape Texture Identification Test (STI) | 2 | 2 | 1 | | 2 | | | | | |
| Two-Point Discrimination Test (2PD) (static/moving) | 1 | 2 | 2 | | 1 | 1 | | | | |
| Vigori-meter | 3 | 1 | 1 | | | | | | | 3 |
| Visual Analogue Scale (Pain) | 1 | 1 | 1 | | | | 1 | | | |
| Volumeter | 1 | 2 | 1 | | | | | | | |
| Wire Tracing Method | 1 | 1 | 1 | | | | | 1 | | |

| b760 | b810 | s120 | s720 | s730 | d230 | d430 | d440 | d445 | d5 | d6 | d7 | d840-d859 | e1 | e3 | e5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 4 | | | | | | | | | | | |
| | | | | | | | | | 2 | | 1 | 1 | | | |
| | | | | | | | 3 | | | | | | | | |
| | | | | 1 | | | | | | | | | | | |

**Table 2** Continued

***Table 2c. Pegboard tests***

| | Total number of items | Number of different concepts | Total Number of linked categories | b152 | b265 | b270 | b280 | b710 | b715 | b730 |
|---|---|---|---|---|---|---|---|---|---|---|
| Functional Dexterity Test (FDT) | 1 | 3 | 1 | | | | | | | |
| Grooved Pegboard Test | 1 | 3 | 1 | | | | | | | |
| Nine-Hole Peg Test (NHPT) | 1 | 3 | 1 | | | | | | | |
| Purdue Pegboard Test (PPT) | 4 | 3 | 1 | | | | | | | |

***Table 2d. Instruments measuring fine hand use by handling different objects***

| | Total number of items | Number of different concepts | Total Number of linked categories | b152 | b265 | b270 | b280 | b710 | b715 | b730 |
|---|---|---|---|---|---|---|---|---|---|---|
| Box and Block Test (BBT) | 1 | 3 | 1 | | | | | | | |
| Minnesota Manual Dexterity Test (MMDT) | 2 | 3 | 1 | | | | | | | |
| Moberg Pick Up Test (MPUT) | 3 | 2 | 2 | | 3 | | | | | |
| O'Neill Hand Function Assessment | 8 | 4 | 4 | | | | | | | |
| Rosenbusch Test of Finger Dexterity | 1 | 3 | 1 | | | | | | | |

***Table 2e. Instruments measuring single tasks (and fine hand use) by scoring tasks***

| | Total number of items | Number of different concepts | Total Number of linked categories | b152 | b265 | b270 | b280 | b710 | b715 | b730 |
|---|---|---|---|---|---|---|---|---|---|---|
| Arthritis Hand Function Test (AHFT) | 11 | 8 | 5 | | | | | | | 3 |
| Jebsen-Taylor Test of Hand Function (JTHF) | 7 | 7 | 2 | | | | | | | |
| Radboud Skills Test (RST) | 10 +3 | 6 | 5 | | | | 3 | | | |
| Sequential Occupational Dexterity Assessment (SODA) | 12 +12x2 | 8+2 | 4 | | | | | | | |
| Smith Hand Function Evaluation (SHFE) | 15 | 6 | 3 | | | | | | | 1 |
| Sollerman Hand Function Test (SHFT) | 20 | 7 | 4 | | | | | | | |
| Southampton Hand Assessment Procedure (SHAP) | 12+14 | 7 | 4 | | | | | | | |

| b760 | b810 | s120 | s720 | s730 | d230 | d430 | d440 | d445 | d5 | d6 | d7 | d840-d859 | e1 | e3 | e5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1 | | | | | | | | |
| | | | | | | | 1 | | | | | | | | |
| | | | | | | | 1 | | | | | | | | |
| | | | | | | | 4 | | | | | | | | |

| b760 | b810 | s120 | s720 | s730 | d230 | d430 | d440 | d445 | d5 | d6 | d7 | d840-d859 | e1 | e3 | e5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1 | | | | | | | | |
| | | | | | | | 2 | | | | | | | | |
| | | | | | | | 3 | | | | | | | | |
| 1 | | | | | | 2 | 7 | 1 | | | | | | | |
| | | | | | | | 1 | | | | | | | | |

| b760 | b810 | s120 | s720 | s730 | d230 | d430 | d440 | d445 | d5 | d6 | d7 | d840-d859 | e1 | e3 | e5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1 | 7 | 2 | 2 | | | | | | |
| | | | | | | | 6 | 4 | | | | | | | |
| | | | | | | | 3 | 6 | 5 | 2 | | | | | |
| | | | | | | 1 | 7 | 4 | 3 | | | | | | |
| | | | | | | | 14 | | 6 | | | | | | |
| | | | | | | 1 | 15 | 8 | 2 | | | | | | |
| | | | | | | 1 | 12+9 | 8 | 2 | | | | | | |

**Table 2** Continued

***Table 2e. Continued***

| | **Total number of items** | **Number of different concepts** | **Total Number of linked categories** | b152 | b265 | b270 | b280 | b710 | b715 | b730 |
|---|---|---|---|---|---|---|---|---|---|---|
| TEMPA - Upper Extremity Performance Test for Elderly | 9 | 5 | 3 | | | | | | | |
| Upper Extremity Function Test (UEFT) | 11 | 7 | 3 | | | | | | | |

***Table 2f. Questionnaires***

| | **Total number of items** | **Number of different concepts** | **Total Number of linked categories** | b152 | b265 | b270 | b280 | b710 | b715 | b730 |
|---|---|---|---|---|---|---|---|---|---|---|
| Australian/Canadian Osteoarthritis Hand Index (AUSCAN) | 15 | 20 | 7 | | | | 5 | 1 | | |
| Canadian Occupational Performance Measure (COPM) | 9 | 40 | 4 | | | | | | | |
| Cold Intolerance Symptom Severity Questionnaire (CISS) | 14 | 13 | 9 | | | 8 | 3 | 3 | 3 | 3 |
| Disabilities of the Arm, Shoulder and Hand questionnaire (DASH) | 38 | 81 | 14 | 1 | 1 | 1 | 5 | 1 | | 1 |
| Michigan Hand Outcomes Questionnaire (MHQ) | 57 (2x20 +17) | 52 | 14 | 7 | 4 | 2 | 7 | 8 | | 4 |
| Patient Evaluation Measure (PEM) | 19 | 22 | 9 | 1 | 1 | 1 | 3 | 1 | | 1 |
| Patient Rated Wrist/hand Evaluation (PRWHE) | 17 | 24 | 9 | 2 | | | 5 | | | |
| Subjective Hand Function Scoring System (HFS) | 25 | 27 | 5 | | | | | | | |
| Upper Extremity Functional Scale (UEFS) | 8 | 9 | 4 | | | | | | | |

| b760 | b810 | s120 | s720 | s730 | d230 | d430 | d440 | d445 | d5 | d6 | d7 | d840-d859 | e1 | e3 | e5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 8 | 5 | 1 | | | | | | |
| | | | | | | | 5 | 2 | 4 | | | | | | |

| b760 | b810 | s120 | s720 | s730 | d230 | d430 | d440 | d445 | d5 | d6 | d7 | d840-d859 | e1 | e3 | e5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2 | 5 | 5 | 2 | 2 | | | | | |
| | | | | | | | | | 1 | 2 | 1 | 1 | | | |
| | | | | | | | 1 | | 2 | 1 | | 1 | | | |
| | | | | | 1 | 3 | 3 | 6 | 3 | 5 | 2 | 5 | | | |
| | | | | 8 | | 4 | 14 | 10 | 10 | 9 | 2 | 10 | | | |
| | | | | 1 | | | | | | | | 1 | | 5 | 2 |
| | | | | 1 | | 2 | 1 | 3 | 3 | 3 | | 1 | | | |
| | | | | | | 2 | 14 | 10 | 11 | 3 | | | | | |
| | | | | | | 1 | 4 | 2 | | 2 | | | | | |

## DISCUSSION

This study provides an overview of the item content of 46 assessment tools, known within the area of hand surgery and hand rehabilitation, and compares this content to the 23 categories of the Brief ICF Core Set for Hand Conditions (BICF-CS). The results showed that 19 of the 23 BICF-CS categories were addressed by the included assessment tools.

The area of Activities and Participation was well represented by the various assessment tools. Twenty-seven instruments (60%) could be linked to one or more categories of this ICF domain. Although this finding suggests that the impact of hand conditions on a broad range of activities of daily living is well addressed clinically, outcome assessments in clinical practice and research focus on 'Body Functions' rather than on 'Activities and Participation'.[11,12,18,19] An explanation for this discrepancy might be that assessment tools such as goniometers or dynamometers are readily available in most clinical settings, whereas instruments to measure activities are less easily available or relatively unknown. Furthermore, only recently, a first consensus was aimed on which assessment tools should be used to assess activities and participation in patients with hand conditions.[20] This could be the reason that these latter assessment tools are not yet implemented in clinical practice and research.

An important additional finding of this study is that Environmental Factors were hardly addressed by the included assessment tools. From the reviewed instruments, only one instrument captured two of the three environmental factors included in the BICF-CS. The PEM includes several items addressing "medical attention by one or various specialists" and was therefore linked to the categories *e3 "Support and relationships"* and *e5 "Services, systems and policies"*. According to the bio-psychosocial understanding of disability and health, environmental factors dynamically interact with an individual's functioning.[1] However, it seems that these factors are hardly formally assessed in the current clinical practice of hand therapy. Interventions primarily aim to improve body functions and structures, even though it is important to consider abilities and activities that are relevant to a patient's daily life performance as well. In this context, therapists need to know which environmental aspects (e.g., assistive products, family support or climate) influence a patient's daily life performance either in a facilitating or in a complicating way. Environmental factors should, therefore, be an integral part of the overall functional assessment. They need to be taken into account in the decision-making process with regard to a patient's treatment to provide client-centred care. Thus, more assessment tools should be (developed and) implemented in daily clinical practice that address the impact of an individual's environment on his or her daily life performance.

It is important to realize that the ICF distinguishes two qualifiers (or constructs) for the ICF domain Activities and Participation: "Capacity" and "Performance". Capacity refers to an individual's ability to execute a task or an action in a standardized environment, while performance refers to the activities that an individual executes in his or her daily-life

environment. Neither information concerning the extent to which an item refers to activities, to participation, or to both, nor information about whether an item addresses this ICF domain from the perspective of Capacity or Performance is addressed in the existing linking rules. This might be an aspect of possible improvement of these rules in the future. aspects (e.g., assistive products, family support or climate) influence a patient's daily life performance either in a facilitating or in a complicating way. Environmental factors should, therefore, be an integral part of the overall functional assessment. They need to be taken into account in the decision-making process with regard to a patient's treatment to provide client-centred care.

Thus, more assessment tools should be (developed and) implemented in daily clinical practice that address the impact of an individual's environment on his or her daily life performance.aspects (e.g., assistive products, family support or climate) influence a patient's daily life performance either in a facilitating or in a complicating way. Environmental factors should, therefore, be an integral part of the overall functional assessment. They need to be taken into account in the decision-making process with regard to a patient's treatment to provide client-centred care. Thus, more assessment tools should be (developed and) implemented in daily clinical practice that address the impact of an individual's environment on his or her daily life performance.

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Whereas most tests of 'Body Functions and Structures' address only one (b- or s-) category, many assessment tools that evaluate 'Activities and Participation' address more than one (d-)category. Based on the results of this study, we suggest to use guiding principles for selecting assessment tools as described by Fekete et al. (2011) such as redundancy (the overlap between instruments with respect to underlying ICF categories), efficiency (the number of items that address the domain of interest in relation to the total number of items), level of detail of information (the number of items assessing a single ICF category and the response scale), and feasibility (issues important for researchers and issues relevant for participants).[21]

Although the BICF-CS is very useful for the content comparison of different assessment tools, we encountered several discussion topics per category or item during the linking process (see table 3). In addition, it should be mentioned that many items were linked to *d440 "Fine hand use"*. This ICF category includes third-level categories, such as picking up,

grasping, manipulating and releasing. The BICF-CS does not contain those third-level categories separately, however, to improve discrimination between assessment tools of fine hand use, these third-level categories should be used.

Additionally, it was noticed that in linking items to the ICF more options can be possible. The number of concepts that was identified for a particular item varied from one to four (e.g. pain, hand/wrist, pain in hand/wrist, daily activities). Furthermore, it was sometimes unclear whether one or two concepts had to be scored when an item was applicable to both the right and the left hand. Occasionally, it was discussed *which* concept(s) were applicable. For example, is the item "doing up buttons" referring to *fine hand use (d440),* to *dressing (d5),* or to both? In previously published studies[15,16,22] comparable uncertainties arose. In a content comparison of clinical, occupation-based instruments, the Functional Dexterity Test (FDT) and the Jebsen-Taylor Test of Hand Function (JTHF) were differently linked to the ICF.[16] For the FDT only one time score has to be noted that is needed to pick up, manipulate and release 16 pegs on a pegboard. The JTHF also contains several items that include the scoring of time needed to pick up and release a number of objects. As a result, the FDT was linked to d440- (d4400 and d4402) 16 times, whereas the JTHF was linked to d440 (d4400, d4401 and d4402) only once.[16] Hence, caution must be taken in selecting an assessment tool for clinical practice or scientific research if based only on one study. We, therefore, suggest that the linking rules are adjusted in the future. In addition, linking instruments to the ICF should preferably be done by at least two reviewers.

Another discussion topic mentioned in table 3 addresses some domains that were missing, such as oedema and cold intolerance. During the consensus conference in 2009, there were some differences in the knowledge of and familiarity with the ICF codes, definitions and terminology. For example, "Cold-intolerance" was seen as being part of *Sensitivity to temperature* by some participants and as part of *Thermoregulatory functions* by others. These differences have influenced the categories that were included in the BICF-CS.[6]

Although an ICF Core Set indicates what aspects should be addressed to describe an individual's functioning and which environmental factors should be considered, some category definitions might be complemented, for example *b265-Touch functions* and *b270- Sensory functions related to temperature and other stimuli* which might include terms such as "stereognosis" and "threshold detection". In addition, to apply an ICF Core Set in clinical practice it needs to be defined how its aspects should be assessed. As an ICF Core Set refers to a classification system it does not provide this information.[5,6]

The most adequate assessment tools to address individual functioning and environmental factors in patients with hand conditions have not yet been determined.[20,23] Consequently, there is no standardized or universally accepted core set of assessment tools to be used in hand surgery or hand rehabilitation.[7,24-28] Since professionals are stimulated to make use of the same assessment tools, reliable and validated instruments to assess (and preferably

predict) patients' functioning and to evaluate outcomes of different interventions are required. The increasing number of instruments developed during the last decades has made it difficult to select the best tools, however, the results of the present study can be used in a consensus process to determine which instruments should be used.

## Strengths and limitations

This is the first study to relate the item content of 46 assessment tools that are available to assess Body Functions and Structures as well as Activities and Participation in patients with hand conditions to the 23 categories of the BICF-CS. The applied method adhered to the updated version of the ICF linking rules. On the other hand, the results highlight some points of discussion in applying these rules and, thus, provide indications for their improvement. Some differences between the present results and those of other studies may be due to differences in the interpretation and application of the linking rules. In addition, the assessment tools in this study were linked to the BICF-CS for Hand Conditions and not, as in other studies, to the ICF itself. As a consequence, some concepts might have been linked to another level category (e.g. second instead of third or fourth level) in comparison with other studies. Another methodological limitation is that this study only used information written in the English, German and Dutch languages, discarding assessment tools published in other languages. Lastly, we restricted ourselves to the analysis of item content independent of the psychometric properties of the included instruments. This latter aspect has been investigated for instruments assessing activities and participation in previous work of our group.[7] This clinimetric review revealed that none of the 23 instruments had satisfactory results for *all* clinimetric properties according to the quality criteria. This means that therapist should be aware that selecting assessment tools based only on the content comparison in this study might still result in the collection of unreliable or invalid data. Thus, further improvement of existing instruments or development of new instruments is needed to cover all the clinimetric properties needed for valid and reliable assessments in patients with hand conditions.

**Table 3** Discussion topics among the reviewers being involved in the linking process per category or item

| Category or construct | Clarification and points of discussion |
|---|---|
| b710 - Mobility of joint functions and Grip strength measurement | It was discussed whether someone who has maximum muscle power, but does not achieve the full range of motion, would be able to receive a maximum score during Grip strength measurement. The ICF does not describe clearly if mobility of joint functions (b710) had to be added. It was decided to make a comment on top of the instrument, to explain that while the main goal of the instrument is testing the muscle power, one needs mobility to accomplish maximum grip strength. |
| b760, Control of voluntary movement functions | Control of voluntary movement functions could be added to almost every question that refers to a function of one's hands or arms. To prevent an extensive linking, it was decided to link an assessment tool to the category b760 Control of voluntary movement functions only if the question refers to a very specific task that requires precise control of the movement. |
| Cold Intolerance | The specific category b5501 to describe cold intolerance (b5501 – maintenance of body temperature, including cold tolerance) was not included in neither the Brief nor the Comprehensive ICF Core Set for Hand Conditions. b5501 would be the most accurate choice to describe the functions involved in the maintenance of body temperature, which includes heat and cold (in)tolerance. However, in absence of this category, it was decided to link „cold intolerance" to b270 (sensory functions related to temperature and other stimuli), as sensitivity to cold came closest to the concept of cold intolerance. |
| b810 - Protective functions of the skin | Using inspection, one could also evaluate b810 – protective functions of the skin, as this category focuses on the forming of callus, ulcers, bedsores, hardening or insulating of the skin, which can be seen and evaluated while inspecting the patient. None of the instruments was linked to this category. |
| s120-Spinal cord and related structures and b415–blood vessel functions | The category s120 and b415 can refer to the underlying cause of the impairments that are evaluated in several instruments (such as the Carpal Tunnel Questionnaire or the Semmes-Weinstein Monofilament Test). However, the spinal cord or blood vessel function itself is not evaluated in these instruments. Evaluation of the spinal cord would require an MRI or a similar method. s120 and b415 itself is not linked to any of the instruments if only the consequences are evaluated. |

**Table 3** Continued

| Category or construct | Clarification and points of discussion |
|---|---|
| d170 - Writing | This is not a Brief ICF Core Set category. The ICF description of d170-writing is 'Using or producing symbols or language to convey information' and this category is part of chapter 1 'Learning And Applying Knowledge' of the ICF. In tests or questionnaires that are used in hand therapy the item 'writing' refers to the skills or dexterity of the hand. As the category d170 writing only covers the cognitive development of writing, it was decided to link the item 'writing' of the instruments to the category d440 fine hand use in questions about writing. |
| d230 - Carrying out daily routine | Because of uncertainties concerning the definition of carrying out daily routine and its relation to activities of the daily living, both the ICF category description and the ICF research group were consulted. It was concluded that this ICF category is concerned with the planning of one's activities rather than with carrying out the activities themselves. d220 Undertaking multiple tasks includes carrying out the activities. Consequently, those items of the instruments that are concerned with carrying out activities could not be linked to this category. However, one of the questionnaires, the DASH, includes one item that focused indeed on the effect of the injury or problem on the planning of the daily activities and was therefore linked to this category |
| Pegboard test | Regarding pegboard tests, it was decided to link the category d440-fine hand use only once per task, independently on how many pegs have to be placed or removed. The Purdue Pegboard Test contains 4 different tasks and therefore is linked to the category d440 4 times. |
| d4402 - Grasping versus d430 - Lifting and carrying objects | It was uncertain to what extent grasping is covered within the category lifting and carrying objects. Whenever an object can be held in several ways and thus does not require a developed grasping skill, only the category lifting and carrying objects was added. Whenever the question described an activity that obviously required a grasping skill both categories were added. |
| d440 – Fine hand use) (Brief ICF Core Set) versus d550 - Eating versus d630 - Preparing meals (Comprehensive ICF Core Set) | Some difficulties arose concerning linking questions about eating skills. For example, it was often asked if someone could accomplish cutting with knife and fork. It was unclear when it was necessary to link both the categories d440-fine hand use and d5-selfcare (including eating). It was decided to add fine hand use only when the question was about the skills that are required to use cutlery (Arthritis hand function test: cutting with knife and fork). If the question contained words that referred to food, then d5 (eating) and/or d6 (including preparing meals) were also added, depending on whether the question referred to the preparation of food or its consumption. |

**Table 3** Continued

| Category or construct | Clarification and points of discussion |
|---|---|
| Pouring water: d4453 - Turning or twisting the hands and arms versus d4401 - Grasping versus d560 – Drinking (all categories from the Comprehensive ICF Core Set) | Some assessment tools contain questions about pouring water. There was some doubt concerning the question whether grasping is necessary to pour water. It was decided that pouring can be accomplished in many ways and does not always require a developed grasping skill. After all, one can hold a jug in many ways, and a person without a developed grasping skill is also able to pour water from a jug. Thus, only turning or twisting the hands and arms was added to questions which concern pouring. However, already in other studies instruments have been linked and then the category drinking has been added to questions about pouring. This category was probably linked because pouring can been seen as a preliminary activity to drinking. However, pouring does not necessarily lead to drinking. It was decided not to link the category drinking, and thus d5 Self-care (Brief Core Set), to those questions. |
| Not definable (nd) versus specific activity or fine hand use: other specified (d4408) | A lot of assessment tools contain questions referring to specific activities or movements (typing, shaking hands, using tools). It proved to be difficult to describe those activities or movements using the categories of the Brief or Comprehensive ICF Core Set. It was decided to use Nd or fine hand use: other specified to link those items, following the linking rules from Cieza et al. |
| 'Swelling' - Circumference Measure (Finger) and volume meter | The aspect swelling in arms and hands is not covered by the ICF. Swelling was linked as Not defined. However, instruments Circumference Measure (Finger) and volume meter are linked to s730 Structure of upper extremity. |
| 'Recreation and leisure' (COPM) | Some items could not have been linked to the BICF-CS, for example the items including concepts concerning 'recreation and leisure', which is included in d920 Recreation and leisure of the ICF. This category is not part of the BICF-CS |
| One item scored for right and left hand | In case one item had to be scored for both the right and the left hand, the specific category has been linked twice. |

## CONCLUSION AND RECOMMENDATIONS

This study has related the item content of 46 assessment tools within the area of hand surgery and hand rehabilitation to the 23 categories of the Brief ICF Core Set (BICF-CS) for hand conditions. The results can support decisions on which instruments are most appropriate for assessing human functioning and environmental factors in patients with hand conditions, taking into account test properties such as redundancy, efficiency, level of detail and feasibility. The results of this ICF linking study are currently used in a European Delphi study of the HandART-*Hand Assessment Recommendations for Therapy* project.[22] The aim of this project is to reach European consensus on the selection of a core set of assessment tools to assess 'Body Functions and Structures' and 'Activities and Participation' in patients with hand conditions according to the BICF-CS.

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# PART III

## COPM validation study and HandART Delphi study

# 7

# Construct Validity of the COPM in participants with tendon injury and Dupuytren disease


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## ABSTRACT

**Background:** In patient-centered practice instruments need to assess outcomes that are meaningful to patients with hand conditions. It is unclear which assessment tools address these subjective perspectives best.

**Objective:** The aim of this study was to establish the construct validity of the Canadian Occupational Performance Measure (COPM) in relation to the Disabilities of Arm, Shoulder and Hand (DASH) questionnaire, and the Michigan Hand Outcomes Questionnaire (MHQ) in people with hand conditions. It was hypothesized that COPM scores would correlate with DASH and MHQ total scores only to a moderate degree and that the COPM, DASH questionnaire, and MHQ would all correlate weakly with measures of hand impairments.

**Design:** This was a validation study.

**Methods:** The COPM, DASH questionnaire, and MHQ were scored, and then hand impairments were measured (pain [Numeric Rating Scale], active range of motion [goniometer], grip strength [dynamometer] and pinch grip strength (pinch meter)). People who had received post-surgery rehabilitation for flexor tendon injuries, extensor tendon injuries, or Dupuytren disease were eligible.

**Results:** Seventy-two patients were included. For all diagnosis groups, the Pearson coefficient of correlation between the DASH questionnaire and the MHQ was higher than .60, whereas the correlation between the performance scale of the COPM- and either the DASH questionnaire or the MHQ was lower than .51. Correlations of these assessment tools with measures of hand impairments were lower than .46.

**Limitations:** The small sample sizes may limit the generalization of the results.

**Conclusions:** The results supported the hypotheses and, thus, the construct validity of the COPM after surgery in people with hand conditions.

## INTRODUCTION

Hand injuries and diseases (hand conditions), such as tendon injury or Dupuytren disease, may affect a person's ability to successfully engage in day-to-day self-care, work, and leisure activities. Although impaired hand function can cause limitations in activities and participation, this relationship is not linear.[1-8] Therefore, assessment of activity limitations in addition to evaluation of impairments is fundamental for clinical decision making, monitoring progress, and determining effectiveness of treatment in patients with hand conditions.[9-12] Although many tools for assessing activity limitations in patients with hand conditions are available, there is no consensus on the most appropriate instruments to use.[13-20]

Instruments that measure activity limitations can be classified as either performance tests or subjective assessment tools, such as questionnaires.[19] The current study focused on the latter category. In client-centered practice, instruments need to assess outcomes that are meaningful to patients; Therefore, it is important that these assessments reflect patients' perspectives including their own values, judgments and preferences regarding occupational performance. At present, it is unclear which assessment tools address these subjective perspectives best in patients with hand conditions.[21-23]

Recent clinimetric reviews showed that the Canadian Occupational Performance Measure (COPM)[24,25], the Disabilities of Arm, Shoulder and Hand (DASH) questionnaire [26,27], and the Michigan Hand Outcomes Questionnaire (MHQ)[28,29] are the most widely used and probably the best available assessment tools for measuring activity limitations in patients with hand conditions on the basis of their psychometric properties.[2,11,17-19,26,28-39] Although the MHQ and DASH questionnaire assess a combination of impairments (e.g., pain, sensibility, joint mobility, strength) and predefined activity limitations in patients with hand and upper-limb conditions, respectively, the COPM is a patient-specific instrument for evaluating self-reported activity limitations in the areas of self-care, occupational and household activities and leisure.[32,40]

The reproducibility of the performance and satisfaction scores on the COPM was found to be moderate to high for scores averaged over all problems identified by an individual patient.[34] Supportive evidence for the content, convergent, and divergent validity of the COPM was found in several studies.[11,24,33,41,42] The responsiveness of the COPM indicated good discriminatory power for detecting improvement.[6-8,35,42,43] However, the psychometric properties of this instrument in patients with tendon injury or Dupuytren disease have not yet been sufficiently established.[19,32-35] The DASH questionnaire is generally considered to be valid and reliable for measuring activity limitations.[2,19,26,37-39] However, the responsiveness of the DASH questionnaire[18,19,30,31,36,37] has not yet been established according to the quality criteria for measurement properties.[44] The MHQ is generally considered to be valid for measuring activity limitations. However, its reliability and responsiveness have not yet been sufficiently established[2,18,19,28,29,37] according to the

quality criteria[44]. Although the clinimetric properties of all three assessment tools (COPM, DASH, MHQ) have been investigated,few data comparing these instruments are available.[2,11,17-19,26,28-39]

Thus, the aim of this study was to establish the construct validity of the COPM in relation to the DASH questionnaire and MHQ. We hypothesized that the COPM scores would correlate positively with the DASH and MHQ total scores (convergent validity), but only to a moderate degree (.4< r <.7)[45]. In other words, we expected the positive correlation between the DASH and the MHQ total scores to be stronger than their respective correlations with the COPM scores, because the DASH questionnaire and MHQ are more similar in content and structure. Furthermore, we hypothesized that the COPM, DASH questionnaire, and MHQ would all correlate positively, but weakly (.2< r <.4)[45] with measures of hand impairments (pain, active range of motion [AROM], and grip and pinch grip strength) because they focus, to a large degree, on limitations in activity and participation, which constitute a different domain of the International Classification of Functioning, Disability and Health (ICF)[46] (divergent validity).

## METHOD

### Participants

People who had received postsurgery rehabilitation at our university hospital between 2005 and 2011 and who had flexor tendon injuries in any of the 5 anatomical flexor tendon zones, extensor tendon injuries in any of the five anatomical extensor tendon zones, or Dupuytren disease were eligible. Only those who responded, to an open-ended question, that they experienced activity limitations were included. Exclusion criteria were as follows: age of less than 16 years, injury of the contralateral hand, other injuries or surgeries limiting the performance of daily activities, diagnosis of severe cognitive or mental retardation, or inadequate understanding of the Dutch language. Potential participants received a written description of the study, and invitations to participate were extended by postal mail and by telephone. Upon inclusion, written informed consent was obtained.

### Procedure

Participants were approached beginning 3 months after surgery. Demographic and clinical information about age, sex, profession, date of injury and date of surgery was extracted from the electronic patient files. Participants were asked to complete the COPM, DASH questionnaire, and the MHQ. The order of administration was systematically balanced across participants on the basis of the order of inclusion. Next, measurements of hand impairments were obtained at the end of each measurement session to avoid the possibility of results influencing the outcomes of the subjective assessments. Pain was scored first, and then AROM (only flexor tendon injury group) and grip and pinch grip

strength were measured. All assessments were carried out by 5 investigators who were trained by education and by comparison of each others' results during practice. The study design was approved by the local medical-ethical committee.

## Outcome measures

The conceptual basis of the COPM is derived from the Canadian Model of Occupational Performance and Engagement.[47,48] The COPM is frequently used to identify limitations experienced in the performance of activities (and satisfaction with this performance) in the areas of self-care, household and occupational activities and leisure.[47] This outcome measure is administered through a semistructured interview that has been designed to help patients identify, prioritize, and evaluate important problems that they encounter in daily life.[47] The importance of each activity limitation, as perceived by the patient, is first rated on a scale ranging from 1 (not important at all) to 10 (extremely important). In the next step, the patient prioritizes a maximum of 5 activity limitations. Consecutively, the patient has to evaluate his or her performance on the activities and satisfaction with these performance. The performance and satisfaction scores are ranging from 1 to 10, whith higher values indicating better performance and greater satisfaction, respectively. A structured approach is used and there are specific instructions and methods for administering and scoring.[25]

The DASH questionnaire was developed by the American Academy of Orthopedic Surgeons and the Institute for Work and Health.[27] It is a standardized questionnaire that measures the degree of disability resulting from a disorder of the upper extremity by assessing severity of symptoms and difficulty in completing specific tasks. The DASH questionnaire contains 30 questions that are scored on a 5- point scale. Part A contains 21 'physical function' items, 6 'symptom' items (including pain, sensibility, strength, mobility) and 3 'social' or 'role function' items. Part B is optional and contains 4 questions about the impact of arm or hand problems on work performance and playing an instrument or sports. All items refer to the situation in the preceding week. The DASH questionnaire is a self-report questionnaire designed to be completed by patients. It does not distinguish between disabilities of the left upper extremity or those of the right upper extremity. The scores are converted into an overall score ranging from 0 to 100, with higher values reflecting greater disability.

The MHQ[29] is also a self-report questionnaire that assesses hand-specific outcomes, including pain and activities of daily living, as a result of hand disorders. It consists of 37 items reflecting 6 domains: general functioning of the hand, activities of daily living, pain, work performance, esthetics, and patient satisfaction with functioning. For every domain, except for the domains pain and work performance, patients evaluate either their right hand or their left hand,. In the present study, all items had to be scored for one hand (the affected side) in addition to the bimanual items. The scores on all items (ranging from 1 to 5) were converted into a single total score ranging from 0 to 100, with lower values reflecting greater disability**.**

Several measures of impairments were used to assess pain, AROM, grip and pinch grip strength. The overall pain intensity that a patient had experienced during the previous week was scored on a Numerical Rating Scale (NRS)[15,49] from 0 to 10 (0=no pain, 10 = maximum pain). The AROM[3,15] of the metacarpophalangeal (MCP), proximal interphalangeal (PIP) and distal interphalangeal (DIP) joints was determined with a finger goniometer (Smith and Nephew Rolyan Inc., Germantown, Wisconsin).[15] The values for the different joints were converted into one value per finger.[3] Grip strength was measured with a calibrated Jamar dynamometer (J. A. Preston Corp., Jackson, MI)[15,50] in the second handle position.[15,51] Pinch grip strength was measured with a B&L pinch meter (B&L Engineering, Santa Fe Springs, CA)[15,51,52], testing the strength of the lateral and tripod pinches. All measurements of grip and pinch grip strength were obtained 3 times for each participant and the individual average was calculated. For AROM (only flexor tendon injury group) and grip and pinch grip strength, the mean score for the injured hand was expressed as a percentage of the score for the contra-lateral (sound) hand.

## Data analysis

Floor and ceiling effects were considered to be present when more than 15% of the participants achieved the lowest and highest possible score on each of the assessment tools, respectively.[44]

Convergent validity was determined by calculating Pearson product correlation coefficients ($r_p$) for performance scores on the COPM, overall DASH scores and the total MHQ scores. The divergent validity was determined by calculating Pearson's correlation coefficients ($r_p$) between these assessment tools and the measures of hand impairments. All statistical analyses were performed with SPSS® version 18.0 for Windows[53]. The critical level for statistical significance was set at *Pvalue of less than*.05.

# RESULTS

## Participants

Of a total of 113 participants, 72 (64%) indicated in a response to an open-ended question that they experienced activity limitations: 43 participants with flexor tendon injury, 8 participants with extensor tendon injury, and 21 participants with Dupuytren disease. Forty-one participants (36%) answered that they did not experience any activity limitations: 4 participants with flexor tendon injury, 7 participants with extensor tendon injury, and 30 participants with Dupuytren disease. For further analysis, only the data from the 72 participants who experienced activity limitations were used. Their mean scores on the three assessments are shown in Table 1.

**Table 1** Mean scores (standard deviations) on the three assessments for the patients with activity limitations (n=72)

| Diagnosis group | N | COPM- Performance | N | COPM- Satisfaction | N | DASH | N | MHQ |
|---|---|---|---|---|---|---|---|---|
| Flexor tendon injury | 41 | 6.1 (1.7) | 41 | 6.7 (2.0) | 43 | 7.7 (8.4) | 43 | 84.8 (11.3) |
| Extensor tendon injury | 6 | 7.0 (0.7) | 6 | 6.9 (2.0) | 8 | 8.6 (8.3) | 8 | 80.1 (11.8) |
| Dupuytren disease | 16 | 5.2 (1.1) | 16 | 5.1 (0.8) | 21 | 20.1 (9.1) | 21 | 68.8 (12.7) |
| Total | 63 | 6.0 (1.6) | 63 | 6.3 (1.9) | 72 | 11.4 (10.2) | 72 | 79.6 (13.6) |

COPM: Canadian Occupational Performance Measure (1=not able or not satisfied, 10=able to do well or extremely satisfied);
DASH: Disabilities of Arm, Shoulder and Hand questionnaire (0=no disability, 100=maximum disability);
MHQ: Michigan Hand Outcomes Questionnaire (0=maximum disability, 100=no disability)

**Table 2** Pearson product correlations between assessments per diagnosis and overall

| population | N | COPM-P - DASH | N | COPM-P - MHQ | N | COPM-S - DASH | N | COPM-S - MHQ | N | DASH - MHQ |
|---|---|---|---|---|---|---|---|---|---|---|
| Flexor tendon injury | 41 | -.506** | 41 | .496** | 41 | -.621** | 41 | .602** | 43 | -.625** |
| Extensor tendon injury | 6 | .084 | 6 | -.251 | 6 | .064 | 6 | .083 | 8 | -.831* |
| Dupuytren disease | 16 | -.137 | 16 | .169 | 16 | -.352 | 16 | .606* | 21 | -.621** |
| Total | 63 | -.447** | 63 | .419** | 63 | -.579** | 63 | .593** | 72 | -.744** |

*Correlation is significant at the 0.05 level (2-tailed)
**Correlation is significant at the 0.01 level (2-tailed)
COPM-P: Canadian Occupational Performance Measure-Performance
COPM-S: Canadian Occupational Performance Measure-Satisfaction
DASH: Disabilities of Arm, Shoulder and Hand questionnaire
MHQ : Michigan Hand Outcomes Questionnair

**Table 3** Pearson product correlations between subjective assessments and measures of hand impairments per diagnosis and overall

| | PAIN | | | | GRIP STRENGTH (%) | | | |
|---|---|---|---|---|---|---|---|---|
| | COPM-performance | COPM-satisfaction | DASH | MHQ | COPM-performance | COPM-satisfaction | DASH | MHQ |
| Flexor tendon injury (N=43) | -.278 (N=41) | -.454** (N=41) | .412** (N=43) | -.550** (N=43) | .387* (N=41) | .500** (N=41) | -.455** (N=43) | .522** (N=43) |
| Extensor tendon injury (N=8) | .509 (N=6) | .246 (N=6) | .416 (N=8) | -.562 (N=8) | .344 (N=6) | -.436 (N=6) | -.620 (N=8) | .431 (N=8) |
| Dupuytren disease (N=21) | -.177 (N=16) | -.002 (N=16) | .098 (N=21) | -.367 (N=21) | .187 (N=16) | .410 (N=16) | -.378 (N=21) | .311 (N=21) |
| Total (N=72) | -.155 (N=63) | -.243 (N=72) | .295* (N=72) | -.457** (N=72) | .367** (N=63) | .402** (N=63) | -.425** (N=51) | .426** (N=72) |

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
COPM-P: Canadian Occupational Performance Measure-Performance
COPM-S: Canadian Occupational Performance Measure-Satisfaction
DASH: Disabilities of Arm, Shoulder and Hand questionnaire
MHQ : Michigan Hand Outcomes Questionnaire
AROM: Active Range Of Motion (only obtained for flexor tendon injury group)

## Floor and ceiling effects

No floor or ceiling effects were observed for the COPM, DASH questionnaire, or MHQ. The maximum score was recorded on the satisfaction scale of the COPM for 4 participants (6,3%), on the DASH questionnaire for five participants (6,9 %), and on the MHQ in one patient (1,4 %). On the performance scale of the COPM, no maximum score was recorded. No patient recorded a minimum score on any of the three assessment tools.

## Convergent and divergent validity

The Pearson product correlation coefficients for the performance and the satisfaction scores on the COPM, the overall DASH scores and the total MHQ scores are shown in Table 2. For all groups together, the coefficient of correlation between the DASH questionnaire and the MHQ was higher ($r_p$ = -.744, p<.01) than that between the COPMperformance scale and either the DASH questionnaire or the MHQ ($r_p$= -.447 and $r_p$=.419, respectively, p<.01) . The coefficient of correlations between the COPMsatisfaction scale and either the

| PINCH STRENGTH - KEY (%) | | | | PINCH STRENGTH –TRIPOD (%) | | | | AROM (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| COPM-performance | COPM-satisfaction | DASH | MHQ | COPM-performance | COPM-satisfaction | DASH | MHQ | COPM-performance | COPM-satisfaction | DASH | MHQ |
| .242 (N=40) | .332* (N=40) | -.092 (N=42) | .323* (N=42) | .432** (N=40) | .479** (N=40) | -.195 (N=42) | .390* (N=42) | .324 (N=31) | .371* (N=31) | -.152 (N=32) | .369* (N=32) |
| .923** (N=6) | .258 (N=6) | .134 (N=8) | -.126 (N=8) | .952** (N=6) | -.202 (N=6) | .113 (N=8) | -.159 (N=8) | - | - | - | - |
| .331 (N=16) | .316 (N=16) | .143 (N=21) | -.061 (N=21) | -.111 (N=16) | -.014 (N=16) | -.061 (N=21) | -.183 (N=21) | - | - | - | - |
| .266* (N=62) | .282* (N=62) | -.031 (N=71) | .154 (N=71) | .336** (N=62) | .290* (N=62) | -.110 (N=71) | .111 (N=71) | - | - | - | - |

DASH questionnaire or the MHQ also was lower than that between the DASH questionnaire and the MHQ ($r_{p=-.}$ 0.579 and $r_p$=.593, respectively, p <.01).

The Pearson coefficients of correlation of the COPM, DASH questionnaire and MHQ with measures of hand impairments (pain, AROM and strength) are shown in Table 3. For all groups together, 10 of 16 correlation coefficients were significant. All $r_p$ –values were lower than 0.46, and 6 of the significant $r_p$ values were lower than 0.40. Of these, 5 were correlations between the COPM and measures of hand impairments.

## DISCUSSION

The aim of the present study was to establish the construct validity of the COPM in relation to the DASH questionnaire and the MHQ in people with hand conditions (flexor or extensor tendon injury or Dupuytrens' disease) at least 3 months after surgery. As hypothesized, the correlation of the COPM with either the DASH questionnaire or the MHQ was only moderate and was lower than the correlation between the DASH questionnaire and the MHQ. The finding that the lowest correlations of the three assessments with hand impairments were observed for the COPM further underscores the construct (divergent) validity of this measure in relation to the DASH questionnaire and the MHQ. Indeed, both the DASH questionnaire and the MHQ integrate the subjective assessment of impairments and predefined activity limitations, whereas the COPM assesses self-reported activity limitations on the basis of people's experiences. As a consequence, the COPM may reveal important activity limitations that are not identified with either the DASH questionnaire or the MHQ, such as problems with shaking hands, nail clipping, making vegetable mash or knotting shoe laces. Taken together, the results support the notion that the COPM provides patient-specific information that is not obtained with standardized measures that have predefined items such as the DASH questionnaire and MHQ, or with measures of hand impairments. This information is related to what people value as their most important daily life activities. The large variation in problems identified with the COPM in other studies[33,34,54,55] confirms the notion that values with regard to occupational performance differ greatly among people depending on their physical, cultural and social environment.[47,48] Because rehabilitation is aimed at improving a person's functioning in his or her natural environment (i.e. reducing disability), it is crucial that functional assessments identify activity limitations as experienced by the individual person.[56] The focus on a person's priorities helps both the therapist and the patient to formulate goals and expectations of treatment, a valuable addition to the evaluation of the outcomes of hand surgery and hand therapy.[8] From this perspective, the COPM may be a useful addition to standardized questionnaires in client-centered rehabilitation of people with hand conditions.

We found that the correlation of the performance scores on the COPM with the DASH and MHQ scores were even lower than those of the satisfaction scores, at least for the participants with flexor tendon injury. An explanation for this result might be that the COPM-performance scale assesses self-reported activity limitations, whereas the DASH questionnaire and MHQ evaluate more global performance on predefined activities. It is possible that the COPM-satisfaction scale is more strongly influenced by general functioning, as assessed with the DASH questionnaire and MHQ, than the COPM-performance scale. It is also possible that general functioning is determined more by the people's abilities than by their disabilities. This notion is supported by the finding that the

satisfaction scores were higher than the performance scores for all groups together in the present study.

The International Classification of Functioning, Disability and Health (ICF) has 2 main components: one is 'body functions and structures (impairments)', and the other is 'activities (limitations) and participation (restrictions)'. It is well known that bodily functions are not unambiguously related to functional activities,[1,2,21] partly because a relatively small percentage of the AROM of the hand is necessary for the satisfactory completion of most functional tasks.[57] On the other hand, even minor impairments can have a severe impact on the performance of daily activities and societal participation,[4,5] for instance, in musicians or surgeons. From this perspective, Jansen and Watson[3] already argued that functional assessments as well as goniometric assessments of the hand joints should be performed for optimal understanding of the capacity and use of the upper extremity after flexor tendon injury. In addition, for nerve disorders, it has been found that questionnaires on activity limitations are poorly related to objective measures of sensibility and the widely used carpal tunnel syndrome symptom score.[2] Furthermore, Michener et al.[4] reported that the recovery of grip strength predicts merely 37% of the performance of daily activities. In the same vein, we found relatively low correlations between the subjective assessment tools and the measures of hand impairments in the present study. This result emphasizes the necessity to assess activity limitations in addition to impairments, such as contracture, reduced hand strength and pain, in patients with hand conditions.

For identification of the most suitable instrument for assessing activity limitations in people with hand conditions, the feasibility of the COPM, DASH questionnaire, and MHQ should also be considered. Overall, the COPM is more time consuming (approximately 20 minutes administration time) than the DASH questionnaire or MHQ (approximately 10 minutes).[2,42] In particular, in people who have not experienced activity limitations, the application of the DASH questionnaire or MHQ will save time and costs. On the other hand, it could be argued that, even in patients with minimal activity limitations, the COPM offers the advantage of evaluating a wide range of possible (otherwise perhaps neglected) problems. Because the COPM is primarily based on people's perspectives including their values, judgments and preferences regarding occupational performance, it can facilitate both clinical decision making and monitoring of functional progress. With the COPM, people also can be effectively engaged in problem identification and goal setting[32] to increase the efficacy of individually-tailored interventions.

## Study limitations

The present study was conducted at only one university hospital and included 72 participants who had hand conditions and experienced daily life activity limitations after surgery; these aspects of the study may limit the generalizability of the results. In particular

the sample sizes of the extensor tendon injury (n=6 or 8) and Dupuytren disease (n=16 or21) groups were relatively small. Intrarater reliability and interrater reliability were not addressed in the present study. However, possible differences between assessors might have influenced the results of the COPM and the measures of hand impairments.

## CONCLUSION

As hypothesized, the correlation of the COPM with either the DASH questionnaire or the MHQ was only moderate and was lower than the correlation between the DASH questionnaire and the MHQ. The correlations of the 3 assessment tools with measures of hand impairments further support the construct validity of the COPM in relation to the DASH questionnaire and MHQ. The value of the COPM lies in the structured self-report of experienced (importance of) activity limitations, on the basis of an open dialogue between patient and hand therapist. Therefore, along with standardized measures, such as the DASH questionnaire and the MHQ, the COPM seems to be a suitable instrument for indicating and evaluating individually-tailored interventions in patients with hand conditions .

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# 8

# Instruments for assessment of impairments and activity limitations in patients with hand conditions: a European Delphi study


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## ABSTRACT

**Objective**: To reach multidisciplinary European consensus on the assessment tools for impairments and activity limitations in patients with hand conditions.

**Design**: Electronic Delphi-method.

**Subjects**: Thirty experts from European societies for hand therapy, hand surgery, and physical and rehabilitation medicine.

**Methods**: In 3 rounds, participants were asked which of 13 preselected categories of the Brief International Classification of Functioning, Disability and Health (ICF) Core Set for Hand Conditions should be assessed. In addition, they were asked to choose which of 55 preselected instruments they preferred for each category by confirming or rejecting instrument-specific statements.

**Results**: All 13 preselected ICF categories were considered relevant. Consensus was based on ≥75% agreement. After 3 rounds, 9 instruments were selected: Shape Texture Identification Test, Semmes Weinstein Monofilament Test, Visual Analogue Scale for Pain, goniometer, Jamar Dynamometer, Pinch Gauge device, Cold Intolerance Symptom Severity questionnaire, Canadian Occupational Performance Measure, and Disabilities of the Arm, Shoulder and Hand Questionnaire. It remained undecided whether to use the Nine Hole Pegboard Test or the Purdue Pegboard Test.

**Conclusions**: In this European Delphi study, multidisciplinary consensus was reached on 9 assessment tools for impairments and activity limitations in patients with hand conditions addressing 13 categories of the Brief ICF Core Set for Hand Conditions.

## INTRODUCTION

Injuries of the hand are among the most common injuries[1] and accounting for approximately 20% of all visits to hospital emergency departments[2] Both hand injuries and hand diseases (i.e., hand conditions) may affect a person's ability to engage successfully in day-to-day self-care, work, and leisure activities[1,3], and therefore may have a serious impact on social participation and health-related quality of life.[4,5]

The use of valid, reliable and responsive instruments to assess the impact of hand conditions on functioning and quality of life is essential for clinical decision-making, monitoring patient progress and evaluating the effectiveness of treatment.[6-8] Although hand impairments can cause activity limitations, this relationship is rather complex.[9-11] It is, thus, important to assess not only body functions (impairments), but also a person's (limitations to perform) activities in order to determine how different hand conditions impact the daily lives of individual patients.[6,8,12-19]

In recent decades, professionals in the field of hand surgery and hand rehabilitation have emphasized the need for consensus in defining a core group of assessment instruments to facilitate a universal description and comparison of individual hand impairments and related disabilities.[6,7,20,21] This, however, requires consensus on which of the available validated instruments, that are also reliable and responsive, should be used to assess (and preferably predict) a patient's functioning and/or to evaluate outcomes of different interventions. Many tools are available to assess impairments and activity limitations in patients with hand conditions, but there is currently no standardized accepted core set for use with this patient group.[6,12,14,18,20] To support the development of such a core set, we first conducted 2 systematic reviews in order to identify 23 instruments that can be used to evaluate activity limitations in patients with hand conditions.[18,19] In a previous study, the content of published studies on hand conditions was analyzed[22] for the development of the Brief and Comprehensive International Classification of Functioning, Disability and Health (ICF) Core Set for Hand Conditions (BICF-CS)[23] The BICF-CS is a subset derived from the International Classification of Functioning, Disability and Health (ICF)[24] consisting of 23 ICF categories.[22,25] Based on the knowledge about available instruments and their relationship with relevant ICF categories, we conducted an international Delphi study (the HandART-Delphi study). The aim was to reach multidisciplinary European consensus on a core set of assessment tools to be used in patients with hand conditions who may need surgical or non-surgical interventions. The focus was to include *as few* instruments as possible, but *as many* as necessary to assess impairments and activity limitations, addressing all categories of the BICF-CS.[25]

# METHOD

## Participants

Experts of the European Federations of Societies for Hand Therapy (EFSHT), Hand Surgery (FESSH), and Physical and Rehabilitation Medicine (ESPRM) were invited to participate. To this end, a written invitation was sent to these European societies, and subsequently to their individual members by the national societies. To participate in the HandART-Delphi study, experts had to have ample clinical experience of treatment of hand injuries and/or hand diseases during the last 5 years and have sufficient knowledge of the English language. Participants were selected based on fulfilment of at least 1 of the following criteria, in the field of hand surgery or hand therapy: (i) being involved in research on the use of assessment tools; (ii) being a (co-) author of one or more published articles about assessment tools; (iii) being a lecturer on clinimetrics; or (iv) being involved in developing an assessment protocol or standardized assessment. Participants had to indicate their expertise on a separate form that was sent together with the written invitation. In advance, it was decided to invite a maximum of 32 experts, including, physical therapists (PTs), occupational therapists (OTs), hand surgeons, and rehabilitation physicians. This number of participants was considered appropriate in order that all disciplines were well represented. The preferred ratio between disciplines was set beforehand at 16 hand therapists (PTs and OTs), 8 hand surgeons, and 8 rehabilitation physicians.

## Instruments

Assessment tools considered in this study were instruments that (i) are used to measure impairments and activity limitations in patients with hand conditions; (ii) are used in adults; (iii) can be used in the acute phase or post-acute phase of rehabilitation; and (iv) are used in addition to general physical examination (table 1). We excluded instruments concerning quality of life, instruments concerning personal and environmental factors, diagnostic tests (i.e. medical or laboratory tests, such as x-ray or electromyography), and instruments that were specifically developed for children.

## Design

A web-based electronic Delphi method was used. To make effective decisions in situations in which there is contradictory or insufficient information, the Delphi Survey Technique for reaching consensus is recommended.[20,26-28] This procedure includes a series of sequential questionnaires ("rounds") that need to be completed by a group of multidisciplinary experts.[20,26-28] An electronic Delphi-method was considered most appropriate because of its feasibility in the case of an international study.[28]

The formal consensus method consisted of 3 rounds, conducted via the internet supported by an IT-company (www.horn.nl). Anonymity of responses was ensured in order to prevent opinion leaders influencing the individual opinions of other experts.

Feedback of expressed expert input was provided after the first and second rounds, leading to a cyclical procedure to enable each participant to reconsider his/her earlier opinion or to provide arguments in favour of one's opinion.[28] The identity of the experts was known only to the principle investigator (LvdV).

## Procedure

Three Delphi-rounds were conducted. In each round all participants received an invitation e-mail providing background information. They were requested to login to a secure HandART-Delphi website to access the pages with questions and statements. If participants did not respond to the first invitation within 2 weeks, or if they left some of the questions unanswered, they were sent a reminder e-mail. They were asked to use both the best-available evidence and their clinical experience to make their decisions. Questions and statements were developed based on the results of previous studies[18,19,22,25] using the ICF structure as a framework.[24]

Each round consisted of formulating questionnaires and statements, sending these questionnaires to the participants, performing an analysis on the data received, and writing a feedback report. All tasks were carried out by the principle investigator (LvdV) with feedback from the research group (AG, MG, RS, TS, PS and HL). Although there is no universally accepted percentage of agreement for reaching consensus, the literature recommends 70-80% agreement to be set prior to data analysis.[28] In the present study, a ≥75% agreement level was used to define consensus on a particular item.[27,28]

### First round

First, 13 of the 23 ICF categories of the Brief ICF Core Set for Hand Conditions, referring to the levels of "body functions" and "activities and participation", were selected (table 2). Two categories (i.e., "touch function" and "sensory functions related to temperature and other stimuli") were combined because of the overlay of constructs and associated instruments, resulting in 12 categories. Each category was presented with a variable number of assessment tools that had been linked to this specific category based on previous work.[29]

For each category two questions had to be answered by the experts:

- *Is it important to assess this category? (yes/no/do not know)*
- *Are there any instruments missing that are commonly used and can be linked to this category? (yes, namely…./no/do not know)*

For each instrument within each category two more questions had to be answered:

- *Do you use this instrument to assess this category? (yes/no)*
- *Should this instrument be part of a core set to represent this category? (not at all / perhaps / certainly / do not know).*

Participants were invited to provide argumentation and add literature in support of their answers.

**Table 1** Assessment tools that were linked to the components "Body functions" and "Activity and Participation" of the Brief ICF Core Set for Hand Conditions

| **Assessment Tools (abbreviations)** | |
|---|---|
| ***Instruments mainly measuring body functions and structures*** | ***Instruments measuring fine hand use by handling different objects*** |
| Ab-Adductometer | Box and Block Test (BBT) |
| AIKOH dynamometer gauge | Minnesota Manual Dexterity Test (MMDT) |
| Blood-Pressure Cuff | Moberg Pick Up Test (MPT) |
| Goniometer | O'Neill Hand Function Assessment |
| Grated Orientation Task | Rosenbusch Test of Finger Dexterity |
| Grippit | |
| Hot & Cold Discriminator Test | ***Instruments measuring single tasks (and fine hand use) by scoring tasks*** |
| Intrinsic–o-meter (Mannerfelt) | Arthritis Hand Function Test (AHFT) |
| Jamar Dynamometer | Jebsen-Taylor Test of Hand Function (JTHF) |
| Locognosia Test | Radboud Skills Test (RST) |
| Lode handgrip dynamometer | Sequential Occupational Dexterity Assessment (SODA) |
| Lode pinch-grip dynamometer | Smith Hand Function Evaluation (SHFE) |
| Moberg Pick Up Test (MPT) | Sollerman Hand Function Test (Sollerman HFT) |
| Numeric Rating Scale | Southampton Hand Assessment Procedure (SHAP) |
| Pinch Gauge device | Upper Extremity Performance Test Elderly (TEMPA) |
| Pollexograph | Upper Extremity Function Test (UEFT) |
| Rotterdam Intrinsic Hand Myometer (RIHM) | |
| Semmes Weinstein Monofilament Test (SWMT) | ***Questionnaires*** |
| Shape Texture Identification Test (STI) | Australian/Canadian Osteoarthritis Hand Index (AUSCAN) |
| Tuning fork | Canadian Occupational Performance Measure (COPM) |
| Two-Point Discrimination Test – Static (2PD-S) | Cold Intolerance Symptom Severity Questionnaire (CISS) |
| Two-Point Discrimination Test- Moving (2PD-M) | Disabilities of the Arm, Shoulder and Hand (DASH) |
| Verbal Rating Scale | Michigan Hand Outcomes Questionnaire (MHQ) |
| Vibrometer | McGill Pain Questionnaire-long form (MPQ) |
| Vigori-meter | McGill Pain Questionnaire-short form (MPQ) |
| Visual Analogue Scale (Pain) (VAS) | Patient Evaluation Measure (PEM) |
| Wire Tracing Method | Patient Rated Wrist/hand Evaluation (PRWHE) |
| | Subjective Hand Function Scoring System (HFS) |
| ***Pegboard tests*** | Upper Extremity Functional Scale (UEFS) |
| Functional Dexterity Test (FDT) | |
| Grooved Pegboard Test | |
| Nine-Hole Peg Test (NHPT) | |
| Purdue Pegboard Test (PPT) | |

**Table 2** Selected categories of the Brief ICF Core Set for Hand Conditions, concerning the components 'Body functions' and 'Activity and Participation'

| **Categories** | |
|---|---|
| **ICF code** | **Description** |
| b265 & b270 | Touch function & Sensory functions related to temperature and other stimuli<br>*Including: stereognosis, tactile gnosis, temperature recognition, detection threshold, and spatial discrimination* |
| b280 | Sensation of pain |
| b710 | Mobility of joint functions |
| b730 | Muscle power functions |
| d230 | Carrying out daily routine |
| d430 | Lifting and carrying objects |
| d440 | Fine hand use |
| d445 | Hand and arm use |
| d5 | Self-care |
| d6 | Domestic life |
| d7 | Interpersonal interactions and relationships |
| d840 to d859 | Work and employment |

If, for a specific assessment tool, 75% or more of the respondents had answered "certainly" on the last question, the instrument was selected and included in the HandART core set of instruments. The other results were used to define questions for the second round.

### Second round

The statements used in the second round were formulated according to decision rules explained in table 3. If in the first round the percentage of respondents who answered "certainly" and "perhaps" was 75% or higher, and the % "certainly" was higher than the % "perhaps", a new statement suggested to select this instrument for assessing the specific ICF category of the core set (*agree / disagree*), taking into account the group opinions and comments given by others in the first round. For the missing instruments mentioned in the first round, participants had to indicate whether this instrument should be part of the core set to assess a specific category (*not at all / perhaps / certainly / do not know*).

If 75% or more of the respondents agreed with the suggestion upon the use (or no use) of an instrument to assess this preselected ICF category, the instrument was definitively selected (or rejected).

**Table 3** Decision rules, based on the results of the first Delphi round, which were used to define second-round statements for each assessment tool

| Result first round | | Statement second round |
|---|---|---|
| A. | 75% or more of respondents had answered "certainly" | The instrument was included in the core set of instruments.<br>No new statement was formulated. |
| B. | The sum of the %respondents that answered "certainly" and "perhaps" ≥ 75% and the %"certainly" > %"perhaps" | A new statement suggested to use this instrument to assess a selected ICF category (*agree / disagree*). |
| C. | An instrument was already included based on ≥ 75% absolute agreement (A) and a second instrument linked to the same ICF category fulfilled the criterion mentioned under B | It was asked whether the second instrument should be added to assess the same ICF category (*yes / no*) |
| D. | The sum of the %respondents that answered "certainly" and "perhaps" < 75% or the %"certainly" < %"perhaps" | A new statement suggested *not* to include this instrument (*agree / disagree*) |
| E. | According to one or more participants, a missing instrument should "certainly" be included in the core set and could be linked to a selected ICF category | It was asked whether this instrument should be used to assess this ICF category (*not at all / perhaps / certainly / do not know*). |
| F. | An instrument was mentioned by one or more respondents as missing, but could not be linked to a selected ICF category | This instrument was *not* proposed to be included.<br>No new statement was formulated. |

### Third round

In the final round a new set of statements was formulated based on the results of the first and second rounds; however, only for those categories and instruments for which consensus had not yet been reached. Participants had to indicate whether they (dis) agreed with each statement, taking into account the group opinions and comments from the first and second rounds as well as the results of the clinimetric review.[18]

Finally, participants were asked an open-ended question about their general opinion of the HandART-Delphi study.

# RESULTS

## Consensus

A total of 30 experts responded to the invitation and participated in the study (see table 4). The group consisted of 10 OTs/hand therapists, 9 PTs/hand therapists, 6 hand surgeons, and 3 rehabilitation physicians. Two hand therapists were also both PTs and OTs. Because the FESSH had sent the invitation to its members after the first Delphi round, the hand surgeons participated only in the second and third rounds. As a result, 7 European countries were represented in the first round, and 9 in the second and third rounds (see figure 1). The response rate varied from 90 to 93%.

In the first round, more than 75% of the participants indicated that it was important to assess each of the selected ICF categories. Eight instruments, assessing 7 categories, were preliminarily included in the HandART core set (table 5). A total of 42 different instruments were reported as missing (table 6), and respondents indicated 19 times that the missing instrument should "certainly" be included in the core set.

In the second round, consensus was reached for 6 ICF categories on which instruments to select and which not to select. Of the 19 instruments that were reported as missing in the first round and that were suggested for inclusion in the core set, no instrument reached the necessary level of ≥75% agreement *(certainly* and *perhaps*) to formulate new statements for inclusion.

In the third and final rounds, consensus was reached on 9 instruments for the assessment of 9 ICF categories of the core set (table 5): the Shape Texture Identification test (STI), the Semmes Weinstein Monofilament Test (SWMT) and the Cold Intolerance Symptom Severity questionnaire (CISS) to assess "Touch function" and "Sensory functions related to temperature and other stimuli" (ICF b265 & b270); the Visual Analogue Scale for pain (VAS) to assess "Sensation of pain" (ICF b280); the Goniometer to assess "Mobility of joint functions" (ICF b710); the Jamar dynamometer and the Pinch Gauge device to assess "Muscle power functions" (ICF b730); the Canadian Occupational Performance Measure (COPM) and the Disabilities of the Arm, Shoulder and Hand questionnaire (DASH) to assess other ICF categories (d230, d430, d445, d6, d840 to d859).

For 39 other instruments (table 1), consensus was reached to exclude these from the core set.

## No consensus

In the categories "Touch function" and "Sensory functions related to temperature and other stimuli" (ICF b265 & b270), no consensus was reached with regard to the Locognosia Test and the Static Two Point Discriminator (2PD-S).

In the category "Fine hand use" (ICF d440), for both the Nine-Hole Peg test (NHPT) and the Purdue Pegboard Test it was suggested in the second round to use these instruments (see table 3). Thirty percent of the respondents favoured the NHPT over the

**Table 4** Participants: numbers and response rates

| HandART Delphi | Primary discipline | | | | | Additional occupation | | | | | | Years of experience, mean | Total number of statements/ questions | Response rate (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | OT/HT | PT/HT | Both OT/HT and PT/HT | Hand Surgeon | Physiatrist | researcher | (co-)author | lecturer | developer | other | | | |
| Round 1 | 22 | 9 | 9 | 2 | - | 2 | 16 | 15 | 17 | 12 | 5 | 19,6 | 306 | 93 |
| Round 2 | 30 | 10 | 9 | 2 | 6 | 3 | 21 | 21 | 22 | 13 | 5 | 17,0 | 141 | 90 |
| Round 3 | 29 | 10 | 9 | 2 | 5 | 3 | 20 | 20 | 22 | 13 | 5 | 17,1 | 54 | 90 |

OT: Occupational therapist
PT: Physical therapist
HT: Hand therapist

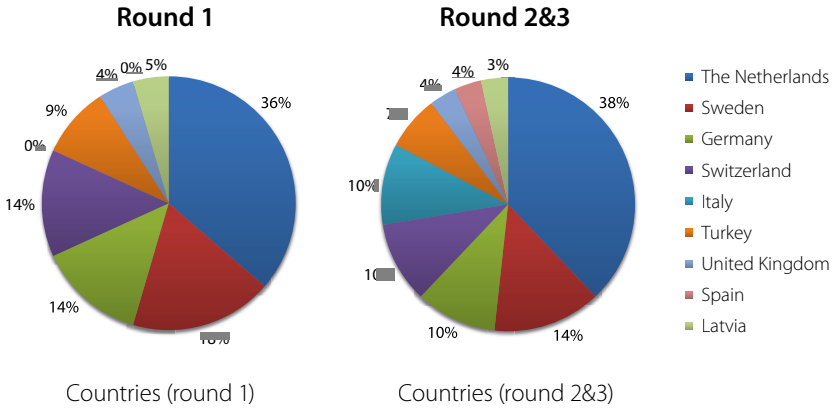


**Figure 1** Represented countries

PPT, 22% favoured the PPT over the NHPT, whereas 48% indicated that both instruments should be selected. In the final round, when participants were forced to choose between these 2 instruments, 37% selected the NHPT and 59% the PPT.

In the category "Hand and arm use" (d445), the DASH was included. For both the Jebsen-Taylor Test of Hand Function (JTHF) and the Sollerman Hand Function Test (SHFT) it was suggested in the second round to use these instruments to assess "hand and arm use" (see table 3). Twenty-two percent of the participants chose the JTHF, 37% the SHFT, 22% both tests, and 19% neither of these tests. In the final round, when participants had to choose between these 2 instruments, 31% selected the JTHT and 69% the SHFT (table 5).

Collected comments and arguments regarding the undecided instruments obtained in the 3 rounds together are presented in table 7.

## General opinion

Ten participants (35%) gave an opinion about the HandART-Delphi study. According to these respondents, the study had been well organized and information and feedback on each round was well provided. Sixteen other participants (55%) responded that they had no comments. Three participants (10%) did not respond to this question.

**Table 5** Selected instruments related to the preselected ICF categories

| ICF codes | b265& b270 | b280 | b710 | b730 | d230 | d430 | d440 | d445 | d5 | d6 | d7 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Should this category be assessed? (Yes/No (%))** | **Yes[1] (91)** | Yes[1] (100) | Yes[1] (100) | Yes[1] (100) | Yes[1] (81) | Yes[1] (90) | Yes[1] (100) | Yes[1] (100) | Yes[1] (95) | Yes[1] (100) | Yes[1] (80) | Yes[1] (90) |
| *Instruments measuring body functions* | | | | | | | | | | | | |
| **STI** | **X[2]** | | | | | | | | | | | |
| **SWMT** | **X[2]** | | | | | | | | | | | |
| **Static Two-Point Discrimination Test** | **50%** | | | | | | | | | | | |
| **Locognosia test** | **36% yes** | | | | | | | | | | | |
| **Visual Analogue Scale (VAS)** | | **X[2]** | | | | | | | | | | |
| **Goniometer** | | | **X[2]** | | | | | | | | | |
| **Jamar Dynamometer** | | | | **X[2]** | | | | | | | | |
| **Pinch gauge device** | | | | **X[2]** | | | | | | | | |
| *Pegboard Tests* | | | | | | | | | | | | |
| **Nine Hole Pegboard Test** | | | | | | | **37% yes** | | | | | |
| **Purdue Pegboard Test** | | | | | | | **59% yes** | | | | | |
| *Instruments measuring only fine hand use by picking up, manipulating and placing different objects* | | | | | | | | | | | | |
| **none** | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Instruments measuring single tasks (and fine hand use) by scoring executed tasks* | | | | | | | | | | | | | |
| **Jebsen-Taylor Test of Hand Function** | | | | | | | x | x | **31% yes** | x | | | |
| **Sollerman Hand Function Test** | | | | | | | x | x | **69% yes** | x | | | |
| *Questionnaires* | | | | | | | | | | | | | |
| **Cold Intolerance Symptom Severity Questionnaire (CISS)** | **X** | x | | x | | | x | | | x | x | | x |
| **COPM** | | | | | | | | | | **?** **4% yes** | **X**[2] | **?** **23% yes** | **X** |
| **DASH** | x | x | x | x | **X** | **X** | x | **X**[2] | | **?** **46% yes** | **X** | **?** **46% yes** | **X**[2] |
| **Both COPM and DASH** | | | | | | | | | | **50%** | | **31%** | |
| **PRWHE** | x | x | | | | | x | **?** | **73% no** | x | x | | x |

[1] – Confirmed to be important based on ≥75% agreement in the first round

[2] - Selected based on ≥75% agreement in the first round

**X** – Selected based on ≥ 75% agreement after three rounds

x – Not selected based on >75% agreement, but linked to this ICF category

? – No agreement

**Table 6** Non-selected instruments, mentioned as missing in the first round for each ICF category

| ICF category | Instrument (number of times mentioned)<br>19 instrument that should "certainly" be included in the core set, according to one or more participants, given in italic |
|---|---|
| b265 & b270 | Detection threshold: Mapping<br>Localization Test<br>Ninhydrin Test (2x)<br>Sollerman Test<br>The Ten Test (2x)<br>The Ten Test Revisited<br>Wrinkle Test (mentioned 3x) |
| b280 | body-pain-chart<br>*LANSS pain scale (Leeds Assessment of Neuropathic Symptoms and Signs)*<br>*Pain Self-Efficacy Questionnaire (PSEQ)*<br>Schultz UE Pain Assessment (SUEPA) |
| b710 | *(Slide) Caliper for ROM CMCI*<br>*Inclinometer Pro- Supination*<br>Kapandji thumb range of motion (2x)<br>Kapandji: functional hand Grasps<br>PRWHE<br>*Tip-To-Palm / centimeter (2x)* |
| b730 | dyNex1 grip dynamometer<br>Manual muscle testing, scored using the MRC scale (0-5)<br>MIE Myometer<br>*Worksimulator (BTE, Baltimore Technical equipment)* |
| d230 | Canadian Occupational Performance Measure (COPM)(2x)<br>EQ-5D (EuroQol) The European Research Questionnaire Quality of Life) , general questions<br>Medical Outcomes Study, Short Form 12 (MO-SF12) and SF 36<br>MHQ<br>Milliken Activities of Daily Living Scale<br>PRWHE (2x)<br>PSFS – Patient Specific Functional Scale<br>Quick DASH |
| d430 | COPM (2x)<br>Patient Specific Functional Scale (PSFS)<br>Valpar work samples<br>WEST Standard Evaluation Procedure (2x)<br>*Worksimulator (BTE)* |
| d440 | *Cambridge Hand Function test*<br>Crawford Small Parts Dexterity Test<br>Functional Capacity Evaluation<br>O'Conner Dexterity test |

**Table 6** Continued

| ICF category | Instrument (number of times mentioned)<br>19 instrument that should "certainly" be included in the core set, according to one or more participants, given in italic |
|---|---|
| d445 | Abilhand<br>Alderson_McGall Hand Function Questionnaire<br>COPM<br>Valpar work sample<br>*Worksimulator (BTE)* |
| d5 | *Milliken Activities of Daily Living Scale*<br>*Patient Specific Functional Scale (PSFS)*<br>Patient Specifieke Klachten (PSK) (Dutch)<br>Short Form-36 (SF-36) |
| d6 | SF-36<br>*Impact on Participation and Autonomy (IPA)*<br>Jebsen Taylor hand function test<br>*Milliken Activities of Daily Living Scale (MAS)*<br>*Patient Specific Functional Scale (PSFS)* |
| d7 | *Impact on Participation and Autonomy questionnaire (IPA) (2x)*<br>MOHO Kielhofner& Henry 1988<br>Patient Specific Functional Scale (PSFS)<br>SF-36 (2x) |
| d840 - d859 | *Beck depression inventory, Beck anxiety inventory*<br>*Evaluation der Funktionellen Leistungsfähigkeit (EFL) (German)*<br>*Impact on Participation and Autonomy (IPA)*<br>*Potential Work Exposure Scale (PWES) (McCabe, 1991) (2x)*<br>Patient Specific Functional Scale (PSFS)<br>Valpar Work Samples |

## DISCUSSION

The aim of the HandART-Delphi study was to reach multidisciplinary European consensus on a core set of assessment tools for impairments and activity limitations in patients with hand conditions, addressing the 13 categories of "body functions" and "activities and participation" of the Brief ICF Core Set for Hand Conditions (BICF-CS).[25] After 3 Delphi rounds, a group of 30 international experts from 9 European countries, consisting of hand therapists, hand surgeons and rehabilitation physicians, reached consensus (based on at least 75% agreement) on the majority of the preselected instruments. In the second and third round, consensus was reached on 9 instruments for the assessment of 9 ICF categories of the core set (see table 5). For 39 other instruments, consensus was reached that these should *not* be selected.

Regarding the assessment of "body functions", consensus was reached for the domains Pain, Mobility of joint functions (Active Range of Motion), and Muscle power functions (Grip strength and Pinch strength). The VAS, goniometer, Jamar Dynamometer and Pinch gauge device were selected to assess these ICF categories, which is consistent with common clinical practice as well as with the literature in which these instruments are frequently used and recommended.[7,13,22,30-35] In addition, the Shape Texture Identification test (STI), Semmes Weinstein Monofilament Test (SWMT), and Cold Intolerance Symptom Severity Questionnaire (CISS) were included in the core set to assess Touch function & Sensory functions. Although there is evidence for the validity of the Swedish version of the CISS[36], information about the validity of the English language version is not available. No consensus was reached with regard to the Locognosia Test or the Static Two Point Discriminator (2PD-S) to assess spatial discrimination. Several participants commented that the Locognosia Test is time-consuming and provides little extra information. Others were in favour of the Locognosia test emphasizing its reliability and responsiveness. Hence, in a diagnosis-specific core set, the Locognosia test might still be selected, but only if the test is administered according to a standardized protocol.[37]

Regarding the assessment of "activities and participation", consensus was reached on most of the preselected instruments assessing the ICF categories "fine hand use" and "hand and arm use" that these should *not* be included in the core set. The choice between two remaining assessment tools, the Nine Hole Pegboard Test (NHPT) and the Purdue Pegboard Test (PPT), that had both been linked to the ICF category "fine hand use", remained undecided due to personal preferences, although the value of each instrument was agreed upon. Considering that, preferably, only one pegboard test should be part of the core set, an argument in favour of the NHPT would be the relatively short administration time. On the other hand, the PPT might be favoured over the NHPT, because it involves bilateral and unilateral hand use, has a broader age range of normative data, and has good test-retest reliability.[38]

In the category "hand and arm use", the selection of the DASH was readily agreed upon. However, the DASH is a questionnaire that evaluates the experienced disabilities of the patient and is not an observational instrument to assess the execution of specific tasks. For this reason, the Jebsen-Taylor Test of Hand Function (JTHF) and the Sollerman Hand Function Test (SHFT) were also considered, but neither of these instruments reached 75% agreement. Still, the participants indicated that at least one of these instruments should be included in the core set. The SHFT might be preferred for various reasons. It is not only based on the time needed to finish tasks, but also on the quality of the movement.[17,18] Furthermore, it received a better rating than the JTHF in recent studies[39,40], and 8 of its items (compared with 4 items of the JTHF) can be linked to the d445 category.[29] A disadvantage of the SHFT is, however, that it is not (yet) commercially available, as mentioned by several experts.(table 7)

## Strengths and limitations

This Delphi study showed a very high response rate in all 3 rounds. According to the participants, the electronic method was feasible and adequate to reach consensus on the various topics addressed. If necessary, participants received a reminder if they had not yet responded. None of the participants (post-hoc) expressed the necessity of real-life meetings to reach consensus on the issues raised.

The present study had several limitations. In advance, it was decided to invite a maximum of 32 experts to participate, preferably 16 hand therapists (PTs and OTs), 8 hand surgeons, and 8 rehabilitation physicians. It turned out that only 30 professionals were available in a different ratio. Considering that, in clinical practice, mostly hand therapists will use the selected assessment tools, we believe that the multi-disciplinarity of the included experts was fair, albeit that rehabilitation physicians were underrepresented. The external validity of the participants may be questioned because of an overrepresentation of Dutch experts. Under-representation of other countries occurred due to limitations of Internet accessibility, problems with the English language, and the lack of well represented networks of professionals in some European countries. Another limitation is the absence of patients and insurers as participants.

A core set of instruments developed by a consensus procedure, such as a Delphi study, is developed through consideration of the opinions of experts and is influenced by current practice. Therefore, if new clinimetric data become available, a revision of this core set of instruments may be necessary. The HandART-Delphi study was restricted to the selection of assessment tools. Standardization or protocols for administration of tests were not the subject of this study. The update of the Clinical Assessment Recommendations of the American Society of Hand Therapists (13) can be used for such purposes. Furthermore, this study was focused on instruments to be used in a generic core set for patients with hand conditions. In addition to such a generic core set, several diagnosis-specific assessment tools are available. Thus, instruments such as the Patient Rated Wrist and Hand Evaluation (PRWHE) or the Carpal Tunnel Syndrome questionnaire[41] that were not selected in this Delphi study might still be valuable for a diagnosis-specific evaluation.

## Recommendations

Future research, should aim to reach consensus on which assessment tools should be used to address the remaining categories of the Brief ICF Core Set of Hand Conditions, such as "emotional functions" and "environmental factors". Moreover, future research should evaluate the clinical feasibility of this core set as well as the acceptance by professionals, patients and insurers. Furthermore, diagnosis-specific core sets may need to be developed in addition to this generic core set.

**Table 7** Comments collected during 3 rounds regarding instruments for which no consensus was reached

| Instrument | Yes, should be selected<br>Comments and arguments |
|---|---|
| **Static Two Point Discriminator (2PD-S)** | - quick assessment (2x)<br>- quantitative<br>- measure of density receptors<br>- reliable (2x)<br>- for evaluation in research |
| **Locognosia Test** | - gives complex data<br>- only when using published standardized protocol by Jerosch (45)<br>- good for diagnostics (2x)<br>- responsive (2x)<br>- in peripheral nerve injury as prognostic sign<br>- correlation with tactile gnosis tests<br>- reliable in median and ulnar nerve injury |
| **Nine-Hole Peg Test (NHPT)** | - faster than PPT |
| **Purdue Pegboard Test (PPT)** | - many options to look at fine hand use or dexterity<br>- involves bilateral and unilateral hand use (4x)<br>- broader age range of normative data (2x)<br>- reliable (2x) |
| **Jebsen-Taylor Test of Hand Function (JTHF)** | - high degree of standardization<br>- commercial availability |
| **the Sollerman Hand Function Test (SHFT)** | - many items linked to hand and arm use (2x)<br>- also assesses quality of movement |

**No, should not be selected**
**Comments and arguments**

- limited reliability (5x) and validity;
  - pressure not manageable: the amount of pressure applied can vary with each application (2x)
  - not clear if patient can discriminate between 2 points or if he feels a line
  - validity for spatial threshold questionable

- long administration time
- STI already selected
- only useful for quick clinical detection
- not suitable for research
- not suitable for follow-up
- often unresponsive especially in complete nerve injuries (2x)
- different protocols and instruments exist
- very time consuming (5x)
- complicated to apply (3x)
- little extra information (2x)
- unknown (2x)
- preference to use monofilaments
- useful in nerve injury, only when sensory re-education is indicated,

- the complexity of fine hand use inadequately captured by simple grasp and release tasks
- more focused on hand/arm and eye coordination than on manual dexterity

- the complexity of fine hand use inadequately captured by simple grasp and release tasks
- time consuming

- writing task is out-dated (writing with the non-dominant hand is odd)

- not commercially available (3x)

## CONCLUSION

In this HandART-Delphi study, multidisciplinary European consensus was reached on assessment tools for impairments and activity limitations in patients with hand conditions, addressing 13 categories of the Brief ICF Core Set for Hand Conditions. After 3 rounds, 9 instruments were selected, while 39 other instruments were excluded. The HandART core set is an important step forward in clinical practice and research in this population, enabling clinicians and researchers to select the best available tests for their purposes and facilitate comparisons between clinical studies.

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# 9

# Summary and General Discussion

# SUMMARY AND GENERAL DISCUSSION

## SUMMARY

The main objective of this thesis was to reach consensus on which instruments should be used for the functional assessment of patients with hand conditions. This thesis describes the different parts of the project '*HandART: Hand Assessment Recommendations for Therapy*'.

### Introduction

**Chapter 1,** the general introduction, emphasizes the impact of hand conditions on the performance of daily life activities and on related healthcare and productivity costs. In the assessment and treatment of persons with hand conditions, a bottom-up approach and a top-down approach can be distinguished. A *bottom-up approach* is often used in the first weeks after a hand trauma or surgical intervention and uses a biomechanical frame of reference. Its primary focus is to reduce deficits in hand functions and structures. Several weeks after a hand injury or surgery, a *top-down approach* becomes more important because it is 'occupation-based' and 'person-centered'. In this approach, the therapist and the patient together determine what aspects of occupational (or vocational) performance require attention. To provide a standard language and conceptual basis for the definition and measurement of hand conditions, the International Classification of Functioning, Disability and Health (ICF) is discussed. Finally, the HandART project, the main topic of this thesis, is introduced. This project consisted of several preparatory studies that are described in part I (literature reviews) and part II (ICF core set studies) of this thesis. The main body of the HandART project consisted of a validation study and a Delphi consensus study that are reported in part III.

### Part I Literature review

In ***Chapter 2*** a literature review is described that aimed to identify available instruments to assess activity limitations in patients with hand conditions. Out of 72 identified instruments, a total of 23 were selected that met four predefined selection criteria: (1) adequate description of the target population, type of tasks, and type of results; (2) relevant study population, i.e. adults with a hand injury or hand disorder; (3) minimally 50% of the items referring to the upper extremity; and (4) focus on activities. These 23 selected instruments were then classified according to: (1) the specific components of the ICF that were addressed (body functions, activities, and/or participation); (2) the activity aspects that were assessed; and (3) how the activity was assessed (questionnaire or performance test). As for the second criterion, the following aspects were distinguished:

(a) (fine) arm and hand use (e.g. reaching, grasping, picking up); (b) single tasks (e.g. writing a sentence, pouring a glass of water, fasten shoe laces); and (c) activities of daily living (e.g. sending a letter, preparing breakfast, grooming and dressing).

In ***Chapter 3***, based on a systematic review, the clinimetric properties of the 23 selected instruments measuring activity limitations were described and, subsequently, evaluated using well accepted quality criteria. Based on 54 publications, these instruments were reviewed and categorized as: a) pegboard tests measuring fine hand use only; b) instruments measuring only fine hand use by picking up, manipulating, and placing different objects; c) instruments measuring single tasks (and fine hand use) by scoring task performance; and d) questionnaires. The description of the clinimetric properties of the instruments was mostly considered to be insufficient. The validity, reliability, and responsiveness of merely five instruments (Sequential Occupational Dexterity Assessment (SODA), self-administered questionnaire for the assessment of severity of symptoms and functional status in carpal tunnel syndrome, Canadian Occupational Performance Measure (COPM), Disabilities of the Arm, Shoulder and Hand questionnaire (DASH), Michigan Hand Outcomes Questionnaire (MHQ)) were adequately described. None of the instruments had a positive rating for all clinimetric properties. Thus, based on literature, it was not possible to decide which instrument should be used for the functional assessment of patients with hand conditions in clinical practice.

## Part II ICF Core Set for Hand Conditions

***Chapter 4*** starts with a systematic review that used three steps: Step 1, selection of published studies on hand conditions; Step 2, data extraction from the selected studies; and Step 3, a content analysis of the selected studies**,** using the International Classification of Functioning, Disability and Health (ICF) as a reference. All outcome measures were categorized and each item of the patient-reported and health professional-reported measures was linked to the ICF. Sixty-six different outcome measures were identified: 34 patient-reported measures, 19 health professional-reported measures, and 13 standardized performance tests. The most often reported instrument was the DASH. The clinical characteristics most frequently aimed at were range of joint motion, pain, sensibility and pinch or grip strength. In addition, further reported outcomes, such as nerve re-growth and muscle atrophy, were extracted.

The impact of hand conditions on a person's health was reflected in the large number of different ICF categories (n=127) identified in this review. Only 48 ICF categories (38%) were related to the 'Activities and Participation' domain of the ICF. 'Fine hand use' and 'hand and arm use' were the most frequently identified ICF categories at the level of Activities and Participation. It was argued that research on hand conditions needs to widen its focus toward mental functions, driving and using transportation, self-care

activities, domestic life activities as well as environmental factors in order to fully understand the impact of hand conditions on an individual's health.

***Chapter 5*** contains a report of an international consensus conference on the development of ICF core sets for hand conditions. Evidence obtained from preparatory studies, including the systematic literature review reported in chapter 4, was integrated in a consensus process in which 23 multidisciplinary experts from 22 countries participated. Eventually, two ICF Core Sets were developed:

- a *Comprehensive ICF Core Set for Hand Conditions* consisting of 117 ICF categories to be taken into account in a comprehensive, multi-disciplinary assessment;
- a *Brief ICF Core Set for Hand Conditions (BICF-CS)* consisting of a selection of 23 ICF categories from the comprehensive ICF Core Set that should be assessed in every patient with a hand condition, irrespective of the health care setting and the number of health care professionals involved. Both ICF Core Sets can serve as a clinical framework to comprehensively assess persons with hand conditions in the acute phase and early post-acute phase.

***Chapter 6*** provides a linkage of the content of 46 assessment tools, known in the area of hand surgery and hand rehabilitation, to the 23 categories of the BICF-CS. The results showed that 19 of the 23 categories were addressed by the included assessment tools. These results can support decisions about which instruments are most appropriate for assessing human functioning and contextual environmental factors in persons with hand conditions.

## Part III COPM validation study and HandART Delphi study

In client-centered practice assessment tools need to measure outcomes that are meaningful to persons. Because, in this respect, the most commonly used assessment tools fall short, ***Chapter 7*** describes the construct validity of the COPM in relation to the DASH and the MHQ in persons with flexor tendon injuries, extensor tendon injuries, or Dupuytren's disease. As hypothesized, due to its client-centered orientation, the COPM scores correlated with the DASH and MHQ total scores only to a moderate degree. The correlation between the DASH and MHQ was higher ($r_p$ 0.60) than the correlation between the COPM-performance and either the DASH or the MHQ ($r_p$ < 0.51). As hypothesized, only a weak correlation of the COPM, DASH and MHQ with hand impairments was found ($r_p$ < 0.46). The results of this study support the notion that the COPM provides additional information about activity limitations compared to established self-report measures with predefined items (such as the DASH and MHQ) in persons with flexor tendon injuries, extensor tendon injuries, or Dupuytren's disease.

Finally, ***Chapter 8*** describes the HandART Delphi study aimed to reach consensus on which instruments should be used for the functional assessment of patients with hand conditions. Thirty experts from the European societies for Hand Therapy, Hand Surgery, and Physical and Rehabilitation Medicine participated. Based on the linkage of 46 assessment tools to the 23 BICF-CS categories, 13 categories were preselected, namely categories addressing the ICF domains 'Body Functions' and 'Activities and Participation', for which all available instruments were presented. Participants were asked to indicate, for every category, whether it should be assessed and, for every instrument, whether it should be included in a HandART Core Set of Instruments to address Body Functions, Activities and Participation.

The response rate was high and varied from 90 to 93%. In the first round, participants indicated that all 13 preselected ICF categories were considered relevant. After three rounds, for nine categories, consensus was reached, based on minimally 75% agreement, about which assessment tools should be used for patients with hand conditions. The selected instruments were: the *Shape Texture Identification test (STI)*, the *Semmes Weinstein Monofilament Test (SWMT)* and the *Cold Intolerance Symptom Severity questionnaire (CISS)* to assess "Touch function" and "Sensory functions related to temperature and other stimuli" (ICF b265 & b270); the *Visual Analogue Scale for pain (VAS)* to assess "Sensation of pain" (ICF b280); the *Goniometer* to assess "Mobility of joint functions" (ICF b710); the *Jamar dynamometer* and the *Pinch Gauge device* to assess "Muscle power functions" (ICF b730); and the *COPM* and the *DASH* to assess other ICF categories (d230, d430, d445, d6, d840 to d859).

As a result of this HandART project, in particularly the Delphi study, for 4 ICF categories regarding body functions and 5 ICF categories regarding activities and participation, consensus was reached on which instruments should be selected for the HandART Core Set of Instruments.

## GENERAL DISCUSSION

The aim of the HandArt project was to determine which domains and categories of the International Classification of Functioning, Disability and Health (ICF) should be addressed when assessing patients with hand conditions. Furthermore, this project aimed to determine by which instruments these ICF components can and should be assessed. The ultimate aim was to reach consensus on the standardization of the functional assessment of patients with hand conditions to support functional diagnostics, clinical decision making and evaluation of interventions.

### How do the results of the HandART preparatory studies and Delphi study relate to one another?

Instruments that were selected in the Delphi study were coherent with the results of the preparatory studies (table 1), even though in the Delphi study participants were allowed to select any of the listed instruments linked to a specific category and even though they were allowed to add missing instruments. The core set of instruments that was eventually selected in the Delphi study differs not much from the instruments that are commonly used in clinical practice. The results confirm the value of well-known instruments, especially those that are used to assess 'Body Functions', such as the goniometer and the Jamar dynamometer. They also confirm the doubts regarding some other instruments that are routinely used, such as the Two Point Discriminator (2PD; Static/Moving). Some physicians, therapists and researchers are using this instrument to assess the recovery of sensibility as an indication of neural re-innervation. However, the 2PD is only valid for assessing spatial discrimination and, thus, to be used validly, re-innervation must already have occurred.[1] Furthermore, both the reliability and validity of the 2PD are limited, because not the instrument but the therapist determines the amount and pace of pressure. In addition, it is difficult to apply the same pressure in alternately one and two points.[2-4] Therefore, the 2PD lacks sensitivity in comparison with other instruments such as the Semmes Weinstein monofilaments.[5-7]

With regard to the assessment of 'Activities and Participation', for most instruments more than one Delphi round was needed to reach consensus whether or not the instrument had to be selected. As a result, consensus was reached to exclude 39 instruments from the HandART core set, which confirms the presumption that in clinical practice not as many instruments are used as the 72 tests that were identified in the literature search (Chapter 2). By selecting the COPM for the HandART core set, client-centered aspects are addressed. These aspects are complementary to the information provided by instruments with predefined items, such as the DASH and MHQ, that are most commonly used in clinical practice. The COPM was, therefore, recommended and selected based on consensus in the Delphi rounds.

**Table 1** Summary of results for every studyCategories of the Brief ICF core set for hand Conditions that are addressed in the Delphi study

| | | **Delphi study (chapter 8)** | **Review of instruments & clinimetric review (chapters 2 and 3)** | **Content comparison with ICF (chapter 4)** | **Linkage of instruments to Brief ICF Core set for Hand Conditions (chapter 6)** |
|---|---|---|---|---|---|
| ICF code | Category | Selected instruments | Summary of results | Measures and clinical assessments* | Number of instruments linked to an ICF category and instruments selected in Delphi study (number of items linked to this category) |
| Domain 'Body functions and Body structures' | | | | | |
| b265 & b270 | Touch function & Sensory functions related to temperature and other stimuli<br>*Including: stereognosis, tactile gnosis, temperature recognition, detection threshold, and spatial discrimination* | STI<br>SWMT<br>CISS<br><br>Undecided:<br>- Static Two Point Discrimination Test (2PD-S)<br>- Locognosia test | | B265: 58 studies (30,85%)<br>Sensory assessment<br><br>B270:62 (32,98%)<br><br>Semmes Weinstein Monofilament test | linked to category b265:<br>7 instruments<br>-STI (2 items)<br>-SWMT (1 item)<br>-S2DT (1 item)<br><br>Linked to category b270:<br>7 instruments<br>-SWMT (1 item)<br>-S2DT (1 item)<br>-CISS (8 items) |
| b280 | Sensation of pain | VAS pain | | 131 studies (69,68%)<br>VASpain | linked to category b280:<br>9 instruments<br>-VAS pain (1 item) |
| b710 | Mobility of joint functions | Goniometer | | 124 studies (65,96%)<br>Range of motion/ goniometrics | linked to category b710:<br>9 instruments<br>-Goniometer (1 item) |
| b730 | Muscle power functions | Jamar Dynamometer<br>Pinch Gauge Device | | 112 studies (59,57%)<br>Pinch and grip strength dynamometer | linked to category b730:<br>13 instruments<br>- Jamar Dynamometer (1 item)<br>- Pinch Gauge Device (3 items) |
| Domain 'Activities and Participation' | | | None of the instruments had a positive rating for all measurement properties. the following instruments might be recommended: | | |

| | | | | | |
|---|---|---|---|---|---|
| d230 | Carrying out daily routine | DASH | DASH | 29 studies (15,43%)<br>DASH | linked to category d230:<br>1 instrument<br>- DASH (1 item) |
| d430 | Lifting and carrying objects | DASH | DASH | 49 studies (26,06%) | linked to category d430:<br>11 instruments<br>- DASH (3 items) |
| d440 | Fine hand use | Undecided:<br>- NHPT (37%) ?<br>- PPT (59%) ? | - PPT<br>- Box and Block Test<br>- JTHF<br>- DASH | 55 studies (29,26%) | linked to category d440:<br>25 instruments<br>- NHPT (1 item)<br>- PPT (4 items) |
| d445 | Hand and arm use | DASH<br><br>Undecided:<br>JTHF (31%) ?<br>SHFT (69%) ? | JTHF<br>DASH | 52 studies (27,66%)<br>Jebsen | linked to category d445:<br>15 instruments<br>-DASH (6 items)<br>- JTHF (4 items)<br>- SHFT (8 items) |
| d5 | Self-care | Undecided:<br>COPM or<br>DASH or<br>both | COPM<br>DASH | 135 (72,34%)<br>(cumulated) | linked to category d5:<br>16 instruments<br>- COPM (1 item)<br>- DASH (3 items) |
| d6 | Domestic life | COPM<br>DASH | COPM<br>DASH | 96 (51,06%)<br>(cumulated) | linked to category d6:<br>9 instruments<br>- COPM (2 items)<br>- DASH (5 items) |
| d7 | Interpersonal interactions and relationships | Undecided:<br>COPM or<br>DASH or<br>both | COPM<br>DASH | 88 (46,81%)<br>(cumulated) | linked to category d7:<br>4 instruments<br>- COPM (1 item)<br>- DASH (2 items) |
| d840 to d859 | Work and employment | COPM<br>DASH | COPM<br>DASH | 77 (40,96)<br>(cumulated) | linked to category d840-d859:<br>7 instruments<br>- COPM (1 item)<br>- DASH (5 items) |

* Mentioned if more than 3% of studies addressed this category (table 4, chapter 4); Standardized Outcome Measures that are mentioned more than 3 times and Clinical assessments that are reported in more than 10 percent of studies (table 3, chapter 4).

- STI: Shape Texture Identification Test; SWMT: Semmes Weinstein Monofilament Test; CISS: Cold Intolerance Symptom Severity Questionnaire; NHPT: Nine Hole Pegboard Test; PPT: Purdue Pegboard Test; JTHF: Jebsen-Taylor Test of Hand Function; SHFT: Sollerman Hand Function Test; DASH: Disabilities of the Arm, Shoulder and Hand questionnaire; COPM Canadian Occupational Performance Measure

**Do the results of the HandART project support person-centered clinical practice in hand rehabilitation?**

*'To have a significant impact on healthcare'*, every person has a right to receive the best care, always. However, the best care in general is not necessarily the best care for a particular individual. That is why Radboudumc chooses to provide participatory and personalized healthcare. In participatory healthcare, patients are regarded as valuable members of their own treatment team. Personalized healthcare means that, whenever possible, diagnostic and therapeutic procedures are matched to the specific characteristics and needs of the person (Strategie Radboudumc, 2014).

To structure the process of functional assessment and decision making in a multidisciplinary team, a flowchart was constructed.[8] This flowchart (fig 1) consists of two parts. The first part depicts the functional assessment performed by the hand therapist including the indication and referral by the hand surgeon or rehabilitation specialist, while the second part illustrates the decision making process and interventions performed by the multi-disciplinary team. To support person-centered practice, the 'top-down' (or 'occupation-based') approach is advocated in which the therapist and the patient together determine what occupational performance problems need attention. The assessment part starts with the intake. So called 'signal questions' indicate whether the patient experiences participation restrictions, activity limitations and/or impairments. These 'signal questions' can be used by physicians to determine the need for referral to a hand therapist as well as by the hand therapist to determine the need for more detailed assessment. In the case of participation restrictions and/or activity limitations, some form of hand rehabilitation will nearly always be indicated. When the more detailed assessment reveals that the patient experiences no participation restrictions or activity limitations, the patient has to decide whether he wants or needs to receive treatment for any residual impairments or not. Indeed, in some cases the patient may want to receive treatment for such impairments, but in other cases he will decide that surgery or conservative treatment is not preferred because the treatment is too invasive or because the impairments are not bothering enough.

The instruments selected in the HandART project are depicted in figure 1. Although the ICF domain 'Activities and Participation' contains two constructs, different instruments are needed to assess either activities or participation. It should be noted that, regarding this ICF domain, the HandART project has focused on instruments to assess activities.

Except for the COPM[9], most instruments of the HandART core set have not been developed based on a person-centered model. When using the 'top-down' approach of this flow-chart, the therapist and patient first evaluate what activity limitations and participation restrictions the person experiences. An analysis of the activity limitations could accordingly reveal that these limitations are caused by specific impairments. Or it may appear that the person experiences merely impairments without activity limitations

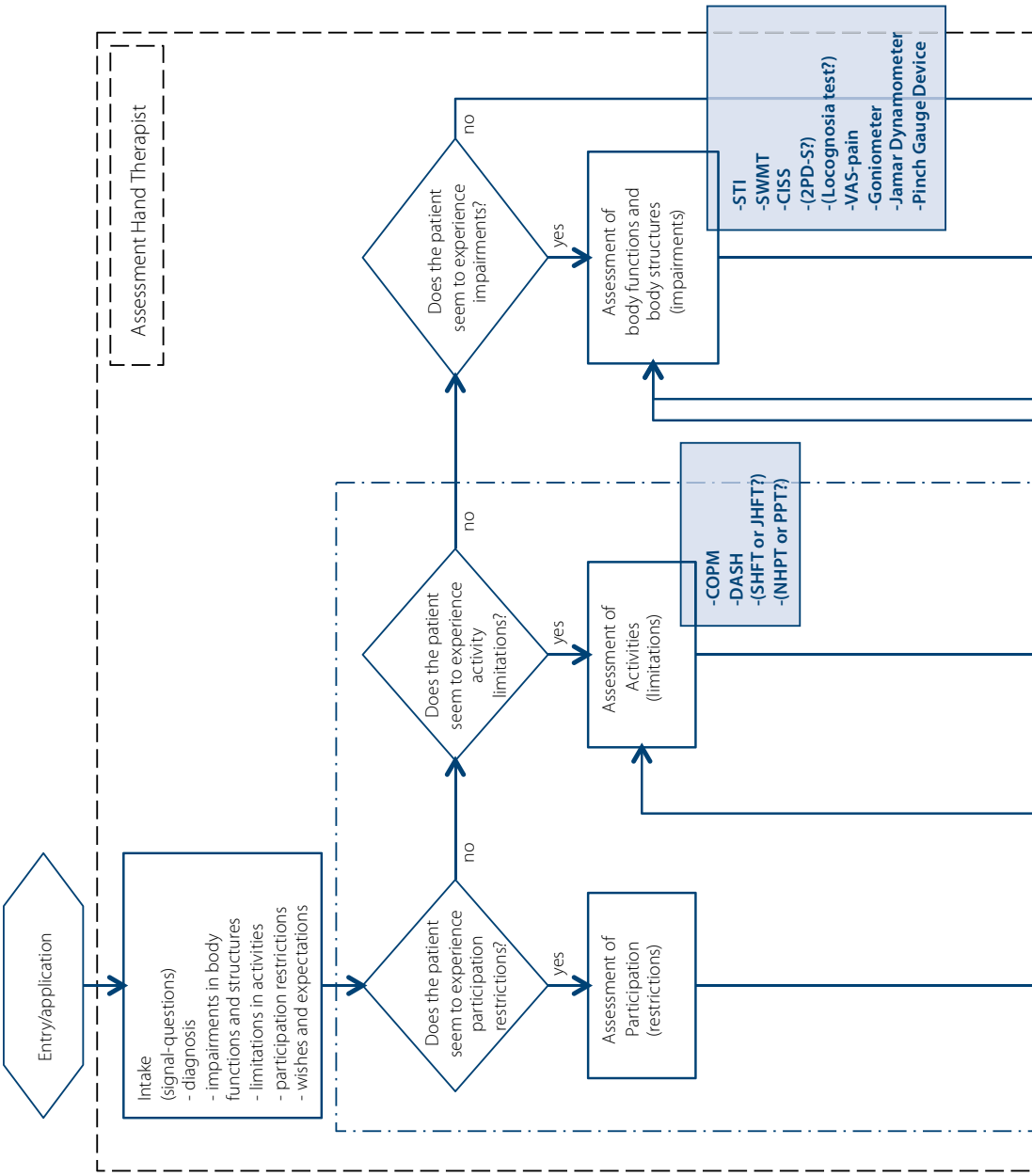
(e.g. an extension deficit in a finger joint) that he wishes to ameliorate this impairment. In both cases it is necessary to assess his specific hand impairments. By performing and discussing the results of targeted impairment tests, both the patient and the therapist get insight in the hand impairments in relation to possible activity limitations and to the personal needs. The patient receives information that will enable him to make decisions about the services (surgical and/or conservative interventions) that will most effectively meet his needs. Thus, the instruments that assess body functions and structures can be used as elements of the 'top-down' approach and, in this way, be considered as part of participatory and personalized care.

**Why does the Canadian Occupational Performance Measure comply with patient-centered clinical practice?**

In the validity study of chapter 7, we found that the person-centered COPM yielded additional information in patients with hand conditions in comparison with questionnaires with predefined items such as the DASH and MHQ. In addition, at about 3 months after surgery, persons with a tendon injury or Dupuytren's disease were asked for their most prominent experienced activity limitations using an open-ended question: "During the past weeks, in which activities did you experience limitations due to impaired hand function?". Participants were not restricted in the number of activity limitations they were allowed to mention nor in the number of words they could use to describe each activity limitation. These unpublished data are worth mentioning in this general discussion.

Regarding the total group, the estimated mean percentage correspondence with the open-ended question was 24% higher for the COPM than for the DASH, while it was 17% higher for the DASH than for the MHQ. These results further support the notion that the COPM provides additional information that is not obtained by using currently available self-report measures with predefined items. This information is specifically related to what persons value as their most important daily life activities. As mentioned before in the validity study (chapter 7), the large variation in participation problems identified with the COPM in other studies confirms the notion that values with regard to occupational performance greatly differ between persons depending on their physical, cultural and social environment.[10,11] Because rehabilitation is aimed at improving a person's functioning in his natural environment, it is crucial that functional assessments identify activity limitations as experienced by the individual person in his social context.[12] In this perspective, the COPM supports personalized care in a specific manner and is a valuable addition to self-report questionnaires in client-centered rehabilitation of persons with hand conditions.

Currently, the opinion of the Dutch government about healthcare is changing. The National Health Care Institute (Zorg Instituut Nederland (ZIN)) has referred to a recently published definition of health[12] and concluded that, instead of treating diseases, more


Assessment Hand Therapist
Entry/application
Intake
(signal-questions)
- diagnosis
- impairments in body functions and structures
- limitations in activities
- participation restrictions
- wishes and expectations
Does the patient seem to experience participation restrictions?
yes
no
Assessment of Participation (restrictions)
Does the patient seem to experience activity limitations?
yes
no
Assessment of Activities (limitations)
-COPM
-DASH
-(SHFT or JHFT?)
-(NHPT or PPT?)
Does the patient seem to experience impairments?
yes
no
Assessment of body functions and body structures (impairments)
-STI
-SWMT
-CISS
-(2PD-S?)
-(Locognosia test?)
-VAS-pain
-Goniometer
-Jamar Dynamometer
-Pinch Gauge Device

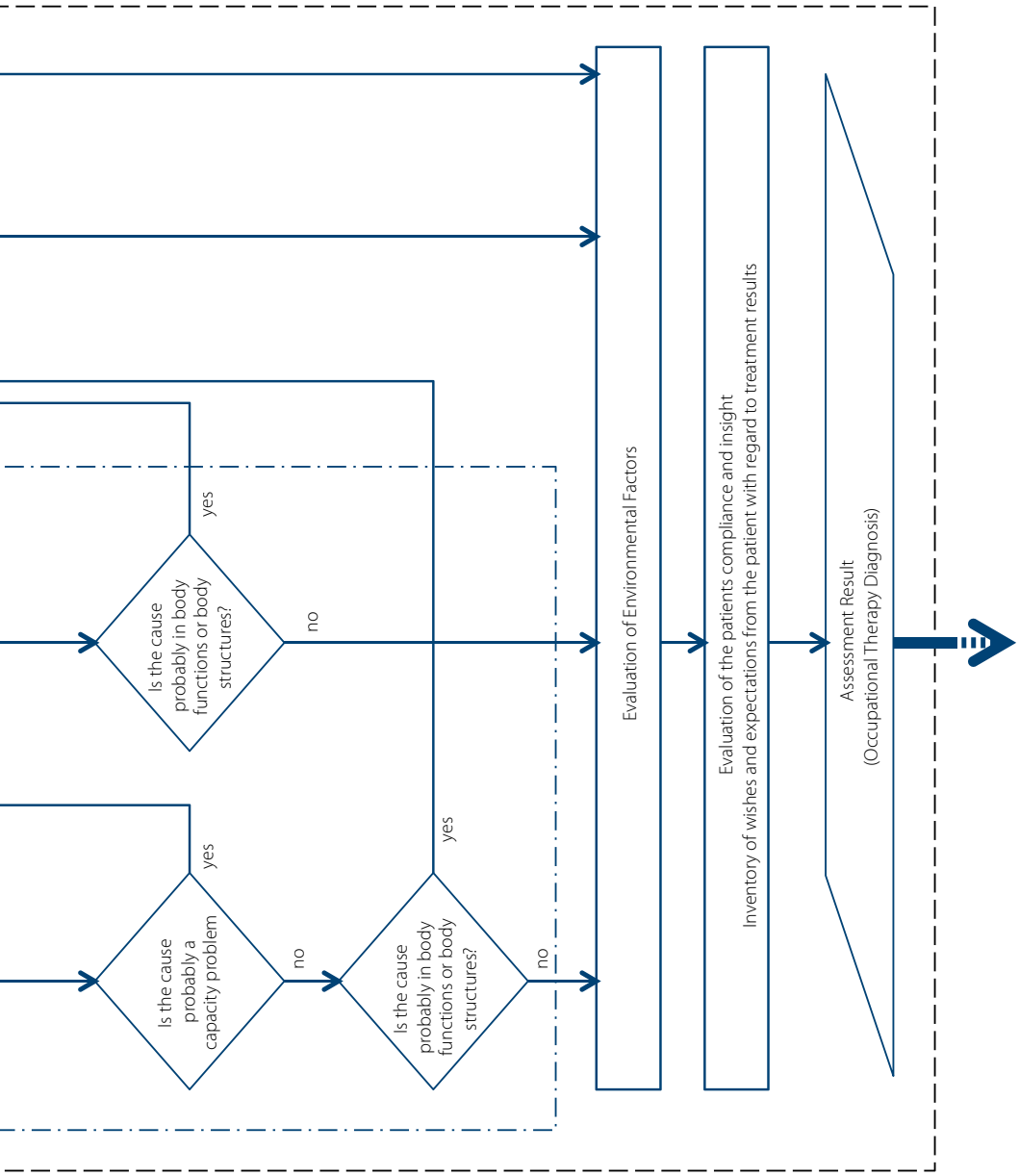
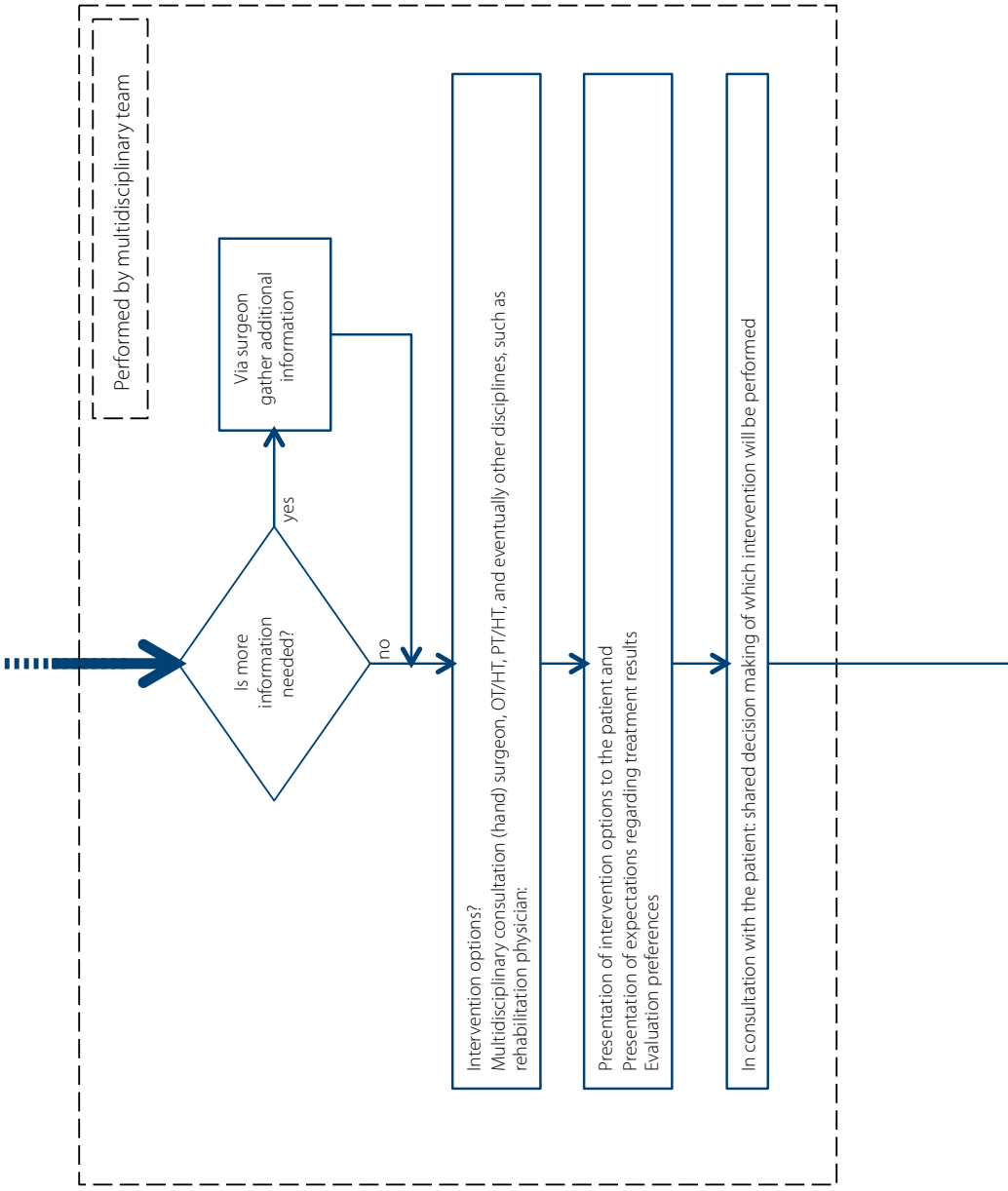



**Figure 1** Flow chart of functional assessment and decision-making process[8]


Performed by multidisciplinary team
Via surgeon gather additional information
yes
Is more information needed?
no
Intervention options?
Multidisciplinary consultation (hand) surgeon, OT/HT, PT/HT, and eventually other disciplines, such as rehabilitation physician:
Presentation of intervention options to the patient and
Presentation of expectations regarding treatment results
Evaluation preferences
In consultation with the patient: shared decision making of which intervention will be performed

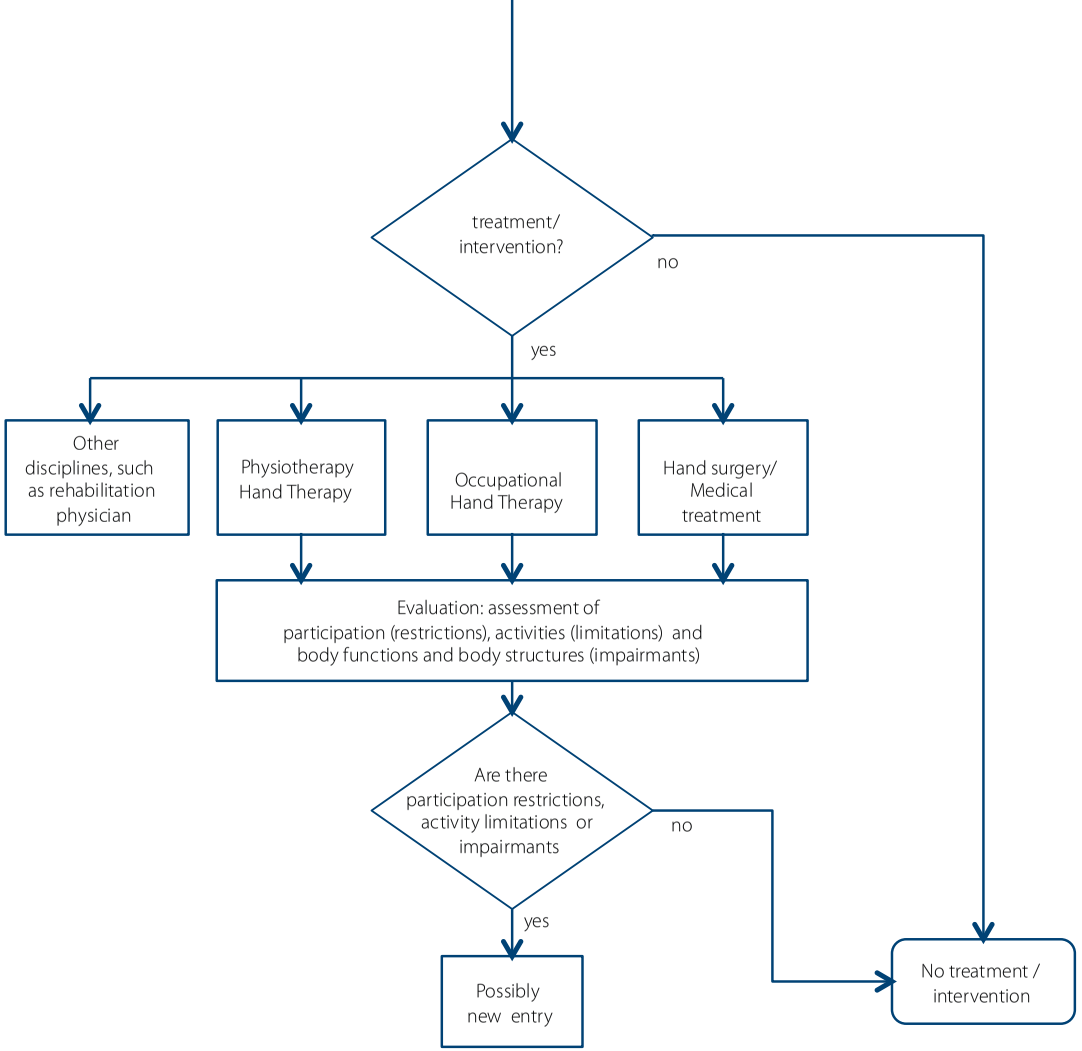



**Figure 1** Continued

attention has to be paid to how people function and in what way they are able to manage their lives despite the presence of disorders or disabilities. Notably, people's functioning and their experienced disabilities have always been the focus of rehabilitation professionals, of occupational therapists in particular.[13-16] The 'core business' of occupational therapy is analyzing and improving the occupational performance of persons, focusing on daily life activities and social participation, taking into account personal wishes and needs. This is also applicable to the occupational therapist/hand therapist, as described in the profile speciality occupational therapist/hand therapist of the Dutch Association of Occupational Therapy (Ergotherapie Nederland) and the Dutch Society for Hand Therapy (Nederlandse Vereniging voor HandTherapie).[17] As defined in this profile, in the management of persons with hand conditions, the occupational therapist/hand therapist should perform a person-centered assessment using (at least partly) the 'top-down' approach as presented in figure 1 and using client-centered instruments such as the COPM.

**How to improve evidence-based practice in hand rehabilitation?**

In the treatment of hand conditions, conservative (non-surgical) treatment is sometimes preferred to surgical interventions in order to reach a satisfying recovery of structures and functions. For example, in a traumatic boutonnière deformity or mallet finger, a conservative treatment is probably saving healthcare costs with good results. Unfortunately, it is hard to find sufficient evidence for the (cost-)effectiviness of non-surgical interventions in hand conditions. Recently, a literature search was carried out by SEO Economic Research (www.seo.nl/en/home*)* to find evidence for the effectiveness of occupational therapy, including hand therapy. Unfortunately, only a few publications mentioning occupational therapy or hand therapy as an intervention met the criteria, i.e. describing a randomized controlled clinical trial or a review of randomized controlled clinical trials on hand therapy. This is a surprising result given the fact that many non-surgical (or post-surgery) treatment protocols and guidelines are available. This lack of high quality studies implies that, in developing multidisciplinary guidelines, the contribution of hand therapy can easily be underestimated. The conclusion is justified that it is necessary to conduct more research to determine whether and which hand therapy interventions are (cost-) effective. This research must be of adequate quality to provide clinical evidence and focus on the added value of hand therapy in the multidisciplinary management of patient with hand conditions. It is important that the term 'occupational therapy' or 'hand therapy' is used in the title and/or abstracts of these studies, so that they can easily be retrieved. In the perspective of evidence-based hand therapy, it is of utmost importance that valid, reliable and responsive outcome measures are available in different domains of the ICF, particularly at the level of 'Activities and Participation'. Additionally, it is important that researchers select the same outcome measures in comparable trials to facilitate meta-analysis of the results. The HandART project is a first step in this direction.

**Methodological limitations of the studies described in this thesis**

The literature reviews of chapters 2, 3, and 4 only included English language studies. Consequently, some publications of interest may have been missed. After publication of the clinimetric review (chapter 3), new studies evaluating the clinimetric properties of assessment tools or questionnaires were published or identified. As a consequence, some instruments were unjustly not included in the clinimetric review, such as the Australian/Canadian Osteoarthritis Hand Index (AUSCAN), the Patient Evaluation Measure (PEM), the Patient Rated Wrist/hand Evaluation (PRWHE), and the Upper Extremity Functional Scale. Fortunately, these instruments could be included in the linkage of instruments to the BICF-CS (chapter 6) and in the Delphi study (chapter 8).

The HandART Delphi study was purposely restricted to the selection of assessment tools for body functions (impairments) and activities (limitations). The ICF domains participation, personal and environmental factors remained, therefore, largely unaddressed. In addition, the way of administration of tests was not made subject of the Delphi study. Future studies should address these issues.

We included only professionals from European countries with an overrepresentation of Dutch experts and an underrepresentation of rehabilitation physicians, which may limit the generalizability of the results of the Delphi study.

In personalized healthcare, persons with a hand condition are preferably involved in the process of selecting meaningful assessment tools. Because people with hand conditions were already involved in the development of several instruments (vdVen2009) and because the primary goal of the Delphi study was to reach consensus on a generic core set of instruments among professionals, it was decided to not yet involve patients. Nevertheless, evaluating the opinion of people with hand conditions on the feasibility of the HandART core set in clinical practice is recommended.

## Recommendations for the future

The development of a HandART core set of assessment tools for people with hand conditions is not finished. It still has to be decided which of the remaining performance tests should be selected to assess 'fine hand use' and 'hand and arm use'. The same applies to the assessment of 'self care' and 'interpersonal interactions and relationships' but, considering that the COPM and DASH have already been selected, both instruments could (preliminarily) be used for this purpose. Instruments have to be selected to evaluate participation and to address the remaining 10 categories of the BICF-CS for Hand Conditions, including the categories emotional functions (b152), body functions (b715stability of joint functions, b760-control of voluntary movement functions, b810-protective functions of the skin), body structures (s120-spinal cord and related structures, s720-structure of shoulder region, s730-structure of upper extremity), and environmental factors (e1-products and technology, e3-support and relationships, e5-services, systems and policies).

Most of the clinimetric properties of the selected instruments still have to be established or improved, according to the quality criteria by Terwee et al. (2007). However, given the present selection of instruments in the HandART core set, it is recommended that these instruments are used in future research until new insights are available. For specific hand conditions, it may be useful to develop or improve disease-specific instruments, but the added value to generic instruments should have been clearly shown. Otherwise, generic instruments are preferred to facilitate meta-analysis of study results both within and between different patient groups.

It is recommended that the feasibility of the HandART core set of assessment tools for patients with hand conditions is established in future studies regarding, for instance, the time and context needed to administer the different tests, the opimal timing of test administration, and the acceptance of the tests by people with hand conditions. In addition, the discriminative, evaluative and prognostic value of every test should be investigated to identify its optimal contribution to evidence-based practice. Finally, it has to be determined to what extent the HandART core set contributes to the decision-making process in hand rehabilitation.

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# NEDERLANDSE SAMENVATTING

*De heer K. had een amputatie van de duim, wijsvinger en middelvinger van de linkerhand als gevolg van een vuurwerkletsel. Enkele maanden na het letsel was een teen-duim transplantatie één van de opties die door de handchirurg werden voorgesteld. Alvorens tot definitieve besluitvorming en planning van de operatie over te gaan, werd de heer K. verwezen naar een ergotherapeut/ handtherapeut voor een functionele evaluatie. Naast het meten van functies (stoornissen) evalueerde de handtherapeut de functionele capaciteiten van de patiënt en de beperkingen in activiteiten, evenals de esthetische aspecten en zijn persoonlijke wensen en behoeften. Deze functionele evaluatie maakte duidelijk dat de heer K. nauwelijks beperkingen in activiteiten of participatieproblemen ondervond. Zo was hij in staat om zijn aangedane hand te gebruiken voor het schrijven, het spelen van basketbal, en voor technisch tekenen. Sterker nog, hij vond zijn hand zeer functioneel, omdat hij thuis drinkglazen makkelijker kon afdrogen en eenvoudiger defecte onderdelen van zijn auto kon bereiken dan vóór het letsel. Samen met zijn handtherapeut besloot hij dat een teen-duim transplantatie niet geïndiceerd was.*

Dergelijke casuïstiek was de aanleiding voor het starten van het onderzoeksproject.

Dit proefschrift beschrijft de verschillende delen van het onderzoeksproject 'HandART: Hand Assessment Richtlijnen voor Therapie. De doelstelling van dit onderzoeksproject was het bereiken van consensus over welke meetinstrumenten het beste gebruikt kunnen worden voor de evaluatie van stoornissen en beperkingen bij patiënten met handletsels en handaandoeningen.

## Introductie

**Hoofdstuk 1**, de algemene introductie, benadrukt de impact van handletsels en hand-aandoeningen op dagelijkse activiteiten en de daaraan gerelateerde gezondheidszorg- en productiviteitskosten. Bij de evaluatie en behandeling van mensen met handaandoeningen kan een 'bottum-up' benadering en een 'top-down' benadering worden onderscheiden. Een 'bottum-up' benadering wordt vaak gevolgd tijdens de eerste weken na een hand-trauma of chirurgische ingreep en deze benadering is gebaseerd op een biomechanisch referentiekader. Het focus hierbij is primair gericht op het verminderen van de gebreken in de structuren en functies van de hand. Enkele weken na een handtrauma of chirurgische ingreep wordt de 'top-down' benadering meer van belang. Deze 'top-down' benadering is persoonsgericht, hetgeen wil zeggen dat de persoon centraal staat. Deze benadering richt zich op wat iemand als betekenisvol ervaart ('occupation-based'). In deze benadering bepalen de therapeut en de patiënt samen welke aspecten van de dagelijkse (zelf-verzorgings-, huishoudelijke, werk- of hobbygerelateerde) bezigheden aandacht vereisen. Om dezelfde taal en conceptuele basis te hanteren wordt multidisciplinair en internationaal de International Classification of Functioning, Disability and Health ( ICF) gehanteerd voor

de definitie en evaluatie van de handaandoeningen. Tenslotte wordt het HandART project, het onderwerp van dit proefschrift, geïntroduceerd. Dit project bestond uit verschillende voorbereidende studies die worden beschreven in deel I (literatuuronderzoek) en deel II (ICF Core Set studies) van dit proefschrift. Het belangrijkste onderdeel van het HandART project bestond uit een validatiestudie en een Delphi consensus studie. Deze worden beide beschreven in deel III.

## Deel I Literatuuronderzoek

**Hoofdstuk 2** beschrijft de literatuurstudie naar de beschikbare instrumenten die de activiteiten (beperkingen) evalueren bij mensen met handaandoeningen. Van de 72 geïdentificeerde instrumenten werden 23 instrumenten geselecteerd die voldeden aan vier vooraf gedefinieerde selectiecriteria: (1) een adequate beschrijving van de doelgroep, van de taken, en van het soort resultaten; (2) een relevante studiepopulatie, d.w.z. volwassenen met een handletsel of handaandoening; (3) minimaal 50% van de items heeft betrekking op de bovenste extremiteit; en (4) het instrument is gericht op activiteiten. De 23 geselecteerde instrumenten werden vervolgens geclassificeerd naar: (1) de specifieke componenten van de ICF die geëvalueerd werden (lichaamsfuncties, activiteiten en / of participatie); (2) het soort items waarmee activiteiten geëvalueerd werden; en (3) de manier waarop de activiteit werd geëvalueerd (door middel van een vragenlijst of functionele test). Wat beteft de evaluatie van activiteiten werden de volgende soort items onderscheiden: (a) (nauwkeurig) gebruik van arm en hand (basisvaardigheden, bijvoorbeeld: reiken, grijpen, en oppakken); (b) enkelvoudige taken (bijvoorbeeld: schrijven van een zin, inschenken van een glas water, strikken van veters); en (c) de activiteiten van het dagelijks leven (bijvoorbeeld: sturen van een brief, maken van het ontbijt, wassen en aankleden).

Op basis van een systematische review werden in **hoofdstuk 3** de klinimetrische eigenschappen beschreven van de 23 geselecteerde instrumenten die beperkingen evalueren. Vervolgens werden deze klinimetrische eigenschappen geëvalueerd met behulp van breed geaccepteerde kwaliteitscriteria. Op basis van 54 publicaties werden deze instrumenten opnieuw beoordeeld en gecategoriseerd als: a) pegboard testen die het nauwkeurig gebruik van de hand meten; b) instrumenten die het nauwkeurig gebruik van de hand meten door het oppakken, manipuleren, en plaatsen van verschillende objecten; c) instrumenten die enkelvoudige taken (en het nauwkeurig gebruik van de hand) evalueren door het scoren van taakuitvoering; en d) vragenlijsten. De beschrijving van de klinimetrische eigenschappen van de instrumenten werd in de meeste gevallen als onvoldoende beschouwd. De validiteit, betrouwbaarheid en responsiviteit werden van slechts vijf instrumenten adequaat beschreven: de Sequential Occupational Dexterity Assessment (SODA), de Carpaal Tunnel Syndroom vragenlijst voor de beoordeling van de ernst van de symptomen en functionele status, de Canadian Occupational Performance

Measure (COPM), de Disabilities of the Arm, Shoulder, and Hand Questionnaire (DASH), en de Michigan Hand Outcomes Questionnaire (MHQ). Echter, geen van de instrumenten had een positieve waardering voor alle klinimetrische eigenschappen. Het was derhalve op basis van de literatuur niet mogelijk te bepalen welke instrumenten gebruikt zouden moeten worden voor de functionele beoordeling van mensen met handaandoeningen in de klinische praktijk.

## Deel II ICF Core Set voor Handaandoeningen

**Hoofdstuk 4** begint met een systematische review bestaande uit drie stappen: stap 1 betreft de selectie van de gepubliceerde studies over handaandoeningen; stap 2 betreft de extractie van gegevens uit de geselecteerde studies; en stap 3 betreft een analyse van de inhoud van deze geselecteerde studies waarbij de ICF het referentiekader vormde. Eerst werden de uitkomstmaten die gebruikt werden in deze studies gecategoriseerd. Vervolgens werd elk onderdeel van de patiënt-gerapporteerde en behandelaar-gerapporteerde uitkomstmaten gekoppeld aan de ICF. Dit leverde 66 verschillende uitkomstmaten op, bestaande uit: 34 patiënt-gerapporteerde uitkomstmaten, 19 behandelaar-gerapporteerde uitkomstmaten, en 13 gestandaardiseerde functionele testen. Het meest gerapporteerde instrument was de DASH. De klinische kenmerken die het meest onderzocht werden waren gewrichtsmobiliteit (Range of Motion), pijn, sensibiliteit, en knijp- of grijpkracht. Aanvullend werden andere gerapporteerde resultaten, zoals zenuw-re-innervatie en spieratrofie, uit de studies geëxtraheerd.

De impact van de handaandoeningen op de gezondheid van een persoon werd weerspiegeld in het grote aantal verschillende categorieën van de ICF (n = 127) dat in deze review werd geïdentificeerd. Slechts 48 ICF categorieën (38%) waren gerelateerd aan het ICF-domein 'Activiteiten en Participatie'. Het 'nauwkeurig gebruiken van de hand' en 'hand en arm gebruik' waren de meest gekoppelde ICF categorieën in dit domein. In dit hoofdstuk werd geconcludeerd dat het focus van het onderzoek naar handaandoeningen zou moeten worden verbreed in de richting van mentale functies, autorijden, gebruik van vervoer, zelfzorg activiteiten, huishoudelijke activiteiten, en omgevingsfactoren om de impact van deze aandoeningen op de gezondheid van een individu volledig te kunnen begrijpen.

**Hoofdstuk 5** bevat een rapport van een internationale consensusconferentie over de ontwikkeling van de ICF core sets voor handaandoeningen. De resultaten uit de voorbereidende studies, met inbegrip van het systematisch literatuuronderzoek zoals beschreven in hoofdstuk 4, werden samengevoegd ten behoeve van deze consensus-conferentie. Hieraan namen 23 deskundigen vanuit verschillende disciplines uit 22 landen deel. Uiteindelijk werden twee ICF Core Sets ontwikkeld. Dit betrof:

- een *uitgebreide* ICF Core set voor Handaandoeningen bestaande uit 117 ICF categorieën, waarmee in een uitgebreide, multidisciplinaire beoordeling, rekening gehouden moet worden;
- een *beknopte* ICF Core Set voor Handaandoeningen (BICF-CS), bestaande uit een selectie van 23 ICF categorieën uit de uitgebreide ICF Core set, die beoordeeld zouden moeten worden bij elke persoon met een handaandoening, ongeacht de setting van de gezondheidszorginstelling of het aantal betrokken zorgverleners.

Beide ICF Core Sets kunnen als een klinisch kader dienen om personen met handaandoeningen uitgebreid te onderzoeken in de acute fase en eveneens in de (vroege) postacute fase.

Voor **hoofdstuk 6** werd de inhoud van 46 evaluatie-instrumenten, die binnen de handchirurgie en hand revalidatie bekend zijn, gekoppeld aan de 23 categorieën van de BICF-CS. De resultaten lieten zien dat door de geïncludeerde evaluatie-instrumenten 19 van de 23 categorieën konden worden gekoppeld. Deze resultaten zijn van belang om beslissingen te ondersteunen over welke instrumenten het meest geschikt zijn voor de beoordeling van het menselijk functioneren en de relevante omgevingsfactoren bij personen met handaandoeningen.

## Deel III COPM validatie studie en HandART Delphi-studie

Bij persoonsgerichte zorg is het van belang dat evaluatie-instrumenten uitkomsten meten die betekenisvol zijn voor mensen. Vanwege het feit dat, in dit opzicht, de meest gebruikte evaluatie-instrumenten te kort schieten, wordt in **hoofdstuk 7** de Canadian Occupational Performance Measure (COPM) onderzocht. In dit hoofdstuk wordt het onderzoek naar de constructvaliditeit van de COPM in relatie tot de DASH en MHQ beschreven bij personen met buigpeesletsel, strekpeesletsel, of de ziekte van Dupuytren. Conform de hypothese blijken de COPM scores, als gevolg van de persoonsgerichte oriëntatie van dit instrument, slechts matig te correleren met de totaalscores van de DASH en de MHQ. De correlatie tussen de DASH en MHQ was hoger ($r_p$ 0.60) dan de correlatie tussen de COPM-uitvoeringsscore en de DASH of de MHQ ($r_p$ <0.51). Er werd, eveneens in de lijn van verwachting, slechts een zwakke correlatie gevonden tussen de COPM, DASH en MHQ enerzijds en handfunctiestoornissen anderzijds ($r_p$ <0.46). De resultaten van deze studie ondersteunen de veronderstelling dat de COPM additionele informatie geeft over beperkingen in activiteiten in vergelijking met gevestigde patiënt-gerapporteerde meetinstrumenten met vooraf gedefinieerde items, zoals de DASH en de MHQ, bij personen met buigpeesletsel, strekpeesletsel, of de ziekte van Dupuytren.

**Hoofdstuk 8** beschrijft de HandART Delphi-studie die gericht is op het bereiken van consensus over welke instrumenten moeten worden gebruikt voor de functionele evaluatie van patiënten met handaandoeningen. Dertig experts van de Europese verenigingen voor handtherapie, handchirurgie, en revalidatiegeneeskunde namen hieraan deel. Hiertoe werden 13 ICF categorieën voorgeselecteerd binnen de ICF domeinen 'Lichaamsfuncties' en 'Activiteiten en Participatie'. Hiervoor werden alle beschikbare instrumenten gepresenteerd gebaseerd op de resultaten uit hoofdstuk 6. De deelnemers werd gevraagd om voor elke categorie aan te geven of deze categorie zou moeten worden geëvalueerd en tevens voor elk instrument of dit voor die specifieke categorie zou moeten worden opgenomen in de *HandART Core Set* van instrumenten om lichaamsfuncties, activiteiten en participatie te evalueren.

Het responsepercentage was hoog en varieerde van 90 tot 93%. In de eerste ronde werden alle 13 vooraf geselecteerde ICF categorieën als relevant beschouwd door de deelnemers. Na drie rondes werd, gebaseerd op minimaal 75% overeenkomst, voor negen categorieën consensus bereikt over welke evaluatie-instrumenten gebruikt zouden moeten worden bij mensen met handaandoeningen. De geselecteerde instrumenten waren: de Textuur en Vorm Identificatie-test (STI), de Semmes Weinstein Monofilament Test (SWMT), en de Cold Intolerance Symptom Severity vragenlijst (CISS) om de categorie 'Tast-functie' en 'Sensorische functies gerelateerd aan temperatuur en andere stimuli' ( ICF B265 en B270) te evalueren; de Visuele Analoge Schaal voor pijn (VAS) om 'Sensatie van de pijn' (ICF b280) te evalueren; de Goniometer om 'Mobiliteit van gewrichtsfuncties' te beoordelen (ICF b710); de Jamar Dynamometer en het Pinch Gauge apparaat om 'Spierkracht' (ICF b730) te evalueren; en de COPM en de DASH om andere ICF categorieën (D230, D430, D445, d6, d840 tot D859) te evalueren.

Als resultaat van dit HandART project, in het bijzonder de HandART Delphi-studie, is voor 4 ICF categorieën met betrekking tot 'Lichaamsfuncties' en 5 ICF categorieën met betrekking tot 'Activiteiten en Participatie' consensus bereikt over welke instrumenten zouden moeten worden geselecteerd voor de *HandART Core Set*.

In de discussie in **hoofdstuk 9** komt een aantal onderwerpen aan bod. Allereerst wordt beschreven op welke wijze de resultaten van de voorbereidende studies en de resultaten van de Delphi studie zich tot elkaar verhouden. Vervolgens wordt ingegaan op de vraag of en op welke manier de resultaten van het HandART-project een persoonsgerichte klinische praktijk ondersteunen in de handtherapie. Aansluitend komt aan bod waarom de COPM past bij een persoonsgerichte werkwijze. Er worden suggesties gedaan op welke manier evidence-based practice in handtherapie verbeterd zou kunnen worden.

Tot slot worden de beperkingen van dit HandART-project beschreven en aanbevelingen gedaan voor de toekomst.

# LIST OF ABBREVIATIONS

| | |
|---|---|
| ADLs | Activity of Daily Living |
| AHFT | Arthritis Hand Function Test |
| AROM | Active Range Of Motion |
| AUC | Area Under the Curve |
| AUSCAN | Australian/Canadian Osteoarthritis Hand Index |
| BBT | Box and Block Test |
| BICF-CS | Brief ICF Core Set for Hand Conditions |
| CICF-CS | Comprehensive ICF Core Set for Hand Conditions |
| CISS | Cold Intolerance Symptom Severity Questionnaire |
| COPM | Canadian Occupational Performance Measure |
| COPM-P | Canadian Occupational Performance Measure -Performance score |
| COPM-S | Canadian Occupational Performance Measure -Satisfaction score |
| DASH | Disabilities of the Arm, Shoulder, and Hand Questionnaire |
| EFSHT | European Federation of Societies for Hand Therapy |
| EN | Ergotherapie Nederland (Dutch Association of Occupational Therapists) |
| ES | Effect Size |
| FDT | Functional Dexterity Test |
| HFS | Subjective Hand Function Scoring System |
| ICC | Intraclass correlation coefficient |
| ICF | International Classification of Functioning,Disability and Health |
| JTHF | Jebsen-Taylor Test of Hand Function |
| MHQ | Michigan Hand Outcomes Questionnaire |
| MIC | Minimal Important Change |
| MMDT | Minnesota Manual Dexterity Test |
| MPQ | McGill Pain Questionnaire |
| MPUT | Moberg Pick Up Test |
| NHPT | Nine-Hole Peg Test |
| PEM | Patient Evaluation Measure |
| PPT | Purdue Pegboard Test |
| PRWHE | Patient Rated Wrist/Hand Evaluation |
| RIHM | Rotterdam Intrinsic Hand Myometer |
| ROC | Receiver Operating Characteristics |
| RR | Responsiveness Ratio |
| RST | Radboud Skills Test |
| SDC | Smallest Detectable Change |
| SEM | Standard Error Of Measurement |
| SHAP | Southampton Hand Assessment Procedure |
| SHFE | Smith Hand Function Evaluation |
| SHFT | Sollerman Hand Function Test |
| SODA | Sequential Occupational Dexterity Assessment |
| SRM | Standardized Response Mean |
| STI | Shape Texture Identification Test |
| SWMT | Semmes Weinstein Monofilament Test |
| TAM | Total Active Motion |
| TEMPA | Test d'Evaluation des Membres Supérieurs de Personnes Agées / Upper Extremity Performance Test for Elderly |
| 2PD | Two-Point Discrimination Test |
| 2PD-S | Static Two-Point Discrimination Test |
| 2PD-M | Moving Two-Point Discrimination Test |
| UEFS | Upper Extremity Functional Scale |
| UEFT | Upper Extremity Function Test |
| VAS | Visual Analogue Scale |

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Tja, dit is het dan: "het boekje" waar ik de afgelopen jaren aan gewerkt heb. Tussen de dagelijkse werk- en gezins-bedrijven door.

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**Joep.**
Je hebt me altijd gesteund in datgene wat ik doe. You're the best.

## CURRICULUM VITAE

Lucelle van de Ven-Stevens heeft haar gymnasium-B diploma behaald aan het Boschveld-college te Venray. Tijdens de opleiding Ergotherapie te Hoensbroek (Heerlen) is zij geinteresseerd geraakt in de handtherapie. Zij heeft 2 jaar gewerkt op de revalidatie-afdeling in St. Maartens Gasthuis (thans VieCuri) te Venlo. Vervolgens is zij op de afdeling ergotherapie van het Radboudumc gaan werken, vanaf 2007 onderdeel van de interdiscplinaire afdeling Revalidatie, waar zij altijd gestreefd heeft naar een combinatie van de drie kerntaken patientenzorg, onderzoek en onderwijs; bij aanvang deels, maar al snel fulltime, op het gebied van handtherapie. Sinds 2010 heeft zij het certificaat handtherapeut (CHT-NL) van de Nederlandse Vereniging voor HandTherapie (NVHT).

Naast haar baan heeft zij de studie gezondheidswetenschappen (richting bewegingswetenschappen) in Maastricht in 1998 cum laude afgerond. Tevens is zij geregistreerd als epidemioloog-A.

In het Radboudumc heeft zij, naast patientenzorg, aan diverse (onderzoeks-)projecten meegewerkt en was zij mede-initiatiefnemer van het Nijmeegs Universitair Handen Team (NUHT). Tevens heeft zij lessen verzorgd aan diverse post-HBO opleidingen Handtherapie en cursussen, op het gebied van onder andere de klinimetrie, peesletsels, sensibiliteitsonderzoek/zenuwletsels, hand spalken, en Complex Regionaal Pijn Syndroom type I (CRPS- I). Ook heeft zij tijdens diverse ergotherapie-congressen en handtherapie-congressen, zowel nationaal als internationaal, regelmatig presentaties gegeven.

Zij is altijd actief geweest voor de Nederlandse Vereniging voor HandTherapie (NVHT) als commissielid en/of bestuurslid. Zij was mede-initiatiefnemer van het inmiddels internationaal erkende 'Hand Therapist Profile' en het daarbij behorende Nederlands certificeringstraject, en zij is mede-auteur van het 'Profiel Specialisatie Hand-ergotherapeut'. Tevens is zij actief betrokken bij de European Federation of Societies for Hand Therapy (EFSHT) (Education Committee (waarnemend) en Scientific Committee) en de International Federation of Societies for Hand Therapy (IFSHT) (Education Committee).

Sinds 2013 werkt Lucelle bij de beroepsvereniging Ergotherapie Nederland in de functie van beleidsmedewerker. Naast deze baan heeft zij haar promotie afgerond.

## ABOUT THE AUTHOR

Lucelle van de Ven Stevens graduated from high school at the Boschveld College in Venray (Gymnasium-B). During the Occupational Therapy educational programme at Hoensbroek (Zuyd University, Heerlen) she got interested in hand therapy. She worked for two years at the rehabilitation department of St. Maartens Gasthuis (nowadays VieCuri) in Venlo. Subsequently, she worked at the department of Occupational Therapy of the Radboud University Medical Center, since 2007 part of the interdisciplinary department of Rehabilitation, where she always aimed to combine patient care, research and education; at first part-time, but soon full-time, in hand therapy. Since 2010 she has got the Dutch certificat of hand therapist (CHT-NL) of the Dutch Society for Hand Therapy (NVHT).
Next to her job she finished the part-time study Health Sciences (track Human Movement Sciences) in Maastricht (with honor) in 1998. She is also registered as an epidemiologist-A. In the Radboud University Medical Centre she cooperated in several (research) projects and she was one of the initiators of the Nijmegen Academic Team for Hand Conditions (NUHT). She was also lecturer at several post-graduate courses in Hand Therapy and gave lessons in areas such as clinimetrics, tendon injuries, assessment of sensory functions - nerve injuries, hand splinting, and Complex Regional Pain Syndrome type I (CRPS I). During Occupational Therapy congresses and Hand Therapy congresses, nationally as well as internationally, she has given presentations regularly.
She has always been actively involved in the Dutch Society of Hand Therapy as a committee and / or board member. She was co-initiator of the internationally recognized 'Hand Therapist Profile' and the related Dutch certification process, and also co-author of the 'Profile Specialization Hand-Occupational therapist'. She is also actively involved in the European Federation of Societies for Hand Therapy (EFSHT) (Education Committee (ad interim) and Scientific Committee) and the International Federation of Societies for Hand Therapy (IFSHT) (Education Committee).
Since 2013, she works at the Dutch Association of Occupational Therapy (Ergotherapie Nederland) as Pollicy Officer. Alongside this job, she has finished her PhD thesis.

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No pain
Worst pain
maginable
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