

Shoulder pain within the ICF framework;

patient experiences of functioning and assessment methods



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- I Roe Y, Soberg HL, Bautz-Holter E, Ostensjo S: A systematic review of measures of shoulder pain and functioning using the International Classification of Functioning, Disability and Health (ICF). *BMC Musculoskeletal Disorders* 2013, 14:73.
- II Roe Y, Bautz-Holter E, Juel NG, Soberg HL: Identification of relevant International Classification of Functioning, Disability and Health categories in patients with shoulder pain: A cross-sectional study. *Journal of Rehabilitation Medicine* 2013, 45(7):662-669.
- III Roe Y, Ostensjo S, Bautz-Holter E, Juel NG, Engebretsen K, Soberg HL: Do the current measures of shoulder pain match patient-reported problems in functioning? A comparison based on the ICF. *Disability and Rehabilitation*, under review Sept. 2013.
- IV Roe Y, Haldorsen B, Svege I, Bergland A: Development and Reliability of a Clinician-rated Instrument to Evaluate Function in Individuals with Shoulder Pain: A Preliminary Study. *Physiotherapy Research International* 2013, 28(10).

ABSTRACT

Introduction: Shoulder pain is a common, persistent and disabling disease. The restoration of abnormal movement-patterns is often an important goal in the treatment of patients with shoulder pain. The International Classification of Functioning, Disability and Health (ICF) is a conceptual framework and classification that has been developed by the World Health Organisation. The ICF is a common, multi-disciplinary language that allows identification of condition-specific codes (ICF categories), comparison between patient-experiences of functioning and assessment tools and development of new measures.

Aims: The aims of this thesis are to identify the ICF categories that reflect the concepts used in assessment of shoulder pain and identify the ICF categories that reflect problems related to functioning and interactions with the environment in patients with shoulder pain. As an extension of this aim, whether patient experiences of functioning are captured by the present assessment tools is also investigated. Moreover, the ICF categories that reflect the patient-experiences of functioning and the content of the assessment tools are used to create a preliminary list of ICF categories for shoulder pain. Finally, a clinician-rated activity measure to capture abnormal movement patterns in the upper extremities is developed and tested.

Methods: The present work is based on three studies: a literature review of measures, a cross-sectional study with patient interviews and a test-retest study. In addition, the datasets from the literature review of measures and the cross-sectional study with patient interviews constitute the material used for the comparison of the patient-experiences of functioning and the content of measures, and for the development of a preliminary list of ICF categories for shoulder pain. In the literature review, articles that were written in English, published in peer-reviewed journals and based on clinical studies that included patients with shoulder pain aged 18 years and older were included. Studies on patients with fractures, joint replacement, complete dislocation, malignant condition, rheumatic diagnosis and stroke were excluded. The measures extracted from the articles were linked to ICF categories according to standardised rules. The frequency of the identified ICF categories was calculated and reported for categories with a frequency of at least 1%. In the cross-sectional study, patients in the outpatient clinic at the Department of Physical Medicine and Rehabilitation, Ullevaal University Hospital, were included. The inclusion and exclusion criteria were similar to those in the literature review. The patients were interviewed with a condition-adapted ICF checklist that contained 154 categories. The presence of a functional problem or environmental factor according to these ICF categories was registered. The ICF categories that were registered with a frequency of at least 5% were reported. The correspondence between these two datasets was investigated using the following criteria: (1) categories included in both

datasets with similar rankings, (2) categories included in both datasets with different rankings, and (3) categories included in only one of the datasets. In addition, the match between high frequent patient-derived ICF categories (reported by $\geq 50\%$) and the content of frequently cited condition-specific measures (identified with ≥ 10 citations) was investigated. The preliminary list of ICF categories for shoulder pain was constituted from all the ICF categories that were reported in the cross-sectional study with patient interviews and the literature review of measures. Finally, a simple, clinician-rated activity measure was developed and reliability tested. The development process was based on identification of eligible items in the literature, pilot-testing and statistical analyses. The test-retest study was conducted at the Department of Physiotherapy at Martina Hansens Hospital, Baerum. Patients aged 18 years and older with a main diagnosis of subacromial impingement syndrome were included. The exclusion criteria were similar to those from the literature review and the cross-sectional study. Item-reduction was based on item-to-sum correlations. In the further testing of the final scale, inter- and intra-rater reliability were calculated with the Interclass Correlation Coefficient (ICC) and a 95% Confidence Interval (CI). The minimal detectable change was calculated from the standard error. The content of the scale was linked to ICF categories according to the established rules.

Results: In the literature review, 40 ICF categories were identified in 475 measures. Of these, 28 belonged to activities and participation, 11 to body functions and structures and 1 to environmental factors. In the cross-sectional study with patient interviews, 165 patients with a mean age of 46.5 years (SD = 12.5) were included. A total of 61 ICF categories were identified. Of these, 19 covered body functions and structures, 34 activities and participation, and 8 environmental factors. The correspondence between the two datasets was high for activities and participation, and lower for body functions and structures and environmental factors. In particular, patient-derived mental- and muscle body functions and environmental social support were not present in the measures. Moreover, 6 high frequent patient-derived categories are not matched by the content of any of the most frequently selected condition-specific scales. The American Shoulder and Elbow Surgeons Standardized Form for Assessment of the Shoulder (ASES) and the Disability of the Arm, Shoulder and Hand (DASH) scale match the highest number of high frequent patient-derived categories. The preliminary list of ICF categories for shoulder pain contains a total of 68 second-level ICF categories. Of these more than half belong to activities and participation. In the test-retest study, a total of 63 patients, aged 53.3 (SD = 12.9) and diagnosed with subacromial impingement syndrome, were included. A clinician-rated activity measure, the Shoulder Activity Scale, with 3 items and a summed score ranging from 3 to 15 was developed. The inter-rater reliability and test-retest reliability were ICC = 0.80 (95% CI = 0.51 - 0.90) and ICC

= 0.74 (95% CI = 0.58 - 0.84), respectively. The minimal detectable change of the scale was calculated as 3.32. The scale covers the ICF categories *lifting and carrying objects* (d430), *dressing* (d540), *hand and arm use* (d445) and *control of voluntary movement* (b760).

Conclusions: The patient experiences of shoulder pain are multi-faceted, covering the ICF body functions sensation of pain, movement-related functions and mental functions and the activity and participation functions mobility, self-care, domestic life, interpersonal interactions and relationships, work and leisure activities. Except for social support from immediate family and friends, environmental factors were scarcely represented. The assessments of patients with shoulder pain only partially capture the patient experiences of functioning and there is large variation in the content of condition-specific measures. These findings have implications for clinicians and researchers in the selection of measures. The Shoulder Activity Scale is a simple and reliable measure that fills a gap in the assessment of patients with shoulder pain. Before it is applied in clinical settings, it needs to be validated. For the first time, a preliminary list of ICF categories for shoulder pain is presented. The preliminary list should be further developed with contributions from qualitative patient interviews, an expert survey and a formalised decision process.

ABBREVIATIONS

ASES	=	American Shoulder and Elbow Surgeons Standardized Form for Assessment of the Shoulder.
Constant	=	Constant-Murley Shoulder Score.
DASH	=	Disability of the Arm, Shoulder and Hand Scale.
ICD	=	International Statistical Classification of Diseases and Related Health Problems.
ICF	=	International Classification of Functioning, Disability and Health.
ICIDH	=	International Classification of Impairments, Disabilities and Handicaps.
OSS	=	Oxford Shoulder Score.
Rowe	=	Rating Sheet for Bankart Repair.
SDQ	=	Shoulder Disability Questionnaire.
SF-36	=	Medical Outcomes Study 36-item Short-Form Health Survey.
SPADI	=	Shoulder Pain and Disability Index.
SRQ	=	Shoulder Rating Questionnaire.
SST	=	Simple Shoulder Test.
UCLA	=	University of California at Los Angeles Shoulder Rating Scale.
WHO	=	World Health Organization.
WORC	=	Western Ontario Rotator Cuff Index.

1. INTRODUCTION

This thesis is based on four papers that have been published in peer-reviewed journals or are currently under review. Furthermore, some additional aspects are elaborated, such as the definition of shoulder pain from a bio-psycho-social perspective and future trends within the field of shoulder pain rehabilitation.

The main focus of this thesis is on patients with shoulder pain and the measures used in assessment of the condition. Shoulder pain is a disabling condition that interferes considerably with daily life. Despite this fact, little research has been carried out within a bio-psycho-social context and few measures seem to have included a bio-psycho-social viewpoint.

To investigate the disability in patients from a bio-psycho-social perspective, the International Classification of Functioning, Disability and Health (ICF) can be used as a framework. The ICF can also be used to provide an overview of the content in measures and thus provides the ground for objective comparisons of different measures and/or patient experiences of functioning. Further, it can be used as a basis for development of new measures. Despite its potential, the ICF has been scarcely applied within the field of shoulder pain rehabilitation.

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

1.1.1 History and theoretical underpinnings

Collection of reliable information about the health of populations is one of the key roles of the World Health Organization (WHO) [1]. To meet the demand for information and statistics about non-fatal health outcomes, the WHO launched the International Classification of Impairments, Disabilities and Handicaps (ICIDH) in 1980 [1]. The use of a language that suggested a causal relationship between handicap, disability and impairment in the ICIDH was heavily criticised. Due to this, there was no way the user was able to record whether an improvement in the patients' function was a result of rehabilitation or changes in the physical or social environment. With the assistance of collaborating centres in Holland, France, North America, and the Nordic countries, the WHO began the process of revising the ICIDH in 1993. A preliminary alpha draft was finalised for expert review by May 1996, and a second

beta draft was finalised and prepared for further field testing in 1997. As a result of the revision, the International Classification of Functioning, Disability and Health (ICF) was endorsed in May 2001 [2]. The ICF is currently a member of the WHO's family of classifications: The International Classification of Diseases (ICD) provides the codes for mortality and morbidity whereas the ICF provides codes for the complete range of human functioning and environmental factors [1, 3].

Although the need for a commonly agreed upon framework for functioning and disability is widely acknowledged, the theoretical underpinnings of the ICF are debated [4]. First, bio-psycho-social theory has been characterised as an integration of medicine into a holistic framework; i.e., to include the psychosocial, without sacrificing the enormous advantages of the biomedical approach [5]. However, the contribution of the bio-psycho-social perspective in the development of disability theory has been scarce [4]. Second, the ICF states that the presence of impairment does not indicate that a disease is necessarily present or that the individual should be regarded as sick [2]. Disability is defined as interactions between biology, personal factors and broader environmental constraints [4]. Nevertheless, at the level of body functions and structures, the ICF defines impairment as a significant deviation or loss from established statistical norms [2]. Thus, impairment according to the ICF is a pre-social, biological and bodily difference. Third, the principle of universalism that was already embodied in the ICIDH originates from the understanding that functioning and disablement are understood as co-equal aspects of health, rather than polar opposites [6]. Universalism is secured because the classifications of disablement are etiologically neutral. The principle of universalism has been criticised by the social sciences because it implies the rejection of a separate vocabulary, distinctive for a minority of people with a specific social status [6].

1.1.2 Conceptual framework and classification

The ICF consists of a conceptual framework and a classification [2]. The conceptual framework consists of two parts, functioning and disability, and contextual factors. Functioning and disability contains the components body functions and structures, and activities and participation. Body functions are the physiological functions of body systems (including psychological functions). Body structures are anatomical parts of the body, such as organs, limbs and their components. Activities are the execution of tasks or actions by an individual and participation is involvement in a life situation. The contextual factors consist of the components environmental factors and personal factors. The environmental factors make up the physical, social and attitudinal environment, in which people live and conduct their lives. Personal factors are the particular background of an individual's life and living. In the ICF, individuals' functioning in a domain is an interaction or complex relationship between the

health condition and contextual factors (Figure 1). The contextual factors interact with the individual with a health condition and determine the level and extent of the individuals' functioning.

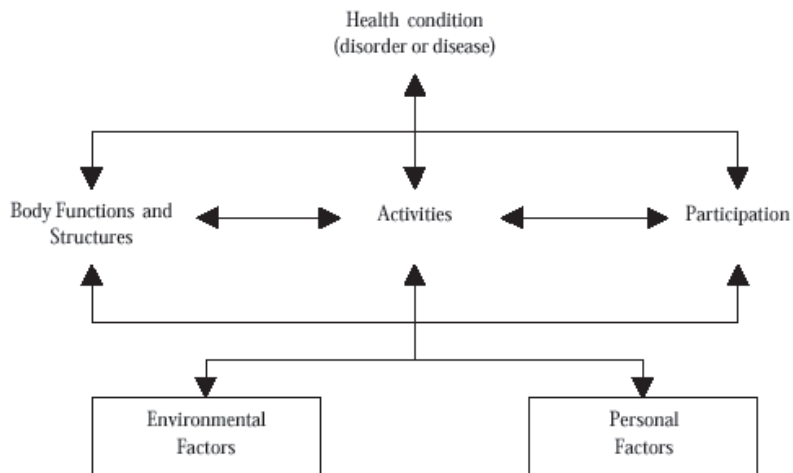


Figure 1. Interactions between the components of the ICF

The ICF also contains a detailed classification of body functions and structures, activities and participation and environmental factors, whereas personal factors are not classified. The classification is organised in a hierarchical structure, with components, chapters and categories [2]. Each category has a letter that refers to the component and a number referring to the domain and level of precision. For example, combing ones hair is classified by the third-level category *caring for hair* (d5202), belonging to the second-level *caring for body parts* (d520) in the self-care chapter (d5) of the activities and participation component (d). For the body functions, the letter that refers to the component is “b”, for body structures “s” and for the environmental factors “e”. The structure of the ICF is generic, meaning that a category is always derived from the overlying domain and components.

The ICF has an inbuilt five-point ordinal scale to rate the magnitude of functional problems or influence of environmental factors [2]. The problems are denoted as impairments in body functions and structures, activity limitations and participation restrictions. Environmental

factors are either barriers or facilitators of functioning. In addition, within activities and participation, there is a distinction between performance which refers to what an individual does in his or her current environment, and capacity, which is the maximum physiological level of an individual in a standardised environment.

1.1.3 ICF Core Sets for specific conditions or settings

The full version of the generic ICF classification contains more than 1400 categories. To improve its feasibility in clinical settings, identification of setting- or condition-specific categories has been suggested as the first step [7]. To achieve this, specific linking rules have been developed to transform information about functioning, into the ICF language [8, 9]. The most comprehensive overview of a condition or setting within the ICF framework is provided with an ICF Core Set. An ICF Core Set is a list of ICF categories, usually at the second level, that includes as few categories as possible to be practical, but as many as necessary to describe the typical spectrum of problems in the functioning of patients with a specific condition [10, 11]. The ICF Core Sets exist in a brief version for patients in a particular clinical study and in a comprehensive version for multidisciplinary assessment in clinical practice and research [10]. The development processes for an ICF Core Set is based on four studies: a literature review of measures, a cross-sectional study with patient interviews, a qualitative study with patient interviews and a global expert survey [10]. After these initial studies, a consensus conference is conducted to decide which ICF categories that should be implemented in the ICF Core Set. Based on these decisions, a tentative ICF Core Set is presented. According to the WHO, the tentative ICF Core Sets need to be further validated in clinical studies.

Since 2004, ICF Core Sets for musculoskeletal conditions have been developed. These are: low back pain, osteoarthritis, osteoporosis, rheumatoid arthritis, chronic widespread pain and ankylosing spondylitis [12-17]. A review that compared five of these musculoskeletal ICF Core Sets indicated that they had a number of commonalities, although some particular condition-specific differences were identified [18].

1.1.4 The Generic ICF Core Set

In a cross-sectional, multi-centre study, a generic ICF Core Set to describe and compare functioning across health conditions was developed [19]. The generic ICF Core Set contains the body functions *energy and drive* (b130), *emotional functions* (b152) and *sensation of pain* (b280), and the activity and participation categories *carrying out daily routine* (d230), *walking* (d450), *moving around* (d455) and *remunerative employment* (d850).

1.1.5 Application of the ICF in rehabilitation

Several attempts have been made to create an interface between the ICF and clinical practice [20-22]. Content analyses of measures within the ICF framework have been considered an important step in this work. Currently, content overviews of a number of measures that commonly used in assessments of musculoskeletal conditions, are available [8, 9, 23-26]. Content analyses of measures within the ICF framework provide useful information for clinicians in the selection of measures and should enhance debates among clinical experts and researchers [27-29].

In an on-going initiative from the Orthopaedic section of the American Physical Therapy Association, evidence-based practice guidelines are developed for musculoskeletal conditions commonly managed by physical therapists, such as adhesive capsulitis of the shoulder, low back pain and neck pain [30-32]. In these guidelines, the ICF is used to classify and define the conditions.

The WHO has advocated the joint use of the International Statistical Classification of Diseases and Related Health Problems (ICD) and the ICF in rehabilitation [2, 3, 21]. The main challenge has been the lack of alignment of concepts and terminology [33]. In the current revision process of the ICD-10 that will be finished in 2015, so-called functional properties are implemented within some health conditions [3, 34]. These functional properties are reworded ICF categories for activities and participation that have been collected from the WHO Disability Assessment Schedule 2.0, the World Health Survey, the condition- or setting-specific ICF Core Set and the generic ICF Core Set [33].

In Norway, the Directorate of Health has taken the initiative to implement the ICF in the health care system within certain fields [35, 36]. The Directorate has stated that future implementation is dependent on further development and testing of the ICF Core Sets.

1.2 Shoulder pain

Shoulder pain is characterised by restricted and painful movement of the arm, which results in difficulties in performing movement-related activities. In recent decades, research has shown that psychological and social functioning may also be affected by shoulder pain; additionally, environmental factors may contribute to the development or persistence of the condition. The main focus of this section is to provide an overview of the current knowledge

about shoulder pain and how the condition affects functioning. In addition, the different types of generic and condition-specific measures that are available are presented, within the conceptual framework of the ICF.

1.2.1 Prevalence, incidence, clinical course and classification

The prevalence of shoulder pain in the general population was estimated to be 7 - 27% in adults younger than 70 years and 13.2 - 26% for adults older than 70 in a previous review [37]. The wide range of prevalence estimates was explained by differing definitions of the condition in studies [37]. A more recent review on upper-extremity disorders, found that the point prevalence estimates varied between 1.6 and 53% [38]. The authors of this review warned that health professionals and policy makers should be aware of the lack of a commonly agreed on method to measure the occurrence of the conditions in populations [38].

The influence of different case-definitions for self-reported shoulder pain was demonstrated in a study that looked at the prevalence of shoulder pain in general practice [39]. With a case definition based on the question “during the past month, have you experienced pain in your shoulder(s) lasting more than 24 hours?”, the prevalence was 51%. When the definition was limited to current symptoms and at least one item in a disability questionnaire being answered positively, the prevalence was restricted to 20% [39]. The authors suggested that the latter case-definition excluded minor episodes of shoulder pain [39]. Few studies have reported the incidence of shoulder pain; in the general population, it has been reported to be 0.9% for those aged 31 - 35 years, 2.5% for 42 - 46 years, 1.1% for 56 - 60 years, and 1.6% for those aged 70 - 74 years [40].

According to gender differences, a study on musculoskeletal complaints in a Norwegian county, found that 56.2% of the women and 36.5% of the men (n = 2740) reported shoulder pain within the last 12 months [41]. In this study shoulder pain was the fourth most frequent complaint after low back pain, neck pain and headache. [41]. The gender difference was consistent with the findings in a Swedish study, in which the prevalence of self-reported neck, shoulder and arm pain rose slightly, from 22.8 to 25.0% among females and from 12.8 to 15.4% among males over a 16 year period from 1990 to 2006 [42]. Interestingly, the prevalence estimates peaked in 2002 and decreased between 2002 and 2006 [42]. The authors, however, warned that it was too early to draw definite conclusions about a decrease in prevalence of shoulder pain [42].

Many cases of shoulder pain are long-lasting; only one in five new episodes had resolved completely six months later and half had not resolved after 18 months in a prospective cohort

study in primary care [43]. In another study in general practice, 41% of the patients presenting symptoms of shoulder pain showed persistent symptoms after 12 months and only 23% had recovered after 1 month [44].

The classification systems for shoulder pain have been criticised for being focused on pathological findings, having overlapping diagnostic categories and for having conceptual inconsistencies [45-50]. Because legitimate debate persists over the aetiology, pathogenesis, anatomy and pathophysiology of shoulder pain, it has been suggested that recognition of abnormal movement-patterns should be implemented in the classification systems of shoulder pain [51, 52].

1.2.2 Subjective experiences of functioning

In the rehabilitation of patients with shoulder pain, the patient experiences of functioning are considered vital. Patient-reported measures are often used as the primary outcome to evaluate treatment interventions [45, 53]. To date, few studies have provided comprehensive overviews of the disability associated with shoulder pain from the perspective of the patients.

In a cross-sectional study of the health status in 544 patients with five shoulder pain diagnoses, self-reported health and functioning measured by the Medical Outcomes Study 36-item Short-Form Health Survey (SF-36) were compared with U.S. general population norms [54]. Statistical differences were found according to physical functioning, role-physical, bodily pain, social functioning, role-emotional, and the physical component summary score [54]. In a register-study comprising 2674 patients with 16 common shoulder diagnoses, substantial deficits in range of motion, muscle strength, activity performance and general comfort were identified as the most common types of disability [55].

A number of studies have investigated limited aspects of the disability, such as mental health, work and employment. In a community-based sample of 142 patients who had visited their general practitioner with chronic shoulder pain, 69% reported that they slept less well because of their shoulder, 54% had problems in carrying objects and 46% had problem reaching for objects [56]. The predictive value of psychological factors was investigated in a cohort study on 443 patients who consulted their general practitioner with neck or shoulder pain and disability. Symptom characteristics, socio-demographic and psychological factors, social support, physical activity, general health, and comorbidity were investigated at baseline [57]. Less vitality, more worrying, duration of the symptoms before consulting the general practitioner and a history of neck or shoulder symptoms were consistently associated with poorer outcome of the condition after 3 and 12 months [57]. Another study on 587 primary care patients with new episodes of shoulder pain or low back pain, found that the

psychological factors were more strongly associated with persistent pain and disability after 3 months in patients with low back pain than in those with shoulder pain [58].

Shoulder pain is a common cause of work-absenteeism, accounting for approximately 18% of the sick-leave benefit claims in Sweden [59]. In a Norwegian study on middle-aged cohorts, participants were asked whether they had experienced any of 11 common health problems in the past month, and whether they considered these to be work-related [60]. Of the, 8594 (33%) that responded, pain in the neck/shoulders was the most frequently reported complaint [60]. Approximately two-thirds reported that the neck/shoulder problem was work-related [60]. Considerable research has been devoted to the identification of risk factors for the development or maintenance of shoulder pain [61]. The effect of individual characteristics and physical and psychosocial workplace factors on neck/shoulder pain was investigated in a cross-sectional study on 3123 workers from 19 plants [62]. The strongest self-reported risk factor was high job demands [62]. In a study on social support, job strain and musculoskeletal pain among female health care personnel, symptoms in the shoulder and neck were found to be significantly related to social support at work [63]. By contrast, symptoms of low back pain were significantly related to job strain [63].

Shoulder pain seems to have been little investigated in qualitative studies. In a study on 24 patients with upper extremity disorders, participants were asked how they interpreted the question “are you better?” [64]. Based on the qualitative analyses, the authors concluded that the interpretation of functional recovery seemed to differ largely among individuals and in some cases improvement did not seem to be linked to changes in the symptoms or function [64].

Disability assessed with patient-reported measures has been found to be higher in subjects with additional diseases or symptoms that cause discomfort in the chest region [65]. Two other studies found that additional pain or symptoms in other body regions were predictive for higher disability levels among the patients [66, 67].

1.2.3 Assessment of body functions and structures

In the ICF, body functions and structures are the physiological functions (including psychological functions) and the anatomical parts of the body [2]. The component covers chapters such as pain, neuromuscular and movement-related functions and mental health.

Traditionally, the physical examinations of movement-related functions and pain intensity have been a cornerstone in assessment of patients with shoulder pain [25, 68-70]. A number of condition-specific single-item measures (physical examination tests) are used in the

clinical decision-making [69, 70]. In addition to these tests, the physical examination of patients is covered by the content of condition-specific multi-item measures that either contain a combination of physical examination sections and patient-reported sections (composite scales) or are completely patient-reported [45, 68, 71].

The aim of treatment interventions in patients with shoulder pain often is to restore movement patterns in the upper extremities [72-74]. Within the field of shoulder pain, there are few clinical measures available that cover observation of movement patterns. In research laboratories, movement patterns have been studied by electromyography [75-81].

In the ICF, mental health functions are classified within body functions. Sleeping problems are common among patients with shoulder pain, and items referring to sleep are integrated in several condition-specific measures [26, 55, 68]. It is a matter of controversy whether the other aspects of mental health or general health should be incorporated in assessment of shoulder pain [82, 83].

The structural deficits in the shoulder-joint area have historically been a major clinical research focus. Ruptures in the supraspinatus tendon were first described in a study from 1834 and several later studies from the early days of modern orthopaedic surgery [84, 85]. In current practice, structural deficits are investigated with plain radiography, magnetic resonance imaging, ultrasonography and direct clinical or surgical observations [86]. The interpretation of structural impairments with respect to functioning is controversial and it has been outlined that it is imperative that magnetic resonance imaging is only used with clear indications and when the results are expected to alter the clinical management [87].

1.2.4 Assessment of activities and participation

Activities are the execution of a task or action by an individual and participation is involvement in a life situation [2]. The component covers domains such as mobility, self-care, interpersonal interactions/relationship, employment and leisure activities.

In assessment of shoulder pain, limitations or restrictions in activities and participation are often covered by patient-reported sections in the condition-specific multi-item measures [25, 26]. It has been a source of controversy among researchers and clinical experts, whether the content of these measures should be targeted to movement functions and pain, or incorporate general aspects of functioning [82, 88, 89]. Although the measurement properties of these measures have been extensively reviewed, scarce attention has been paid to the content of the measures [90-95].

Concepts referring to working performance are often incorporated in condition-specific measures [59, 60]. While some of the measures only address work in a single item, others provide complete sections on work [68, 96]. In addition, concepts reflecting interpersonal interactions/relationships was identified in the content of a condition-specific multi-item measure that was linked to the ICF [26]. Due to the significant disability associated with shoulder pain, a combination of condition-specific and generic measures of general health have been recommended for the assessments [54, 55, 97, 98]. Previously published content analyses of the Medical Outcomes Study 36-item Short-Form Health Survey (SF-36) and five other general health measures, show that much of their content cover the activities and participation component of the ICF [23].

Emerging evidence indicates that clinician-rated measures cover different constructs than the patient-reported measures [99-103]. The need for clinician-rated measures that cover activity limitations in patients with shoulder pain has been advocated [25].

1.2.5 Assessment of environmental factors

The environmental factors of the ICF cover products, technology, social support/relationships and attitudes [2]. According to the ICF, the environmental factors are potential facilitators or barriers of functioning [2]. The shoulder pain rehabilitation research has mostly been devoted to the identification of risk factors in the working environment [61, 62, 104-111]. Based on this scarce research, we did not expect that concepts reflecting environmental factors were frequent in measures used for assessment of shoulder pain.

2. AIMS OF THE PROJECT

The purpose of this thesis was to present a comprehensive picture of shoulder pain within the ICF framework, to investigate the correspondence between the patient experiences of functioning and the content of measures and to develop and test a clinician-rated measure.

In more detail, the specific aims were to:

- Identify the most frequently addressed ICF categories in measures used for assessments of patients with shoulder pain (Paper I).

- Identify the ICF categories that reflects problems related to functioning and interactions with the environment in patients with shoulder pain (Paper II).
- Investigate how the content of measures used in assessments of shoulder pain corresponds with the patient experiences of functioning (Paper III).
- Present a preliminary list of ICF categories for shoulder pain, covering the patient experiences and the concepts included in frequently used measures (Thesis).
- Develop and test the reliability and ability to detect change over time, of a clinician-rated activity measure of the shoulder, based on the assessment of movement patterns (Paper IV).

3. MATERIAL AND METHODS

3.1 Design

The present work was based on a literature review and two clinical studies that comprised patients with shoulder pain. In the literature review, the measures used in the assessment of shoulder pain were identified and analysed according to their content (Paper I). The first clinical study, a cross-sectional study with patient interviews (Paper II), was conducted in parallel with the literature review. The other clinical study was a study with a test-retest design that was used to develop and test the reliability of a clinician-rated activity measure (Paper IV). In addition, the datasets from the literature review and the cross-sectional study constituted the material that was used in the comparison of the patient experiences and the content of measures (Paper III) and in the development of a preliminary list of ICF categories for shoulder pain (Thesis).

3.2 Subjects

Patients with shoulder pain were the focus in all three studies. In the literature review (Paper I) the aim was to analyse the content of measures used in clinical studies on patients with

shoulder pain, aged 18 years or older. Articles written in English and published in peer-reviewed journals between January 2005 and May 2010 were included. The exclusion criteria were: studies on patients with fractures, joint replacement, complete dislocation, malignant condition, rheumatic diagnosis and stroke. In addition to these subject criteria, quantitative studies with less than 31 participants were excluded.

The participants in the cross-sectional study (Paper II) were patients attending the outpatient clinic of the Department of Physical medicine and Rehabilitation at Oslo University Hospital, Ullevaal from November 2009 through February 2011. Patients aged 18 years and older, diagnosed with shoulder pain with symptoms lasting longer than 3 months were eligible for the study. The exclusion criteria were similar to those in the literature review. In addition, patients with a generalised pain condition and insufficient Norwegian language skills were excluded

The subjects in the test-retest study (Paper IV) were patients attending the Department of Physiotherapy at the Martina Hansen Hospital in Baerum, between December 2007 and October 2010. Patients aged 18 years or older diagnosed with subacromial impingement syndrome were included. The exclusion criteria were systematic inflammatory disease or generalised pain, cardiac disease, symptoms of cervical spine disease or surgery in the affected shoulder within the last six months.

The collection of data from the patients was based on approval from the Ethical Committee for Medical Research and all patients gave their informed consent.

3.3 Material

This section describes the search procedure for the literature review of measures (Paper I), the collection of data from the patient interviews (Paper II) and the development process of a clinician-rated activity measure (Paper IV).

3.3.1 Literature review of measures

For the literature review of measures, a highly sensitive 15-step search strategy for Medline was developed and adapted to Embase, PeDro, Cinahl and Central [112]. The retrieved articles were imported to the same Endnote library (version X3, Thomson Reuters 1500 Spring Garden Street, Philadelphia) and screened for duplicates. In cases of multiple

publications, the journal with the highest impact factor was selected. All remaining articles were imported into a Microsoft Access database (Microsoft Office 2003) for the abstract screening. Articles meeting any exclusion criteria were excluded. In cases in which the decision was to include the article or the exclusion decision was ambiguous, full versions of the articles were retrieved. All abstracts were screened by one reviewer; a random selection of 20% was also screened by a second reviewer before a final decision was made. Measures with only one item, for example clinical tests and technical examinations were labelled single-item measures, whereas measures that contained more than one item, for example patient-reported outcome measures or composite scales were labelled as multi-item measures. A total of 13511 articles were identified through the literature search; of these articles, 1591 full versions were screened, and 515 were included.

To investigate whether any recent changes had taken place in the types of multi-item measures applied in clinical studies, an additional literature search in Medline for studies published during the last year (August 2012 - July 2013) was conducted. The same search strategy and inclusion/exclusion criteria as in the literature review (Paper I) was applied. In this updated literature search a total of 1538 articles were retrieved. Of these 1396 were excluded and 142 were included for further analysis. The screening and analysis in this updated review were based on the abstracts of the articles and was conducted by one reviewer (YR).

3.3.2 Patient interviews

In the cross-sectional study with patient interviews (Paper II), an Extended ICF Checklist was derived from the ICF classification. This checklist was a condition-adapted version of the generic ICF Checklist Version 2.1a [113]. To ensure that the most relevant functions were covered, physical examination tests and condition-specific scales were identified in published reviews and linked to ICF categories by one researcher (Y.R.) [8, 9, 69, 92]. A total of 9 physical examination tests and 10 condition-specific scales were identified. From the linked content of these measures, 23 additional second-level ICF categories were added to the 123 categories in the generic checklist. Thus, the Extended ICF Checklist applied in the present study consisted of 146 second level ICF categories (Appendix 1). Of these ICF categories, 52 were from the component body functions and structures, 57 from activities and participation and 37 from environmental factors. The patients' problems in each category were rated on an ordinal scale with scores ranging from 0 to 4 [2]. For the body functions components, the scores included "no impairment", "mild impairment", "moderate impairment", "severe impairment" and "complete impairment". For the body structures component, only the presence of impairment was rated as "impairment" or "no impairment" in this study. In the

activities and participation component, the categories were denominated “no difficulty”, “mild difficulty”, “moderate difficulty”, “severe difficulty” and “complete difficulty”, and the ratings were made according to reported performance. The environmental factors component included both barriers and facilitators of functioning, each categorised as “mild”, “moderate”, “severe” or “complete”. Additional options on the ICF qualifiers scale were “not specified” (score 8) and “not applicable” (score 9). The “not specified” option was avoided, and the “not applicable” was only registered for mutually exclusive categories in the major life areas chapter (d8) in the ICF. Comorbidity was registered on a separate form. The included patients participated in a structured interview using the Extended ICF Checklist. All of the interviews were administered by the same person (YR), a physiotherapist and researcher who had extensive experience with the ICF and shoulder rehabilitation in clinical and educational settings. The ratings of the severity of functional problems in the Extended ICF Checklist were determined through a discussion with the patient.

In addition to the patient interviews, the patients completed the Shoulder Pain and Disability Index (SPADI) and the Self-Administered Comorbidity Questionnaire (SCQ) [114-116]. The SPADI is a patient-reported condition-specific instrument comprising 13 items assessing pain and problems in functioning. Ratings are registered on an eleven point ordinal scale from “no pain/no difficulty” (0) to “worst pain imaginable/so difficult that help is required” (10). A sum score ranging 0 - 100 (best - worst) is estimated by averaging the pain and disability sub-scores. The SCQ is a patient-rated instrument with a list of common health problems. An additional question on neck pain was added. The respondent is asked to mark whether the health problem is present, whether treatment has been received and whether the problem limits activities.

3.3.3 Development of a clinician-rated activity measure

The aim of Paper IV was to develop and test the reliability and ability to detect change over time, of a clinician-rated activity measure of the shoulder. The steps in the development consisted of the identification of eligible items, followed by pilot-testing, clinical testing and scale construction [117-119]. The eligible items were extracted from patient-reported condition-specific scales that had been reviewed [91, 92, 95]. From these scales, 21 items that covered the execution of tasks with dynamic movements of the arm at or above shoulder-level were identified. These patient-reported items were then adapted to a standardised test environment. Some of the items required substantial adaptations; for example, a test rig with a light fixture was constructed to test difficulties in screwing a light bulb. Based on this pilot testing, 14 items that were difficult to standardise, or gave little information about the patient’s movement patterns were excluded. Decisions about exclusion

were based on consensus between the researchers. The remaining 7 items were included in a clinical test-retest study.

To rate the magnitude of a functional problem, a five-point ordinal scale was applied [2]. The anchor-points of the scale were denoted “no difficulty”, “mild difficulty”, “moderate difficulty”, “severe difficulty” and “cannot perform”. No definition of “difficulty” was provided due to the assumption that experienced physical therapists in shoulder rehabilitation have a common understanding of the term.

3.4 Analyses

3.4.1 Content analyses

In the literature review of measures (Paper I), generic and condition-specific measures with a single or multiple items, were extracted from the articles. The meaningful concepts in the measures were linked to the most specific ICF category possible, according to the linking-rules [8, 9]. All measures were linked by one reviewer (YR) and a random selection of 25% of the multi-item measures was also linked by a second reviewer. The ICF links of ten measures that had already been published in scientific journals or were available in previous reviews from the ICF Research Branch were directly applied in the analyses [23, 26].

The analyses of the correspondence between the patient experiences of functioning and the content of measures (Paper III) was based on the datasets from the literature review of measures and the cross-sectional study with patient interviews. The following criteria were applied for the analyses: (1) categories included in both datasets with similar rankings, (2) categories included in both datasets with different rankings, and (3) categories included in only one of the datasets. To investigate the match between common patient-reported problems and the content of condition-specific measures, the high-frequency ICF categories from the cross-sectional study (reported by $\geq 50\%$) were compared with the linked content of the most frequently cited condition-specific multi-item measures (identified with ≥ 10 citations).

For the identification of a preliminary list of ICF categories for shoulder pain (Thesis), the datasets from the literature review of measures and the cross-sectional study with patient interviews were merged and organised according to the ICF structure.

In the development process of the clinician-rated activity measure (Paper IV), the items and the intention of the scale were linked to the ICF by two independent reviewers [8, 9].

3.4.2 Statistical analyses

In the literature review of measures (Paper I), the number of retrieved articles, single/multi-item measures and meaningful concepts, are presented with descriptive statistics. The abstract screening and linking procedures were measured by percentage agreement and the estimation of Cohen's Kappa coefficient. The 95% confidence intervals for the Kappa coefficient were constructed using the bias-corrected percentile method [120, 121]. A Kappa coefficient of 0 - 0.40 was considered poor, 0.41 - 0.60 fair to good and 0.61 - 1 excellent [122]. The agreement between the reviewers in the abstract screening was 87.3%. The estimated Kappa coefficient was 0.62 (95% CI, 0.59 - 0.66), which is considered good. For the linking procedure, the agreement was 80.8%. The estimated Kappa coefficient was 0.81 (95% CI, 0.77 - 0.85), which is considered excellent. The relative frequencies of the identified ICF categories were calculated from the number of times the concept referring to the item was cited, divided by the total number of citations ($n = 2469$). The ICF categories that emerged with a frequency of at least 1% were reported in descending order, for each ICF component separately. In addition, an overview at ICF chapter-level of the content of measures that emerged with more than 5 citations was provided.

In the cross-sectional study with patient interviews (Paper II) the patients' age in years were calculated with the mean and Standard Deviation (SD). Frequencies were used for descriptive statistics concerning gender and employment status. The SPADI total summary score was estimated with the mean (SD). The relative frequencies (%) of ICF categories registered as impairment, limitation, restriction, barrier or facilitator for at least 5% of the participants were reported in descending order, for each ICF component separately.

In the test-retest study (Paper IV), age in years, duration of pain in month and the SPADI total summary score were calculated with the mean (SD). To reduce the number of items, item-to-sum correlation with Pearson's product-moment correlation coefficient (r) was used as the main criterion. In the remaining items, reliability, defined as internal consistency, reliability and measurement error were estimated according to recent recommendations [123, 124]. The internal consistency was calculated with Cronbach's alpha, and an alpha between 0.7 and 0.9 was considered fair. The consistency of the scale was investigated with inter-item correlations, based on the Pearson's product-moment correlation coefficient [125]. Inter-item correlations in the range of 0.15 - 0.50, and mean inter-item correlations of 0.40 - 0.50 were considered acceptable [117]. The inter-rater reliability and test-retest reliability was

calculated from a two-way random effect model and reported with the Intraclass Correlation Coefficient (ICC) and a 95% Confidence Interval (CI) [126, 127]. The measurement error was defined as the systematic and random error of a patient's score that was not attributed to true changes in the construct to be measured [123]. The calculation of measurement error was based on the Standard Error of Measurement (SEM), which reflects the standard deviation of the distribution of the patient's score, with no change in health status and no learning effect taking place [128, 129]. To take the systematic difference into account, the calculation was based on the following formula: $SEM_{agreement} = \sigma_x \sqrt{1 - r_{tt}}$, where (σ_x) is the pooled standard deviation of the test and retest scores, and (r_{tt}) is the reliability coefficient. From the SEM value, it is possible to estimate the Minimal Detectable Change (MDC), which is the smallest change that can be defined by the instrument beyond the measurement error [130, 131]. The following formula was applied: $MDC = 1.96 \times \sqrt{2} \times SEM$, where 2 relates to the test and retest, and 1.96 relates to the 95% confidence interval.

All the statistical analyses were conducted with the IBM SPSS Statistics 19 and 20 for Windows, or Stata/IC 11.1 for Mac.

4. MAIN RESULTS

4.1 Literature review of measures (Paper I)

In the literature review of measures (Paper I), altogether 475 different measures were extracted with a total of 2469 citations. Among them, 370 were single-item measures and 105 were multi-item measures. In all 20517 meaningful concepts were extracted from the measures, of which 86.3% were linked to the ICF. The share of concepts that were not covered or not definable was 13.7%.

A total of 40 second-level ICF categories with a frequency above 1% were identified in the ICF components of body functions and structures, activities and participation and environmental factors. Among the 11 ICF categories that were identified within body functions and structures, 5 categories were located in the neuromusculoskeletal or movement related functions (b7) chapter, 3 in mental functions (b1), 2 in sensory functions

and pain (b2) and 1 in structures related to movements (s7). The highest ranked categories of body functions and structures were in descending order: *sensation of pain* (b280), *mobility of joint functions* (b710), *structure of shoulder region* (s720), *muscle power functions* (b730), *sleep functions* (b134), *stability of joint functions* (b715) and *emotional functions* (b152).

Within activities and participation, 28 ICF categories were identified. Of these, 9 belonged to the mobility chapter (d4), 6 to self-care (d5), 4 to domestic life (d6), 3 to interpersonal interactions and relationships (d7) and major life areas (d8), and 1 category each to the chapters of community, social and civic life (d9), learning and applying knowledge (d1) and general tasks and demands (d2). The highest ranked ICF categories within activities and participation were in descending order: *hand and arm use* (d445), *remunerative employment* (d850), *recreation and leisure* (d920), *lifting and carrying objects* (d430), *washing oneself* (d510), *dressing* (d540), *caring for body parts* (d520), *doing housework* (d640) and *maintaining a body position* (d415).

In the component of environmental factors, the only identified ICF category was *products or substances for personal consumption* (e110). This category belongs to the products and technology (e1) chapter.

Of the 105 multi-item measures, 16 condition-specific and 7 generic measures had 5 or more citations. By far the most cited was the Constant-Murley Shoulder Score (Constant) (124 citations) [68], followed by the American Shoulder and Elbow Surgeons Standardized Form for Assessment of the Shoulder (ASES) (77 citations) [71], the University of California at Los Angeles Shoulder Rating Scale (UCLA) (64 citations) [132] and the Disability of the Arm, Shoulder and Hand (DASH) scale (51 citations) [96]. Of these condition-specific multi-item measures, the DASH and the ASES were the most wide-ranging, containing concepts linked to categories in 11 and 9 ICF chapters, respectively. In contrast, the Constant and the Rating Sheet for Bankart Repair (Rowe) contained concepts linked to 4 and 2 ICF chapters, respectively [68, 133]. None of these most cited measures covered mental functions other than *sleep* (b134), and the UCLA (the third most cited) did not cover any mental functions. The most-frequently cited generic measure, the Medical Outcomes Study 36-item Short-Form Health Survey (SF-36) (46 citations), was linked to 7 ICF-chapters; 2 of which were in the body functions and structures component, and 5 of which were in the activities and participation component [134].

In the updated literature search on Medline that investigated measures extracted from articles published in the last year, a total of 24 different condition-specific measures were identified in 148 citations. The measures that were registered with 5 or more citations were in

descending order: Constant (31 citations), ASES (25 citations), DASH (18 citations), the Simple Shoulder Test (SST) (9 citations), Rowe (8 citations) and the Western Ontario Rotator Cuff Index (WORC) (5 citations). The SF-36 and the Shoulder Pain and Disability Index (SPADI) received only 4 and 3 citations, respectively.

Of the 370 single-item measures that were extracted in the literature review, 28 condition-specific and 7 generic measures had five or more citations. Patient-reported pain intensity was the most frequently cited (200 citations) followed by active range of motion (170 citations), magnetic resonance imaging (125 citations), muscle strength (98 citations), x-ray (81 citations), passive range of motion (61 citations) and ultrasonography (57 citations). The content of the single-item measures covered 3 body functions and structures chapters; these were sensory functions and pain (b2), neuromusculoskeletal or movement related functions (b7) and structures related to movements (s7).

4.2 Patient interviews (Paper II)

In the cross-sectional study with patient interviews (Paper II), 375 patients received information about the study, and 165 (44%) were included. The mean age of the participants was 46.5 years (SD = 12.5). Women were slightly over-represented in the study sample (54%). The diagnosis of shoulder impingement syndrome was the most frequent, accounting for 43% of the cases. With regard to employment status, 92.8% of the participants were employed or students, of whom 35.2% were on sick leave. The rest of the participants (7.2%) were retired, unemployed, received a disability pension, or were homemakers. The SPADI total summary score was 47.4 (SD = 21.1). Additional neck pain was reported by almost two-thirds and low back pain by more than one-third of the patients.

A total of 61 second-level ICF categories were identified from the patient interviews. Of the 19 body functions and structures categories that were identified, 7 each belonged to the mental functions (b1) and neuromuscular and movement-related functions (b7) chapters, 3 to structures related to movements (s7) and 1 each to sensory functions and pain (b2) and functions of the skin and related structures (b8). The 11 high-frequency (> 50%) body functions and structures categories that were identified were in descending order: *sensation of pain* (b280), *structure of shoulder region* (s720), *mobility of joint functions* (b710), *sleep* (b134), *muscle endurance functions* (b740), *energy and drive functions* (b130), *muscle*

power functions (b730), *mobility of bones function* (b720), *sensation related to the skin* (b840), *muscle tone functions* (b735) and *temperament and personality functions* (b126).

With respect to problems in the activities and participation, 34 ICF categories were identified; of these 10 were in the mobility (d4) chapter, 7 in interpersonal interactions and relationships (d7), 5 each in self-care (d5) and domestic life (d6), 3 in general tasks and demands (d2), 2 in major life areas (d8) and 1 each in learning and applying knowledge (d1) and community and social and civic life (d9). The 9 high-frequency (> 50%) activity and participation categories that were identified were in descending order: *lifting and carrying objects* (d430), *remunerative employment* (d850), *recreation and leisure* (d920), *changing basic body positions* (d410), *washing oneself* (d510), *dressings* (d540), *maintaining a body position* (d415), *doing housework* (d640) and *acquisition of goods and services* (d620).

Within the environmental factors, 8 ICF categories were identified; of these, 5 belonged to the support and relationship (e3) chapter. None of the environmental factor categories were high-frequency. With the exception of *products and technology for communication* (e125), all the environmental categories covered various aspects of social support and services; support from *family* (e310), *friends* (e320), *colleagues and others* (e325), *persons in positions of authority* (e330) and *health professionals* (e355) and also their *individual attitudes* (e450) and the *social security services* (e570). The environmental social support from immediate family and friends (e310 and e320 ICF categories) were, in a majority of cases, reported facilitators of functioning.

4.3 Patient experiences in relation to the content of measures (Paper III)

The two separate datasets of ICF categories from the cross-sectional study with patient interviews and the literature review of measures constituted the material that was used to compare the patient experiences in relation to the content of measures (Paper III). The ICF category *higher education* (d830) was not included in the analyses because the relative frequency had not been calculated for this category. The total number of high frequency (\geq 50%) ICF categories from the patient interviews were 20; of these, 11 were in body functions and structures and 9 were in activities and participation.

A total of 21 different ICF categories of body functions and structures were identified either in the patient interviews or the literature review of measures. Almost all of them (19 categories)

were identified in the patient interviews, and approximately half (11 categories) were identified in the measures. Of the 11 patient-derived body functions and structures categories that were high-frequency, 7 also attained a high ranking in the measures. In descending order, these common and high-ranked categories were *sensation of pain* (b280), *structure of shoulder region* (s720), *mobility of joint functions* (b710), *sleep functions* (b134), *energy and drive functions* (b130), *muscle power functions* (b730) and *mobility of bone functions* (b720). Four other high-frequency patient-derived categories; *muscle endurance* (b740), *muscle tone* (b735), *sensation related to the skin* (b840), and *temperament and personality functions* (b126) and also several lower-frequency patient-derived categories were not identified in the measures. Only 2 lower ranked ICF categories were uniquely identified in the measures.

Within activities and participation, 32 ICF categories were derived from the patient interviews and 28 from the measures. All 9 of the high frequent patient-derived categories were also identified in the content of the measures. In descending order, these common and high-frequency categories were *lifting and carrying objects* (d430), *remunerative employment* (d850), *recreation and leisure* (d920), *changing basic body position* (d410), *washing oneself* (d510), *dressing* (d540), *maintaining a body position* (d415), *doing housework* (d640) and *acquisition of goods and services* (d620). Among the 9 low frequency, patient-derived categories that were not identified in the measures, 3 categories concerned various aspects of interpersonal interactions and relationships. Four ICF categories were uniquely identified in the literature review of measures (rank 18 – 24).

With respect to the environmental factors, 8 ICF categories were derived from the patient interviews. None of these were high-frequency or identified in the measures. With the exception of *products and technology for communication* (e125), all the environmental categories covered various aspects of social support and services. The only category that was derived from the measures, *products or substances for personal consumption* (e110), covers the use of pain medication.

The 11 condition-specific multi-item measures that were identified with at least 10 citations in the literature review of measures are compared with the 20 high-frequency ($\geq 50\%$) patient-derived body functions and structures and activities and participation categories in Table 1. These commonly used condition-specific measures were: the Constant [68], the ASES [71], the UCLA [132], the DASH [96], the SST [135], the SPADI [115], the Rowe [133], the WORC [136], the SRQ [137], the SDQ [138] and the OSS [88]. Of these measures, the Constant, ASES, UCLA and Rowe are composite scales whereas the rest are entirely patient-reported scales. The investigation of how these commonly used condition-specific measures match the high-frequency patient-derived categories displays that 6 ICF categories are not included

in any of the measures, these are the 5 body functions *temperament and personality* (b126), *energy and drive* (b130), *muscle tone* (b735), *muscle endurance* (b740), *sensation related to the skin* (b840), and in addition the activity *changing basic body position* (d410). The two most comprehensive measures, the ASES and the DASH, match 11 and 10 of these high frequent patient-derived ICF categories, respectively. By contrast, the SST, SPADI, SDQ and the Rowe match the lowest number of categories (n = 5), while the most cited measure, the Constant, matches 6 high-frequency patient-derived categories.

Table 1. Distribution of high frequency second-level ICF categories (n = 20) derived from the patient interviews within the most frequently cited condition-specific measures of shoulder function (n = 11)

Measures	Number of citations	Body functions and structures										Activities and participation								
		Temperament and personality (b126)	Energy and drive (b130)	Sleep (b134)	Sensation of pain (b280)	Mobility of joint (b710)	Mobility of bones (b720)	Muscle power (b730)	Muscle tone (b735)	Muscle endurance (b740)	Sensation related to the skin (b840)	Structure of shoulder region (s720)	Changing basic body position (d410)	Maintaining a body position (d415)	Lifting and carrying objects (d430)	Washing oneself (d510)	Dressing (d540)	Acquisition of goods and services (d620)	Doing housework (d640)	Remunerative employment (d850)
Constant	124		√	√	√		√												√	√
ASES	77		√	√	√		√			√		√	√	√	√				√	√
UCLA	64				√	√		√							√	√	√	√		
DASH	51		√	√			√	√						√	√	√		√	√	√
SST	46		√	√										√	√				√	
SPADI	31				√								√	√	√	√				
Rowe	31				√	√								√					√	√
WORC	21		√	√										√	√		√	√		
SRQ	15		√	√										√	√	√		√	√	√
SDQ	14		√									√	√	√	√					
OSS	11		√	√										√	√	√	√	√	√	√

Constant = the Constant-Murley shoulder score, ASES = the American Shoulder and Elbow Surgeons standardized form for assessment of the shoulder, UCLA = the University of California at Los Angeles Shoulder Rating Scale, DASH = the Disability of the Arm, Shoulder and Hand scale, SST = the Simple Shoulder Test, SPADI = the Shoulder Pain and Disability Index, Rowe = a Rating Sheet for Bankart Repair, WORC = the Western Ontario Rotator Cuff Index, SRQ = the Shoulder Rating Questionnaire, SDQ the Shoulder Disability Questionnaire, OSS = the Oxford Shoulder Score.

4.4 A preliminary list of ICF categories for shoulder pain (Thesis)

The categories that were identified in the cross-sectional study with patient interviews and the literature review of measures, constitute a preliminary list of 68 ICF categories for shoulder pain (Thesis). Of these, 21 categories are body functions and structures, 38 are activities and participation and 9 are environmental factors. Thirty-three of the categories were identified in both studies; whereas 28 were identified only in the patient interviews and 7 only in the literature review of measures. The preliminary list of ICF categories for shoulder pain with the definition of each category is presented in Table 2.

Table 2. Preliminary list of condition-specific ICF categories for shoulder pain covering body functions and structures, activities and participation and environmental factors.

BODY FUNCTIONS	
= the physiological functions of body systems (including psychological functions).	
b126	Temperament and personality functions
	General mental functions of constitutional disposition of the individual to react in a particular way to situations, including the set of mental characteristics that makes the individual distinct from others. <i>Inclusions: functions of extraversion, introversion, agreeableness, conscientiousness, psychic and emotional stability, and openness to experience; optimism; novelty seeking; confidence; trustworthiness.</i>
b130	Energy and drive functions
	General mental functions of physiological and psychological mechanisms that cause the individual to move towards satisfying specific needs and general goals in a persistent manner. <i>Inclusions: functions of energy level, motivation, appetite, craving (including craving for substances that can be abused), and impulse control.</i>
b134	Sleep functions
	General mental functions of periodic, reversible and selective physical and mental disengagement from one's immediate environment accompanied by characteristic physiological changes. <i>Inclusions: functions of amount of sleeping, and onset, maintenance and quality of sleep; functions involving the sleep cycle, such as in insomnia, hypersomnia and narcolepsy.</i>
b140	Attention functions
	Specific mental functions of focusing on an external stimulus or internal experience for the required period of time. <i>Inclusions: functions of sustaining attention, shifting attention, dividing attention, sharing attention; concentration; distractibility.</i>
b144	Memory functions
	Specific mental functions of registering and storing information and retrieving it as needed. <i>Inclusions: functions of short-term and long-term memory, immediate, recent and remote memory; memory span; retrieval of memory; remembering; functions used in recalling and learning, such as in nominal, selective and dissociative amnesia.</i>
b152	Emotional functions
	Specific mental functions related to the feeling and affective components of the processes of the mind. <i>Inclusions: functions of appropriateness of emotion, regulation and range of emotion; affect;</i>

	<i>sadness, happiness, love, fear, anger, hate, tension, anxiety, joy, sorrow; lability of emotion; flattening of affect.</i>
b164	Higher level cognitive functions
	Specific mental functions especially dependent on the frontal lobes of the brain, including complex goal-directed behaviors such as decision-making, abstract thinking, planning and carrying out plans, mental flexibility, and deciding which behaviors are appropriate under what circumstances; often called executive functions. <i>Inclusions: functions of abstraction and organization of ideas; time management, insight and judgment; concept formation, categorization and cognitive flexibility.</i>
b265	Touch function
	Sensory functions of sensing surfaces and their texture or quality. <i>Inclusions: functions of touching, feeling of touch; impairments such as numbness, anaesthesia, tingling, paraesthesia and hyperaesthesia.</i>
b280	Sensation of pain
	Sensation of unpleasant feeling indicating potential or actual damage to some body structure. <i>Inclusions: sensations of generalized or localized pain, in one or more body part, pain in a dermatome, stabbing pain, burning pain, dull pain, aching pain; impairments such as myalgia, analgesia and hyperalgesia.</i>
b710	Mobility of joint functions
	Functions of the range and ease of movement of a joint. <i>Inclusions: functions of mobility of single or several joints, vertebral, shoulder, elbow, wrist, hip, knee, ankle, small joints of hands and feet; mobility of joints generalized; impairments such as in hypermobility of joints, frozen joints, frozen shoulder, arthritis.</i>
b715	Stability of joint functions
	Functions of the maintenance of structural integrity of the joints. <i>Inclusions: functions of the stability of a single joint, several joints, and joints generalized impairments such as in unstable shoulder joint, dislocation of a joint, dislocation of shoulder and hip.</i>
b720	Mobility of bones function
	Functions of the range and ease of movement of the scapula, pelvis, carpal and tarsal bones. <i>Inclusions: impairments such as frozen scapula and frozen pelvis.</i>
b730	Muscle power functions
	Functions related to the force generated by the contraction of a muscle or muscle groups. <i>Inclusions: functions associated with the power of specific muscles and muscle groups, muscles of one limb, one side of the body, the lower half of the body, all limbs, the trunk and the body as a whole; impairments such as weakness of small muscles in feet and hands, muscle paresis, muscle paralysis, monoplegia, hemiplegia, paraplegia, quadriplegia and akinetic mutism.</i>
b735	Muscle tone functions
	Functions related to the tension present in the resting muscles and the resistance offered when trying to move the muscles passively. <i>Inclusions: functions associated with the tension of isolated muscles and muscle groups, muscles of one limb, one side of the body and the lower half of the body, muscles of all limbs, muscles of the trunk, and all muscles of the body; impairments such as hypotonia, hypertonia and muscle spasticity.</i>
b740	Muscle endurance functions
	Functions related to sustaining muscle contraction for the required period of time. <i>Inclusions: functions associated with sustaining muscle contraction for isolated muscles and muscle groups, and all muscles of the body; impairments such as in myasthenia gravis.</i>
b770	Gait pattern functions
	Functions of movement patterns associated with walking, running or other whole body movements. <i>Inclusions: walking patterns and running patterns; impairments such as spastic gait, hemiplegic gait, paraplegic gait, asymmetric gait, limping and stiff gait pattern.</i>
b780	Sensations related to muscles and movement
	Sensations associated with the muscles or muscle groups of the body and their movement. <i>Inclusions: sensations of muscle stiffness and tightness of muscles, muscle spasm or constriction, and heaviness of muscles.</i>
b840	Sensation related to the skin

BODY STRUCTURES	
= anatomical parts of the body such as organs, limbs and their components.	
s710	Structure of head and neck region
s720	Structure of shoulder region
s730	Structure of upper extremity

ACTIVITIES AND PARTICIPATION	
= the execution of a task or action by an individual or involvement in a life situation.	
d170	Writing
	Using or producing symbols or language to convey information, such as producing a written record of events or ideas or drafting a letter.
d210	Undertaking a single task
	Carrying out simple or complex and coordinated actions related to the mental and physical components of a single task, such as initiating a task, organizing time, space and materials for a task, pacing task performance, and carrying out, completing, and sustaining a task. <i>Inclusions: undertaking a simple or complex task; undertaking a single task independently or in a group.</i>
d220	Undertaking multiple tasks
	Carrying out simple or complex and coordinated actions as components of multiple, integrated and complex tasks in sequence or simultaneously. <i>Inclusions: undertaking multiple tasks; completing multiple tasks; undertaking multiple tasks independently and in a group.</i>
d230	Carrying out daily routine
	Carrying out simple or complex and coordinated actions in order to plan, manage and complete the requirements of day-to-day procedures or duties, such as budgeting time and making plans for separate activities throughout the day. <i>Inclusions: managing and completing the daily routine; managing one's own activity level.</i>
d410	Changing basic body position
	Getting into and out of a body position and moving from one location to another, such as getting up out of a chair to lie down on a bed, and getting into and out of positions of kneeling or squatting. <i>Inclusion: changing body position from lying down, from squatting or kneeling, from sitting or standing, bending and shifting the body's center of gravity.</i>
d415	Maintaining a body position
	Staying in the same body position as required, such as remaining seated or remaining standing for work or school. <i>Inclusions: maintaining a lying, squatting, kneeling, sitting and standing position.</i>
d420	Transferring oneself
	Moving from one surface to another, such as sliding along a bench or moving from a bed to a chair, without changing body position. <i>Inclusions: transferring oneself while sitting or lying.</i>
d430	Lifting and carrying objects
	Raising up an object or taking something from one place to another, such as when lifting a cup or carrying a child from one room to another. <i>Inclusions: lifting, carrying in the hands or arms, or on shoulders, hip, back or head; putting down.</i>
d440	Fine hand use
	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. <i>Inclusions: picking up, grasping, manipulating and releasing.</i>
d445	Hand and arm use
	Performing the coordinated actions required to move objects or to manipulate them by using hands and arms, such as when turning door handles or throwing or catching an object. <i>Inclusions: pulling or pushing objects; reaching; turning or twisting the hands or arms; throwing; catching.</i>
d450	Walking

	Moving along a surface on foot, step by step, so that one foot is always on the ground, such as when strolling, sauntering, walking forwards, backwards, or sideways. <i>Inclusions: walking short or long distances; walking on different surfaces; walking around obstacles</i>
d455	Moving around
	Moving the whole body from one place to another by means other than walking, such as climbing over a rock or running down a street, skipping, scampering, jumping, somersaulting or running around obstacles. <i>Inclusions: crawling, climbing, running, jogging, jumping, and swimming.</i>
d465	Moving around using equipment
	Moving the whole body from place to place, on any surface or space, by using specific devices designed to facilitate moving or create other ways of moving around, such as with skates, skis, or scuba equipment, or moving down the street in a wheelchair or a walker.
d470	Using transportation
	Using transportation to move around as a passenger, such as being driven in a car or on a bus, rickshaw, jitney, animal-powered vehicle, or private or public taxi, bus, train, tram, subway, boat or aircraft. <i>Inclusions: using human-powered transportation; using private motorized or public transportation.</i>
d475	Driving
	Being in control of and moving a vehicle or the animal that draws it, travelling under one's own direction or having at one's disposal any form of transportation, such as a car, bicycle, boat or animal-powered vehicle. <i>Inclusions: driving human-powered transportation, motorized vehicles, animal-powered vehicles.</i>
d510	Washing oneself
	Washing and drying one's whole body, or body parts, using water and appropriate cleaning and drying materials or methods, such as bathing, showering, washing hands and feet, face and hair, and drying with a towel. <i>Inclusions: washing body parts, the whole body; and drying oneself.</i>
d520	Caring for body parts
	Looking after those parts of the body, such as skin, face, teeth, scalp, nails and genitals, that require more than washing and drying. <i>Inclusions: caring for skin, teeth, hair, finger and toe nails.</i>
d530	Toileting
	Planning and carrying out the elimination of human waste (menstruation, urination and defecation), and cleaning oneself afterwards. <i>Inclusions: regulating urination, defecation and menstrual care.</i>
d540	Dressing
	Carrying out the coordinated actions and tasks of putting on and taking off clothes and footwear in sequence and in keeping with climatic and social conditions, such as by putting on, adjusting and removing shirts, skirts, blouses, pants, undergarments, saris, kimono, tights, hats, gloves, coats, shoes, boots, sandals and slippers. <i>Inclusions: putting on or taking off clothes and footwear and choosing appropriate clothing.</i>
d550	Eating
	Carrying out the coordinated tasks and actions of eating food that has been served, bringing it to the mouth and consuming it in culturally acceptable ways, cutting or breaking food into pieces, opening bottles and cans, using eating implements, having meals, feasting or dining.
d570	Looking after one's health
	Ensuring physical comfort, health and physical and mental well-being, such as by maintaining a balanced diet, and an appropriate level of physical activity, keeping warm or cool, avoiding harms to health, following safe sex practices, including using condoms, getting immunizations and regular physical examinations. <i>Inclusions: ensuring one's physical comfort; managing diet and fitness; maintaining one's health.</i>
d620	Acquisition of goods and services
	Selecting, procuring and transporting all goods and services required for daily living, such as selecting, procuring, transporting and storing food, drink, clothing, cleaning materials, fuel, household items, utensils, cooking ware, domestic appliance and tools; procuring utilities and

	other household services. <i>Inclusions: shopping and gathering daily necessities.</i>
d630	Preparing meals
	Planning, organizing, cooking and serving simple and complex meals for oneself and others, such as by making a menu, selecting edible food and drink, getting together ingredients for preparing meals, cooking with heat and preparing cold foods and drinks, and serving the food. <i>Inclusions: preparing simple and complex meals.</i>
d640	Doing housework
	Managing a household by cleaning the house, washing clothes, using household appliances, storing food and disposing of garbage, such as by sweeping, mopping, washing counters, walls and other surfaces; collecting and disposing of household garbage; tidying rooms, closets and drawers; collecting, washing, drying, folding and ironing clothes; cleaning footwear; using brooms, brushes and vacuum cleaners; using washing machines, driers and irons. <i>Inclusions: washing and drying clothes and garments; cleaning cooking area and utensils; cleaning living area; using household appliances, storing daily necessities and disposing of garbage.</i>
d650	Caring for household objects
	Maintaining and repairing household and other personal objects, including house and contents, clothes, vehicles and assistive devices, and caring for plants and animals, such as painting or wallpapering rooms, fixing furniture, repairing plumbing, ensuring the proper working order of vehicles, watering plants, grooming and feeding pets and domestic animals. <i>Inclusions: making and repairing clothes; maintaining dwelling, furnishings and domestic appliances; maintaining vehicles; maintaining assistive devices; taking care of plants (indoor and outdoor) and animals.</i>
d660	Assisting others
	Assisting household members and others with their learning, communicating, self-care, movement, within the house or outside; being concerned about the well-being of household members and others. <i>Inclusions: assisting others with self-care, movement, communication, interpersonal relations, nutrition and health maintenance.</i>
d710	Basic interpersonal interactions
	Interacting with people in a contextually and socially appropriate manner, such as by showing consideration and esteem when appropriate, or responding to the feelings of others. <i>Inclusions: showing respect, warmth, appreciation, and tolerance in relationships; responding to criticism and social cues in relationships; and using appropriate physical contact in relationships.</i>
d720	Complex interpersonal interactions
	Maintaining and managing interactions with other people, in a contextually and socially appropriate manner, such as by regulating motions and impulses, controlling verbal and physical aggression, acting independently in social interactions, and acting in accordance with social rules and conventions. <i>Inclusions: forming and terminating relationships; regulating behaviors within interactions; interacting according to social rules; and maintaining social space.</i>
d730	Relating with strangers
	Engaging in temporary contacts and links with strangers for specific purposes, such as when asking for directions or making a purchase.
d740	Formal relationships
	Creating and maintaining specific relationships in formal settings, such as with employers, professionals or service providers. <i>Inclusions: relating with persons in authority, with subordinates and with equals</i>
d750	Informal social relationships
	Entering into relationships with others, such as casual relationships with people living in the same community or residence, or with co-workers, students, playmates or people with similar backgrounds or professions. <i>Inclusions: informal relationships with friends, neighbors, acquaintances, co-inhabitants and peers.</i>
d760	Family relationships
	Creating and maintaining kinship relationships, such as with members of the nuclear family, extended family, foster and adopted family and step-relationships, more distant relationships

	such as second cousins, or legal guardians. <i>Inclusions: parent-child and child-parent relationships, sibling and extended family relationships.</i>
d770	Intimate relationships
	Creating and maintaining close or romantic relationships between individuals, such as husband and wife, lovers or sexual partners. <i>Inclusions: romantic, spousal and sexual relationships.</i>
d820	School education
	Gaining admission to school, Education, engaging in all school-related responsibilities and privileges, and learning the course material, subjects and other curriculum requirements in a primary or secondary education program, including attending school regularly, working cooperatively with other students, taking direction from teachers, organizing, studying and completing assigned tasks and projects, and advancing to other stages of education.
d830	Higher education
	Engaging in the activities of advanced educational programs in universities, colleges and professional schools and learning all aspects of the curriculum required for degrees, diplomas, certificates and other accreditations, such as completing a university bachelor's or master's course of study, medical school or other professional school.
d850	Remunerative employment
	Engaging in all aspects of work, as an occupation, trade, profession or other form of employment, for payment, as an employee, full or part time, or self-employed, such as seeking employment and getting a job, doing the required tasks of the job, attending work on time as required, supervising other workers or being supervised, and performing required tasks alone or in groups. <i>Inclusions: self-employment, part-time and full-time employment.</i>
d859	Work and employment, other specified/unspecified
d920	Recreation and leisure
	Engaging in any form of play, recreational or leisure activity, such as informal or organized play and sports, programs of physical fitness, relaxation, amusement or diversion, going to art galleries, museums, cinemas or theatres; engaging in crafts or hobbies, reading for enjoyment, playing musical instruments; sightseeing, tourism and travelling for pleasure. <i>Inclusions: play, sports, arts and culture, crafts, hobbies and socializing.</i>

ENVIRONMENTAL FACTORS

= the physical, social and attitudinal environment in which people live and conduct their lives.

e110	Products or substances for personal consumption
	Any natural or human-made object or substance gathered, processed or manufactured for ingestion. <i>Inclusions: food and drugs.</i>
e125	Products and technology for communication
	Equipment, products and technologies used by people in activities of sending and receiving information, including those adapted or specially designed, located in, on or near the person using them. <i>Inclusions: general and assistive products and technology for communication.</i>
e310	Immediate family
	Individuals related by birth, marriage or other relationship recognized by the culture as immediate family, such as spouses, partners, parents, siblings, children, foster parents, adoptive parents and grandparents.
e320	Friends
	Individuals who are close and ongoing participants in relationships characterized by trust and mutual support.
e325	Acquaintances, peers, colleges, neighbors etc.
	Individuals who are familiar to each other as acquaintances, peers, colleagues, neighbors, and community members, in situations of work, school, recreation, or other aspects of life, and who share demographic features such as age, gender, religious creed or ethnicity or pursue common interests.
e330	People in positions of authority

	Individuals who have decision-making responsibilities for others and who have socially defined influence or power based on their social, economic, cultural or religious roles in society, such as teachers, employers, supervisors, religious leaders, substitute decision-makers, guardians or trustees.
e355	Health professionals
	All service providers working within the context of the health system, such as doctors, nurses, physiotherapists, occupational therapists, speech therapists, audiologists, orthotist-prosthetists, medical social workers.
e450	Individual attitudes of health professionals
	General or specific opinions and beliefs of health professionals about the person or about other matters (e.g. social, political and economic issues), that influence individual behavior and actions.
e570	Social security services, systems and policies
	Services, systems and policies aimed at providing income support to people who, because of age, poverty, unemployment, health condition or disability, require public assistance that is funded either by general tax revenues or contributory schemes.

4.5 Reliability of the clinician-rated activity measure (Paper IV)

In the development process of the clinician-rated activity measure (Paper IV), 4 of 7 items were excluded due to low inter-item correlation. The remaining 3 items that constitute the Shoulder Activity Scale are: lifting an object to a shelf, putting on a jacket and moving the arm sideways (Appendix 2). These items were linked to the ICF categories *lifting and carrying objects* (d430), *dressing* (d540) and *hand and arm use* (d445), respectively. In addition, the purpose of the scale was linked to the category *control of voluntary movement* (b760).

In the recruitment of patients to the test-retest study, 94 patients were eligible, of these, 29 patients did not accept participation and 2 were excluded because of generalised pain. A total of 63 patients with a mean age of 53.3 years (SD = 12.9), 30 women and 33 men, were included in the study. Three patients dropped out between the baseline test and the retest. The mean duration of symptoms was 46.6 months (SD = 72.3). According to the employment status, 38 patients were working, 8 were sick-listed and 17 were either retired, receiving disability benefits or unemployed. The mean SPADI score at baseline was 36.2 (SD = 16.6).

The item-to-item correlations for the Shoulder Activity Scale ranged between 0.30 and 0.49, and the item-to-total between 0.70 and 0.82. The Cronbach's alpha of consistency for the summed-score was calculated as $\alpha = 0.86$. There were no significant correlations or non-linear associations between the participants' ages or duration of symptoms and the Shoulder Activity Scale score.

The summed-score of the Shoulder Activity Scale has a possible range of 3 (no difficulties) to 15 (cannot perform). The mean summed-score at the test and retest was 6.81 (SD = 2.38). The inter-rater reliability was calculated to be 0.80 (95% CI = 0.51 - 0.90) and the test-retest reliability was 0.74 (95% CI = 0.58 – 0.84). The minimal detectable change was calculated to be 3.32.

5. DISCUSSION

5.1 Methodological considerations

5.1.1 Subjects and material

The intention of the literature review (Paper I) was to identify the most frequently addressed aspects of functioning in measures used in assessment of shoulder pain. To reduce the large number of articles that were retrieved from the literature search ($n = 13511$), we decided that studies with less than 31 patients should be excluded. Low sample size may in some cases imply poor methodological quality of the study. However, studies that require advanced technical equipment, for example movement analyses often have low sample sizes. Due to this, concepts referring to movement-patterns may have been underestimated in the material. In the ICF, these are covered by the movement body functions.

The patients in the cross-sectional study (Paper II) were interviewed in an outpatient clinic at the Department of Physical medicine and Rehabilitation, Oslo University Hospital – Ullevaal. The outpatient clinic receives approximately 750 patients with shoulder pain annually. The distribution according to diagnoses, gender and age in the present study was quite similar to the annual patient cohort at the clinic. Moreover, the functional level (the Shoulder Pain and Disability Index total score) was quite equal to those enrolled in a previous randomised controlled trial on patients with rotator cuff disease at the department [139]. Compared with other samples, a Dutch prospective follow-up study on patients with shoulder pain in general practice reported similar distribution of gender, age and diagnoses [44]. The functional level of the patients in our study was similar to that reported in a hospital-treated sample of patients with shoulder-related diagnoses in Canada and a sample of patients with shoulder

pain in general practice in the UK [91, 140]. These comparisons indicate that the present study sample were representative for the patient cohort at the included hospital and also did not seem to differ to any great extent from other shoulder pain patient cohorts regarding gender, distribution of diagnoses and functional level.

In the test-retest study (Paper IV), 63 patients with a primary diagnosis of subacromial impingement syndrome at the Department of Physiotherapy, Martina Hansen Hospital - Baerum, were recruited. No statistics on the annual cohort at the hospital were available. However, the mean age of the participants was 53.3 years (SD = 12.9) which was somewhat lower than in another study on patients with small and medium-sized tears of the rotator cuff at the hospital [141]. The gender distribution was approximately equal, whereas the mean age and the functional level were somewhat higher than in the cross-sectional study with patient interviews (Paper II).

The classification systems for shoulder pain have been criticised for being focused on pathological findings, having overlapping diagnostic categories and for having conceptual inconsistencies [45-50]. Due to this, careful conclusions should be drawn regarding the distribution of diagnoses in the cross-sectional study (Paper II) and the diagnostic decisions in the test-retest study (Paper IV). However, in the outpatient clinic at Ullevaal, standardised diagnostic criteria were applied in the diagnostic process [142, 143]. This probably contributed to improved reliability in the diagnostic decision process.

Two-thirds of the patients in the cross-sectional study (Paper II) reported additional neck pain and almost one-third reported low back pain. Additional pain or symptoms in other body regions, in particular the chest region, have been found to predict higher disability levels [65-67]. However, this neck and back pain may be symptoms of the abnormal movement patterns in the upper extremities rather than indication of a widespread pain condition. No analyses were conducted to investigate whether the disability differed between those who reported additional pain and those who did not.

The identification of body structure categories in the cross-sectional study was made according to the symptom description of the diagnostic criteria, thus only three structural categories related to the shoulder were identified. This is however a matter of case definition. The challenges with using topography as the main criterion for classification (such as in back-, neck- and shoulder pain) were outlined in a previous paper [144].

Shoulder pain is a common complaint among patients with stroke, rheumatoid arthritis or tetraplegia/paraplegia [145-147]. None of these conditions were represented in the patient

populations of the present studies (Papers I, II and IV). Thus it is not possible to conclude whether the results of the current study represent a comprehensive picture of shoulder pain for these patients.

5.1.2 Procedures and measures

In the literature review (Paper I), the Medical Outcomes Study 36-item Short-Form Health Survey (SF-36) and a few other measures had previously been linked to the ICF [8, 9]. In the linking of the SF-36, no ICF categories belonging to interpersonal interactions and relationship of activities and participation were identified. In our opinion, the SF-36 item that reads: “during the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives etc.)” and another similar item should have been linked to interpersonal interactions/relationships categories in the activities and participation [23]. Due to the high number of citations for the SF-36, this would have contributed to substantially higher frequency estimates for these ICF categories. Based on our experiences, extensive knowledge not only of the ICF but also in rehabilitation is required to achieve reliable linking results. Unfortunately, few clinical experts are familiar with the ICF linking rules.

The linking rules were updated in 2005, and in our opinion some of the revisions were unfortunate [9]. For example, the rule that stated that all different constructs in items should be linked to different categories, was removed [8]. This may contribute to a more semantic linking procedure in which the underlying constructs are less emphasized.

In the cross-sectional study with patient interviews (Paper II), an Extended ICF Checklist was applied for the interviews (Appendix 1). This condition-adapted checklist was developed from the generic ICF Checklist Version 2.1a, according to previous recommendations [113]. In this process, the generic ICF Checklist was supplemented with ICF categories from the linked content of condition-specific measures. However, as demonstrated in the literature review and the comparison with the patient experiences (Papers I and III), the content of the condition-specific measures of shoulder pain is often limited and does not always match the patient experiences. Because of this, adaption of the generic checklist should also have considered other categories, for example those that were identified in the patient interviews for the musculoskeletal ICF Core Sets. Nevertheless, the low number of ICF categories that were identified within environmental factors was not caused by this limitation; the generic ICF Checklist version 2.1a contains a total of 37 environmental categories, and all of these were implemented in the Extended ICF Checklist. Another methodological decision that should be considered is the application of the ICF qualifier scale in the patient interviews. Consistent

with previous studies, functional problems or environmental factors registered as “mild” (1) to “complete” (4) in the ICF ordinal scale, was classified as a problem, barrier or facilitator. The reliability of the ICF ordinal scale in patient interviews has been questioned: In a study on patients with rheumatoid arthritis, the reliability of the scale increased when the number of response categories was reduced from five to three [148]. As a consequence, collapsing the response categories “mild” (1) – “moderate” (2), and “severe” (3) – “complete” (4), was suggested for body functions and structures and activities and participation [148]. For environmental factors collapsing the response categories into one single category was suggested for each of the negative (barrier) and positive (facilitator) factors [148]. A modification of the scale according to these recommendations could have altered the responses of the patients during the interviews.

The preliminary list of ICF categories for shoulder pain (Thesis) was identified from the datasets of the cross-sectional study with patient interviews (Paper II) and the literature review (Paper I). In the development processes of the ICF Core Sets, an additional qualitative study with patient interviews (usually focus groups), a global survey with the participation of clinical experts and a formalised consensus conference were conducted [10]. Furthermore, it needs to be taken into consideration that the patients in the present cross-sectional study were recruited from one clinic. Due to large variations between the ICF Core Sets, it is not possible to draw definite conclusions regarding the contribution from these additional elements.

The functional level of the patients in the cross-sectional study (Paper II) and the test-retest study (Paper IV) was assessed with the Shoulder Pain and Disability Index (SPADI). Alternatively, a more comprehensive condition-specific measure, such as the Disability of the Arm, Shoulder and Hand (DASH) scale could have been applied. However, at the time when the studies were conducted, the SPADI was routinely used at both hospitals where the data were collected. Furthermore, a cross-culturally adapted Norwegian version of the DASH scale was not available.

5.1.3 Analyses

In the literature review (Paper I), frequencies for the identified ICF categories were based on the number of times their corresponding concept appears in the clinical literature. Due to the calculation method the ICF categories received rather low frequencies. Alternatively, the frequency could have been calculated from the number of articles that mentioned a concept. Although the alternative method would have led to higher frequencies for the ICF categories,

their ranking would have ended up being similar. Both of these calculation methods have been used in previous core set development processes.

In the test-retest study (Paper IV), the minimal detectable change was calculated to be 3.32. Thus a change score of at least 4 is required to exceed the measurement error in individual patients. However, this change score is not necessarily clinically important. The minimal important difference (responsiveness) has been defined as the ability of a measure to detect clinically important changes over time in the construct to be measured [123]. There are two different methods to calculate the responsiveness: statistically based methods and anchor-based methods. The anchor-based methods use an external reference, often a patient-reported global rating of change [119, 149]. Although the concept of global change has certain strengths, it has been criticised for being vulnerable to patients' recall biases, and perceptions of their context and contradicting how people organise their memory [150-152]. The alternative methods to calculate the minimal important difference use formulas that are based on the variability of the data at the baseline [130, 131, 153]. The supporters of these statistically derived methods claim to have found a remarkable relationship between the standard deviation at baseline and the minimal important difference [128, 154]. In the present study, calculations of the minimal important difference based on these recommended statistical methods resulted in a lower estimate than the minimal detectable change. Thus, we suggest that a change score of at least 4 for the Shoulder Activity Scale is also clinically relevant.

5.2 Result discussion

5.2.1 Patient experiences in relation to the content of measures

The patient experiences of functioning are an invaluable source of information in rehabilitation. The results from the patient interviews (Paper II) show that problems covered by neuromuscular and movement-related body functions (b7-chapter) are frequent among the patients. Categories from this chapter were also covered by the content of many condition-specific single-item and multi-item measures (Paper I). As expected, *sensation of pain* was the most frequent patient-derived category and it was also ranked number one in the literature review of measures. This is consistent with the findings in a review in primary care populations with shoulder disorders in which high pain intensity at baseline was identified as a predictor for a poor outcome [155]. The ICF categories *structures of shoulder*

region, mobility and stability of joint functions and *muscle power* were frequently derived in the patient interviews and they were also high ranked based on the measures (Paper III). Two other high-frequency patient-derived categories *muscle endurance* and *muscle tone*, were not identified in the measures, although there is support to suggest that they are frequently affected in patients with shoulder pain [73, 81, 156]. These findings suggest that central aspects of muscle functioning are not covered by the current assessment of shoulder pain.

The limited attention given towards mental health in the rehabilitation of patients with shoulder pain has been criticised [157]. Consistent with this criticism, our findings indicate that high-frequency patient-derived mental health problems are scarcely addressed in commonly used condition-specific measures (Paper III). In particular, these measures do not address *temperament and personality* and *energy and drive* functions. The clinical implications of mental health problems have been debated: in a prospective study that investigated the contribution of psychological distress' to the score in three condition-specific outcome measures of shoulder pain, it was concluded that the DASH scores were more strongly influenced by pain anxiety and depression than the Constant and SST scores [158]. This is consistent with the findings in another study in which higher DASH scores were significantly associated with depressive symptoms [159]. It has been suggested that mental health seems to be influenced by the disability and not by the persistence of pain itself in patients with chronic shoulder pain [56]. These findings indicate that the connection between mental health, disability and pain is complex. In our opinion, mental functions should be more comprehensively addressed in condition-specific measures. The importance of mental health functions in treatment settings remains to be further investigated. It has been suggested that mental health problems are predictive of a poor outcome in treatment interventions, but two prospective studies have drawn opposite conclusions [57, 58].

Parallel with the lack of mental health concepts included in the measures, frequent patient-derived categories of interpersonal interactions/relationships and environmental social support categories were scarcely represented (Papers I-III). This may reflect previously established beliefs among health professionals that the environment, in particular the social and cultural environment has a negligible impact on a person's functioning [160-162]. The minimal use of social function and participation measures in the rehabilitation of musculoskeletal conditions was criticised in a recent paper [163]. The research on the social environmental factors within the field of shoulder pain has mostly been devoted to the negative consequences of the lack of social support at the workplace [61, 63, 106, 109, 110, 164, 165]. The results from our patient interviews, however, indicate that the presence of

environmental social support from family members, friends, peers, colleagues and health professionals is more often a facilitator of functioning. More research should be devoted to investigate the influence of social environmental factors in patients with shoulder pain.

5.2.2 Content variation in condition-specific measures

The content analyses of the condition-specific multi-item measures and the comparison with the patient experiences (Papers I and III), indicate that they cover a very different number of ICF categories and match patient-derived categories differently. These content differences are consistent with the lack of consensus among clinical experts and researchers within the field [82, 88, 89, 166]. As a consequence of the lack of comprehensiveness in some of the measures, we suggest that the wide-ranging Disability of the Arm, Shoulder and Hand (DASH) scale and the American Shoulder and Elbow Surgeons Standardized Form for Assessment of the Shoulder (ASES) would be appropriate for non-surgical clinical treatment situations. Our content analyses indicate that the oldest measures are often less wide-ranging than the more recent measures. For example, the content of the Constant-Murley Shoulder Score (Constant) and the Rating Sheet for Bankart Repair (Rowe) only cover 4 and 3 ICF chapters, respectively, whereas the more recent DASH 22 and ASES cover 14 ICF-chapters [68, 71, 96, 133]. In a study that reviewed the content of 36 condition-specific questionnaires for low back pain within the ICF, similar results were found according to their coverage of activity limitations and body function impairments [24].

The updated literature search we conducted indicated that the DASH and ASES seem to be more frequently selected in studies published within the last year. In contrast, the Constant, the Shoulder Pain and Disability Index (SPADI) and the generic Medical Outcomes Study 36-item Short-Form Health Survey (SF-36) seemed to be less frequently selected. As long as the DASH and ASES are applied the SF-36 does not contribute with a large amount of additional content, according to our analyses within the ICF. Nevertheless, the SF-36 allows comparisons of outcomes across different populations and in cost-effectiveness studies that are valuable in research [98]. For clinical settings however, this development may be advantageous; it is most likely less confusing to apply a single, comprehensive condition-specific measure, instead of combinations of different types of measures [55, 97, 167].

The comparison between high-frequency patient-derived categories and the content of commonly used condition-specific measures (Table 1) demonstrates that almost one third of these categories are not covered by any of these measures. This is an indication that they may not be solid enough regarding how well the content adequately reflects the construct to be measured [123]. Although the measurement properties of the condition-specific measures

have been reviewed in a number of studies, little attention has been paid to the content of the measures [91-93, 95, 168]. This is parallel with the often scarce attention that is paid to establishing content validity in methodological studies; for example, only construct, convergent and discriminant validity were reported for the ASES in the original validation study [169]. The ICF and the linking rules can prove to be useful tools in establishing content validity for measures in future studies [8, 9].

5.2.3 The added value of clinician-rated movement measures

Within the field of shoulder pain, activity limitations are often assessed by measures that are patient-reported or contain patient-reported sections [53, 170]. The results from a number of studies suggest that the correlation between patient-reported and clinician-rated measures is generally low or moderate [171-176].

As part of the development process, the Shoulder Activity Scale (Appendix 2) was linked to the activities *lifting and carrying objects, dressing, and hand and arm use* and to the body function *control of voluntary movement*. Of these ICF categories, only the latter was not identified in the content of the measures or in the patient interviews (Papers I and II). As previously discussed in the method section, this may be explained by one of the exclusion criteria in the literature review. Another explanation is the lack of a simple and clinical measure that covers movement functions. Substantial research supports that abnormal movement patterns are involved in the development or maintenance of shoulder pain and restoration of movement-patterns is often an aim in treatment interventions [73, 75-81, 177-179]. As such, the content of the Shoulder Activity Scale cover key aspects of many treatment interventions.

The minimal availability of clinician-rated activity measures in shoulder pain rehabilitation is different from other rehabilitation fields and has been criticised [25, 103]. The clinician-rated measures have the advantage of directly measuring the unit of interest. Furthermore, they reflect the current situation and they are less vulnerable to the patient's recall, language, and problems with vision or literacy [180, 181]. Because the testing takes place in a standardised environment, they may provide information about the patients' domestic environment. With the development of the Shoulder Activity Scale, a new simple clinician-rated measure testing movement activities is available. To our knowledge, only two other similar measures exists, the Bostrom- and the FIT-HaNSA scales [99, 182]. However, the Bostrom scale assesses four shoulder movements: hand-raising, hand behind the back, hand to neck and hand to opposite shoulder in front of the body [182]. In the ICF language all these movements are covered by neuromuscular and movement-related body functions (b7-chapter). The other

scale, the FIT-HaNSA, measures the number of times participants are able to perform movement-tasks that require grip/manipulation of the hand, elbow and shoulder [99]. Although the content of the FIT-HaNSA covers similar activity ICF categories as the Shoulder Activity Scale, its purpose is different. In the FIT-HaNSA scale, the purpose is to measure the number of repetitions, regardless of the quality of the movement. In addition to these clinician-rated scales, at least two assessment methods of scapular kinematics are available [183-185]. These methods are however different from the Shoulder Activity Scale because they are aimed at identifying abnormal movement in a single body segment, the scapula.

Among physiotherapists, it is often assumed that they have a common understanding of abnormal movement patterns. The results of the test-retest study support this assumption, given some premises. It has been suggested that tests that reflect familiar tasks and have discrete starting and ending points appear to have the best chance to achieve high reliability ratings [186]. The movement tasks of the Shoulder Activity Scale are most likely consistent with these recommendations and the reliability calculations were also higher than in other studies that have investigated clinician-rated activity measures [186]. The basic mechanisms underlying the abnormal movement patterns have to some extent been investigated in electromyography analyses of muscles [75-81]. Further studies with movement analyses may increase the knowledge about abnormal movement-patterns in the upper extremities. The Shoulder Activity Scale is a simple, clinician-rated measure that fills a gap in the present assessment methods. Before it is applied in clinic, it needs to be validated.

5.2.4 A comprehensive picture of shoulder pain within the ICF framework

The categories identified in the literature review of the measures and the cross-sectional study with patient interviews constitutes a preliminary list of 68 ICF categories for shoulder pain (Table 2). This section focuses on how the condition is perceived in the ICF language.

More than half ($n = 38$) of the ICF categories in the list cover activity limitations and participation restrictions, underlining how defining these aspects of functioning are for shoulder pain. Within the body functions and structures, a large majority of the 21 categories covered neuromuscular and movement-related- and mental functions (Figure 2). The list covers only 9 environmental factors. Of these 5 belong to the support and relationships chapter, covering support from family, friends, peers, colleagues and health professionals. Altogether, the list confirms that the disability associated with shoulder pain is multi-faceted.

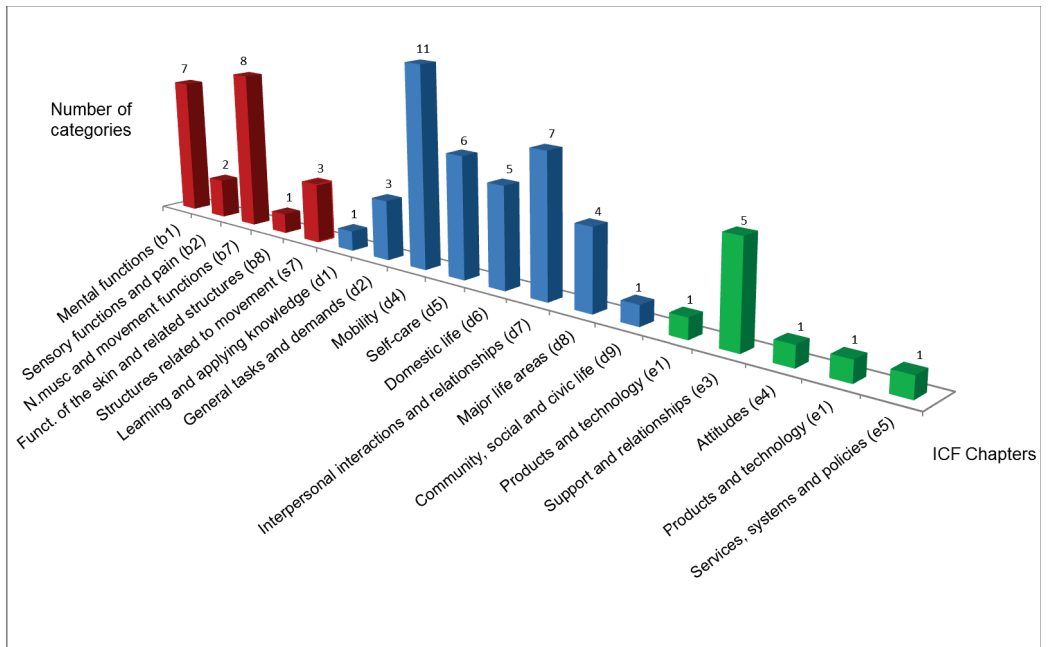


Figure 2. Distribution of categories in the preliminary list for shoulder pain (n = 68) in relation to ICF chapters

The present, preliminary list of ICF categories for shoulder pain has some similarities with the comprehensive musculoskeletal ICF Core Sets for low back pain, osteoarthritis, osteoporosis, rheumatoid arthritis, chronic widespread pain and ankylosing spondylitis [12-17]. The common categories in five of these musculoskeletal ICF Core Sets were identified in a previous article [18]. The body functions *sleep*, *emotional functions*, *pain*, *mobility of joints*, *muscle power* and *muscle endurance* are present in all the ICF Core Sets and in the preliminary list for shoulder pain. There is only one example of a common body function from the ICF Core Sets that is not present in the list, namely *sensations related to muscles and movement functions*. Concerning activities and participation, all the common categories from the ICF Core Sets are also present in this list for shoulder pain, except from the participation function *community life*.

The largest differences between the present list of ICF categories and the musculoskeletal ICF Core Sets are among the environmental factors; only 9 categories are identified in the present list for shoulder pain compared with 25 for low back pain, 17 for osteoarthritis, 26 for osteoporosis, 21 for rheumatoid arthritis, 34 for chronic widespread pain and 14 for

ankylosing spondylitis [12-17]. The environmental categories, *social support from immediate family* and *support or attitudes of health professionals* are present both in the shoulder pain list and in all five musculoskeletal core sets. Three other environmental categories from the musculoskeletal core sets are not included in the list for shoulder pain. These are: *individual attitudes of immediate family members*, *societal attitudes* and *health services, systems and policies*. Careful conclusions should, however, be drawn due to the less comprehensive development process of the preliminary list of ICF categories for shoulder pain. The ICF categories that were common among all five ICF Core Sets, whereas not identified in the present list, represent future candidate categories for shoulder pain. In addition, this may also be the case for the body function *control of voluntary movement* that was linked from the Shoulder Activity Scale (Paper IV).

The generic ICF Core Set was developed and has been recommended for conditions and settings in which an ICF Core Set does not exist [19, 20]. All 7 of the ICF categories in the Generic ICF Core Set are also present in the list for shoulder pain. This finding confirms that the core categories in other chronic conditions are also relevant in shoulder pain.

5.2.5 Benefit of condition-specific ICF categories

The joint use of the ICD and the ICF has been advocated to capture the full impact of a health condition on the individual's functioning [21]. Recently, the Orthopedic Section of the American Physical Therapy Association (APTA) published a practice guideline for adhesive capsulitis of the shoulder, and another for shoulder pain and muscle power deficits is under development [32, 52]. These practice guidelines for the shoulder are part of a series of guidelines for musculoskeletal conditions from the APTA that are all based on the ICF. In the guidelines, ICF categories are used to describe clinically relevant problems in functioning according to body functions and structures, and activities and participation. The purposes of these guidelines were to categorise patients into mutually exclusive impairment patterns upon which to base intervention strategies, and serve as measures in changes of function over the course of an episode of care [32]. Although there was little reference to this in the guidelines, the identification of these condition-specific ICF categories for adhesive capsulitis seemed to have been based on decisions by a group of clinical experts without mention of patient participation. The results that have been presented in the present thesis show that this method has certain limitations. The ICF Core Set development process represents a much more comprehensive approach to the identification of condition-specific ICF categories.

In the 11th version of the International Statistical Classification of Diseases and Related Health Problems. (ICD), that will be finished in 2015, functional properties that are derived from activities and participation categories in the ICF will supplement the ICD codes, within some areas [33, 34]. This development implies an increased application of the ICF in the diagnostic classification of patients. This recent development within the practice guidelines and the revision of the ICD, imply that that the ICF is increasingly being implemented in clinical decision-making. To facilitate this, there is a need for condition-specific ICF categories for shoulder pain that are based on a comprehensive identification process in which the patient perspective is represented.

6. CONCLUSIONS

6.1 Conclusions

This thesis concerning shoulder pain within the ICF framework, presents the work from a literature review on commonly used measures, patient interviews with a condition-adapted checklist, investigation of correspondence between the patient experiences of functioning and the content of measures, identification of a preliminary list of condition-specific categories for shoulder pain, and finally, the development process and reliability testing of a new clinician-rated activity measure. The conclusions that can be drawn are:

- Using the ICF as a reference, a total of 40 ICF categories were identified from the content of condition-specific and generic measures of shoulder pain. The most frequently addressed concepts in the measures were pain, movement-related body functions and structures, sleep, hand and arm use; self-care, household tasks, work and employment, and leisure activities. Concepts of psycho-social functioning and environmental factors were less frequently addressed.
- Commonly used condition-specific measures, that contain patient-reported sections, have large variation in content. The Disability of the Arm, Shoulder and Hand Scale and the American Shoulder and Elbow Surgeons Standardized Form for Assessment of the Shoulder were linked to more than twice as many ICF categories as the Constant-Murley Shoulder Score, the Simple Shoulder Test and the Shoulder Pain

and Disability Index. These large differences signify the importance of clarifying the content to select the most appropriate measure both in research and in clinical work. For clinical situations, we propose the use of a wide-ranging condition-specific measure.

- From the patient interviews with the condition-adapted checklist, a total of 61 ICF categories were identified, indicating that the patient experiences of shoulder pain are complex and multi-faceted. The most frequent problems in functioning were related to the body functions sensation of pain, movement-related functions and mental functions, and the activity and participation functions mobility, self-care, domestic life, interpersonal interactions and relationships, work and leisure activities. Within environmental factors, social support from immediate family and friends were identified as facilitators of functioning in approximately one of five patients.
- The correspondence between the patient experiences of functioning and the content of the generic and condition-specific measures was high within activities and participation, however, more discrepancies were found for body functions and structures and particularly for environmental factors. Patient-derived categories of the body functions temperament and personality, emotional functions, muscle endurance and muscle tone were not identified in the measures; this was also the case for the environmental factors social support from family, friends, colleagues, employers, and health professionals and social security and health services.
- Six of 20 high frequency patient-derived ICF categories were not covered by the content of any of the most commonly used condition-specific measures. This is an indication that these measures, that contain patient-reported sections, may not be solid enough regarding how well the content adequately reflects the construct to be measured.
- A preliminary list of 68 condition-specific, ICF categories for shoulder pain was identified. Of these categories, 28 were uniquely identified in the patient interviews, whereas only 7 low-ranked categories from the content of generic and condition-specific measures were uniquely identified. More than half of the categories in the preliminary list cover activities and participation. Condition-specific ICF categories seem to be increasingly applied in clinical decision-making.
- The preliminary list of ICF categories for shoulder pain has similarities with five musculoskeletal ICF Core Sets, although some differences should be noted: a lower number of environmental factors are included in the list for shoulder pain, and the body functions muscle endurance and sensations related to muscles and movement functions are not present. In addition, activities reflecting individual attitudes of

immediate family members, societal attitudes and health services, and systems and policies were not identified in the preliminary list of ICF categories for shoulder pain.

- The Shoulder Activity Scale is a simple and reliable clinician-rated activity measure for patients with shoulder impingement syndrome. The measure focuses on abnormal movement-patterns in the upper extremities, which is a key concept in treatment interventions of shoulder pain. Clinician-rated activity measures seem to provide additional information to the patient-reported measures.

6.2 Implications for clinical practice and research

The present research on shoulder pain within the ICF framework has several implications for clinical practice. The condition-specific ICF categories that were identified can be applied in different stages of the clinical practice, such as assessment, goal assignment, and evaluation of treatment interventions. In most cases, the ICF categories and their explanations should be easily understood by clinicians and patients.

The lack of comprehensiveness in relation to the patient experiences of functioning in the content of condition-specific measures should facilitate further debate among health professionals within the field. Future reviews of the measurement properties of these measures should pay increased attention to this topic.

The identification of condition-specific categories has been advocated as the starting point to apply the generic ICF in rehabilitation. The present, preliminary list of ICF categories for shoulder pain constitutes the most comprehensive overview of shoulder pain within the ICF framework that is currently available. The list should be applied in development of practice guidelines for shoulder pain. To improve its feasibility, the list should be further developed into an ICF Core Set. To our knowledge, there is currently no plan for such attempt.

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RESEARCH ARTICLE

Open Access

A systematic review of measures of shoulder pain and functioning using the International classification of functioning, disability and health (ICF)

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Abstract

Background: Shoulder pain is a common condition with prevalence estimates of 7–26% and the associated disability is multi-faceted. For functional assessments in clinic and research, a number of condition-specific and generic measures are available. With the approval of the ICF, a system is now available for the analysis of health status measures. The aims of this systematic literature review were to identify the most frequently addressed aspects of functioning in assessments of shoulder pain and provide an overview of the content of frequently used measures.

Methods: Meaningful concepts of the identified measures were extracted and linked to the most precise ICF categories. Second-level categories with a relative frequency above 1% and the content of measures with at least 5 citations were reported.

Results: A set of 40 second-level ICF categories were identified in 370 single-item measures and 105 multi-item measures, of these, 28 belonged to activities and participation, 11 to body functions and structures and 1 to environmental factors. The most frequently addressed concepts were: pain; movement-related body functions and structures; sleep, hand and arm use, self-care, household tasks, work and employment, and leisure. Concepts of psycho-social functions and environmental factors were less frequently included. The content overview of commonly used condition-specific and generic measures displayed large variations in the number of included concepts. The most wide-ranging measures, the DASH and ASES were linked to 23 and 16 second-level ICF categories, respectively, whereas the Constant were linked to 7 categories and the SST and the SPADI to 6 categories each.

Conclusions: This systematic review displayed that measures used for shoulder pain included more than twice as many concepts of activities and participation than concepts of body functions and structures. Environmental factors were scarcely addressed. The huge differences in the content of the condition-specific multi-item measures demonstrates the importance of clarifying the content to select the most appropriate measure both in research and in clinical work. For clinical situations, we propose use of a wide-ranging condition-specific measure that conceptualizes assessments of shoulder pain from a bio-psycho-social perspective. Further research is needed to assess how patient-reported problems in functioning are captured in the commonly used measures.

Keywords: ICF, Outcome assessment (health care), Shoulder pain, Shoulder, Health, Cross-sectional studies, *Disability evaluation, World health organization, Recovery of function, *Rehabilitation

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Background

Shoulder pain is common in the general population; prevalence estimates range from 7 to 26 per cent [1]. The large range in the prevalence rates has been explained by the use of different definitions of the condition in the literature [1]. Pain in the neck or shoulder emerged as the most frequent work-related health complaint in a Norwegian cohort study, and diagnosed shoulder pain accounted for almost 18 per cent of all sick leave benefit claims in a Swedish survey [2,3]. Shoulder pain is characterised by restricted and painful movement of the arm, which results in difficulties in performing movement-related activities [4-6]. In recent decades, research has shown that psychological and social functioning may also be affected by shoulder pain; additionally, environmental factors may contribute to the development or persistence of the condition [7-10].

Functional assessments are an important aspect of clinical decision making and research pertaining to patients with shoulder pain. A number of condition-specific measures are available for making these assessments, including standardised clinical examination methods, patient-reported questionnaires and composite scores [5,6,11-14]. Whether the condition-specific symptoms should be limited to movement-related functions of the shoulder region or be expanded to include additional aspects of functioning, such as work, leisure activities and sleep quality has been debated [12,15]. To make the assessments more comprehensive and to facilitate comparisons with other health conditions, some have advocated the inclusion of generic measures in the assessments [7,13,16]. Generic measures may focus on a specific function or broadly include the concept of general health [12]. So far, there are no commonly accepted guidelines for functional assessment in the area of shoulder pain. Given the increasing standards of health measurements, considerable research effort has been devoted to investigating the psychometric properties of the condition-specific measures [17-24]. Although the content of such measures also needs to be considered, it often receives less attention [25].

With the approval of the International Classification of Functioning, Disability and Health (ICF) in 2001, a conceptual framework and classification is now available for content analysis of functional measures from a bio-psycho-social perspective [26]. The ICF is based on an integrative model that classifies functioning within the components of *body functions* (b), *body structures* (s), *activities & participation* (d) and *environmental* (e) and *personal factors* (not classified). The ICF classification provides categories of functioning and environmental factors that are arranged in a hierarchical fashion using an alphanumeric coding system. The initial letter refers to the component. This letter is followed by a numeric code that starts with the chapter number (e.g., Mobility, d4),

which is followed by the second level (e.g., d445 Hand and arm use) and then the third level (e.g., d4452 Reaching). A fourth level of classification is also available when appropriate. The categories at a lower level are included in the higher level categories and chapters. Procedures have been established to classify the content of functional measures using ICF categories, regardless of their purpose, their extent and administration method [27,28].

The ICF classification is comprehensive. Shorter lists of categories, known as ICF core sets, have been developed to describe the typical spectrum of problems in the functioning of patients with a specific health condition [29]. The core set development process was based on literature reviews, expert surveys and single quantitative and qualitative clinical studies. A review investigating commonalities across ICF core sets for musculoskeletal conditions found a large number of common categories for the conditions low back pain, osteoarthritis, osteoporosis, and rheumatoid arthritis; however, there were also unique categories associated with each particular condition [30]. As part of this core set development process, a literature review was conducted to analyse the content of measures for each of the musculoskeletal disorders [31]. Such a review based on a bio-psycho-social perspective on functioning has not been conducted for shoulder pain. The aims of this systematic literature review were to identify the most frequently addressed aspects of functioning in assessments of shoulder pain and provide an overview of the content of frequently used measures.

Methods

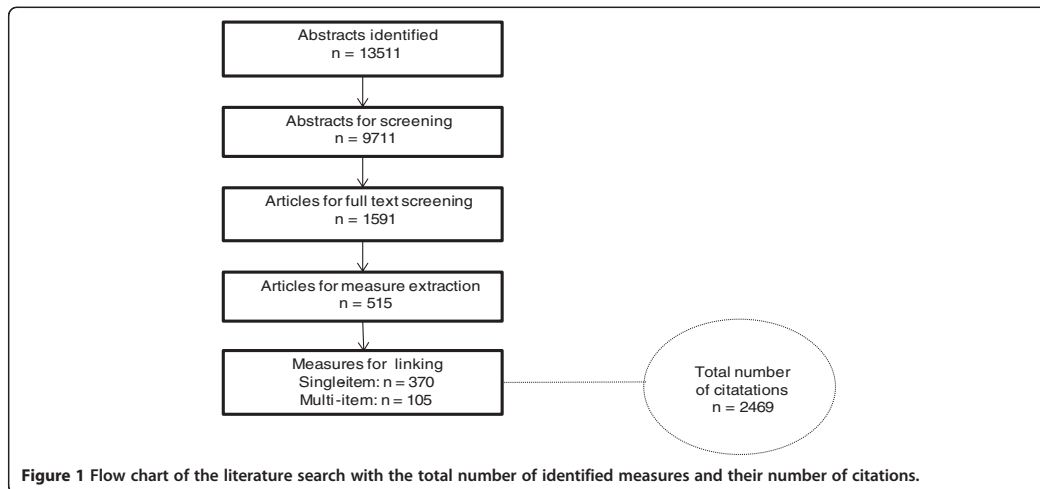
Design

A systematic literature review and content analysis of measures used in shoulder pain. The steps of the screening and extraction of measures are displayed in Figure 1.

Literature search

The inclusion criteria were articles written in English, published in peer-reviewed journals and based on clinical studies on patients having shoulder pain. A highly sensitive 15-step search strategy for Medline was developed (Additional file 1) [32]. The Medline strategy was also adapted to Embase, PeDro, Cinahl and Central. The search was limited to studies published between January 2005 and May 2010. In a first step MeSH-terms related to shoulder pain were exploded and combined using the Boolean operator "OR". Terms used for functional assessments were also combined with the Boolean operator "OR". In the next step the MeSH-terms and the functional assessment terms were combined using the Boolean operator "AND".

Articles based on studies of fractures, joint replacement, complete dislocation, malignant condition, rheumatic



diagnosis and stroke were excluded, as were studies based exclusively on laboratory parameters or on a non-human population. The following designs or types of studies were also excluded: comments, letters, editorials, guidelines, conference reports, literature reviews, primary prevention studies, phase I or II studies, ecologic and economic evaluations, quantitative studies with less than 31 participants and studies on children.

Screening and extraction of measures

All retrieved articles from the databases were imported to the same Endnote library (version X3, Thomson Reuters 1500 Spring Garden Street, Philadelphia) and screened for duplicates. In cases of multiple publications, the journal with the highest impact factor was selected. All remaining articles were imported into a Microsoft Access database (Microsoft Office 2003) for the abstract screening. Articles meeting any exclusion criteria were excluded. In cases where the decision was to include the article or the exclusion decision was ambiguous, full versions of the articles were retrieved. All abstracts were screened by one reviewer (YR); a random selection of 20% was also screened by a second reviewer (SO) before a final decision was made. Another predesigned Access database was used for the full version screening and extraction of measures. Where there was doubt as to which version of a measure had been used, a decision was made using the references given in the methods section of an article.

Information on nationality using the address of the first author, study design and types of interventions was recorded. The extracted measures were categorised as either single-item or multi-item measures. Single-item measures contained only one item, such as imaging and

clinical tests and single questions on different domains; in contrast, multi-item measures included more than one test and question, such as different questionnaires and scales.

Analyses

The content of the measures was linked to the ICF according to established rules [27,28]. Meaningful concepts were extracted and linked to the most specific ICF category possible. Items could contain more than one concept; for example, *I cannot lie on my right side at night because of my shoulder* contains the meaningful concepts *lie on my side* and *because of my shoulder*. The former was linked to the *maintaining a lying position* (d4150) and the latter to the *pain in upper limb* (b28014). For concepts not sufficiently specified to be linked, the *non-definable* option was chosen. If a concept was not covered by the ICF classification, the option *not covered* was chosen [27,28]. All measures were linked by one reviewer (YR) and a random selection of twenty-five per cent of the multi-item measures were also linked by a second reviewer (SO). The single-item measures were discussed with a clinician and researcher experienced in rehabilitation of shoulder pain (KE). The ICF links of ten measures that had already been published in scientific journals or were available from previous reviews performed by the ICF Research Branch were accepted for use in the current study [33,34].

Relative frequencies of the linked second-level ICF categories for each component were estimated from the total number of citations. Only ICF categories that arose with a frequency of at least 1% are presented. A frequency of 10% was chosen as the arbitrary cut off to classify a category as high frequent. In cases where

concepts were linked to a third- or fourth-level category, they were aggregated to the second level. For example, a concept linked to the third-level category *turning or twisting the hands or arms* (d4453) was reported under the second-level *hand and arm use* (d445) category. When an ICF category was assigned repeatedly in the same measure, it was only counted once. Moreover, the content of measures cited in at least 5 different articles were presented at the ICF chapter level and more detailed in the Additional file 2.

Reliability of the abstract screening and linking procedures were measured with percentage agreement and estimation of Cohen's Kappa coefficient. The 95% confidence intervals for the Kappa coefficient were constructed using the bias-corrected percentile method [35,36]. A Kappa coefficient of 0–0.4 was considered poor, 0.41 – 0.60 fair to good and 0.61 – 1.00 excellent [37]. The agreement in the counter-screening of abstracts between reviewers was 87.3%. The estimated Kappa coefficient was 0.62 (95% CI, 0.59 - 0.66), which is considered good or excellent. The agreement in the linking procedure between reviewers was 80.8%. The estimated Kappa coefficient was 0.81 (95% CI, 0.77 - 0.85), which was classified as excellent.

Results

Literature search

A total of 13,511 articles were identified through the literature search; of these articles, 1591 full versions were screened, and 515 were included. Altogether 475 different measures were extracted with a total of 2469 citations. Among them, 370 were single-item measures and 105 were multi-item measures. A total of 20,517 meaningful concepts were extracted from the measures, of which 86.3% were linked to the ICF. The share of concepts that were not covered or not definable was 13.7%. The procedure is displayed in Figure 1.

Study characteristics

According to nationality, Europe accounted for 44% of the articles, Canada and USA for 32% and Asia for 15%. Approximately 9% of the articles were from other continents. Sixty per cent of the articles contained studies with an interventional design (e.g., randomised controlled trial or case control trial), while thirty-nine per cent of articles were based on an observational study (longitudinal or cross-sectional). Only a single article based on a qualitative study was present in the sample. Ninety-one per cent of the articles included participants with a diagnosed shoulder condition, of whom 52% were diagnosed with subacromial pain conditions, 17% with instability or SLAP-lesions, 9% with adhesive capsulitis, 18% with mixed diagnoses and 4% with other diagnoses.

Nine per cent of the articles included individuals with self-reported shoulder conditions only.

Second-level ICF categories linked to concepts contained in the measures

A total of 40 second-level ICF categories with a frequency above 1% were identified in the components of *body functions and structures, activities and participation* and *environmental factors*.

Eleven second-level ICF categories were identified within the *body functions and structures* component, as shown in Table 1. Of these, five categories were located in the *neuromusculoskeletal or movement related functions* (b7) chapter, three in *mental functions* (b1), two in *sensory functions and pain* (b2) and one in *structures related to movements* (s7). The five second-level categories with a relative frequency above 10% were *sensation of pain* (b280), *mobility of joint functions* (b710), *structure of shoulder region* (s720), *muscle power functions* (b730) and *sleep functions* (b134).

As displayed in Table 2, 28 second-level ICF categories were identified within the *activities and participation* component. Of these, eight categories had a relative frequency above 10%. Nine categories belonged to the *mobility* chapter (d4), six to *self-care* (d5), four to *domestic life* (d6), three to *interpersonal interactions and relationships* (d7) and *major life areas* (d8), and one category each to the chapters of *community, social and civic life* (d9), *learning and applying knowledge* (d1) and *general tasks and demands* (d2). The eight categories with a frequency above 10% were, in ranked order: *hand and arm use* (d445), *remunerative employment* (d850), *recreation and leisure* (d920), *lifting and carrying objects* (d430), *washing oneself* (d510), *dressing* (d540), *caring for body parts* (d520) and *doing housework* (d640).

Table 1 Relative frequency (%) of second level ICF categories linked to the concepts contained in the measures for the ICF component body functions and structures (n= 2469) in ranked order

ICF second level categories (n=11)	(%)
b280 Sensation of pain	47,3
b710 Mobility of joint functions	34,7
s720 structure of shoulder region	24,9
b730 Muscle power functions	24,2
b134 Sleep functions	17,5
b715 Stability of joint functions	7,1
b152 Emotional functions	6,3
b780 Sensations related to muscles and movement functions	3,3
b130 Energy and drive functions	3,1
b265 Touch function	2,3
b720 Mobility of bone functions	2,1

Table 2 Relative frequency (%) of second level ICF categories linked to the concepts contained in the measures for the ICF component activities and participation (n= 2469) in ranked order

ICF second level categories (n=28)	(%)
d445 Hand and arm use	24,5
d850 Remunerative employment	23,2
d920 Recreation and leisure	18,3
d430 Lifting and carrying objects	17,1
d510 Washing oneself	17
d540 Dressing	15,8
d520 Caring for body parts	12,7
d640 Doing housework	10,4
d415 Maintaining a body position	6
d230 Carrying out daily routine	4,5
d475 Driving	4,7
d530 Toileting	3,6
d650 Caring for household objects	3,6
d620 Acquisition of goods and services	3,4
d470 Using transportation	3,6
d760 Family relationships	3
d550 Eating	2,9
d450 Walking	2,8
d410 Changing basic body position	2,6
d630 Preparing meals	2,6
d750 Informal social relationships	2,6
d455 Moving around	2,5
d770 Intimate relationships	2,3
d859 Work and employment, other specified and unspecified	2,2
d170 Writing	2,1
d440 Fine hand use	2,1
d570 Looking after one's health	1,1
d820 School education	1

In the ICF component of *environmental factors*, the only identified second-level category was *products or substances for personal consumption* (e110). This category which was located in the *products and technology* (e1) chapter had a relative frequency of 8.8%.

Distribution of ICF codes within the measures

The 16 condition-specific and 7 generic multi-item measures with five or more citations are displayed in Table 3. By far the most cited were Constant-Murley Shoulder Score (Constant) (124 citations), followed by the American Shoulder and Elbow Surgeons standardized form for assessment of the shoulder (ASES) (77 citations), the University of California at Los Angeles shoulder rating scale (UCLA) (64 citations) and the Disability of the Arm, Shoulder and Hand scale (DASH) (51 citations). All of the condition-specific measures

included categories from both the *body functions and structures* and *activities and participation* components of the ICF. Of these, the DASH and ASES were the most wide-ranging, containing meaningful concepts linked to categories in 11 and 9 chapters, respectively. By contrast, the Shoulder Pain and Disability Index (SPADI) and the Walch-Duplay Score only contained categories belonging to three ICF chapters. The most-frequently cited generic measure, the MOS 36-item short-form health survey (SF-36) (46 citations), was linked to seven chapters: two of which were in the *body functions and structures* component, and five of which were in the *activities and participation* component.

Of the condition-specific measures, the ASES, UCLA and the Rating Sheet of Bankard repair (Rowe) also included concepts that were linked to an environmental factor, all of which belonged to the *products and technology* (e1) chapter. Only one of the generic measures, the Job Content Questionnaire (JCQ), included environmental factors. Its content was linked to two chapters other than *products and technology* (e1); specifically, it was also linked to the *natural environment and human-made changes to environment* (e2) and *support and relationships* (e3) chapters.

The most comprehensive measure of *mental functions* (b1) was the generic Four-Dimensional Symptom Questionnaire (4DSQ). It includes concepts linked to five second-level categories: *consciousness functions* (b110), *energy and drive functions* (b130), *sleep functions* (b134), *emotional functions* (b152) and *higher-level cognitive functions* (b164). The SF-36 had concepts linked to two mental function categories: the *energy and drive functions* (b130) and *emotional functions* (b152). Of the condition-specific measures, none of the most cited contained other mental functions than *sleep functions* (b134). The UCLA (the third most cited) did not address any *mental functions* (b1) concepts. Looking at employment and leisure activities, the content of 11 of the 16 condition-specific measures was linked to *remunerative employment* (d850), eight to *recreation and leisure* (d920) and seven of the measures to both ICF categories. The UCLA, SPADI, the Shoulder Disability Questionnaire (SDQ) and the Flexlevel Scale of Shoulder Function (FLEX-SF) contained no concepts related to work and leisure. Of the seven generic measures, five included work functions; only one, the SF-36, asked for information about leisure activities.

The 28 condition-specific and 7 generic single-item measures with five or more citations are displayed in Table 4. Patient-reported shoulder pain intensity was the most frequently cited (200 citations) followed by active range of motion (170 citations), Magnetic Resonance Imaging (MRI/MRA) (125 citations), muscle strength (98 citations), X-ray (81 citations), passive range of

motion (61 citations) and ultrasonography (57 citations). The measures contained concepts that were linked to categories in three ICF chapters of the *body functions and structures* component: *sensory functions and pain* (b2), *neuromusculoskeletal or movement related functions* (b7) and *structures related to movements* (s7). By contrast, the generic single-item measures were (with one exception) linked to categories of *activities and participation* or *environmental factors*. These categories belonged to the *self-care* (d5), *major life areas* (d8), *community, social and civic life* (d9) and *products and technology* (e1) chapters. Two measures that requested the use of medication or smoking habits were the only concepts of environmental factors among the single-item measures.

Discussion

Using the ICF as a reference, we first identified and quantified the concepts included in frequently used measures of shoulder pain and functioning. The content

of the measures was linked to 11 different ICF categories within 3 of 8 domains of *body functions and structures*, and 28 ICF categories within 8 of 9 domains of *activities and participation*. *Environmental factors* were scarcely addressed, accounting for only one category. The finding displays that the measures of shoulder pain cover a large number of concepts of daily activities and also some particular concepts of body functions.

As expected, the ICF category *sensation of pain* was highest ranked. Different concepts of pain were requested in both condition-specific single and multi-item measures and also in generic measures. This is consistent with previous recommendations to regard pain as a global construct measured by pain intensity and by interference with activities [59]. In a systematic literature review on prognostic factors in primary care populations of shoulder disorders, strong evidence was found that high pain intensity at baseline predicts a poor outcome [60]. The ICF categories *mobility of joint, structures of the shoulder region* and *muscle power functions* were

Table 3 Number of citations and content overview at ICF chapter-level of the most frequently identified multi-item measures

Cond-spec. measures (n=16)	Number of citations	Mental functions (b1)	Sensory functions and pain (b2)	Neuromuscular and movement (b7)	Structures related to movement (s7)	Learning and applying knowledge (d11)	General task and demands (d2)	Mobility (d4)
Constant	124	√	√	√				√
ASES	77	√	√	√	√			√
UCLA	64		√	√				√
DASH	51	√	√	√		√	√	√
SST	46	√	√					√
Rowe	31		√	√				√
SPADI	31		√					√
WORC	21	√	√	√				√
SRQ	15	√	√					√
SDQ	14	√	√					√
OSS	11	√	√					√
WOSI	8	√	√	√			√	√
QuickDASH	7	√	√	√			√	√
FLEX-SF	6			√				√
Penn	5		√	√				
Walch-Duply	5		√	√				
Generic measures (n=7)								
SF-36	46	√	√				√	√
SF-12	9	√						√
JCQ	8							√
Nordic	7		√					
EQ-5D	6	√	√					
FABQ	5		√					
4DSQ	5	√	√					√

Table 3 Number of citations and content overview at ICF chapter-level of the most frequently identified multi-item measures (Continued)

Cond-spec. measures (n=16)	Self-care (d5)	Domestic life (d6)	interpersonal interactions and rel. (d7)	Major life areas (d8)	Community, social and civic life (d9)	Products and technology(e1)	Natural environment and hum. ch. (e2)	Support and relationships (e3)
Constant				√	√			
ASES	√			√	√	√		
UCLA	√	√				√		
DASH	√	√	√	√	√			
SST	√			√				
Rowe	√			√	√	√		
SPADI	√							
WORC	√	√		√				
SRQ	√	√		√	√			
SDQ	√							
OSS	√	√		√				
WOSI	√	√	√	√				
QuickDASH	√	√	√	√				
FLEX-SF	√	√		√	√			
Penn					√			
Walch-Duply					√			
Generic measures (n=7)								
SF-36		√		√	√			
SF-12				√				
JCQ			√	√			√	√
Nordic				√				
EQ-5D								
FABQ				√				
4DSQ								

Constant = the Constant Murley shoulder score [5], ASES = the American Shoulder and Elbow Surgeons standardized form for assessment of the shoulder [6], UCLA = the University of California at Los Angeles shoulder rating scale [38], DASH = the Disability of the Arm, Shoulder and Hand scale [39], SST = the Simple Shoulder Test [40], SPADI = the Shoulder Pain and Disability Index [41], Rowe = a Rating sheet for Bankard repair [42], WORC = the Western Ontario Rotator Cuff Index [43], SRQ = the Shoulder Rating Questionnaire [44], SDQ = the Shoulder Disability Questionnaire [45], OSS = the Oxford Shoulder Score [46], WOSI = the Western Ontario Shoulder Instability Index [47], QuickDASH = the shortened disabilities of the arm, shoulder and hand questionnaire [48], FLEX-SF = the Flexilevel Scale of Shoulder Function [49], Penn = the Penn shoulder score [50], the Walch-Duplay shoulder score [51], SF-36 = the MOS 36-item short-form health survey [52], SF-12 = a 12-Item Short-Form Health Survey [53], JCQ = the Job Content Questionnaire [54], Nordic = the standardized Nordic questionnaires for the analysis of musculoskeletal symptoms [55], EQ-5D = a measure of health status from the EuroQol Group [56], FABQ = a Fear-Avoidance Beliefs Questionnaire [57], 4DSQ = the Four-Dimensional Symptom Questionnaire [58].

ranked second, third and fourth, and in most cases linked from concepts in condition-specific measures. However, not all such concepts were common in the measures; the ICF category *muscle endurance* was not frequent above the 1% limit, although isometric muscle endurance has been proposed as a psycho-physiological measure for shoulder pain [61].

Sleep functions, classified in the ICF as a mental function, was the fifth most frequent ICF category. Concepts of sleep were included in many condition-specific and generic measures, whereas concepts linked to the less frequent ICF categories *emotional functions* and *energy and drive* were extracted from only a few measures. A study that included a community based population of

subjects with chronic shoulder pain, found that the relation between pain and psychological health was dependent of level of disability [9]. Moreover, a previous review points to the influence of psychosocial and behavioural factors in chronic neck-and-shoulder pain [62]. According to the current finding, concepts of psychological health may be underestimated in commonly used measures of shoulder pain. However, one comprehensive measure on psychological functioning was found, the generic 4DSQ, which captured five different *mental functions* according to the ICF.

Several of the predominant concepts in measures of shoulder pain and functioning, were in the *activities and participation* component. Ten ICF categories belonged

Table 4 Number of citations and content overview at ICF chapter-level of the most frequently identified single-item measures (Continued)

Smoking habits	14			√
Sport activity	17			√
Comb hair	7		√	
Physical activity	7			√
Sleep quality	5		√	

to *mobility functions* and five each to *self-care* and *domestic life*. *Hand and arm use* and *lifting and carrying* were both among the five highest ranked activities and participation categories. Concepts linked to these two ICF categories were extracted from almost all the condition-specific multi-item measures (see Additional file 2). This demonstrates that task orientated movements of the upper-extremity is in the core of the assessment of shoulder pain. The high ranking of the ICF category *remunerative employment*, was consistent with the high numbers reporting work-relatedness of their shoulder disorder in a previous epidemiological study [2]. Work-related concepts were addressed in a majority of the multi-item condition-specific measures, although the UCLA, SPADI and SDQ did not address any concepts of work. In a recent review of concepts in vocational rehabilitation measures, a number of work-related concepts were extracted [63]. One of the commonly used vocational measures, the JCQ was also identified in the current review [54]. Its comprehensiveness indicates that assessments of work need to capture several different functional domains.

Previous research shows that also social functioning may be affected by shoulder pain [7-10]. *Family-, informal social- and intimate relationship*, all appeared among the lower ranked ICF categories and these concepts were included in only one condition-specific measure, the DASH. Although the SF-36 contains a social subscale, none of its concepts were linked to the ICF category *interpersonal interactions and relationships* [33]. This indicates that the SF-36 requests social relationships in a more general way and not as specific interpersonal interactions.

Products or substances for personal consumption that appeared with a relative frequency of 8.8%, was the only environmental factor above the 1% criteria. This finding reflects that the impact of the environment on functioning is not sufficiently taken into consideration in the assessments of shoulder pain. According to the ICF, the environment contains a large number of physical, social and attitudinal factors which may limit or facilitate functioning. Although some previous research has been devoted to identify risk factors in the workplace environment, the significance of external factors has scarcely been addressed within the shoulder pain research [64].

Concepts measured in different musculoskeletal disorders were identified in a previous review, and of particular interest for the current study was low back pain [31]. Although there were large similarities between the content of the shoulder pain and low back pain measures, some differences emerged. The comparisons showed that the measures of shoulder pain contained a higher number of concepts within self-care and domestic life, whereas the low back pain measures contained a higher number of environmental factor concepts, concerning support and relationships to persons and the attitudes of health professionals.

This review identified 44 condition-specific and 15 generic measures in use to assess functioning in patients with shoulder pain. When comparing the content of the single- and multi-item measures we found that the former requested only pain and movement related functions, whereas the latter included a wide range of body functions and structures, and activities. The wide-ranging DASH and the ASES were linked to 23 and 16 ICF categories respectively, whereas the Constant was linked to 7 categories and the Simple Shoulder Test (SST) and SPADI to 6 categories each (see Additional file 2). These comparisons, using the ICF as a framework, disclose both the similarities and differences in content of measures that all aim to assess aspects of functioning in patient with shoulder pain.

The variation in the type and number of concepts in the condition-specific measures might reflect disparate views on disability among developers of measures. Some of the measures, such as the SPADI and the Oxford Shoulder Score (OSS) were developed to capture joint-specific concepts and to avoid the influence of co-morbidity [41,65]. On the contrary, the DASH aims at capture disability, defined as difficulty in doing activities in any domain of life [39]. Due to the complexity of the disability of shoulder pain, and the narrow content of many condition-specific measures, it has been recommended to supplement the condition-specific measures with the generic SF-36 [7,13,16]. However, as demonstrated in the current study, the SF-36 includes few additional concepts to those requested in the most wide-ranging condition-specific measures. Clarifying the content is of great importance for selecting the most appropriate measures in

clinical work and in research, although the choice of a measure is also dependent on the purpose, patient population and the psychometric properties. In our opinion, use of a wide-ranging condition-specific measure may enhance the quality of assessments in many clinical situations. The wide-ranging (Quick-) DASH and the ASES were found to be among the most extensively investigated measures according to measurement properties in a recent review [24].

The current review had some limitations that should be noted. Meaningful concepts in the measures referring to *personal factors* in the ICF, such as fear avoidance and coping strategies were not reported. The updated linking rules enable the identification of *personal factors*, but they are still not classified in the ICF [28]. For 10 measures identified in the study, the content was linked in previous studies (32, 32). The commonly used SF-36 was analysed using the first version of the ICF linking rules [27]. Use of the updated linking rules may have given a somewhat different result [28]. For interpretation of the results, it is of importance that a particular ICF category was reported only once for each measure. As such, the content overview of the measures provides information on the breadth of each measure rather than their depth.

Conclusions

Using the ICF as a reference, a total of 40 second-level categories was used to classify the content of condition-specific and generic measures of shoulder pain. The most frequently addressed concepts were pain, movement-related body functions and structures, sleep, hand and arm use; self-care, household tasks, work and employment, and leisure activities. Concepts of psycho-social functioning and environmental factors were less frequently addressed. Commonly used condition-specific measures showed a large variation in content; the DASH and the ASES were linked to more than twice as many ICF categories as the Constant, SST and SPADI. These large differences demonstrate the importance of clarifying the content to select the most appropriate measure both in research and in clinical work. For clinical situations, we propose use of a wide-ranging condition specific measure that conceptualizes assessments of shoulder pain from a bio-psycho-social perspective. Further research is needed to investigate whether patient-reported problems in functioning are captured in the commonly used condition-specific and generic measures.

Additional files

Additional file 1: Final search strategy for Medline.

Additional file 2: Overview of second-level ICF categories in the most common multi-item measures.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

YR, HLS, EB-H and SO participated in the planning and design of the study. YR developed a search strategy and collected the data. YR and SO participated in the screening and linking. YR, SO, HLS and EB-H drafted the manuscript. All authors read and approved the manuscript.

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We certify that no party having a direct interest in the results of the research supporting this article has or will confer a benefit on us or on any organization with which we are associated and all financial and material support for this research and work are clearly identified in the title page of the manuscript.

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ORIGINAL REPORT

IDENTIFICATION OF RELEVANT INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH CATEGORIES IN PATIENTS WITH SHOULDER PAIN: A CROSS-SECTIONAL STUDY

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Objective: To identify the most common problems in patients with shoulder pain, using the International Classification of Functioning, Disability and Health (ICF) as a reference.

Design: A cross-sectional study.

Subjects: Outpatients at a hospital with shoulder pain lasting longer than 3 months.

Methods: Patients were interviewed with an extended version of the ICF Checklist version 2.1a. Patients' problems in functioning, and the magnitude of the problem, were registered separately for each category. Categories identified as a problem in at least 5% of patients were reported. To describe the population, age, diagnosis, work participation and the Shoulder Pain and Disability Index (SPADI) were recorded.

Results: A total of 165 patients with a mean age of 46.5 years (standard deviation 12.5) and a SPADI score of 47.4 (standard deviation 21.1) were included. Of the participants, 92.8% were either employed or students, 35.2% of whom were on sick leave. The primary result was the identification of 61 condition-specific second-level ICF categories: 19 in the body functions and structures component, 34 in activities and participation, and 8 in environmental factors.

Conclusion: The findings provide a comprehensive picture from the patient-perspective of the disability associated with shoulder pain. The findings may enhance multidisciplinary communication in clinical settings.

Key words: ICF; outcome assessment (health care); shoulder pain; cross-sectional studies, disability evaluation; World Health Organization; recovery of function; rehabilitation/el [classification]; rehabilitation.

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INTRODUCTION

Shoulder pain is a common condition, with an estimated prevalence of between 7% and 26% (1). In a Norwegian middle-aged

population cohort, pain in the neck or shoulder during the previous month was the most common health complaint, and almost three-quarters reported work-related pain (2). Many cases of shoulder pain are persistent or recurrent, and shoulder pain is a common cause of work absenteeism (3, 4).

The disability associated with shoulder pain has traditionally been explained by deficits in muscular and movement-related functions (5, 6). Findings from more recent research, however, indicate that the condition may also have an impact on mental function and general health (7–12). Moreover, physical and social factors in the work environment have been found to influence functioning (13–16). Although previous research provides a valuable contribution to the understanding of the impact of shoulder pain on functioning, it has often been limited to defined patients groups, rehabilitation settings or specific aspects of functioning. A number of different classifications are in use, and no multidisciplinary clinical practice guidelines exist (17–19).

As a result of the approval of the International Classification of Functioning, Disability and Health (ICF) in 2001, a system of concepts and a classification of functioning became available (20). The ICF provides a hierarchical classification system based on components, chapters and categories. The *body functions and structures* component is ordered according to body regions or systems, and the *activities and participation* component covers the complete range of domains, denoting aspects of functioning from both an individual and a societal perspective (20). The *environmental factors* component is systematically arranged in sequence from the individual's most immediate environment to the general environment and may affect all functional components (20). *Personal factors* are not classified in the ICF because of their wide social and cultural variance (20). The ICF describes situations with regard to human functioning, and serves as a framework to organize information (20).

The ICF classification is comprehensive, as it comprises more than 1,400 categories. To increase its applicability in clinical assessments and research, ICF Core Sets have been developed. The Core Sets contain a selection of categories that describe the typical spectrum of problems in functioning of patients with specific conditions (21). The development processes were based on literature reviews, expert surveys and quantitative

and qualitative clinical studies of patients (21). Currently, ICF Core Sets for a number of chronic conditions and settings are available, e.g. low back pain and vocational rehabilitation (22, 23). As part of the development process, patients' problems in functioning were investigated in cross-sectional studies (24, 25). Until now, shoulder pain has rarely been investigated within the bio-psycho-social perspective, and to our knowledge, there are no condition-specific ICF categories for shoulder pain.

The aim of this study was to identify the ICF categories that best describe problems related to functioning and interactions with the environment due to shoulder pain from the patient's perspective.

METHODS

Study design

This study had a cross-sectional design and included outpatients with shoulder pain at the Department of Physical Medicine and Rehabilitation at Oslo University Hospital from November 2009 through February 2011. The study was approved by the Norwegian Regional Ethical Committee (number 2009/820a) and was conducted according to the Declaration of Helsinki.

Subjects

Patients aged 18 years and older, diagnosed with shoulder pain and symptoms lasting longer than 3 months, were eligible for the study. The exclusion criteria were shoulder joint replacement, surgery in the affected shoulder within the last 6 months, diagnosed rheumatic disease affecting the shoulder, generalized pain conditions, and insufficient Norwegian language skills.

Measures

Data were collected with two sets of case record forms, one for health professionals and another for patients. The case record form for health professionals included registrations of the patients' characteristics and the nature of the patients' work with regard to repetitive movements of the arm, use of the arm at or above shoulder level, and lifting 10 kg or more at work.

An extended ICF Checklist was derived for the patients from the ICF classification. The categories in the ICF classification use an alphanumeric coding system, in which the first letter refers to the component, followed by a numeric code that starts with the chapter number (e.g. d4 mobility), followed by the second-level category (e.g. d445 hand and arm use), the third-level category (e.g. d4452 reaching) and the fourth-level category, when appropriate.

The ICF Checklist in the current study was an extended version of the generic ICF Checklist Version 2.1a (26). The content of the condition-specific scales and clinical tests were extracted and linked to ICF categories by a researcher (Y.R.) to ensure that all relevant functions were covered (27, 28). Twenty-three additional second-level categories from these measures were added to the generic checklist. The final Extended ICF Checklist contained a total of 146 second-level ICF categories. Of these, 52 were from the *body functions and structures* component, 57 were from the *activities and participation* component and 37 were from the *environmental factors* component. The patients' problems in each category were rated on an ordinal scale, with scores ranging from 0 to 4 (20). For the *body functions* components, the scores included *no impairment*, *mild impairment*, *moderate impairment*, *severe impairment* and *complete impairment*. For the *body structures* component, only the presence of impairment was rated, as either *impairment* or *no impairment*, in this study. In the *activities and participation* component, the categories were denominated *no difficulty*, *mild difficulty*, *moderate difficulty*, *severe difficulty* and *complete difficulty* and were rated according to reported performance. The *environmental factors* component included both *barriers* and *facilitators* of function, each categorized as *mild*, *moder-*

ate, *severe* or *complete*. Additional options on the ICF qualifiers scale were 8 (*not specified*), 9 (*not applicable*) and C (*comorbidity*). The *not specified* option was avoided, and *not applicable* was registered only for mutually exclusive categories in the *major life areas* (d8-chapter). Comorbidity was registered on a separate form.

The case record form for patients contained both the Shoulder Pain and Disability Index (SPADI) and the Self-Administered Comorbidity Questionnaire (SCQ). The SPADI is a patient-reported condition-specific instrument comprising 13 items in the pain and disability domains (29, 30). Ratings are registered on an 11-point ordinal scale, from no pain/no difficulty (0) to worst pain imaginable/so difficult it required help (10). A summed score ranging from 0 to 100 (best to worst) is estimated by averaging the pain and disability sub-scores. The SCQ is a patient-rated instrument with a list of common health problems to which an additional question on neck pain was added (31). The respondent was asked to mark whether the health problem was present, whether treatment had been received and whether the problem limited activities.

Procedure

The outpatient clinic of the Department of Physical Medicine and Rehabilitation at Oslo University Hospital receives patients with musculoskeletal conditions who are referred from general practitioners. The patients undergo an assessment by a physician specializing in physical medicine. Based on standardized criteria, a diagnosis according to the International Classification of Diseases (ICD-10) is made and further interventions are recommended (32, 33).

The inclusion of the patients shown in Fig. 1 was based on the contributions of 7 physicians at the clinic. The clinic receives approximately 750 patients with shoulder pain annually (personal communication NGJ). Patients with an appointment on specific weekdays when the researcher (YR) would be present received a letter informing them about the study, and notifying them that they would be asked to participate after the consultation if they met the inclusion criteria. Overall, 375 patients received information about the study, and 165 (44%) patients were included. The distribution of gender and diagnoses of the included patients were in accordance with the general cohort of patients with shoulder pain at the clinic.

The included patients participated in a structured interview using the case record form for health professionals and completed the case record form for patients. The interviews were administered by a physiotherapist and researcher (YR) who has experience with the ICF and with shoulder rehabilitation in clinical and educational settings. The ratings of the severity of functional problems in the Extended ICF Checklist were determined through discussion with the patient. When categories were not self-explanatory, examples from the *inclusions* of the ICF were provided. For example, the second-level category of *emotional functions* (b152) was exemplified by *joy*, *sorrow*, *tension*, *fear*, *anger*, etc. The ratings of structural impairment were based on the standardized diagnostic criteria (32, 33). The mean duration was approximately 40 min for the interviews and 20 min for the questionnaires.

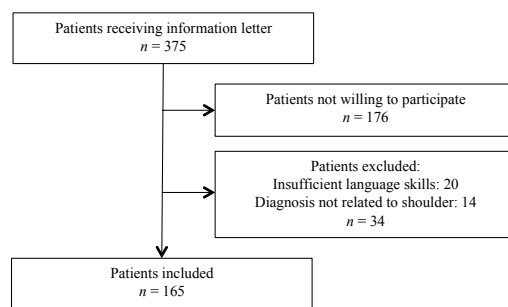


Fig. 1. Inclusion procedure.

Table I. Characteristics of the patient population (n = 165)

Characteristics	
Gender, male, %	46
Age, years, mean (SD) [range]	46.5 (12.5) [19–86]
Education, %	
≤12 years in school	56
University/college	44
Employment status, %	
Remuneratively employed	76.3
Student in higher education	16.5
Other	7.2
Duration of pain, %	
3–6 months	15
6–12 months	26
> 12 months	59
Main ICD-10 diagnoses of the shoulder, %	
m75.4 Impingement syndrome ^a	42.9
m79.1 Myalgia	18.0
m75.0 Adhesive capsulitis	13.7
m24.3 Instability	5.5
m75.1 Rotator cuff syndrome ^b	5.0
m19.8 Acromioclavicular-joint rupture or arthrosis	3.8
Other diagnoses	11.1
Comorbidity ^c , %	
Neck pain	66
Back pain	35
Osteoarthritis (other than in shoulder)	14
Depression	12
Rheumatoid arthritis	4
Other medical conditions	37
SPADI total score, mean (SD)	47.4 (21.1)

^aInclusive bursitis and partial thickness tears.

^bOnly full thickness tears.

^cMore than one comorbidity was registered in some participants.

SD: standard deviation; SPADI: Shoulder Pain and Disability Index;

ICD-10: International Classification of Diseases – version 10.

Statistical analysis

Descriptive statistics are used to characterize the study population. Gender, educational level, employment status, primary ICD-10 diagnosis of the shoulder, comorbidity and the nature of the work were estimated as relative frequencies (%). Age and the SPADI total summary score were estimated with the mean and the standard deviation (SD).

The relative frequencies (%) of ICF categories that registered as *impairment, limitation, restriction, barrier or facilitator* for at least 5% of the participants were reported for each ICF component separately.

IBM SPSS Statistics, version 19 was used for the statistical analysis (IBM Corporation, Armonk, NY, USA).

RESULTS

The characteristics of the included patients and their comorbidities are shown in Table I. There was a slight overrepresentation of women (54%). The diagnosis impingement syndrome (m75.4) was the most frequent, accounting for 43% of the cases. Additional neck pain was reported by almost two-thirds of the patients and low back pain was reported by more than one-third of the patients.

With regard to employment status, 92.8% of the participants were either employed or students, 35.2% of whom were on sick leave. The remainder of the participants (7.2%) were retired, unemployed, received disability pension or were homemakers. The nature of the work varied; 82% reported repetitive movements of the arm, 29% reported frequent use of the arm at or above shoulder level, and 27% reported frequent lifting of 10 kg or more at work.

The 19 second-level ICF categories that were identified as a problem in the *body functions and structures* component are shown in descending order in Table II. The most frequent problems were related to the *sensation of pain* (b280), *mobility of joint functions* (b710), *sleep* (b134), *muscle endurance functions* (b740) and *energy and drive functions* (b130).

Table II. International Classification of Functioning, Disability and Health (ICF) categories of the body functions and structures component with relative frequencies (%), rated as impaired in at least 5% of participants

Body functions and structures categories	0	1	2	3	4	Sum 1–4
b280 Sensation of pain	1.2	13.9	34.5	43.6	6.7	98.8
s720 Structure of shoulder region	4.2	–	–	–	–	95.8
b710 Mobility of joint functions	9.1	18.2	20.6	45.5	6.7	90.9
b134 Sleep functions	21.2	20.6	23.0	30.9	4.2	78.8
b740 Muscle endurance functions	26.1	15.8	23.0	32.1	3.0	73.9
b130 Energy and drive functions	29.7	22.4	27.9	18.8	1.2	70.3
b730 Muscle power functions	30.9	13.3	24.2	29.7	1.8	69.1
b720 Mobility of bones function	32.1	24.8	21.8	21.2	0	67.9
b840 Sensation related to the skin	36.4	24.2	20.6	18.2	0.6	63.6
b735 Muscle tone functions	40.6	18.2	21.8	18.8	0.6	59.4
b126 Temperament and personality functions	48.5	26.1	20.6	4.8	0	51.5
b152 Emotional functions	53.9	24.2	14.5	7.3	0	46.1
s730 Structure of upper extremity	56.6	–	–	–	–	43.6
b715 Stability of joint functions	70.3	13.9	6.7	9.1	0	29.7
s710 Structure of head and neck region	82.4	–	–	–	–	17.6
b140 Attention functions	89.7	4.8	4.2	1.2	0	10.3
b144 Memory functions	90.3	7.9	1.2	0.6	0	9.7
b770 Gait pattern functions	92.7	4.8	1.8	0.6	0	7.3
b164 Higher level cognitive functions	93.9	4.8	1.2	0	0	6.1

Table III. *International Classification of Functioning, Disability and Health (ICF) categories of the activities and participation component with relative frequencies (%), rated as a limited or restricted in at least 5% of participants*

Activities and participation categories	0	1	2	3	4	Sum 1-4
d430 Lifting and carrying objects	15.2	26.7	26.1	28.5	3.6	84.8
d850 Remunerative employment	21.2	20.0	18.2	21.2	19.4	78.8
d920 Recreation and leisure	23.6	18.2	27.3	25.5	5.5	76.4
d410 Changing basic body position	24.8	20.6	24.8	26.7	3.0	75.2
d510 Washing oneself	30.9	25.5	29.7	13.3	0.6	69.1
d540 Dressing	33.3	26.7	27.3	12.1	0.6	66.7
d415 Maintaining a body position	37.0	16.4	22.4	23.6	0.6	63.0
d640 Doing housework	40.0	23.0	23.0	12.7	1.2	60.0
d620 Acquisition of goods and services	48.5	26.7	18.8	6.1	0	51.5
d475 Driving	62.4	15.8	12.1	8.5	1.2	37.6
d445 Hand and arm use	66.1	17.6	13.3	2.4	0.6	33.9
d520 Caring for body parts	70.3	16.4	9.1	4.2	0	29.7
d630 Preparing meals	72.7	14.5	10.3	1.8	0.6	27.3
d465 Moving around using equipment	73.9	15.8	6.7	3.0	0.6	26.1
d440 Fine hand use	76.4	10.3	7.3	6.1	0	23.6
d770 Intimate relationships	81.2	10.9	6.1	1.8	0	18.8
d530 Toileting	81.8	7.9	8.5	1.8	0	18.2
d660 Assisting others	84.2	10.9	3.6	1.2	0	15.8
d550 Eating	86.1	11.5	2.4	0	0	13.9
d760 Family relationships	86.1	8.5	4.8	0.6	0	13.9
d455 Moving around	86.7	7.9	3.0	1.8	0.6	13.3
d750 Informal social relationships	86.7	9.1	1.8	2.4	0	13.3
d740 Formal relationships	89.7	7.3	2.4	0.6	0	10.3
d230 Carrying out daily routine	90.9	2.4	4.2	2.4	0	9.1
d170 Writing	91.5	2.4	2.4	3.6	0	8.5
d650 Caring for household objects	92.1	5.5	2.4	0	0	7.9
d710 Basic interpersonal interactions	92.1	5.5	1.8	0.6	0	7.9
d720 Complex interpersonal interactions	92.1	4.8	1.8	1.2	0	7.9
d420 Transferring oneself	93.3	4.8	1.2	0.6	0	6.7
d210 Undertaking a single task	93.9	1.8	3.0	1.2	0	6.1
d730 Relating with strangers	93.9	4.8	0.6	0.6	0	6.1
d220 Undertaking multiple tasks	94.5	1.8	2.4	1.2	0	5.5
d470 Using transportation	94.5	2.4	3.0	0	0	5.5

The higher education (d830) category was limited or restricted in 6 out of 10 of the patients registered as students.

With respect to problems in the *activities and participation* 33 second-level ICF categories that were identified as a problem are shown in descending order in Table III. The most frequent problems were related to *lifting and carrying objects* (d430), *remunerative employment* (d850), *recreation and leisure* (d920) and *changing basic body positions* (d410). Of the 10 patients who were students, 6 reported difficulties in the *higher education category* (d830) (not shown in Table III).

The 8 second-level ICF categories of the *environmental factors* component identified as a barrier or facilitator are shown in descending order in Table IV. No categories exceeded a frequency of 20%. *Immediate family and friends* (e310 and e320) were the most frequently reported facilitators, while *social security services, systems and policies* (e570) was the most frequently reported barrier.

The distribution of categories according to ICF chapter-level in Fig. 2 shows that the highest number of categories were

Table IV. *International Classification of Functioning, Disability and Health (ICF) categories of the environmental factors component with relative frequencies (%), rated as a barrier or facilitator in at least 5% of participants*

Environmental factors categories	Barrier					Sum (1-4)	Facilitator				Sum (1-4)
	0	-1	-2	-3	-4		1	2	3	4	
e310 Immediate family	80.6	0.6	0.6	0	0	1.2	6.7	10.3	1.2	0	18.2
e320 Friends	86.0	0	0	0	0	0	6.1	7.3	0.6	0	14.0
e570 Social security services, systems and policies	86.2	1.8	4.2	4.2	0	10.2	1.8	1.2	0.6	0	3.6
e125 Products and technology for communication	85.5	1.2	6.7	0.6	0	8.5	0.6	4.8	0.6	0	6.0
e325 Acquaintances, peers, colleagues, neighbours and community members	86.8	0.6	4.2	0.6	0	5.4	4.2	3.6	0	0	7.8
e330 People in positions of authority	88.6	0.6	3.0	1.2	0	4.8	3.6	3.0	0	0	6.6
e355 Health professionals	91.6	1.2	1.8	0	0	3.0	2.4	3.0	0	0	5.4
e450 Individual attitudes of health professionals	91.0	1.2	3.0	1.2	0	5.4	1.2	2.4	0	0	3.6

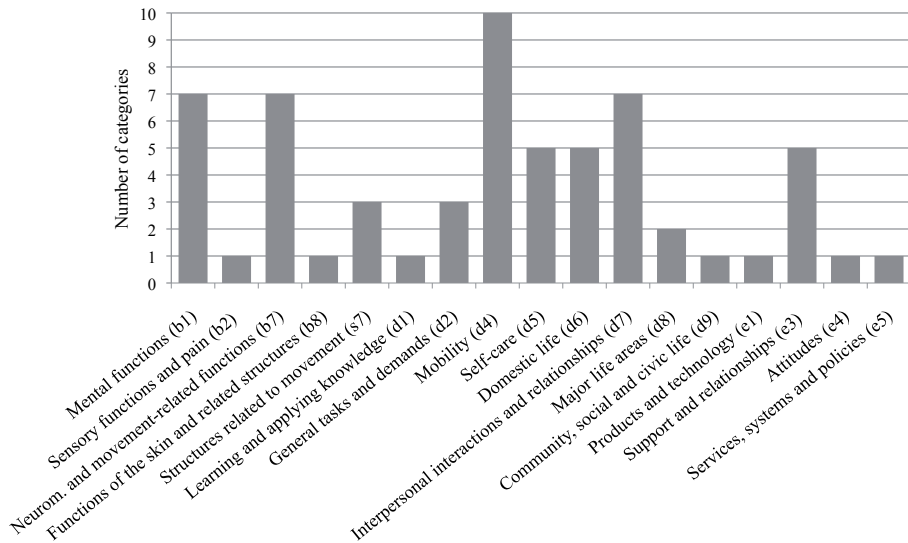


Fig. 2. Overview of International Classification of Functioning, Disability and Health (ICF) chapters containing one or more second-level categories identified as a frequent problem, barrier or facilitator ($n=61$).

identified in the chapters of *mobility* (d4), with 10 categories, followed by the *neuromusculoskeletal and movement-related functions* (b7), *mental functions* (b1) and *interpersonal interactions and relationships* (d7) chapters, with seven categories each, and *self-care* (d5), *domestic life* (d6) and *support and relationships* (e3), comprising 5 categories each.

DISCUSSION

The primary result of this study was the identification of a set of 61 second-level ICF categories reflecting common problems in functioning and environmental factors in chronic shoulder pain from the patients' perspective.

The characteristics of the patients show that patients in the current study had a distribution of gender, age and diagnoses that paralleled a sample of patients in a general practice reported by van der Windt and colleagues (4). The mean SPADI-total score did not deviate substantially from the scores reported by Beaton and colleagues in a hospital-treated sample of patients with shoulder-related diagnoses, or from a study by Ostor and colleagues on patients in primary care (34, 35).

Problems in functioning that related to a total of 19 categories in the *body functions and structures* component are shown in Table II. The *sensation of pain* (b280) was a problem for almost all of the patients, and more than half of the patients rated their pain as *severe or complete*. The frequency estimate and severity ratings show that pain itself is a major issue in the understanding of shoulder pain. Pain has also been found to be an almost equally prevalent problem in other musculoskeletal disorders, such as low back pain (24).

Furthermore, 7 categories related to problems of *neuromusculoskeletal and movement-related functions* (b7) were identified. Of these, the most frequently reported problems were in the *mobility of joint functions* (b710), *muscle endurance functions* (b740), *muscle power functions* (b730) and *mobility of bone functions* (b720). Most of these categories reflect functions that are considered key elements in the clinical examination of shoulder pain (6, 36). The findings of the current study thus show that patients have perceptions of aspects of functioning that traditionally have been assessed by clinicians. However, one of the frequent functions, muscle endurance, has received less attention in the clinical literature. Brox and colleagues (37) found that isometric muscle endurance was associated with both emotional distress and increased pain in a group of patients with rotator cuff tendinosis, and they recommended muscle endurance testing as a psychophysiological measure in assessments. The findings indicate that patients have perceptions of aspects of functioning that are often assessed by clinicians, and future research should investigate the benefits of the improved participation of patients in the examinations.

Three categories were identified within the *body structures* component, of which the *structure of shoulder region* (s720) was the most frequently reported. The registrations were made according to the evidence-based diagnostic criteria of symptom localization and imaging used in the department (32, 33). Almost two-thirds of the patients reported additional neck pain, and more than one-third reported additional low back pain. Others have shown that additional pain or symptom sites may be predictive for patients' disability. Cunningham and colleagues (38) suggested that persons with multiple pain

sites were more likely to report disability, while Kamaleri and colleagues (39) found an almost linear relationship between the number of pain sites and overall health, sleep quality, and psychological health. Whether pain in the neck should be considered a comorbidity is, however, a matter of definition, which has been handled differently in different studies. However, we believe that only a few patients in the current study may be characterized as having multiple pain sites because generalized pain was an exclusion criterion.

In the area of *mental functions* (b1-chapter), problems related to 7 categories were identified. More than half of the participants had problems with *sleep* (b134), *energy and drive functions* (b130) and *temperament and personality functions* (b126). However, only 12% of the patients in the current study reported depression on the comorbidity form. Psychological factors have been found to be important in understanding the development or maintenance of shoulder pain (7, 11, 12). Van der Windt and colleagues (40) found that these factors were more strongly associated with persistent pain and disability in patients with low back pain than in those with shoulder pain, and they suggested that the influence of psychological factors on outcome varies across patients with different types of pain. By contrast, difficulties with mental function in the current study were found with somewhat higher frequencies than for the patients with low back pain in the cross-sectional study by Ewert and colleagues (24). Until now, how problems in mental functioning should influence clinical decision-making has been little discussed.

With regard to problems in *activities and participation*, a total of 33 categories were identified. Related to *mobility* (d4-chapter), problems in *lifting and carrying objects* (d430) and *changing or maintaining a body position* (d410 and d415) were the most commonly reported. When comparing the d4 mobility chapter findings with the other musculoskeletal cross-sectional studies, lifting and carrying appeared to be a functional problem that was very frequent in all conditions (24). Unlike shoulder pain, problems walking were also frequent among the other musculoskeletal conditions.

Activities of daily living were also affected. With respect to the *self-care* (d5) and *domestic life* (d6), problems in *washing oneself* (d510), *dressing* (d540), *doing housework* (d640) and *acquisition of goods and services* (d620) were the most frequent. Functioning according to self-care and domestic life has been considered important and are thus often implemented in the items of condition-specific scales (8, 10, 41). By contrast, for low back pain, no frequent functions related to self-care, and only 1 related to domestic life, were identified in the cross-sectional study (24). Nevertheless, the self-care and domestic life functions were added during the development of the ICF Core Set for low back pain, and these functions are also present in the other musculoskeletal Core Sets (22, 42).

Although problems in social participation were reported by less than 20% of the patients, 7 functions of *interpersonal interactions and relationships* (d7-chapter) were identified. These primarily concerned *intimate relationships* (d770), *family relationships* (d760) and *informal social relationships* (d750),

and indicate that for some patients their shoulder pain has consequences for their social life. In an overview of psychosocial and behavioural factors in shoulder and neck pain, Linton (11) suggested that a better understanding of these factors might enhance the treatment and prevention of the condition. An almost equal number of low frequent functional problems in the *interpersonal interactions and relationships* (d7-chapter) were found among the other musculoskeletal conditions (24), and problems in intimate relationships (d770) were found to represent a common problem in all musculoskeletal ICF Core Sets (42).

A large majority of the working patients reported problems with *remunerative employment* (d850), and 6 of 10 of the students reported problems with *higher education* (d830). These findings are in line with previous findings of a negative relationship between shoulder pain and work (2, 3). Moreover, the high frequency of problems in remunerative employment was parallel to the other cross-sectional study on musculoskeletal conditions (24). In a recent cross-sectional study on patients in vocational rehabilitation, 40 activities and participation functions were identified as a problem, a substantially higher number than in the other studies (25). The finding from vocational rehabilitation shows that problems related to work performance are complex, and thus need to be classified by a range of ICF categories of the component.

Problems in *recreation and leisure* (d920) were reported by more than two-thirds of the patients. This category covers sports, playing, and engaging in handicrafts, hobbies and gatherings with others. However, we did not register whether the problems were related to sports or other recreational activities. Participation in sports is known to be affected in patients with shoulder pain (43). Problems in recreation and leisure were also reported by patients with low back pain and also found in all 5 condition-specific ICF Core Sets for musculoskeletal conditions (24, 42).

Eight *environmental factors* were identified as facilitators or barriers to functioning in the current study. Five of the 8 categories were in *support and relationships* (e3-chapter) and were primarily reported as facilitators. The findings of relevant *environmental factors* in the current study indicate that social factors may positively contribute to functioning for patients with shoulder pain. Although environmental factors have generally received little attention in shoulder pain research, there is some evidence to support the current findings (14–16). The cross-sectional study on musculoskeletal conditions also found few and low frequency categories according to the component (24). However, a number of categories of environmental factors were identified in other elements of the ICF Core Set development process for these conditions, indicating that structured interviews with limited time frames may not be the most adequate method to identify these factors (22, 24, 42).

The ICF chapters registered with the highest number of functional problems are shown in Fig. 2. The finding illustrates the complexity of the disability associated with chronic shoulder pain, and underscores the need to address a number of different functional domains in clinical decision-making (41).

The strength of this study is that it provides, for the first time, a comprehensive overview of functioning in shoulder pain within the ICF framework. However, this study has some limitations that should be considered. First, some condition-specific categories of interest may have been missed due to the development procedure of the Extended Checklist. For example, the *handling stress and other psychological demands* (d240) category occurred frequently in the vocational rehabilitation study, but it was not found in the measures used to extend the checklist in the current study (25). Secondly, few elderly patients and patients with rheumatic disorders were included in the current study, even though shoulder pain may be common in such patients (44, 45). The results may thus not be generalized to these patient groups. Thirdly, this study was conducted with a cohort referred to a university hospital. Therefore, the patients may not be representative of the general population of shoulder pain patients seen by general practitioners.

In conclusion, this study provides the first comprehensive overview of disability in shoulder pain from the perspective of patients, using the ICF as a reference. A set of 61 second-level ICF categories from the components of body functions and structures, activity and participation and environmental factors were identified. The categories reflect functional problems and relevant environmental factors in middle-aged patients with chronic shoulder pain. The findings may have implications for clinical decision-making and promote multidisciplinary communication. Future work should investigate whether the patient's perspective is sufficiently addressed in the current practice of shoulder pain rehabilitation.

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RESEARCH ARTICLE

Development and Reliability of a Clinician-rated Instrument to Evaluate Function in Individuals with Shoulder Pain: A Preliminary Study

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Abstract

Background and Purpose. Subacromial impingement syndrome (SIS) is a common and disabling condition in the population. Interventions are often evaluated with patient-rated outcome measures. The purpose of this study was to develop a simple clinician-rated measure to detect difficulties in the execution of movement-related tasks among patients with subacromial impingement syndrome. **Method.** The steps in the scale development included a review of the clinical literature of shoulder pain to identify condition-specific questionnaires, pilot testing, clinical testing and scale construction. Twenty-one eligible items from thirteen questionnaires were extracted and included in a pilot test. All items were scored on a five-point ordinal scale ranging from 1 (no difficulty) to 5 (cannot perform). Fourteen items were excluded after pilot testing because of difficulties in standardization or other practical considerations. The remaining seven items were included in a clinical test-retest study with outpatients at a hospital. Of these, four were excluded because of psychometric reasons. From the remaining three items, a measure named Shoulder Activity Scale (summed score ranging from 3 to 15) was developed. **Results.** A total of 33 men and 30 women were included in the clinical study; age range 27–80 years. The intraclass correlation coefficient results for inter-rater reliability and test-retest reliability were 0.80 (95% CI = 0.51–0.90) and 0.74 (95% CI = 0.58–0.84), respectively. The standard error of measurement and minimal detectable change were 1.19 and 3.32, respectively. The scale was linked to the International Classification of Functioning, Disability and Health second level categories lifting and carrying objects (d430), dressing (d540), hand and arm use (d445) and control of voluntary movement (b760). **Conclusion.** The Shoulder Activity Scale showed acceptable reliability in a sample of outpatients at a hospital, rated by clinicians experienced in shoulder rehabilitation. The validity of the scale should be investigated in future studies before application to common practice. © 2013 The Authors. Physiotherapy Research International published by John Wiley & Sons Ltd.

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Introduction

Shoulder pain is an umbrella term for conditions with different aetiologies and courses, and prevalence estimates have varied between 7% and 26% (Luime *et al.*, 2004, van der Heijden, 1999). Subacromial impingement syndrome (SIS) is probably the most common shoulder diagnosis, and the condition is associated with substantial loss of function (Neumann, 2010, Silva *et al.*, 2008, Lewis *et al.*, 2005, van der Windt *et al.*, 1995). SIS is describing a dysfunctional mechanism, and the alterations in movement patterns associated with the condition have been extensively analysed (Bigliani and Levine, 1997, Michener *et al.*, 2003, Neumann, 2010, Lin *et al.*, 2006, Ludewig and Cook, 2000, Lukaszewicz *et al.*, 1999). It is essential that the alterations in movement patterns are also included in functional assessments in the clinic, but few such standardized measures are available.

Reliable and valid standardized measures are important for clinical decision making and research. Patient-rated outcome measures have been recommended to evaluate interventions in patients with shoulder pain, and a number of condition-specific measures are now available (Bot *et al.*, 2004, Michener, 2011). Clinician-rated methods are also considered important in assessments, but the most commonly used measures are either a standardization of the clinical examination or physical examination tests (Constant and Murley, 1987, Richards *et al.*, 1994, Hegedus *et al.*, 2008). Although the patient-rated and clinician-rated condition-specific measures probably capture different aspects of functioning, few efforts have been made to analyse the content.

The International Classification Of Functioning, Disability and Health (ICF), provides a framework for describing and classifying the content of all measures of function (WHO, 2001). The ICF is based on an integrative model covering functioning within its components of *body functions (b)*, *body structures (s)*, *activities and participation (d)* and the *environmental (e)* and *personal factors* (not classified). The ICF classification provides categories of functioning and environmental factors that are arranged in a hierarchical fashion by using an alphanumeric coding system; the first letter referring to the component, followed by a numeric code that starts with the chapter number (e.g. *mobility*, d4-chapter), followed by the second level (e.g. *hand and arm use*, d445), third level (e.g. *reaching*, d4452) and fourth level when appropriate. Because of a generic structure, the categories at a lower level are included in the higher level categories and chapters. Procedures have been established to classify the content

of functional measures by ICF categories, regardless of their purpose, extent and by whom they are rated (Cieza *et al.*, 2002, Cieza *et al.*, 2005).

According to the ICF, the traditional clinician-rated measures may be referred to as belonging to the body functions and structures components, whereas the available patient-rated questionnaires to the activities and participation (Michener, 2011). To our knowledge, no clinician-rated measure containing content relating to the activities & participation component of the ICF has been developed. The clinician-rated measures have the advantage of directly measuring the unit of interest; they reflect the current situation and are less vulnerable to the patient's recall, language and problems with vision or literacy (Gotay, 1996). Patient and clinician ratings probably reflect different constructs, and a low to moderate correlation has been reported (Reneman *et al.*, 2002, Mannerkorpi *et al.*, 2006, Stratford and Kennedy, 2006). The aim of this study was to develop a reliable clinician-rated functional scale to measure change over time, according to the ICF component activities and participation, in patients with SIS.

Methods

Scale development

The steps in the scale development included a review of the scientific literature of shoulder pain, pilot testing, clinical testing and scale construction (Clark and Watson, 1995, Loevinger, 1957, Streiner and Norman, 2008) (Figure 1). Thirteen frequently used condition-specific questionnaires of shoulder function were identified after a review of the scientific literature. From these, 21 single items were extracted and considered eligible for pilot testing after discussions between the researchers (YR, BH and IS). All items described the execution of tasks with dynamic movements of the arm at or above shoulder level. With the participation of outpatients with shoulder pain at a hospital, the eligible items were further investigated in a pilot test. The researchers (BH and IS) and other experienced physiotherapists at the hospital participated as observers. As a result of the pilot test, 14 items that were difficult to standardize or gave little information about the patient's movement patterns were excluded. Decisions were based on agreement between all observers. In cases of disagreement, a senior member of the research group (AB) was consulted. There were no examples of such disagreement. The remaining 7 items were included in a full-scale clinical study for investigation of reliability and representation in the ICF classification.

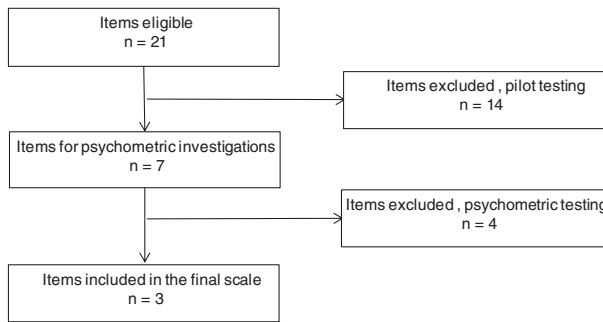


Figure 1. Flowchart of the item reduction process

To rate the magnitude of a functional problem, a five-point ordinal scale similar to the qualifiers in the ICF classification was used (WHO, 2001). The anchor points of the scale were no difficulty (1), mild difficulty (2), moderate difficulty (3), severe difficulty (4) and cannot perform (5). No definition of the term difficulty was given, as it was assumed that physical therapists experienced in shoulder rehabilitation have a common understanding of the term. The intervals between the categories were not further investigated but treated as equal in the statistical analyses.

All items were linked to second level ICF categories according to established rules (Cieza *et al.*, 2005). Inter-item and item-to-sum correlations and representation in the ICF classification were used as exclusion criteria. A tentative summed scale named Shoulder Activity Scale (SAS) was constructed from the remaining three items and further statistically examined (Appendix 1). The included items were *lifting an object to a shelf*, *putting on a jacket* and *moving an arm sideways*. All items were weighted equal, and the scale had a possible range of 3 (no difficulties) to 15 (cannot perform). The scale was easy to administer and was in most cases completed within 5 minutes. No adverse effects from performing the SAS items were reported by the subjects or identified by the raters.

The items were linked to the ICF second level categories *lifting and carrying objects* (d430), *dressing* (d540) and *hand and arm use* (d445), respectively. The aim of the scale, to measure difficulty in terms of altered movement patterns, was linked to the *control of voluntary movement* (b760) category.

Subjects

A clinical test-retest study with outpatients attending the orthopaedic division at a hospital between December

2007 and October 2010 was conducted. The eligible patients were non-native English speakers. Inclusion criteria were primary diagnosis of SIS according to standardized criteria (Juel *et al.*, 2008, Walker-Bone *et al.*, 2003). Exclusion criteria were systematic inflammatory disease or generalized pain, cardiac disease, symptoms of cervical spine disease or surgery in the affected shoulder within the last 6 months.

Power analysis

A method for sample size based on the intraclass correlation coefficient (ICC), was chosen (Walter *et al.*, 1998). The minimally acceptable ICC value ($\rho_1 = 0.7$) versus an alternative ICC value reflecting the expectations ($\rho_1 = 0.8$) was chosen. With a power of 80% ($\beta = 0.2$) and a significance level of 5%, a sample size of at least 40 patients was required (Walter *et al.*, 1998).

Procedure and measures

Descriptive information was collected for all participants. The items were tested twice for each participant without any treatment in between. The instruction to the patients was as far as possible provided in a standardized manner and is shown in Appendix 1. The average time between baseline test and retest was 7.5 days (range 7–21). The participants were asked on the day of retest whether a substantial change in their shoulder condition had occurred since the baseline test. Participants were included in the further analyses regardless of whether a substantial change in their condition had occurred. Two independent clinicians took part in the testing at baseline, where one participated at retest. A total of five clinicians participated in the test sessions; all experienced in shoulder rehabilitation at the hospital. All clinicians

had participated in a standardized training session before conducting the test sessions.

Participants also completed the Shoulder Pain and Disability Index (SPADI) at baseline test (Roach *et al.*, 1991). SPADI is a patient-rated measure for patients with shoulder pain consisting of 13 questions, divided in the domains pain (5 items) and disability (8 items). Each item is rated on a numerical scale from 0 (best) to 10 (worst) and summed up to a domain score. Each domain score is equally weighted then added for a total percentage score ranging from 0 to 100.

Statistical analysis

The statistical analysis was conducted with the IBM SPSS Statistics 19 for windows (IBM Corporation, New York, USA) and the STATA/IC 11.1 for Mac (StataCorp LP, Lakeway Drive, Texas, USA).

The mean values or frequencies with the standard deviations (SD) were reported for the numerical or categorical variables. The association between the SAS scores and age and duration of symptoms was investigated with estimations with Pearson's product-moment correlation coefficient (r) and visual inspection of bivariate data for non-linear relations.

For further investigation of reliability, the following underlying measurement properties were chosen (Mokkink *et al.*, 2010, Terwee *et al.*, 2007): internal consistency, reliability and measurement error. Internal consistency was estimated with Cronbach's alpha. An alpha between 0.7 and 0.9 was considered fair. Consistency and unidimensionality was further investigated with inter-item correlations estimated with Pearson's product-moment correlation coefficient (Cortina, 1993). Inter-item correlations in the range of 0.15–0.50 and mean inter-item correlations of 0.40–0.50 were considered acceptable (Clark and Watson, 1995). Inter-rater reliability and test-retest reliability was estimated with the ICC. To be able to generalize the results to a population of other clinicians and because the difficulty of the items was considered to be a systematic source of variance, a two-way random effect model single measure reliability had to be chosen (Shrout and Fleiss, 1979, McGraw and Wong, 1996).

The measurement error was defined as the systematic and random error of a patient's score that was not attributed to true changes in the construct to be measured (Mokkink *et al.*, 2010). The standard error of measurement (SEM), which reflects the standard deviation of the distribution of the patient's score, with

no change in health status and no learning effect taking place, was used (Wyrwich, 2004, Weir, 2005). There are two types of SEM: $SEM_{\text{agreement}}$ and $SEM_{\text{consistency}}$. To take the systematic difference into account, the $SEM_{\text{agreement}}$ was chosen, estimated with the formula $= \sigma_x \sqrt{1 - r_{tt}}$, where (σ_x) was the pooled standard deviation of test and retest scores, and (r_{tt}) was the reliability coefficient. From the SEM value, it is possible to estimate the minimal detectable change (MDC), which is the smallest change that can be defined by the instrument beyond measurement error (de Vet *et al.*, 2006, Beckerman *et al.*, 2001). The following formula was used: $MDC = 1.96 \times \sqrt{2} \times SEM$, where 2 relates to test and retest, and 1.96 relates to the 95% confidence interval. A plot with the difference of the baseline and retest versus the mean of the sum scores was drawn (Bland and Altman, 1999). The limits of agreement (LOA) were plotted as the standard deviation of the mean difference (SD) multiplied by ± 1.96 .

All the participants signed a written consent, and the study was approved by the Norwegian Regional Committee for Ethics and conducted according to the Helsinki Declarations.

Results

Sixty-three patients, thirty women and thirty-three men participated in the clinical study. Ninety-four met the inclusion criteria, twenty-nine did not accept participation, two were excluded because of generalized pain and three dropped out between baseline test and retest. No descriptive data were recorded on eligible patients who did not accept participation. The mean age of the participants was 53.3 years (SD = 12.9). The mean duration of symptoms was 46.6 months (SD = 72.3). Thirty-eight of the participants were working, eight were sick listed and seventeen were retired, receiving disability benefit or unemployed. There were 30 cases of pain in the right shoulder, 19 in the left shoulder and 14 cases of bilateral pain. The dominant arm was affected in 30 of the cases. Five patients reported a substantial change of the condition during the test period. The mean SPADI score at baseline was 36.2 (SD = 16.6).

The item-to-item correlations ranged between 0.30 and 0.49, and the item-to-total between 0.70 and 0.82 (Table 1). The Cronbach's alpha of consistency for the SAS sum score was estimated at $\alpha = 0.86$. There were no significant correlations or non-linear associations between the participants' ages or permanence of symptoms and the SAS score.

Table 1. Significant inter-item and item-to-sum correlations with Pearson's *r* in the baseline test scores (*n* = 63)

Item	Putting on a jacket	Moving an arm sideways	Shoulder Activity Scale sum score
Lifting an object to a shelf	0.30	0.49	0.77
Putting on a jacket		0.34	0.70
Moving an arm sideways			0.82

The distribution of the scale were positively skewed as two participants had an SAS score of 3 and none above 12 (Figure 2).

The moving the arm sideways had a higher mean score than the other items, indicating that it was a more difficult task (Table 2).

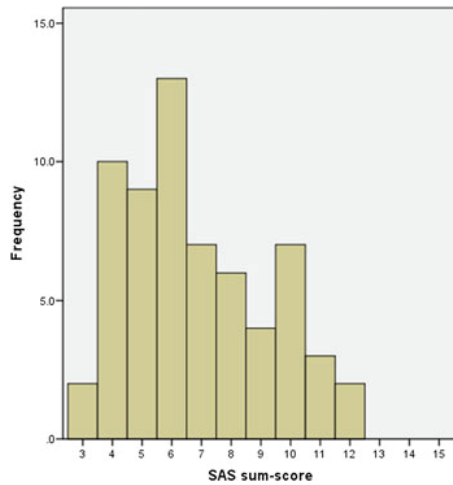
The difference between SAS test and retest was plotted against the average, with the 95% limits of agreement at -2.72 and 3.79 (Figure 3). The mean difference was 0.53 . Three out of sixty values were outside the LOA.

Discussion

The aim of this study was to develop a reliable clinician-rated functional scale to measure change over time, according to the ICF component activities and participation, in patients with SIS.

The main results of the clinical study were the findings of an inter-rater reliability and test-retest reliability of the SAS of 0.80 and 0.74 , respectively (Table 2), in line with what was expected in the power analysis. There is no commonly agreed limit for what should be considered an acceptable ICC value, but an ICC above 0.70 with the lower limit of the confidence interval above 0.60 has been proposed in clinician-rated methods (Terwee *et al.*, 2006). Even though both reliability estimates exceeded the minimum recommendations, the lower limits of the 95% confidence interval for both estimates were slightly below 0.60 . The acceptable reliability found in the current study were in line with previous findings of Westerberg and colleagues who concluded that three active motor tests had good reliability when used as functional tests in painful shoulders (Westerberg *et al.*, 1996).

The inter-item correlations (Table 1) in the final scale was within what was considered acceptable, ranging from 0.30 to 0.49 (Clark and Watson, 1995). An internal

**Figure 2.** Histogram with the distribution of Shoulder Activity Scale sum scores at the baseline test (*n* = 63)

consistency of 0.88 indicates that no items were redundant or measured other constructs. Other possible combinations of items resulted in lower alpha values. The three items were most likely not equally difficult as the item moving an arm sideways had a higher mean score (Table 2). However, the item had an acceptable inter-item correlation and item-to-total correlation (Table 1). The problems of different item-difficulty in scales are shared with other scales developed through statistical analysis based on classical test theory.

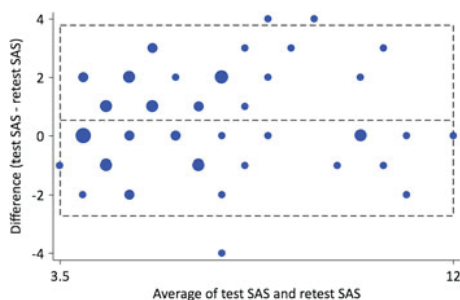
The MDC for the SAS was estimated to 3.30 (Table 2). The interpretation is that individual changes in the sum score of $1-3$ points can be due to systematic or random errors. In classical test theory, the MDC is considered a stable property of the instrument, and a change in the sum score of 4 or higher should thus be considered real but not necessarily clinically relevant (de Vet *et al.*, 2006). The MDC should not be interchanged with the minimal important difference, which refers to the benefit of treatment in a specific population (de Vet *et al.*, 2006, de Vet and Terwee, 2010). Controversy exists whether the benefit of treatment estimates should be derived from distribution-based or anchor-based methods. Norman and colleagues found consistent evidence that the minimal important difference equals close to half of an SD at baseline in a systematic literature review where both anchor-based and distribution-based methods had been used (Norman *et al.*, 2003). Furthermore, Wyrwich suggested

Table 2. Reliability estimates ($n=60$) with pooled test-retest mean, range and inter-rater reliability, test-retest reliability, standard error of measurement (SEM), minimal detectable change (MDC) and effect size for single items (1–5) and sum score (3–15)

Item	Mean (SD)	Range	ICC inter-rater (95% CI)	ICC test-retest (95% CI)	SEM	MDC
Lifting an object to a shelf	1.87 (0.98)	1–5	0.66 (0.35–0.82)	0.59 (0.40–0.73)	0.61	1.69
Putting on a jacket	1.94 (0.98)	1–5	0.71 (0.42–0.85)	0.55 (0.35–0.71)	0.62	1.72
Moving an arm sideways	3.00 (1.15)	1–5	0.75 (0.61–0.84)	0.84 (0.75–0.90)	0.45	1.25
SAS sum score	6.81 (2.38)	13–12	0.80 (0.51–0.90)	0.74 (0.58–0.84)	1.19	3.30

a one-to-one relation between the minimal important difference and the SEM (Wyrwich, 2004). Estimates based on the aforementioned distribution-based methods resulted in a minimal important difference of 1.19 in both cases. According to the estimation methods recommended by Norman and Wyrwich, an SAS sum score of at least 4 is also clinically important.

The participants had a high functional level measured with SPADI, compared with other studies including patients with subacromial conditions (Ekeberg *et al.*, 2008, Williams *et al.*, 1995). There were only two patients with the lowest SAS score of 3, and none with the sum scores 13–15 (Figure 2). Even though the distribution was obviously skewed, this is less than the 15% normally considered a floor effect (Terwee *et al.*, 2007). A skewed distribution however should not necessarily be considered a problem in functional scales but rather a common and logical manifestation of the underlying construct (Streiner and Norman, 2008). The LOA-plot (Figure 3) gives a graphical expression of the ability of an instrument to replicate observations, and the differences should ideally be close to zero (Bland and Altman, 1999). The plot gives a visual indication of a slightly higher retest score among most participants, consistent for both low and high SAS average scores.

**Figure 3.** Intra-individual differences ($n=60$) plotted against the difference between test and retest scores on Shoulder Activity Scale. The central horizontal line represents the mean difference, whereas the flanking lines represent the 95% limits of agreement

The items in SAS were linked to ICF categories from the *mobility* (d4-chapter) or *self-care* (d5-chapter) of the *activities and participation* component, and the aim of the scale was linked to the *neuromusculoskeletal and movement-related functions* (b7-chapter) of the *body functions* component (WHO, 2001). To our knowledge, no other similar clinician-rated activity scale exists. The standardized clinical examination methods and the physical examination tests commonly used in the assessments have no content relating to the *activities and participation* component of the ICF (Constant and Murley, 1987, Hegedus *et al.*, 2008, Richards *et al.*, 1994). The FiT-HaNSA-test focuses on muscle endurance, which is also covered by the *body functions* component (MacDermid *et al.*, 2007). Hence, the test probably measures a different construct than the SAS.

The SAS needs to be validated before implemented into clinic. Nevertheless, the current study may contribute to increase the attention on the content of functional assessments in patients with shoulder pain. The study may facilitate a further use of the ICF to classify functional measures. Future work should further investigate how standardized clinician-rated measures may be implemented in functional assessments and how they relate to the patient-rated measures.

Study limitations

First, the SAS is based on the assumption that clinicians have a common understanding of the term *difficulty*. Although the assumption is supported by the findings of the current study, it may have contributed that all the raters were working at the same hospital. No commonly agreed on guidelines for assessments of shoulder pain yet exists. Second, the treatment of ordinal data as numerical in the statistical analyses may be questioned, because no investigations of the intervals between the anchor points had been conducted. The approach was chosen because of the fact that most statistical methods used in psychometric evaluations require numerical

data (Streiner and Norman, 2008). Third, it should be recognized that the test was applied to a non-native English-speaking population, and it is thus possible that native English-speaking patients might interpret the instructions differently.

Conclusions

The SAS seems to be a reliable clinician-rated instrument to measure functional change in patients with SIS. A change score of at least 4 points is required for evaluation of individual patients. Time of administration was less than 5 minutes, and no specialized equipment is required. The content of the scale is covered by the mobility (d4-chapter) and self-care (d5-chapter) of the ICF. The validity of the scale needs to be established before it is applied to common practice.

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We certify that no party having a direct interest in the results of the research supporting this article has or will confer a benefit on us or on any organization with which we are associated and all financial and material support for this research and work are clearly identified in the title page of the manuscript.

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Appendix 1. Shoulder Activity Scale

Test	Procedure	Instruction	Score (circle the most relevant)				
			No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Cannot perform
1. Lifting an object to a shelf	From a standing or sitting position, the subject lifts a 1-kg object from a table to a high shelf. The task is repeated three times without a break. The height of the shelf should be slightly above the subject's head, and the difference in height between the table and the shelf is at least 0.7 m.	<i>Lift the object up on the shelf and back on the table three times.</i>	1	2	3	4	5
2. Putting on a jacket	From a standing or sitting position, the subject puts on a jacket with the healthy arm in the first sleeve and then off beginning with the painful arm. The jacket should be medium tight and made of non-stretchy material.	<i>Put on the jacket with the healthy arm in the first sleeve and take it off with the painful arm first.</i>	1	2	3	4	5
3. Moving an arm sideways	From a sitting position, with approximately 90° angle in the hip and knee, the subject lifts a 2-kg object with a straight and approximately 90° internal rotated arm, from a table in front and to the height of the shoulder. The arm is now at 90° flexion, internal rotated in a sagittal plane. The straight arm is abducted to the frontal plane, and adducted to the sagittal plane without allowing any variation in the height or the rotation of the arm. The task is repeated once without a break.	<i>Lift the object up from the desk to shoulder height with a straight arm. Keep the upper body stable. Move the object sideways until the arm is outside the shoulder, and then back to forward position. Keep the arm at shoulder level and straight through the movement. The task is repeated once without a break.</i>	1	2	3	4	5
Sum-score	1 + 2 + 3 = ____ points						

APPENDIXES

Extended ICF Checklist

AVVIK I KROPPSFUNKSJONER

MENTALE FUNKSJONER

- b110 Bevissthetsfunksjoner**
Grunnleggende funksjoner som bestemmer bevissthetens klarhet og kontinuitet, oppmerksomhet og aktsomhet.
- b114 Orienteringsfunksjoner**
Bevissthet om og kjennskap til forholdet til egen person, til andre personer, til tid og omgivelser.
- b117 Intellektuelle funksjoner**
Grunnleggende mentale funksjoner som må til for å forstå og konstruktivt integrere de forskjellige mentale funksjoner, herunder alle kognitive funksjoner og deres utvikling i løpet av livet.
- b126 Temperament og personlighet**
Tendens til å reagere på bestemte måter i situasjoner, deriblant de mentale særtrekk som skiller individet fra andre personer.
- b130 Energi og handlekraft**
Grunnleggende mentale funksjoner tilknyttet fysiologiske og psykiske mekanismer som fører til vedvarende innsats for å tilfredsstille behov og oppnå mål.
- b134 Søvn**
Periodisk, reversibel og selektiv fysisk og mental frakobling fra ens umiddelbare omgivelser, ledsaget av karakteristiske fysiologiske forandringer.
- b140 Oppmerksomhetsfunksjoner**
Funksjoner for å fokusere på ytre stimuli eller indre opplevelser så lenge som det behøves.
- b144 Hukommelsesfunksjoner**
Spesifikke kognitive funksjoner for registrering, lagring og fremhenting av informasjon.
- b152 Emosjonelle funksjoner**
Spesifikke funksjoner knyttet til følelser og affektive komponenter i mentale prosesser.
- b156 Persepsjonsfunksjoner**
Spesifikke kognitive funksjoner for å gjenkjenne og tolke det som sanses.
- b164 Høyere kognitive funksjoner**
Spesifikke mentale funksjoner som er spesielt avhengige av hjernens pannelapper: Sammensatte målrettede atferdsformer, som å ta beslutninger, abstrakt tankevirksomhet, planlegging og gjennomføring av planer, mental fleksibilitet og å avgjøre hva slags atferd som er hensiktsmessig under hvilke

omstendigheter, ofte benevnt eksekutive funksjoner.

- b167 Mentale språkfunksjoner**
Spesifikke funksjoner for å gjenkjenne og bruke tegn, symboler og andre bestanddeler av et språk.
- b2 SANSEFUNKSJONER OG SMERTE**
- b210 Synsfunksjoner**
Sanser lys og farge, og se størrelse, form og avstand.
- b230 Hørselsfunksjoner**
Sanser lyd og skille mellom lyders tonehøyde, styrke, egenart og sted.
- b235 Vestibularisfunksjoner**
Sanser kroppsstilling, balanse og bevegelse.
- b265 Berøringssans**
Sanser overflater og deres struktur eller egenart.
- b280 Smertesans**
Sanser ubehagelige stimuli som tyder på mulig eller faktisk skade på kroppen.
- b3 STEMME- OG TALEFUNKSJONER**
- b310 Stemmefunksjoner**
Funksjoner for å frembringe lyd ved passasjen av luft gjennom strupen.
- b4 KRETSLØPS-, BLOD-, IMMUN- OG RESPIRASJONSFUNKSJONER**
- b410 Hjerterfunksjoner**
Funksjoner for å pumpe blodet ut i kroppen i tilstrekkelig mengde og med passende trykk.
- b420 Blodtrykksfunksjoner**
Regulering av arterielt blodtrykk.
- b430 Blodfunksjoner og bloddannelse**
Bloddannelse, transport av oksygen og stoffskifteprodukter, blødningsstillende funksjoner.
- b435 Immunfunksjoner**
Forsvar mot fremmede substanser og mikroorganismer.
- b440 Respirasjon**
Innånding av luft i lungene, gassutveksling mellom luft og blod og utånding av luft.
- b5 FORDØYELSE, STOFFSKIFTE OG INDRESEKRETORISKE FUNKSJONER**
- b515 Fordøyelse**
Funksjoner for transport av mat og drikke gjennom fordøyelseskanaalen, nedbryting til næringsstoffer og oppsuging av næringsstoffene.
- b525 Avføringsfunksjoner**
Utskillelse av ufordøyet mat og avfallsprodukter fra tarmen, med tilhørende funksjoner.
- b530 Regulering av kroppsvekt**
Herunder vektøkning under vekst og utvikling.
- b555 Indresekretoriske funksjoner**
Hormonproduksjon og regulering av

hormonspeil i kroppen, herunder sykliske forandringer.

b6 URINSYSTEMETS FUNKSJONER, KJØNNFUNKSJONER OG FORPLANTNING

b620 Vannlatingsfunksjoner
Funksjoner for uttømming av urin fra urinblæren.

b640 Kjønnfunksjoner
Psykiske og fysiske funksjoner med tilknytning til kjønnsakten, herunder seksuell opphisselse (eksitasjonsfase), funksjoner under selve kjønnsakten (platåfase), utløsning (orgasme) og påfølgende avspenning (resolusjonsfase).

b7 NERVE-, MUSKEL-, SKJELETT- OG BEVEGELSERELATERTE FUNKSJONER

b710 Leddbevegelighet
Bevegelsesutslag og bevegelsesfrihet i ledd.

b715 Leddstabilitet
Opprettholdelse av leddenes strukturelle forbindelse.

b720 Knokkelbevegelighet
Bevegelsesutslag og bevegelsesfrihet i skulderblad, bekken, håndrots- og fotrotsknokler.

b730 Muskelstyrke
Kraft oppstått ved sammentrekning av muskel eller muskelgruppe.

b735 Muskeltonus
Hvilespenning i muskler og musklenes motstand mot passive bevegelser.

b740 Muskelutholdenhet
Opprettholdelse av muskelsammentrekning i så lang tid som det kreves.

b760 Kontroll av viljestyrte bevegelser
Kontroll og koordinasjon av viljestyrte bevegelser.

b765 Ufrivillige muskelbevegelser
Utilsiktete, helt eller delvis uhensiktsmessige ufrivillige sammentrekninger av en muskel eller muskelgruppe

b770 Gangmønster
Bevegelsesmønstre ved gang, løp eller andre bevegelser av hele kroppen

b780 Sansefølelser i forbindelse med muskler og bevegelsesfunksjoner
Sansefølelser i tilknytning til muskler og muskelgrupper, og deres bevegelser

b8 HUDEN OG TILHØRENDE FUNKSJONER

b840 Hudens sansefølelser
Følelser som kløe, svie og parestesier

AVVIK I KROPPSSTRUKTURER

s1 NERVESYSTEMETS STRUKTURER

s110 Hjernens struktur

s120 Ryggmargen og tilhørende strukturer

s4 STRUKTURER TILHØRENDE KRETSLØPSSYSTEMET, BLODSYSTEMET, DET IMMUNOLOGISKE SYSTEM OG RESPIRASJONSSYSTEMET

s410 Kretsløpssystemets struktur

s430 Respirasjonssystemets struktur

s6 STRUKTURER MED TILKNYTNING TIL URINSYSTEMET, KJØNNORGANENE OG FORPLANTNINGEN

s610 Urinsystemets struktur

s630 Kjønnorganenes strukturer

s7 BEVEGELSESPARATETS STRUKTURER

s710 Hode- og halsregionens struktur

s720 Skulderregionens struktur

s730 Overekstremitetens struktur

s740 Bekkenregionens struktur

s750 Underekstremitetens struktur

s760 Bryst- og bukregionens og ryggens struktur

AKTIVITETSBEGRENSNINGER OG DELTAGELSESINNSKREKNINGER

d1 LÆRING OG KUNNSKAPSANVENDELSE

- d110 Betrakte**
Tilsiktet bruk av synssansen, som å se på en idrettsbegivenhet eller barn som leker
- d115 Lytte**
Tilsiktet bruk av hørselssansen, som å lytte på radio, musikk eller et foredrag
- d140 Lære å lese**
Utvikle ferdighet til å lese skriftlig materiale (herunder blindeskrift) flytende og nøyaktig, gjenkjenne bokstaver og alfabet, fremsi ord med korrekt uttale, og forstå ord og fraser
- d145 Lære å skrive**
Utvikle ferdighet til å fremstille symboler (herunder blindeskrift) som representerer lyder, ord eller fraser for å formidle mening, som ved å stave riktig og bruke god grammatikk
- d150 Lære å regne**
Utvikle ferdighet til å behandle tall og utføre enkle og komplekse matematiske operasjoner og anvende riktig regnemetode for å løse et problem
- d170 Skrive**
Nedtegne symboler eller språk for å formidle informasjon, som ved å utarbeide en skriftlig redegjørelse for hendelser eller idéer, eller lage et brevutkast
- d175 Løse problemer**
Finne løsninger på spørsmål eller en situasjon ved å identifisere og analysere problemstillinger, utvikle valgmuligheter og løsninger, bedømme mulige virkninger av løsningene og iverksette en valgt løsning, som ved å avgjøre en meningsforskjell mellom to mennesker.

d2 ALLMENNE OPPGAVER OG KRAV

- d210 Utføre en enkeltstående oppgave**
Utføre enkle eller sammensatte og koordinerte handlinger forbundet med mentale og fysiske sider ved en enkeltstående oppgave, som ved å begynne på en oppgave, organisere tid, plass og virkemidler for en oppgave, bestemme tempoet i utførelsen, og fullføre oppgaven, og holde ut under gjennomføringen.
- d220 Utføre multiple oppgaver**
Utføre handlinger enkeltvis i rekkefølge eller integrert og koordinert som ledd i multiple, sammenhengende oppgaver
- d230 Utføre daglige rutiner**
Utføre enkle eller sammensatte og koordinerte handlinger for å planlegge, styre og fullføre det som kreves i

dagliglivets gjøremål eller plikter, som å disponere tiden og legge planer for ulike gjøremål gjennom hele dagen

d3 KOMMUNIKASJON

- d310 Forstå talte ytringer**
Forstå bokstavelig og underforstått meningsinnhold i ytringer på talespråk, som ved å forstå om et utsagn fastslår et faktum eller er en talemåte
- d315 Forstå ytringer uten ord**
Forstå bokstavelig og underforstått meningsinnhold i ytringer formidlet ved fakter, symboler og tegninger, som å forstå at et barn er søvnnig når det gnir seg i øynene eller at en varselsklokke betyr brannalarm
- d330 Tale**
Frembringe ord, fraser og lengre ordsammenstillinger i talte ytringer med bokstavelig og underforstått meningsinnhold, som å gi uttrykk for et faktum eller fortelle en historie med talespråk
- d335 Ytre seg uten ord**
Bruke fakter, symboler og tegninger for å formidle ytringer, som ved å riste på hodet som uttrykk for uenighet eller tegne et bilde eller diagram for å formidle et faktum eller en sammensatt idé
- d350 Samtale**
Innlede, gjennomføre og avslutte en utveksling av tanker og idéer ved hjelp av tale, skrift eller andre former for språk, med en eller flere personer, i formell eller uformell sammenheng

d4 MOBILITET

- d410 Endre grunnleggende kroppsstillinger**
Innta en kroppsstilling og skifte til en annen, og bevege seg fra en posisjon til et annet, som ved å reise seg fra en stol for å legge seg i sengen, bøye seg, knele eller sette seg på huk, eller reise seg fra disse stillingene
- d415 Opprettholde en kroppsstilling**
Bli værende i samme kroppsstilling etter behov, som ved å bli sittende eller stående i arbeidet eller på skolen
- d420 Forflytte seg**
Bevege seg fra et underlag til en annen, som ved å gli langs en benk eller bevege seg fra en seng til en stol, uten å endre kroppsstilling
- d430 Løfte og bære gjenstander**
Løfte en gjenstand eller flytte noe fra et sted til et annet, som ved å løfte en kopp eller bære et barn fra et rom til et annet
- d440 Finere håndbevegelser**
Utføre koordinerte handlinger for å håndtere gjenstander, plukke opp, manipulere og slippe dem med hånd og fingre, som ved å ta opp mynter fra et bord, dreie en tallskive eller skru på en bryter

- d445 Bruke hender og armer**
Utføre koordinerte handlinger for å bevege gjenstander eller håndtere dem med hender og armer, som ved å bruke dørhåndtak eller kaste og ta imot en gjenstand
- d450 Gå**
Bevege seg på et underlag til fots, skritt for skritt, slik at en fot alltid er i kontakt med underlaget, som ved å spasere, rusle, og gå forover, bakover eller sidelengs
- d455 Bevege seg omkring**
Flytte hele seg fra et sted til et annet uten å gå, som ved å klatre, løpe, hinke, småspringe, jogge, hoppe, slå kollbøtte, eller løpe utenom hindere
- d460 Bevege seg omkring på ulike steder**
Gå og bevege seg omkring på ulike måter og steder i forskjellige situasjoner, som fra et rom til et annet i et hus eller fra sted til sted utendørs
- d465 Bevege seg omkring ved hjelp av utstyr**
Flytte hele kroppen fra sted til sted, på hvilket som helst underlag eller område, ved bruk av spesielt utstyr, som skøyter, ski, dykkerutstyr, rullestol eller gåstol
- d470 Bruke transportmidler**
Bruke et transportmiddel som passasjer, som i bil, buss, tog, trikk, båt eller luftfartøy, eller transportmiddel drevet av trekkdyr eller mannekraft
- d475 Føre et transportmiddel**
Føre et kjøretøy eller kjøretøyets trekkdyr, reise med et hvilket som helst transportmiddel som man kjører eller styrer selv, som bil, sykkel eller båt
- d5 EGENOMSORG**
- d510 Vaske seg**
Bruke vann og passende midler og metoder for å gjøre seg ren og tørke seg, som ved å bade, dusje, vaske ulike kroppsdeler, og bruke håndkle
- d520 Stelle sine kroppsdeler**
Stell av kroppsdeler som trenger mer enn å vaskes og tørkes, som hud-, hår-, ansikts- og tannpleie, stell av negler og kjønnsorganer
- d530 Gå på toalettet**
Planlegge og utføre fjerning av avfallsprodukter fra kroppen (menstruasjonsprodukter, urin, avføring), og gjøre seg ren etterpå
- d540 Kle seg**
Ta av og på klær og fottøy overensstemmende med klimatiske og sosiale forhold, som ved å ta på, rette på og ta av seg alle slags klesplagg og fottøy
- d550 Spise**
Dele opp, føre til munnen og innta servert mat på kulturelt akseptabel måte,

- åpne matvareemballasje, bruke spiseredskaper, innta måltider til hverdags og fest
- d560 Drikke**
Gripe, føre til munnen og innta en drikkevare på kulturelt akseptabel måte, blande og skjenke drikkevarer, åpne emballasjen, bruke sugerør, eller drikke rennende vann fra en kran eller kilde, men også å die
- d570 Ta vare på helsen**
Sikre helse, fysisk og psykisk velvære, som ved et balansert kosthold, passende fysisk aktivitet, holde seg varm eller avkjølt, unngå helseskade, ha sikre seksualvaner, herunder bruk av kondom, la seg vaksinere og gjennomgå regelmessig helsekontroll
- d6 HJEMMELIV**
- d620 Skaffe seg varer og tjenester**
Velge ut, anskaffe og transportere alle varer og tjenester som er nødvendige i dagliglivet, og lagre varene, som mat, drikkevarer, klær, rengjøringsmidler, brensel, husholdningsgjenstander, redskaper, kokekar, husholdningsapparater og verktøy, skaffe seg tekniske tjenester og andre husholdningstjenester
- d630 Lage mat**
Planlegge, organisere, tilberede og servere enkle og sammensatte måltider for seg selv og andre, som ved å sette opp en meny, velge ut mat og drikke, samle sammen ingredienser til matretter, koke og steke, tilberede kald mat og drikkevarer, og servere mat og drikke
- d640 Husarbeid**
Være ansvarlig for et hjem når det gjelder rengjøring og rydding av rom og inventar, vask, stell og vedlikehold av klær og skotøy, bruk av husholdningsapparater, å kaste avfall
- d650 Ta vare på husholdningsgjenstander**
Vedlikeholde og reparere husholdningsgjenstander og personlige eiendeler, innbo, klær, kjøretøy og tekniske hjelpemidler, ta vare på planter og husdyr, som ved å male eller tapetsere, reparere møbler, vannforsyning og avløp, vanne planter, stelle og mate husdyr
- d660 Hjelpe andre**
Hjelpe medlemmer av husholdningen og andre personer med å lære, kommunisere, ta vare på seg selv, og bevege seg omkring, i huset eller utenfor, være opptatt av husstandens og andres velvære

d7 MELLOMMENNESKELIGE**INTERAKSJONER OG RELASJONER****d710 Grunnleggende mellommenneskelige interaksjoner**

Interaksjon med mennesker tilpasset situasjon og sosiale krav, som ved å ta hensyn og gi anerkjennelse når det er på sin plass, eller reagere på andres følelser

d720 Sammensatte mellommenneskelige interaksjoner

Opprettholde og mestre interaksjoner med andre mennesker, tilpasset situasjon og sosiale krav, som ved å ha kontroll over følelsesuttrykk og impulser, ha kontroll over verbal og fysisk aggresjon, handle uavhengig i sosiale interaksjoner, og handle i overensstemmelse med sosiale regler og sedvaner

d730 Forholde seg til fremmede personer

Inngå i midlertidige kontakter og forbindelser med fremmede personer for bestemte formål, som ved å spørre om veien eller gjøre et innkjøp

d740 Formelle mellommenneskelige relasjoner

Skape og opprettholde særskilte personlige forhold i formell sammenheng, som med arbeidsgivere, fagpersoner eller tjenesteytere

d750 Uformelle sosiale relasjoner

Inngå i personlige forhold til andre, som ved tilfeldige forhold til personer som bor i samme nærsamfunn eller boligområde, eller med medarbeidere, studenter, lekekamerater eller personer med lignende bakgrunn eller yrke

d760 Familierelasjoner

Skape og opprettholde forbindelser med slekten, som med medlemmer av kjernefamilien, fjernere familie, foster- og adoptivfamilie, stebarn eller steforeldre, fjernere forhold som med tremenninger eller formyndere

d770 Intime relasjoner

Innlede og opprettholde nære eller romantiske forhold mellom personer, som ektefeller, kjærester eller seksualpartnere

d8 VIKTIGE LIVSOMRÅDER**d810 Uformell opplæring**

Læring i hjemmet eller på annen måte utenfor utdanningsinstitusjon, som å lære håndverk og andre ferdigheter av foreldre eller familiemedlemmer, eller skoleundervisning i hjemmet

d820 Skoleutdanning

Bli opptatt i skole, delta i alle skolerelaterte plikter og rettigheter, tilegne seg fagstoff og pensum i barneskolen og senere skoletrinn, herunder møte frem regelmessig på

skolen, delta i samarbeid med andre elever, motta veiledning fra lærere, organisere, sette seg inn i og fullføre tildelte oppgaver og prosjekter, og gå videre til høyere utdanningsnivå

d830 Høyere utdanning

Delta i aktivitetene i et avansert utdanningsprogram ved universitet, høyskole eller akademisk fagutdanning og tilegne seg alt pensum som kreves for å oppnå akademisk grad, diplom, sertifikat eller annen offentlig godkjenning, som ved å fullføre en mellomfags- eller hovedfagsutdanning ved universitet, medisinerutdanning eller annen akademisk fagutdanning.

d850 Betalt sysselsetting

Delta i alle sider av arbeidet i et yrke, håndverk, akademisk fag eller annen sysselsetting, for betaling, som ansatt på hel tid eller deltid, eller som egen arbeidsgiver, som ved å søke arbeid og skaffe seg en jobb, utføre de nødvendige arbeidsoppgaver, møte frem på arbeidet i tide, utføre og motta supervisjon, og utføre de oppgaver som kreves, alene eller i gruppe

d860 Grunnleggende økonomiske transaksjoner

Delta i enkle økonomiske transaksjoner, som å kjøpe mat for penger eller ved byttehandel, utveksling av varer eller tjenester, eller å spare penger

d870 Være økonomisk selvhjulpen

Ha rådighet over økonomiske ressurser fra private eller offentlige kilder, for å sikre økonomisk trygghet for nåværende og fremtidige behov

d9 SAMFUNNSLIV OG SOSIALE LIVSOMRÅDER**d910 Samfunnsliv**

Delta i alle sosiale livsområder i samfunnet, som ved å delta i veldedige organisasjoner, sosiale klubber og organisasjoner for yrkesgrupper eller samfunnslag

d920 Rekreasjon og fritid

Delta i all slags lek og spill, rekreasjons- eller fritidsaktiviteter, som uformell eller organisert lek og sport, fysiske treningsprogrammer, avkobling, fornøyelse eller adspredelse, gå på kunstgalleri, museum, kino eller teater, delta i husflid og hobbyer, lese for fornøynsens skyld, spille på musikkinstrumenter, sightseeing, turisme og reisevirksomhet

d930 Religion og åndelighet

Delta i religiøse eller åndelige aktiviteter, organisasjoner og livsførsel, for å oppnå egne mål, for å finne mening i livet, religiøse eller åndelige verdier, og å oppnå kontakt med en guddommelig makt, som ved å være tilstede i gudshus

som kirke, tempel, moské eller synagoge, delta i eller utøve bønn eller religiøs messe, og åndelig kontemplasjon

d940 Menneskerettigheter

Nyte godt av rettigheter, beskyttelse, privilegier og plikter som tilkommer personer utelukkende i kraft av at de er mennesker, som ved menneskerettigheter slik de er anerkjent i FNs menneskerettighetserklæring (1948) og FNs standardregler for like muligheter for mennesker med funksjonshemming (1993), retten til selvbestemmelse eller uavhengighet, retten til kontroll over sin egen skjebne

d950 Politisk liv og statsborgerskap

Delta i en borgers liv i samfunnet, politikken og styresettet, ha juridisk status som statsborger, og nyte godt av borgerrettigheter, beskyttelse, privilegier og samfunnsplikter, som stemmerett, valgbarhet til politiske verv og rett til å danne politiske foreninger, utøve borgerrettigheter som ytringsfrihet, organisasjonsfrihet, religionsfrihet, beskyttelse mot urettmessig ransaking og beslag, rett til juridisk bistand og til å føre sin sak for retten, andre juridiske rettigheter og rett til beskyttelse mot diskriminering, ha juridisk status som statsborger

HEMMEDE ELLER FREMMEDE

MILJØFAKTORER

e1 PRODUKTER OG TEKNOLOGI

e110 Produkter eller substanser til å spise eller drikke

Enhver naturlig eller menneskeskapt gjenstand eller substans som er innsamlet, bearbeidet eller fremstilt for å spises eller drikkes

e115 Produkter og teknologi til personlig bruk i dagliglivet

Utstyr, produkter og teknologier som benyttes i dagliglivet, herunder slike som er tilpasset eller spesielt utformet, og som befinner seg i, på eller i nærheten av personen som benytter dem

e120 Produkter og teknologi for personlig mobilitet og transport innen- og utendørs

Utstyr, produkter og teknologier som benyttes til å bevege seg omkring innen- og utendørs, herunder slike som er tilpasset eller spesielt utformet, og som befinner seg i, på eller i nærheten av personen som benytter dem

e125 Produkter og teknologi for kommunikasjonsformål

Utstyr, produkter og teknologi som brukes til å sende og motta informasjon, herunder slike som er tilpasset eller spesielt utformet, og som befinner seg i, på eller i nærheten av personen som benytter dem

e150 Utforming, konstruksjon, produkter og teknologi for bygninger til offentlig bruk

Produkter og teknologi som utgjør det menneskeskapte innen- og utendørs miljø for allmenhetens bruk, herunder slike som er tilpasset eller spesielt utformet

e155 Produkter og teknologi for utforming og konstruksjon av bygninger til privat bruk

Produkter og teknologi som utgjør det menneskeskapte innen- og utendørs miljø for privat bruk, herunder slike som er tilpasset eller spesielt utformet

e225 Klima

Meteorologiske egenskaper og hendelser, for eksempel været

e240 Lys

Elektromagnetisk stråling som gjør ting synlige, enten ved sollys eller kunstig belysning (for eksempel stearinlys, olje- eller parafinlamper, ildsteder og elektrisk lys), og som kan gi nyttig eller forstyrrende informasjon om omverdenen

e250 Lyd

Fenomener som høres eller kan høres, som brak, ringelyder, bankelyder, sang,

fløyting, skrik eller summing, uansett lydstyrke, klang og toneleie, som kan gi nyttig eller forstyrrende informasjon om verdenen

e3 STØTTE OG SOSIALT NETTVERK

e310 Nærmeste familie

Individer som er i familie ved fødsel, ekteskap eller andre forhold regnet som nærmeste familieforhold i den aktuelle kultur, som ektefeller, partnere, foreldre, søsken, avkom, fosterforeldre, adoptivforeldre og besteforeldre

e320 Venner

Personer som er nære og vedvarende deltagere i forhold kjennetegnet ved tillit og gjensidig støtte

e325 Bekjente, likemenn, kolleger, naboer og medlemmer av nærsamfunnet

Personer som kjenner hverandre som bekjente, likemenn, kolleger, naboer og medlemmer av nærsamfunnet, i arbeidssituasjoner, skole, rekreasjon eller andre livsområder, og som deler demografiske egenskaper som alder, kjønn, religiøs oppfatning, etnisitet eller som dyrker felles interesser

e330 Personer i autoritetsposisjon

Personer som har ansvar for å treffe beslutninger for andre og som har sosialt bestemt innflytelse eller makt i kraft av sine sosiale, kulturelle eller religiøse roller i samfunnet, som lærere, arbeidsgivere, overordnede i arbeidslivet, religiøse ledere, personer som tar beslutninger på vegne av andre, formyndere eller fullmektiger i juridisk eller økonomisk forbindelse

e340 Personer som yter personlig omsorg og hjelp

Personer som utfører tjenester for å støtte en person i dagliglivets gjøremål og i å opprettholde yteevne i arbeid, utdanning eller andre livssituasjoner, og som stilles til rådighet ved offentlige eller private midler, eller eventuelt på frivillig grunnlag, som hjemmehjelps- og omsorgspersonale, transportmedhjelpere, betalte hushjelpere, barnepiker og andre som har primære omsorgsfunksjoner

e355 Helsepersonell

Alle tjenesteytere som arbeider i sammenheng med helsevesenet, som leger, sykepleiere, fysioterapeuter, ergoterapeuter, logopeder, audioteknikere, protesemakere, sosionomer og andre slike tjenesteytere

e360 Helserelaterte fagpersoner

Alle tjenesteytere som arbeider utenom helsevesenet, men som leverer helsereelaterte tjenester, som sosialarbeidere, lærere, arkitekter eller designere

e4 HOLDNINGER

e410 Individuelle holdninger hos nærmeste familiemedlemmer

Allmenne og særskilte oppfatninger og overbevisninger hos nærmeste familiemedlemmer om personen eller om andre spørsmål (som sosiale, politiske og økonomiske temaer) som påvirker individuell atferd og handlinger

e420 Individuelle holdninger hos venner

Allmenne og særskilte oppfatninger og overbevisninger hos venner om personen eller om andre spørsmål (som sosiale, politiske og økonomiske temaer) som påvirker individuell atferd og handlinger

e425 Individuelle holdninger hos bekjente, likemenn, kolleger, naboer og medlemmer av nærsamfunnet

Allmenne og særskilte oppfatninger og overbevisninger hos bekjente, likemenn, kolleger, naboer og medlemmer av nærsamfunnet om personen eller om andre spørsmål (som sosiale, politiske og økonomiske temaer) som påvirker individuell atferd og handlinger

e430 Individuelle holdninger hos personer i autoritetsposisjon

Allmenne og særskilte oppfatninger og overbevisninger hos personer i autoritetsposisjon om personen eller om andre spørsmål (som sosiale, politiske og økonomiske temaer) som påvirker individuell atferd og handlinger

e435 Individuelle holdninger hos personer i posisjon som underordnet

Allmenne og særskilte oppfatninger og overbevisninger hos personer i posisjon som underordnet om personen eller om andre spørsmål (som sosiale, politiske og økonomiske temaer) som påvirker individuell atferd og handlinger

e440 Individuelle holdninger hos personer som yter personlig omsorg og hjelp

Allmenne og særskilte oppfatninger og overbevisninger hos personer som yter personlig omsorg og hjelp om personen eller om andre spørsmål (som sosiale, politiske og økonomiske temaer) som påvirker individuell atferd og handlinger

e450 Individuelle holdninger hos helsepersonell

Allmenne og særskilte oppfatninger og overbevisninger hos helsepersonell om personen eller om andre spørsmål (som sosiale, politiske og økonomiske temaer) som påvirker individuell atferd og handlinger

e455 Individuelle holdninger hos helsereelaterte fagpersoner

Allmenne og særskilte oppfatninger og overbevisninger hos helsereelaterte

- fagpersoner om personen eller om andre spørsmål (som sosiale, politiske og økonomiske temaer) som påvirker individuell atferd og handlinger
- e460 Holdninger i samfunnet**
Allmenne og særskilte oppfatninger og overbevisninger om andre mennesker eller om sosiale, politiske og økonomiske spørsmål, som holdes av personer i en kultur, et samfunn, en subkultur eller annen sosial gruppe, og som påvirker atferd og handlinger hos individer eller grupper
- e465 Sosiale normer, handlingsmønstre og ideologier**
Skikker, handlingsmønstre, regler, abstrakte verdisystemer og retningsgivende overbevisninger (som ideologier, livssyn og moralfilosofi) som oppstår i sosial sammenheng og som påvirker eller skaper handlingsmønstre og atferd i samfunnet og hos enkeltmennesker, som sosiale moralnormer, etikette og religiøs atferd, religiøs doktrine med resulterende normer og handlingsmønstre, normer som styrer ritualer eller sosiale sammenkomster
- e5 TJENESTER, SYSTEMER OG STRATEGIER FOR TILTAK**
- e515 Tjenester, systemer og strategier for arkitektur og byggevirksomhet**
Tjenester, systemer og strategier for utforming og oppføring av offentlige og private bygninger
- e525 Tjenester, systemer og strategier for boligsektoren**
Tjenester, systemer og strategier for å skaffe folk et sted å bo
- e535 Tjenester, systemer og strategier for kommunikasjon**
Tjenester, systemer og strategier for overføring og utveksling av informasjon
- Tjenester, systemer og strategier for transport**
- e540**
Tjenester, systemer og strategier for person- og varetransport
- e550 Tjenester, systemer og strategier for lov og rett**
Tjenester, systemer og strategier vedrørende lovgivingen i et land
- e560 Tjenester, systemer og strategier for media**
Tjenester, systemer og strategier for massekommunikasjon gjennom radio, fjernsyn, aviser og Internett
- e570 Tjenester, systemer og strategier for trygdevesen**
Tjenester, systemer og strategier med sikte på å gi inntektsstøtte til mennesker som på grunn av alder, fattigdom, arbeidsløshet, helsetilstand eller funksjonshemming trenger offentlig stønad som finansieres enten ved allmenn skatteinntekt eller bidragsordninger
- e575 Tjenester, systemer og strategier for allmenn sosial omsorg**
Tjenester, systemer og strategier med sikte på å skaffe støtte til personer som trenger hjelp på områder som innkjøp, husarbeid, transport, egenomsorg og omsorg for andre, for å fungere best mulig i samfunnet
- e580 Tjenester, systemer og strategier for helsevesen**
Tjenester, systemer og strategier for å forebygge og behandle helseproblemer, gi medisinsk rehabilitering og fremme sunne levevaner
- e585 Tjenester, systemer og strategier for utdanning og opplæring**
Tjenester, systemer og strategier for tilegnelse, vedlikehold og forbedring av kunnskap, ekspertise og yrkesmessige eller kunstneriske ferdigheter, Se UNESCO's International Standard Classification of Education (ISCED), November 1997, vedrørende detaljer om nivåer i utdanningsprogrammer. Norsk standard overensstemmende med ISCED 1997 er "Norsk standard for utdanningsgruppering" (NUS2000)
- e590 Tjenester, systemer og strategier for arbeid og sysselsetting**
Tjenester, systemer og strategier for arbeidsformidling til personer som er arbeidsløse eller ønsker å skifte arbeid, eller for å støtte personer som er i arbeid og søker forfremmelse

Shoulder Activity Scale

Test	Procedure	Instruction	Score (circle the most relevant)				
			NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	CANNOT PERFORM
1. Lifting an object to a shelf	From a standing or sitting position the subject lifts a 1 kg object from a table to a high shelf. The task is repeated three times without a break. The height of the shelf should be slightly above the subjects head and the difference in height between the table and the shelf at least 0.7 meters.	<i>Lift the object up on the shelf and back on the table three times.</i>	1	2	3	4	5
2. Putting on a jacket	Test 2: From a standing or sitting position the subject puts on a jacket with the healthy arm in the first sleeve and then off beginning with the painful arm. The jacket should be medium tight and made of non-stretchy material.	<i>Put on the jacket with the healthy arm in the first sleeve and take it off with the painful arm first.</i>	1	2	3	4	5
3. Moving an arm sideways	From a sitting position with approximately 90 degrees angle in the hip and knee the subject lifts a 2 kg object with a straight and approximately 90 degrees internal rotated arm, from a table in front and to the height of the shoulder. The arm is now at 90 degrees flexion, internal rotated in a sagittal plane. The straight arm is abducted to the frontal plane, and adducted to the sagittal plane without allowing any variation in the height or the rotation of the arm. The task is repeated once without a break.	<i>Lift the object up from the desk to shoulder height with a straight arm. Keep the upper body stable. Move the object sideways until the arm is outside the shoulder, and then back to forward position. Keep the arm at shoulder level and straight through the movement. The task is repeated once without a break.</i>	1	2	3	4	5

SUM-SCORE 1. + 2. + 3. = _____ points

