Running head:

**Associations between Shoulder Pain and Functioning on the ICF Checklist and the Disabilities of the Arm, Shoulder and Hand scale – a Cross-sectional Study**

Article category:

**Research paper**

## Abstract

Purpose: The association between patients' shoulder pain and functioning according to the International Classification of Functioning, Disability and Health (ICF), and outcome on a condition specific patient reported outcome measure, has not been studied. The aim was to investigate how the most common problems on the ICF checklist were associated with shoulder function and disability.

Materials and methods: In a cross-sectional design 164 patients ≥ 18years with chronic shoulder pain were included. The ICF checklist, the Disability of the Arm, Shoulder and Hand outcome measure and the Self-Report Comorbidity Questionnaire were used. A hierarchical regression model tested categories for functioning on the ICF checklist associated with disability on the Disability of the Arm, Shoulder and Hand.

Results: Mean age was 46.5 years, 54% were women. 85% had had the shoulder pain longer than 6 months. Mean Disability of the Arm, Shoulder and Hand score was 33.2 points (SD 17.1). Adjusted $R^2$ was 0.67. Older age, being woman and having a lower education explained 22% of the variance on the Disability of the Arm, Shoulder and Hand. The body functions bodily pain, mobility of joints and energy and drive function explained 30% of the variance, and the activities and participation problems lifting and carrying objects, washing oneself and recreation and leisure explained an additional 13%.

Conclusion: The shoulder disability was multi-dimensional and comprised body functions and activities and participation. 67% of the variance in the Disability of the Arm, Shoulder and Hand score was explained.


**Key words:** Shoulder pain, ICF, outcome assessment, patient reported outcome measures

## Introduction

The assessment of musculoskeletal disorders relies on patient self-reporting of pain and other aspects of functioning in addition to clinical examination and imaging [1,2]. Shoulder pain is a common musculoskeletal disorder, and a systematic review reported 1-year prevalence estimates of shoulder pain ranging from 5 to 47% in general population surveys and point prevalence estimates ranging from 7 to 26% [3]. In a Norwegian epidemiologic follow-up study, the stability of shoulder pain was high, and >70% of people who reported shoulder pain in 1990 still reported shoulder pain in 2014 [4].

For many patients, persistent shoulder pain results in multi-dimensional disability, with problems in arm mobility, activity limitations, restrictions in work participation and sick leave, and reduced quality of life [5-9]. Regarding pain and psychosocial factors, the results of systematic reviews on musculoskeletal pain, shoulder and arm disorders are divergent [10-12]. Mallen et al.'s systematic review, which included four studies on shoulder pain, found that pain-related factors and psychological distress were predictors of outcome in musculoskeletal pain [10]. In reviews of musculoskeletal disorders in general and arm, neck and shoulder pain in particular, psychosocial factors were not confirmed as prognostic factors for outcomes such as pain/symptoms, disability or sick leave absence [11,12]. Laisne et al. in a review that included patients suffering from musculoskeletal disorders including the upper extremity, recommended that a biopsychosocial approach should be considered starting in the acute phase [11]. However, these reviews comprise studies of varying quality, and are limited by heterogenic populations and not specifically patients with shoulder pain.

Within shoulder pain research, several patient-reported outcome measures (PROMs) are applied, most of which are body, region or condition specific [13-15]. The PROMs used for shoulder pain should capture key aspects of the patients' functioning and disability. From a

biopsychosocial perspective, this relates to the individual's body functioning, including psychological functioning, and ability to perform activities and participate in different life arenas [2]. Furthermore, it is important to assess shoulder functioning in the context of the upper extremity as a functional unit because the upper extremities are involved in most daily activities and work tasks.

PROMs covering shoulder pain and functioning should capture relevant aspects of the shoulder problem. In a literature review, we showed that the content of PROMs that have been developed for and within diverse contexts [13,15] from a biopsychosocial perspective varies according to the International Classification of Functioning, Disability and Health (ICF) [2,14]. One of the most comprehensive measures was the Disabilities of the Arm, Shoulder and Hand scale (DASH) [16,17]. The DASH has been linked to the ICF and is one of the most extensively tested self-report measures used in shoulder pain research [13,17,18].

The ICF can be applied when studying measures and clinical tests and for profiling functioning in specific patient populations, groups or subgroups [2,14,19]. The ICF can also be utilized as an analysis framework [20-22]. In a previous study, we investigated shoulder patients' disability using a generic ICF Checklist for functioning and disability [5]. The ICF Checklist is a sample of generic ICF categories, aimed to cover the most important aspects of disability. It is a structured interview pertaining to the patients' problems in functioning and the environmental factors that impact their functioning [23]. In our previous study we found that a number of functional problems covered by these ICF categories, were highly frequent among patients with shoulder pain [5].

The ICF has been applied in cross-sectional studies exploring functioning in patients with musculoskeletal disorders [5,24-27]. To our knowledge, the association between patients' shoulder pain and functioning according to the ICF and the outcomes of condition-specific

shoulder pain and upper extremity PROM has not been studied. The DASH is a commonly used outcome measure within shoulder rehabilitation and research, and is intended to capture multi-dimensional aspects of disability. It was developed to provide a comprehensive picture of disability, rather than investigating specific components of the patient experience.

The ICF is intended for clinical use, and considered for documentation of assessments as a basis for treatment and billing [28]. Therefore, it is of importance to achieve knowledge regarding which aspects of the shoulder pain and functioning expressed in ICF categories are significantly associated with the DASH. In addition, for shoulder patients the DASH is more often applied in clinical assessment than the ICF, and the association between ICF and DASH is therefore of interest.

The main aim of the present study was to investigate how the most common problems according to the ICF are associated with shoulder function and disability on a comprehensive, condition-specific PROM (DASH). We hypothesized that pain, mental health, body functions according to the ICF, and activities of daily living (ADL) would be independently and significantly associated with self-reported problems in shoulder functioning. As secondary aims, we explored how the severity of the shoulder problems was rated according to the ICF Checklist, and compared the patients' self-reported shoulder disability with that of the general population.

## Material and methods

All patients gave their informed consent for participation in the study. The study was approved by the Norwegian Regional Ethical Committee #2009/820a. The material in the present paper consists of checklist-interviews, identifying ICF categories which represent the most frequent functional problems in a mixed diagnostic cohort of shoulder pain patients [29].

Other aspects have previously been presented from this larger project, Shoulder pain and functioning within the ICF framework [5,14,30].

***Design***

This study had a cross-sectional design. It included patients with shoulder pain who were referred to the outpatient clinic at the Department of Physical Medicine and Rehabilitation, Oslo University Hospital, a secondary care setting, over a 15-month period.

***Subjects***

One hundred sixty-four patients aged ≥ 18 years who were diagnosed with shoulder pain lasting longer than 3 months were included in the study from November 2009 through February 2011 [5]. The patients were diagnosed according to a structured clinical examination by experienced specialists in physical medicine and rehabilitation in a secondary care outpatient clinic [31,32]. The exclusion criteria were shoulder joint replacement, surgery on the affected shoulder within the last six months, rheumatic disease, generalized pain condition and insufficient Norwegian language skills.

***Methods***

Demographic information, type of work, duration of shoulder pain and diagnosis established at the preceding consultation were registered on a case record form. Education was categorized into elementary school/high school and college/university. The type of work was categorized according to work strain on the upper extremities due to heavy lifting (10 kg; no/yes) and work above shoulder level on a six-point scale from never to all the time [7,33].

The treating specialist in physical medicine and rehabilitation performed a clinical examination, and established the diagnosis according to the International Classification of

Diseases 10th edition (ICD-10) [31]. The inclusion procedure is described in more detail in a previous study [5]. In this study, the primary ICD-10 diagnoses were grouped into 5 categories based on anatomic or physiological pathology: 1) subacromial pain, including bursitis, tendinopathy and partial rupture; 2) adhesive capsulitis; 3) labrum injuries, full-thickness rotator cuff tears, anterior instability or complete tendon ruptures; 4) myalgia; or 5) other (including mononeuropathy, acromioclavicular pathology and osteoarthritis of the glenohumeral joint). Concurrent neck pain was also registered. Information about comorbidities was registered on a Self-Report Comorbidity Questionnaire [34], and comorbidities described by 10% or more of the patients are reported.

The ICF Checklist: The participants underwent an interview with the same physiotherapist (Y.R.) according to a condition-adapted ICF Checklist Version 2.1a with 146 second-level ICF categories. The checklist was supplemented with ICF categories from the linked content of measures that are used within the field of shoulder pain [5,23]. In the ICF checklist the presence of a problem in functioning, and a barrier or facilitator of functioning over the last 30 days are registered. Problems in functioning in each ICF category are rated on a 5-point ordinal scale from 0 for no problem to 4 for complete problem. Environmental factors are scored on a similar scale but are rated from no facilitator or barrier to complete facilitator or barrier [2]. Body structures were dichotomized and rated as impairment or no impairment. The metric properties of the ICF qualifiers have been tested in populations with musculoskeletal disorders. Rasch analysis suggested a satisfactory fit of the qualifiers for ankylosing spondylitis, low back pain and osteoarthritis [35-37]. In the current study, we chose to report the 20 most frequently reported ICF categories from Roe et al. [5] describing problems in functioning reported by more than 50% of the participants and applied them in the analyses. This subjective cut-off was also based on a subjective clinical judgement that the included ICF categories should be reported as moderate to severe problems by at least 25% of

the patients as we intended to ensure that prevalent clinically important problems in the shoulder patients admitted to the university hospital were included. The

The main outcome measure and dependent variable was the DASH score. It is a region-specific 30-item questionnaire measuring self-reported function in the upper extremity (arm, shoulder or hand) in the past week [17]. The DASH is frequently used in studies on shoulder disorders and has strong correlations (≥0.8) with the condition-specific measures the Shoulder Pain and Disability Index, American Shoulder and Elbow Surgeons Shoulder Score and Constant Score for shoulder pain [38]. The questions address symptoms, pain and difficulties related to the arm, shoulder or hand problem. The domains address arm-related activities, how the problem interferes with social participation and work, the extent to which the pain interferes with sleep, and the psychological impact of the problem. All items are scored on a five-point ordinal scale (best-worst). The DASH summed score ranges from 0 to 100 (best-worst). The algorithm for DASH allows for calculating the DASH score with up to three missing items. Only 13 data points (0.3%) were missing for DASH. No patients had more than 3 missing, thus, no missing were imputed. Optional work and leisure activities modules were not included in the current study. The DASH has satisfactory psychometric properties [17,39,40]. The internal consistency for the current sample, measured by Cronbach's alpha, was 0.95. Norwegian normative general population data for the DASH are available [41]. The normative values were weighted to the current study population's mean age and gender distribution.

***Data analysis and statistics***

Descriptive statistics for demographic information and data on shoulder functioning were used. Correlations were analysed using Spearman's ρ. T-tests were used to compare groups, and the weighted age and gender comparable Norwegian population norms were compared with the study population using a two-sample t-test.

We built a hierarchical linear regression model to test which of the ICF categories reported by more than 50% of the patients were associated with shoulder/upper extremity function on the DASH. The independent variables from the ICF Checklist were dichotomized into a No/mild problem group and Moderate/severe/complete problem group for the regression analyses as many were skewed. We applied statistical criteria ($p \leq 0.1$ in the univariate regression, and inter-correlation coefficients <0.7 according to Spearman's Rho as collinearity criterion for the independent variables). First, we tested body functions and activities and participation separately in multiple regression models with a stepwise procedure. The significant body functions (b130, b710, b280, b740 and b840) and activities and participation variables (d430, d510, d640, d850 and d920) were entered into a final hierarchical regression model. We adjusted for demographic variables and comorbidity in the first and second step. The demographic factors were age, sex and education (high/low). The comorbidities noted on the Self-Report Comorbidity Questionnaire were dichotomized into no comorbidity vs. any comorbidity. The shoulder diagnosis categories did not qualify for entry into the regression analysis as they presented p-values >0.1 in the univariate analysis. The multicollinearity, residuals and influential data points showed that the assumptions of the regression models were not violated (Cook's distance [D<0.1]; centred leverage value [<0.2]). All the variables in the analysis had 10% or fewer missing cases. The results are presented as $R^2$, adjusted $R^2$ and F, beta and confidence intervals (C.I.) and standardized β-values. Significance level was set at $p \leq 0.05$. IBM SPSS 21 was used for the analyses, and we used openepi.com (http://www.openepi.com/Menu/OE_Menu.htm) to test the differences between our study population's functioning on the DASH and the Norwegian population norm.

**Results**

There were 164 participants, of whom the majority (54%) was women. The mean age was 46.5 years (SD 12.5). Of the participants, 44% had a higher education, 87% were

employed/self-employed, 6% were students, and 5% were on a pension, were homemakers or were unemployed. Of the 142 patients who were employed, 41% were on full- or part time sick leave or received rehabilitation support from social security insurance. Regarding occupational strain on the upper extremity, 41% reported that they lifted 10 kg a good deal of the time or more often, and 43% used the arm above shoulder level a good deal of the time or more often.

The patients' primary shoulder pain diagnoses are shown in table 1. The most frequent diagnosis was subacromial pain, including bursitis tendinopathy and partial rupture (45%). The duration of the shoulder problem was more than a year for almost 60% of the patients.

*[Insert table 1 about here]*.

The mean DASH total score was 33.2 (C.I. 30.6 – 35.8). A two-sample t-test showed that the patients' DASH scores were 23.2 points worse (C.I. 19.6 – 26.8; $p<0.001$) than the weighted Norwegian normative values which are 10.0 (C.I. 6.6 – 13.5) [41].

The 20 most frequently reported problems in body functions/structures and activities and participation on the ICF Checklist are shown in table 2. There were 10 body functions and 9 activities and participation functions that were rated as a problem by more than 50% of the patients. Among the body functions, pain and mobility of joint functions were reported by 99.8% and 95.8% of the patients, respectively. Approximately one third rated their problems with pain, joint mobility, muscle endurance, muscle strength and sleep as severe or complete (not shown in table 2). Regarding activities and participation, lifting and carrying objects was a problem for 84.8%, and remunerative employment was reported as a problem for 78.8%. Approximately one third of the patients rated their problems with lifting/carrying, work, recreation and changing body position as severe or complete (not shown in table 2). No environmental factors were reported as facilitators or barriers among the 20 most frequently

reported ICF categories. In addition, structure of the shoulder region (s720) on the ICF Checklist was rated as an impairment problem by all the patients.

*[Insert table 2 about here]*.

**Factors associated with self-reported shoulder and upper extremity function**

Univariate analyses showed that all the candidate ICF categories from the checklist were highly and significantly associated with the DASH scores, with r-values ranging from 0.15 (muscle tone function) to 0.55 (mobility of joints function) and p-values <0.001-0.002 (not shown in a table). Diagnosis was not associated with the DASH outcome. The results of the multivariate regression analysis are presented in table 3. Of the most frequently reported problems in functioning, three body functions (sensation of pain; mobility of joint functions; and energy and drive functions) and three activities and participation functions (lifting and carrying; washing oneself; leisure and recreation) were significantly associated with shoulder disability on the DASH. The strongest predictors according to the standardized β were mobility of joint functions (b710; β=0.18) and washing oneself (d510; β=0.27). This final adjusted model explained 67% of the variance in the DASH score. The $R^2$ change showed that the body functions explained 30% of the variance and that the activities and participation variables added another 13% to the explained variance. Older age, female gender and lower education were all independently associated with more self-reported shoulder disability on the DASH. These factors explained 22% of the variance in the model.

*[Insert table 3 about here]*.

**Discussion**

In this study, we examined how shoulder pain and functioning as assessed by the ICF Checklist were associated with shoulder disability on the DASH. All the problems in

functioning that were most frequently reported on the ICF Checklist by patients with shoulder pain, were significantly associated with disability on the DASH. The multivariate analysis showed that three ICF body function categories representing different aspects of impairments (pain, biomechanical/range of motion, psychological) were significantly associated with the shoulder problem. Among activities and participation, personal ADL (washing one-self), instrumental ADL (lifting and carrying) and leisure activities were associated with disability.

The main symptom in patients referred to a secondary care specialist outpatient clinic is pain [31]. Almost all the patients included in the present study reported pain. The multivariate model showed that patients who reported pain intensity as a moderate to complete problem scored higher (mean 6 points (C.I. 1.5-11.2)) on the DASH than those who reported having less pain. In addition, reduced shoulder mobility was reported by more than 90%, and having a moderate to complete problem with shoulder mobility added almost 7 points to the DASH (C.I. 2.9-10.8).

The current study suggests that in particular moderate or more severe pain should have implications for treatment, as pain is associated with disability. Thus, a clinical approach aiming at reducing pain and disability by supervised exercises is recommended [42]. Moreover, a recent systematic review showed that pain beliefs were associated with disability, and that higher levels of self-efficacy predicted reduction of pain and disability over time [43].

Other studies have reported that the duration of pain is a prognostic factor in musculoskeletal disorders and shoulder pain [9,11,12]. A systematic review focusing on the chronification of shoulder pain showed strong evidence that baseline pain intensity and pain duration longer than 3 months were predictors of long-term shoulder problems [44]. In the current study, duration of pain was not associated with concurrent disability on the DASH. However, the

present study included only patients with chronic pain (>3 months), and we only assessed the influence of a short versus a long duration of chronic pain. Others have found that both pain severity and pain duration predicted shoulder function outcomes [9], and should thus be an important factor when assessing the risk of chronification.

The DASH is a measure of disability that includes impairments and activities and participation. Pain is a complex symptom that, according to the ICF, is classified as an impairment at the body function level. Activities are defined as the execution of a task or action by an individual, while participation is defined as involvement in a life situation [2], and these are more complex phenomena that are performed within an environmental context. As expected, regarding functioning, impairments contributed most to disability on the DASH score and explained 30% of the variance. Activities and participation added another 13%, showing the impact of shoulder disability on everyday life. Washing oneself (on the back), which usually involves positions of internal/external rotation, flexion/extension and adduction of the shoulder, was the strongest predictor. In the adjusted analysis, patients who had moderate-complete problems washing themselves scored 9.1 points higher (C.I. 5.2-13.0) on the DASH when controlled for the other factors in the model. Our finding is in accordance with a study that included more than 2600 patients with shoulder pain and reported that 50-70% were unable to perform ADL activities such as washing and dressing [45]. Supervised exercises in shoulder rehabilitation focusing on functioning and movement patterns that can be transferred to daily activities are recommended [42].

Two aspects of mental health were associated with functioning on the DASH in the univariate analysis. They were the energy and drive function, which covers fatigue, and the temperament and personality function, which covers emotional stability. Loss of energy and drive are common symptoms in depression, which is commonly associated with chronic pain. However, when controlled for the other factors including demographic factors that explained

22% of the variance in the hierarchical multivariate regression analyses, only energy and drive function was significantly associated with disability. Psychological factors are often not reported in studies on shoulder pain and are covered in only 15% of randomized trials related to shoulder pain [46]. Wylie et al. found that the Mental Component Summary (MCS) on the SF-36 had the strongest correlation with shoulder pain functioning, in contrast with rotator cuff tear size, a body structure impairment that was only correlated with shoulder function [47]. The MCS includes the SF-36 Vitality subscale, which is a measure of fatigue related to the experienced health condition. In a recent study, Chester et al. reported that severe self-reported anxiety at baseline predicted more pain and disability at the 6-month follow-up of patients referred to physiotherapy for musculoskeletal shoulder pain [9]. From a biopsychosocial perspective, the patients' mental health is an important factor that preferably should be assessed in patients with shoulder pain [48].

There was a significant difference in sick-leave status for patients reporting moderate-total problems in work function (remunerative employment) over the last 30 days compared to those with no-mild problems, but work disability was not significantly associated with the DASH outcome in the multivariate analysis. This is not surprising as return to work depends on several work-related factors and legal-cultural factors that vary from country to country. Systematic reviews by Desmaule et al. and Rinaldo et al. assessed factors associated with work or sick leave in workers with shoulder problems [49,50]. In addition to the pain problem, psychological rather than sociodemographic factors were a focus [50]. It was recommended that work-related factors that also comprise environmental factors should be included in interventions aimed at return-to-work for patients with long-term neck and/or shoulder problems. In the current study, environmental factors were not included among the most frequent categories reported on the ICF Checklist. However, in vocational rehabilitation

settings, environmental factors should receive specific attention [51]. The comprehensive ICF core set for vocational rehabilitation comprises 33 e-categories [52].

In this cross-sectional study, other factors, such as pain, more problems with joint mobility and more activity limitations in arm use due to the shoulder problem, were stronger predictors of the DASH outcome than work disability. Our findings were in accordance with those of Buchbinder et al., who suggested that a core outcome set for shoulder disorders should include pain and physical function/activity as core domains, and should include emotional well-being and participation in work and recreation in a middle core [46].

In the current study, comorbidity was not significantly associated with disability on the DASH. This result is in accordance with Laisne et al.'s review of biopsychosocial predictors of prognosis in musculoskeletal disorders [11]. They reported strong evidence that comorbidity predicts pain but inconclusive evidence regarding comorbidity and disability. Pain was one of the strongest predictors in our study. Chester et al. suggested providing pain relief medication for pain associated with comorbidities in patients with shoulder pain who are being treated in physiotherapy practices [9].

The result that the 20 most frequently reported problems on the ICF checklist were highly associated with scores on the DASH, indicates that the ICF checklist captures most of the important aspects in a valid and reliable upper extremity PROM such as the DASH [17,39]. ICF core sets have been developed for several health conditions and in the development of a brief core set for hand conditions, the DASH was also applied [53]. Thus, for a development of an ICF core set for shoulder conditions, applying the DASH in the process would be valid, as it has already been linked to the ICF [18].

The findings of this study can also be discussed from a validity perspective. There are some frequent categories from the ICF Checklist interviews that are not represented in the linked

content the DASH [18]. We have added two Supplementary tables using the COSMIN criteria for content validity on this current study to illustrate this [54]. Our assessment based on the current study shows that the DASH has high-moderate content validity in capturing the breadth of problems in functioning in patients with shoulder pain (see Supplemental file).

The limitations of the current study include its cross-sectional design and the use of the ICF as an ordinal scale. We did not perform a reliability testing of the physiotherapist's (Y.R.) scoring on the ICF checklist. The ICF qualifiers that are used in the ICF Checklist as an ordinal scale have only been tested for metric properties to some extent [55,56]. These studies suggest a need to collapse some of the response categories. We opted to use the whole qualifier scale; however, we dichotomized it into no/mild problem and moderate-compete problem in the regression analysis because of skew distribution on several of the candidate categories. In doing so, we may have lost some information that might have influenced the results. The cross-sectional design means that we were unable to infer any causal relationships between self-reported disability on the DASH and problems in functioning according to the ICF Checklist. However, this was study based on a larger project exploring and utilizing the ICF on patients and measures in related to shoulder pain [5,14].

## Conclusions

Disability in shoulder patients, as measured by the DASH, was associated with the following body functions from the ICF Checklist, namely, pain, joint mobility and energy level, and with the following activities and participation functions: lifting and carrying, washing, and recreation. When personal factors were added, 67% of the variance in the DASH score was explained.

**Declaration of interest: The authors report no conflicts of interest**

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Table 1. Primary shoulder pain diagnosis, duration of pain and comorbidities. N= 164 patients

| **Primary shoulder pain diagnosis** (n=160) | **n (%)** |
|---|---|
| Subacromial pain including bursitis, tendinopathy and partial rupture | 72 (45%) |
| Adhesive capsulitis | 22 (14%) |
| Labral lesion, full thickness rotator cuff rupture, anterior instability or complete tendon ruptures | 18 (11%) |
| Myalgia | 29 (18%) |
| Other (including mono neuropathy, acromioclavicular pathology and osteoarthritis of the glenohumeral joint) | 19 (12%) |
| **Duration of shoulder pain n (%)** (n=164) | |
| 3-6 months | 24 (15%) |
| 6-12 months | 42 (26%) |
| >12 months | 98 (59%) |
| **Concurrent neck pain** (n=162) | 110 (68%) |
| **Self-reported comorbidity*** | |
| Back pain (n=160) | 58 (36%) |
| Osteoarthritis (other than in shoulder) (n=162) | 23 (14%) |
| Depressive symptoms (n=162) | 20 (12%) |

*More than one comorbidity were registered in some patients

Table 2. The 20 problems in functioning on the ICF Checklist reported by more than 50% of the 164 patients. Median score for any problem, and proportion of problems rated as moderate, severe or complete. n.a.= not applied

| **ICF components and categories** | **Function rated as any problem. % of patients** | **Function rated as moderate – complete problem. % of patients** | **Median score (IQR) when rated as a problem** |
|---|---|---|---|
| **Body functions and structures** | | | |
| s720 Structure of shoulder region (n=161) | 100 | n.a. | n.a. |
| b280 Sensation of pain | 99 | 85 | 3 (2-3) |
| b710 Mobility of joint functions | 91 | 73 | 3 (2-3) |
| b134 Sleep functions | 79 | 58 | 2 (1-3) |
| b740 Muscle endurance functions | 74 | 59 | 2 (2-3) |
| b130 Energy and drive functions | 70 | 48 | 2 (1-3) |
| b730 Muscle power functions | 69 | 56 | 2 (2-3) |
| b720 Mobility of bones function | 68 | 43 | 2 (1-3) |
| b840 Sensation related to the skin | 64 | 40 | 2 (1-3) |
| b735 Muscle tone functions | 60 | 42 | 2 (1-3) |
| b126 Temperament and personality functions | 52 | 26 | 1 (1-2) |
| **Activities and participation** | | | |
| d430 Lifting and carrying objects | 85 | 59 | 2 (1-3) |
| d850 Remunerative employment | 79 | 59 | 3 (1-3.3) |
| d920 Recreation and leisure | 76 | 58 | 2 (2-3) |
| d410 Changing basic body position | 75 | 54 | 2 (1-3) |
| d510 Washing oneself | 70 | 44 | 2 (1-2) |
| d540 Dressing | 67 | 40 | 2 (1-2) |

| | | | |
|---|---|---|---|
| d415 Maintaining a body position | 63 | 47 | 2 (1-3) |
| d640 Doing housework | 60 | 37 | 2 (1-2) |
| d620 Acquisition of goods and services | 52 | 25 | 1 (1-2) |

Table 3. Final adjusted model for self-reported function in the shoulder/upper extremity on the DASH. Functioning from the ICF-Checklist was dichotomized as no/mild or moderate-complete problem.

| | | DASH B (C.I.) | DASH Standardized β | p-value | $R^2$ Change |
|---|---|---|---|---|---|
| Demographic variables | Age | 0.16 (0.11 – 0.49) | 0.12 | p=0.022 | 0.22 |
| | Sex man/woman | 4.71 (0.97 – 8.45) | 0.14 | p=0.014 | |
| | Education (high/low) | 4.40 (0.92 – 7.87) | 0.13 | p=0.014 | |
| Comorbidity | No comorbidity/ any comorbidity | 3.44 (-0.05 – 6.93) | 0.10 | p=0.053 | 0.05 |
| Body functions | b280 Sensation of pain | 6.36 (1.49 – 11.23) | 0.13 | p<0.001 | 0.30 |
| | b710 Mobility of joint functions | 6.83 (2.89 – 10.76) | 0.18 | p=0.001 | |
| | b130 Energy and drive function | 3.90 (0.46 – 7.34) | 0.12 | p=0.027 | |
| Activities and participation | d430 Lifting and carrying objects | 4.58 (0.51 – 8.65) | 0.13 | p=0.028 | 0.13 |
| | d510 Washing oneself | 9.10 (5.20 – 13.00) | 0.27 | p<0.001 | |
| | d920 Recreation and leisure | 4.19 (0.0.74 – 7.64) | 0.12 | p=0.018 | |
| | | | | | Total $R^2$ |
| Model summary | $R^2$ | | | | 0.70 |
| | Adjusted $R^2$ | | | | 0.67 |
| | F | | 24.1 | p=<0.001 | |

**Word count: 4193**