

Effect of depressive symptoms on perceived disability in patients with chronic shoulder pain

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Abstract

Background Psychological distress may be an important determinant of perceived disability in patients with chronic musculoskeletal disorders. We evaluated the relationship between depressive symptoms and perceived disability in patients with chronic shoulder pain and quantified the contribution made by depression to perceived disability.

Methods In this prospective study, 109 patients with chronic shoulder pain caused by degenerative or inflammatory disorders were evaluated using the Disability of Arm, Shoulder and Hand (DASH) questionnaire and the Center for Epidemiologic Studies-Depression (CES-D) Scale to determine relationships between depressive symptoms and perceived disability in patients with chronic shoulder pain. In addition, pain scores were evaluated using a visual analog scale (VAS) during activity, and range of motion (ROM) and abduction strength (strength) measurements were measured. Multivariate analyses of variance and regression modeling were used to assess the relative contributions made by depressive symptoms (CES-D) and other clinical parameters to patient-perceived disability (DASH).

Results DASH scores were found to be moderately correlated ($0.3 < r < 0.6$) with ROM, strength, pain VAS and CES-D; DASH scores were more strongly correlated with CES-D scores than with pain VAS scores or range of motion ($r = 0.58$; $p < 0.001$, 0.37 ; $p < 0.001$, 0.32 ; $p = 0.04$ respectively). Multiple stepwise regression analyses revealed that gender, ROM, pain VAS and CES-D scores independently predicted DASH score and accounted for 43 % of the variance. CES-D score was found to be the strongest predictor of DASH score and accounted for 23 % of the variance.

Conclusions Degrees of depressive symptoms were found to be significantly associated with higher symptom scores and greater disability in patients with chronic shoulder pain. Although a large proportion of perceived disability remains unexplained, perceived disability in patients with chronic shoulder pain was found to be strongly influenced by depressive symptoms.

Type of study/level of evidence Level 2, prospective cohort study, prognostic study.

Keywords Chronic shoulder pain · Perceived disability · Depressive symptom

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Introduction

Musculoskeletal disorders are among the most frequently encountered chronic conditions that affect the general population and have substantial impacts on physical activity, mental state, and quality of life (QOL) [1, 2]. Several studies have previously suggested an association between chronic pain and psychological distress, as depressive symptoms are frequently found in patients with chronic pain and depressed patients often report pain and

disability [3, 4]. One interpretation of these observations might be that depression is a consequence of pain and disability, but it is also possible that chronic pain and disability reflect an underlying depressive disturbance. Providing care to patients with musculoskeletal disabilities is no longer limited to reducing signs and symptoms and improving a patients' ability to function, but also embraces general well-being and QOL, which include the mental and physical aspects of health [5].

Chronic shoulder pain is a common problem, especially in patients with degenerative or inflammatory disorders, and has a prevalence of 7 % of the general population [6]. This type of pain restricts daily activities due to range of motion limitations and reduced muscle power, and also because it is accompanied by different types and degrees of psychological distress [7]. Psychological distress, particularly depression, is highly prevalent in the elderly, and has been consistently demonstrated to contribute or even predict symptom severity in several musculoskeletal disorders [8, 9]. On the other hand, the association between depressive symptoms and functional and symptomatic disabilities in patients with chronic shoulder pain has not been well demonstrated.

Therefore, we prospectively investigated the association between depressive symptoms and perceived disability in patients with chronic shoulder pain caused by a degenerative or inflammatory disorder. We hypothesized that depressive symptoms are associated with symptomatic and functional disability in these patients. In addition, we studied the relations between ranges of motion, muscle strengths, pain VAS scores and levels of depression and the severity of patient-perceived disability. Furthermore, we quantified the contribution made by depressive symptoms to disability and symptom severity.

Materials and methods

Subjects

All subjects were recruited between November 2010 and July 2011 at the Department of Orthopedic Surgery at the authors' hospital. All subjects provided informed consent, and the study protocol was approved by our institutional ethics committee. The inclusion criteria applied were: shoulder disorders caused by degenerative or inflammatory changes in the shoulder region (adhesive capsulitis, arthritis, cuff pathology, or tendinitis calcarea), a symptom duration >3 months, an age of ≥ 30 years, and the ability to complete the questionnaires. Patients with shoulder instability, those with shoulder pain originating from cardiovascular or neurological problems, and those who had been previously diagnosed with psychological disorders were

excluded. A total of 130 patients with chronic shoulder pain were initially invited to the study and 11 subjects refused to participate. Among the remaining 119 participants, 4 subjects with cardiovascular problems, 4 patients who had been previously diagnosed with psychological disorder, and 2 subjects who had a shoulder pain combined with neurological problems were excluded, and finally 109 patients formed the basis of subsequent analysis.

Demographic and clinical data were collected by a physician at the first visit. Clinical investigations included body mass index, disease duration, pain score during activity (measured using a visual analog scale [VAS], 0–100 mm), range of motion (measured using a goniometer), and muscle force (measured using a tensiometer). We normally checked the internal rotation to the back as the highest bony landmark reached with the extended thumb, which should be transformed to numeric variable to facilitate statistical analysis. In addition, too many explanatory variables, such as ranges of motion in each direction, in regression analysis are likely to overfit and difficult to interpret. Therefore, we used simplified summary subscales of Constant score [10]. Constant score is the most widely used shoulder evaluation instrument in Europe [11] that showed a high degree of reproducibility among observers, with an intraobserver error of 3 % [10]. The following constant subscale scores were used: range of motion (ROM, range 0–40) and abduction strength (strength, range 0–25).

Assessments of disability and depression in patients with chronic shoulder pain

The Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire [12] was used to measure patient-perceived disability. DASH is a self-administered, upper extremity-specific questionnaire that consists of 30 questions. It includes 21 physical functions, 5 symptoms, and 4 social role function, work, sleep, and confidence items. DASH scores range from 0 to 100, and higher scores indicate greater upper extremity disability. The average DASH score in the general population has been reported to be 10.10 ± 14.68 [13]. The main part of DASH, that is, its disability/symptom (D/S) scale, and the two optional modules, DASH work and DASH sport/music (S/M) scales, were used.

The Center for Epidemiologic Studies Depression Scale (CES-D) [14] was used to assess depressive symptoms. CES-D is used for to screen for symptoms related to depression or psychological distress, and is regarded as providing a valuable means of identifying those at risk of depression. CES-D is composed of 20 items, which are rated on a scale of 0–3. Thus, the total possible scores range from 0 to 60, and the average score for the general

population is 9.1 ± 8.6 [15]. A score of 16 is widely used as a cutoff value when estimating the prevalence of major depressive disorder [15].

Data analysis

Descriptive statistics were calculated with SPSS software, version 17.0 (SPSS, Chicago, IL, USA) to describe the demographics and clinical characteristics of the study subjects. Univariate analysis was conducted to determine associations between independent variables (patient age, sex, BMI, pain, range of motion, muscle strength, and CES-D score) and the dependent variable (DASH score). Associations between continuous explanatory variables and response variables were evaluated using Pearson's correlations coefficients. Associations of dichotomous explanatory variables with ordinal response variables were evaluated using the Mann–Whitney *U* test, and those with continuous response variables were evaluated using the Student's *t* test after normality testing. Independent variables found to have significant ($p < 0.05$) or near-significant ($p < 0.1$) associations were entered into a multivariate regression model.

Multiple linear regression analysis with stepwise variable selection was used to identify independent predictors of DASH scores, account for potential confounding variables, and to assess the relative contributions made by depressive symptoms (measured using CES-D) to symptomatic and functional disability (measured using DASH) in patients with chronic shoulder pain. Multiple linear regressions assess the ability of explanatory variables to cause variations in response variables and to account for any confounding between the explanatory variables. This analysis produces a statistic called adjusted R^2 , which reflects the percentage of overall variability in the dependent variable that can be explained or accounted for by the explanatory variables included in a multiple linear regression model.

A power analysis indicated that a minimum sample size of 100 patients would provide 90 % statistical power ($b = 0.1$, $a = 0.05$) to detect a moderate correlation ($\rho \geq 0.30$), with excellent precision, between CES-D and DASH scores.

Results

A total of 109 patients completed the questionnaire and were investigated clinically (Table 1). Descriptive values for pain severities, ranges of motion, muscle strengths, and CES-D and DASH scores are shown in Table 2. The average DASH and CES-D scores for all participants were 26.4 ± 14.1 and 12.7 ± 7.2 , respectively. Eight male subjects (14 %) and 14

Table 1 Demographic and clinical characteristics of the patients

Variable	No.	Mean (range)
Gender		
Male	57	
Female	52	
Age (years)		52.1 (32–78)
Body mass index (kg/m ²)		23.3 (19.7–28.4)
Disease duration (months)		7.2 (4–16)
Affected shoulder		
Dominant side	59	
Nondominant side	50	
Diagnosis		
Adhesive capsulitis	36	
Impingement syndrome without rotator cuff tear	31	
Rotator cuff tear with/without impingement syndrome	24	
Calcific tendinitis	14	
Acromioclavicular joint arthritis	4	

Table 2 Absolute value of all scores

Scores	Mean \pm SD	Range
Pain VAS	5.1 ± 2.8	2–10
(Constant subscale)		
ROM-FE	7.1 ± 2.9	2–10
ROM-ER	4.8 ± 2.5	2–8
ROM-IR	7.2 ± 3.2	2–10
ROM-total score	19.0 ± 4.9	8–28
Muscle strength	23.3 ± 3.5	5–25
CES-D	12.7 ± 7.2	0–37
DASH score		
Disability/symptom	26.4 ± 14.1	5.0–64.2
Work	34.0 ± 20.3	0.0–81.2
Sports/music	40.5 ± 26.1	0.0–100.0

SD standard deviation, VAS visual analog scale, ROM range of motion, CES-D Center for Epidemiologic Studies-Depression, DASH Disability of Arm Shoulder and Hand questionnaire

female subjects (27 %) had scored above the cutoff of 16 in the CES-D scores ($p = 0.09$). Women had significantly higher pain VAS, CES-D, and DASH work scores than men ($p = 0.04$, 0.03 , and 0.04 , respectively), but range of motion, strength, and DASH D/S scores of men and women were not significantly different (Table 3).

DASH D/S scores were moderately correlated ($0.3 < r < 0.6$) with ROMs, strengths, and pain VAS and CES-D scores. DASH scores showed a stronger correlation with CES-D scores than with pain VAS scores or ranges of motion (Pearson correlation coefficient $r = 0.58$;

Table 3 Comparisons of clinical and demographic findings by gender

Scales	Male (n = 57)	Female (n = 52)	p
Age	50.7 ± 10.0	53.6 ± 9.6	0.12 ^b
BMI	23.89 ± 3.9	22.73 ± 4.3	0.14 ^b
ROM	19.4 ± 4.9	18.6 ± 6.0	0.49 ^a
Strength	23.7 ± 3.2	22.9 ± 3.9	0.33 ^a
Pain VAS	4.6 ± 3.0	5.6 ± 2.7	0.04^b
CES-D	11.2 ± 7.5	14.4 ± 8.1	0.03^b
DASH DS	24.5 ± 13.2	28.5 ± 15.4	0.14 ^b
DASH work	30.2 ± 20.6	38.2 ± 19.7	0.04^b
DASH SM	38.5 ± 25.5	42.7 ± 27.9	0.41 ^b

Values are expressed as mean ± SDs

Significant correlations have been highlighted

BMI body mass index, *ROM*, range of motion, *VAS* visual analog scale, *CES-D* Center for Epidemiologic Studies-Depression, *DASH* Disability of Arm Shoulder and Hand questionnaire, *D/S* disability/symptom, *S/M* sports/music

Statistical differences with gender were conducted using the ^a Mann-Whitney *U* or ^b Student's *t* test

$p < 0.001$, 0.37; $p < 0.001$, 0.31; $p = 0.04$ respectively, Table 4). CES-D scores showed a moderate correlation with DASH D/S scores, strengths, and pain VAS scores. Pain VAS scores showed a moderate ($0.3 < r < 0.6$) correlation with DASH D/S and CES-D scores. Ranges of motion showed a moderate correlation with DASH D/S scores and ages.

Analysis of covariance revealed a highly significant effect of CES-D scores on DASH D/S scores. Gender, range of motion, strength, and pain VAS activity were found to account for 2, 7, 4, and 12 % of the variance of

Table 5 Results of multiple regression analyses of variance

Model	Dependent variable	Independent variables	Beta	p value	R ²
Univariate	DASH	Gender		0.08	2
		ROM		0.01	7
		Strength		0.02	4
		Pain VAS		<0.01	12
Multivariate ^a	DASH	CES-D		<0.01	23
		Gender	0.169	0.04	43
		ROM	0.200	0.02	
		Pain VAS	0.241	0.01	
		CES-D	0.392	<0.01	

^a Selected by multiple linear regression analyses with stepwise variable selection

Beta standardized regression coefficient, *R²* % variance explained by each variable, *DASH* Disability of Arm Shoulder and Hand questionnaire, *ROM* range of motion, *VAS* visual analog scale, *CES-D* Center for Epidemiologic Studies-depression

DASH D/S score, respectively, whereas CES-D score accounted for 23 % of the variances (Table 5). Stepwise multiple regression analysis revealed that gender, ROM, and pain VAS and CES-D scores were independent predictors of DASH scores and that they accounted for 43 % of the variance in DASH scores, whereas only gender and DASH scores were predictors of CES-D score and accounted for 24 % of the variance. The relative importance of the independent variables, gender, range of motion, pain VAS, and CES-D as dependent variables of DASH are described by the equation: $Y_{[DASH]} = -0.59 \times (ROM) + 0.87 \times (\text{pain VAS score}) + 0.73 \times (\text{CES-D score}) - 5.4 \text{ points (male gender)} + 27.8$.

Table 4 Correlation coefficients between assessed clinical parameters and instruments, adjusted by gender

	Age	BMI	ROM	Strength	Pain VAS	CES-D	DASH D/S	DASH work	DASH S/M
Age	1	0.263	0.317[‡]	0.045	0.097	0.154	0.182	0.264	0.417[†]
BMI	0.263	1	0.069	0.123	0.190	0.190	0.055	0.090	0.043
ROM	0.317[‡]	0.069	1	0.241[†]	0.075	0.144	0.311[†]	0.125	0.206
Strength	0.045	0.123	0.241[†]	1	0.004	0.354[†]	0.320[†]	0.136	0.115
Pain VAS	0.097	0.190	0.075	0.004	1	0.302[†]	0.372[†]	0.417[†]	0.410[†]
CES-D	0.154	0.190	0.144	0.354[†]	0.302[†]	1	0.583[‡]	0.498[‡]	0.524[‡]
DASH D/S	0.182	0.055	0.311[†]	0.320[†]	0.372[†]	0.583[‡]	1	0.723[‡]	0.591[‡]
DASH work	0.264	0.090	0.125	0.136	0.417[†]	0.498[‡]	0.723[‡]	1	0.612[‡]
DASH S/M	0.417[†]	0.043	0.206	0.115	0.410[†]	0.524[‡]	0.591[‡]	0.612[‡]	1

Partial correlation was conducted by controlling for gender

Significant correlations have been highlighted

BMI body mass index, *ROM* range of motion, *VAS* visual analog scale, *CES-D* Center for Epidemiologic Studies-Depression, *DASH* Disability of Arm Shoulder and Hand questionnaire, *D/S* disability/symptom, *S/M* sports/music

[†] $p < 0.05$, [‡] $p < 0.001$

Discussion

In this study, we explored the possibility of an association between depressive symptoms and perceived disability in patients with chronic shoulder pain, and we sought to determine whether higher levels of depressive symptoms cause greater symptomatic and functional disabilities in patients with chronic shoulder pain. This study demonstrates that CES-D scores (a measure of level of depression) are significantly associated with symptom severity and disability in patients with chronic shoulder pain. Furthermore, CES-D scores were found to account for more variance of DASH (a measure of perceived disability) than other objective clinical measurements, such as muscle strength and range of motion. Although a large proportion of self-perceived disability in patients with chronic shoulder pain remains unexplained, in the present study, perceived disability due to chronic shoulder pain was found to be strongly influenced by depressive symptoms.

Depression has been reported to be highly prevalent in the elderly, and been consistently shown to contribute to symptom severity in some musculoskeletal disorders [16, 17]. In the present study, patients with chronic shoulder pain were also found to have high CES-D scores. Furthermore, CES-D scores were found to be associated with functional disability and symptom severity, more so than objective clinical parameters, such as range of motion and muscle strength. These findings concur with those of a previous study, in that a large variability in DASH scores in upper extremity disorders was found to arise from psychosocial rather than physical factors, which may also be case for most health-status measures [9]. Subjective factors, such as pain or depression have also been reported to have greater influences when disability is measured with respect to the entire arm, such as, by using DASH scores, rather than with respect to more specific regional site [18].

In the present study, depressive symptoms were found to affect perceived shoulder disability, and perceived shoulder disability was found to affect depressive illness, although the percentage of variance explained was relatively low for the prediction of depression as compared to perceived disability (43 vs. 24 %). This bidirectional relationship between perceived disability and depression suggests that both should be considered targets during the management of patients with chronic shoulder pain. Patients suffering from depression may see themselves as being more disabled than might be expected from objective findings and, thus, might not be as capable of adapting to and managing painful upper extremity problems [19]. The presence of chronic musculoskeletal pain has already been reported to be one of the strongest predictors of depression [4]. The long-term experience of pain and disability increases depression, thereby creating a vicious cycle, which is likely

to influence response to treatment [19]. Magni et al. [4] substantiated the bidirectional causal relationship in their prospective community-based cohort study: depression is able to predict chronic musculoskeletal pain and chronic musculoskeletal pain can predict depression, whereas the latter effect is more powerful than the former. They categorized four locations of pain, namely neck/back, hip, knee, and swelling/pain in joints, and reported that only two pain locations (neck/back, hip) significantly predicted the development of depression. However, they used only socio-demographic factors, which were obtained from questionnaire surveys, as explanatory variables without considering clinical differences of study subjects, although exploring the causal relationship would require considering complex biological and psychological factors. The association between depression and perceived disability is likely to be affected by the disease characteristics and symptom severity, and particular patient cohorts with specific disability or disease are necessary to determine the relationship between depression and chronic musculoskeletal pain. Our study demonstrated the relationships between depressive symptoms and perceived disability in patients with chronic shoulder pain, accounting for both demographic and clinical parameters. In addition, several antidepressant medications have been reported to have significant analgesic effects, including in patients with a musculoskeletal disorder [20, 21]. Further studies are needed to investigate the efficacy of treating depression in patients with chronic shoulder pain.

Our results show that women reported more musculoskeletal pain, disability, and had higher CES-D scores, although objective findings, such as range of motion and abduction strength, did not differ between genders. Musculoskeletal pain or disability has been previously reported to be both more prevalent [22] and more severe in women [2], which could be due to a higher physical vulnerability [23] or sensitivity to pain [24] in women. On the other hand, depression may be associated with social support, socioeconomic status, education level, and secondary life events, such as divorce, change of job, and death of someone in the family [3, 25]; thus, the effect of gender on depression needs determination after controlling for background variables. Currently, it is uncertain whether the association between depression and patient-perceived disability is different for men and women.

The strength of the present study is that it evaluated relations between depressive symptoms and perceived disability in patients with chronic shoulder pain while controlling for other demographic and clinical parameters, and it quantified the relative contribution made by depression and other clinical parameters to patient-perceived disability. However, the present study has also several limitations. First, it was based on a cross-sectional

cohort, which prevented investigation of the causal relation between patient-perceived disability and depression and evaluations of changes in disability and depression. A further prospective longitudinal study is probably needed to resolve these issues. Second, a considerable amount of variance in upper extremity disability measured using DASH remained unexplained. In terms of DASH scores, only 43 % of total variance was accounted for by range of motion, strength, pain, gender, and depression. Other potential contributors to upper extremity disability, such as elbow and wrist/hand joint disorders, level of physical activity, and education, were not measured in the present study and might also have contributed to variance. Third, our assessment of depressive symptoms was limited to CES-D, and a more comprehensive assessment including illness behavior, coping, and other aspects of psychological morbidity would have been more informative. Fourth, our study was performed on a hospital-based and not on a community-based population. Hospital-based cases are normally selected according to personal characteristics, diseases states, and associated health conditions, which means that their characteristics are likely to differ from community-based populations. Finally, we used stepwise recording of range of motion and strength in Constant score and this might diminish the discriminant power of statistical analysis, although we used these subscale scores to facilitate statistical analysis.

This study demonstrates that degrees of depressive symptoms are significantly associated with higher symptom scores and greater disability in patients with chronic shoulder pain. Although a large proportion of perceived disability remains unexplained, perceived disability in patients with chronic shoulder pain was found to be strongly influenced by depressive symptoms. We believe that it might be possible to use these results to identify patients likely to experience poor functional outcome and patients who require a cautious treatment approach.

Conflict of interest The authors declare that they have no conflict of interest.

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